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Heat Release Rate Requirements for Railcar Interior Finish: Appendices A Through E

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Appendix A.
Heat Rate Release Database of Rail Car Lining Materials

The database presented in this appendix includes over 700 items in total, and over 650 of these include heat rate release (HRR) data from cone calorimeter tests. These data were used to aid in the development of an empirical model to qualify passenger railcar materials for fire safety.

A.1 Heat Release Rate and Room Corner Test Data (ASTM E1354, E162, NFPA 286)

The following table presents the heat release rate and room-corner test data, including American Society for Testing and Materials (ASTM) E162 flame spread data, ASTM E1354 cone calorimeter test and National Fire Protection Association (NFPA) 286 test, of four rail car materials tested.[1]

[1] P. D. Gandhi and J. L. Borgerson, “Investigation of the fire performance of materials and products for use in U.S. railcar and bus applications,” 2008.

Table A 1. HRR and Room-corner Test Data

	ASTM E1354					ASTM E162			NFPA 286				
Sample ID	Heat Flux (kW/m^2)	Time to Ignition (sec)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)		Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time			Peak HRR (kW)	Peak SRR (m^2/s)	Time to FO (sec)		Source
Nomex® rail panel - Melaminium (melamine fused to aluminum) face, Nomex® honeycomb core (0.25" cell size), aluminum backer	25	433	17.5	123		3			1260	18.1	416		1
Nomex® rail panel - Melaminium (melamine fused to aluminum) face, Nomex® honeycomb core (0.25" cell size), aluminum backer	35	456	17.3	149									1
Nomex® rail panel - Melaminium (melamine fused to aluminum) face, Nomex® honeycomb core (0.25" cell size), aluminum backer	50	63	15.7	168									1
Plywood rail panel - Melaminium (melamine fused to aluminum) face, plywood core, aluminum backer	25	605	10.1	198		6			1268	14.7	589		1
Plywood rail panel - Melaminium (melamine fused to aluminum) face, plywood core, aluminum backer	35	304	10.3	159									1
Plywood rail panel - Melaminium (melamine fused to aluminum) face, plywood core, aluminum backer	50	107	11.2	201									1
Fiberglass-reinforced plastic (FRP) - Wool/Nylon Fabric cover (benchmark)	25	454	14.3	99		8			401	2.17	--		1
Fiberglass-reinforced plastic (FRP) - Wool/Nylon Fabric cover (benchmark)	35	256	14.2	113									1
Fiberglass-reinforced plastic (FRP) - Wool/Nylon Fabric cover (benchmark)	50	166	15.2	137									1
Plywood - Plywood, C-D Exposure 1 (CDX) (benchmark)	25	128	8.2	95		141			2142	10.6	317		1
Plywood - Plywood, C-D Exposure 1 (CDX) (benchmark)	35	61	13.7	219									1
Plywood - Plywood, C-D Exposure 1 (CDX) (benchmark)	50	26	15.2	238									1

A.2. Small Scale Heat Release Rate Data: Cone Calorimeter (ASTM E1354) and Flame Spread (ASTM E162)

The following table contains the small-scale heat release rate data from both ASTM E1354 cone calorimeter test and ASTM E162 flame spread test.

Table A 2. Small-scale HRR Data

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Nomex® rail panel - Melaminium (melamine fused to aluminum) face, Nomex® honeycomb core (0.25" cell size), aluminum backer		25	433					17.5	123					3	1
Nomex® rail panel - Melaminium (melamine fused to aluminum) face, Nomex® honeycomb core (0.25" cell size), aluminum backer		35	456					17.3	149						1
Nomex® rail panel - Melaminium (melamine fused to aluminum) face, Nomex® honeycomb core (0.25" cell size), aluminum backer		50	63					15.7	168						1
Plywood rail panel - Melaminium (melamine fused to aluminum) face, plywood core, aluminum backer		25	605					10.1	198					6	1
Plywood rail panel - Melaminium (melamine fused to aluminum) face, plywood core, aluminum backer		35	304					10.3	159						1
Plywood rail panel - Melaminium (melamine fused to aluminum) face, plywood core, aluminum backer		50	107					11.2	201						1
Fiberglass-reinforced plastic (FRP) - Wool/Nylon Fabric cover (benchmark)		25	454					14.3	99					8	1
Fiberglass-reinforced plastic (RFP) - Wool/Nylon Fabric cover (benchmark)		35	256					14.2	113						1
Fiberglass-reinforced plastic (FRP) - Wool/Nylon Fabric cover (benchmark)		50	166					15.2	137						1
Plywood - Plywood, C-D Exposure 1 (CDX) (benchmark)		25	128					8.2	95					141	1
Plywood - Plywood, C-D Exposure 1 (CDX) (benchmark)		35	61					13.7	219						1
Plywood - Plywood, C-D Exposure 1 (CDX) (benchmark)		50	26					15.2	238						1
Vinyl & Kevlar® - Vinyl cover with Kevlar® backing layer		25	26					13.7	149						1

Sample ID	Thick-ness (mm)	Heat Flux (kW/m²)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m²)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m²)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m²)	Avg. HRR - Test (kW/m²)	Smoke SEA (m²/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Vinyl & Kevlar® - Vinyl cover with Kevlar® backing layer		35	11				15.5	12.1	172		48				1
Vinyl & Kevlar® - Vinyl cover with Kevlar® backing layer		50	9					13.2	197						1
Wool & Kevlar® - Wool fabric cover with Kevlar® backing layer		25	126					11.5	126						1
Wool & Kevlar® - Wool fabric cover with Kevlar® backing layer		35	76				19.8	11.8	133		48				1
Wool & Kevlar® - Wool fabric cover with Kevlar® backing layer		50	40					13.1	182						1
Polyester & foam - Polyester fabric cover with polyurethane foam insert		25						0.1	2						1
Polyester & foam - Polyester fabric cover with polyurethane foam insert		35	39				70.1	21.3	322		191				1
Polyester & foam - Polyester fabric cover with polyurethane foam insert		50	25					20.3	324						1
Wool & foam - Wool fabric cover with polyurethane foam insert		25	121					3.4	83						1
Wool & foam - Wool fabric cover with polyurethane foam insert		35	76				68.5	14.9	113		29				1
Wool & foam - Wool fabric cover with polyurethane foam insert		50	33					15.5	166						1
3 mm thick Poly (phenylene sulphide)/glass fiber (Ryton) panels		35	205						220						10
3 mm thick Poly (phenylene sulphide)/glass fiber (Ryton) panels		50	80						70						10
3 mm thick Poly (phenylene sulphide)/glass fiber (Ryton) panels		75	30						66						10
Glass Reinforced Panel (GRP) Panel		50	41	97.6	68		160.0	21.5	342		221		866		11
Phenolic resin (preimpregnated + honeycomb+ preimpregnated) (1mm+2mm+1mm thick), Fiberglass(30mm), Aluminium(3mm)	37	50							98	40		30			2
Compact panel with bands and edges in aluminium (0.8mm+3mm thick), Fiberglass(30mm), Aluminium(3mm)	36.8	50							85	220		41			2

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Phenolic resin (preimpregnated+ honeycomb+preimpregnated) (1mm+2mm+1mm thick), Fiberglass(30mm), Aluminium(3mm)	37	50							107	350		46			2
Wool carpet 100% Zirpro (3.5mm+2mm thick), Floor panel (Aluminium+ Foam+Aluminium) (1.5mm+16mm+1.5mm), Fiberglass(3mm)	27.5	25							150	380		38			2
Upholstery (1mm), Fire barrier fabric (Dufelt)(1mm), Polyurethane Foam(36mm), Aluminium(1.3mm) or Pieces SMC (3.7mm)	40.5	25							175	75		28			2
Sunblind in glass and PVC (530 g/m^2)	0.6	25	23				2.0		66		6				3
Curtains in PVC fibre (600 g/m^2)	1.3	25	98				2.1		50		5				3
Curtains in preoxydate fibre (200 g/m^2)	0.5	25					1.4		6						3
Curtains in polyester (300 g/m^2)	0.5	25							2						3
Sunblind in glass and PVC (530 g/m^2)	0.6	35	19				2.1		101		7				3
Curtains in PVC fibre (600 g/m^2)	1.3	35	97				2.8		52		8				3
Curtains in preoxydate fibre (200 g/m^2)	0.5	35	23				2.6		59		8.1				3
Curtains in polyester (300 g/m^2)	0.5	35							148						3
Mattress foam, Mattress covering	12	25	34				4.1		111		15.8				3
Sheet (130g/m^2)	0.2	25	n.d.						4						3
Blanket (600g/m^2)	4	25	48				360.3		175		79.7				3
Pillow (18g/m^2)		25	198				16.2		172		55.6				3
Mattress foam, Mattress covering	12	35	211				8.7		163		32.4				3
Sheet (130g/m^2)	0.2	35	17				10.2		91		9.4				3
Blanket (600g/m^2)	4	35	17				186.7		271		81.7				3
Pillow (18g/m^2)		35	42				20.4		182		69				3
Silicone unlacarable fabric (6000g/m^2)	0.778	25	131				48.3		117		20.8				3
Polyurethane foam (100kg/m^2)		25	10				10.7		117		38				3
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3)		25	50				53.5		130		12.7				3

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3)		25	37				17.4		115		11.5				3
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3)		25	79				43.5		98		31.1				3
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		25	52				8.0		160		22.9				3
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		25	53				83.1		166		51.9				3
Seat covering wool/acrylic fibre (600g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		25	35				33.3		205		20.8				3
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		25	45				4.3		128		17.1				3
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3)		25	35				17.7		227		59.2				3
Seat covering woollen spun cloth (400g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), Polyurethane foam (70 kg/m^3)		25	24				8.8		214		29.5				3
Seat covering double plush seating moquette,Zirpro treated (800g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2),Polyurethane foam (70 kg/m^3)		25	71				74.4		206		63.1				3
Seat covering cut & uncut seating moquette, untreated (850g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), Polyurethane foam (70 kg/m^3)		25	57				77.0		439		98.7				3
Seat covering double plush seating moquette, untreated (800g/m^2), inner layer fibrous glass substrate with plymeric treatement and special		25	83				37.0		322		87.4				3

Sample ID	Thick-ness (mm)	Heat Flux (kW/m²)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m²)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m²)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m²)	Avg. HRR - Test (kW/m²)	Smoke SEA (m²/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
coating (0.5mm, 170g/m^2), Polyurethane foam (70 kg/m^3)															
Silicone unlacarable fabric (6000g/m^2)		35	73				48.1		137		58.1				3
Polyurethane foam (100kg/m^2)		35	1				16.1		125		49.1				3
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3)		35	88				62.9		160		38.7				3
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3)		35	23				88.2		170		61.6				3
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3)		35	21				82.2		132		47.7				3
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		35	28				80.1		283		66.4				3
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		35	23				88.9		182		68.2				3
Seat covering wool/acrylic fibre (600g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		35	20				86.7		279		52.1				3
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3)		35	34				15.9		167		62.5				3
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3)		35	15				64.6		266		72.2				3
Seat covering woollen spun cloth (400g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), Polyurethane foam (70 kg/m^3)		35	17				15.3		247		46				3

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Seat covering double plush seating moquette, Zirpro treated (800g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), Polyurethane foam (70 kg/m^3)		35	16				87.0		281		93.2				3
Seat covering cut & uncut seating moquette, untreated (850g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), inner layer polyacrylate-aramide fibre (2mm, 450 g/m^2), Polyurethane foam (70 kg/m^3)		35	14				92.1		525		147.8				3
Seat covering double plush seating moquette, untreated (800g/m^2), inner layer fibrous glass substrate with plymeric treatement and special coating (0.5mm, 170g/m^2), Polyurethane foam (70 kg/m^3)		35	16				53.9		329		110.4				3
Film self-adhesive bonded to Al sheet		50							104	57	2				4
Polycarbonate (good fire performance)		50							432	167	118				4
Polychloroprene rubber		50							241	137	79				4
Flame retarded glass reinforced unsaturated polyester (FR GRUP)		50					23.6		85		58				4
Glass mat		50					39.7		182		90				4
Glass reinforced unsaturated polyester (GRUP)		50					39.1		141		95				4
Polycarbonate (10% glass fibre)		50					98.0		243		179				4
Mica paper on silicon resin		50					12.5 (1)		9.4 (1)		1.5 (1)				4
Cotton textile and epoxy resin		50					138.0		212		129				4
Pultruded glass reinforced unsaturated polyester (GRUP)		50					56.0		284		146				4
Polyvinyl chloride (PVC)		50					52.4		163		67.8				4
Glass reinforced unsaturated polyester (GRUP)		50					35.5		159		89				4
Polyurethane (PUR) foam with fabric on top (77kg/m^3)	50	35	14				58.6		284		85	154			7
Polyurethane (PUR) foam with fabric on top (77kg/m^3)	50	50	11				69.2		342		123	195			7

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Polyurethane (PUR) foam with fabric on top (77kg/m^3)	50	75	3				71.8		444		180	302			7
1.6 mm metal laminate on 18 mm plywood (648kg/m^3)	20	35	-				0.9		9		-	7			7
1.6 mm metal laminate on 18 mm plywood (648kg/m^3)	20	50	77				3.2		58		10	17			7
1.6 mm metal laminate on 18 mm plywood (648kg/m^3)	20	75	46				45.3		157		66	76			7
1 mm HPL laminate on 18 mm plywood (548 kg/m^3)	20	35	575				53.6		133		65	45			7
1 mm HPL laminate on 18 mm plywood (548 kg/m^3)	20	50	110				49.5		131		104	83			7
1 mm HPL laminate on 18 mm plywood (548 kg/m^3)	20	75	14				36.7		238		122	131			7
PVC Carpet (1400 kg/m^3)	2	35	26				22.8		251		75	139			7
PVC Carpet (1400 kg/m^3)	2	50	12				23.8		284		80	201			7
PVC Carpet (1400 kg/m^3)	2	75	7				23.3		344		78	274			7
Wood Table with HPL laminate on top (616 kg/m^3)	30	35	101				29.6		173		65	65			7
Wood Table with HPL laminate on top (616 kg/m^3)	30	50	38				46.8		210		99	110			7
Wood Table with HPL laminate on top (616 kg/m^3)	30	75	22				64.5		364		133	184			7
Cover (70%wool, 20% viscose, 10%aramide polymers), interliner (aramide polymers), foam (polyurethane & melamine foam)		20							79	280					8
Cover (70%wool, 20% viscose, 10%aramide polymers), interliner (aramide polymers), foam (polyurethane & melamine foam)		25							104	121					8
Cover (70%wool, 20% viscose, 10%aramide polymers), interliner (aramide polymers), foam (polyurethane & melamine foam)		35							269	42					8
Cover (70%wool, 20% viscose, 10%aramide polymers), interliner (aramide polymers), foam (polyurethane & melamine foam)		50							330	42					8

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Cover (70%wool, 20% viscose, 10%aramide polymers), interliner (aramide polymers), foam (polyurethane & melamine foam)		75							400	32					8
GRP (polyester gelcoat & hand-laminated glass fibres/polyester/mineral filler composite)		20							68	197					9
GRP (polyester gelcoat & hand-laminated glass fibres/polyester/mineral filler composite)		25							74	163					9
GRP (polyester gelcoat & hand-laminated glass fibres/polyester/mineral filler composite)		35							111	168					9
GRP (polyester gelcoat & hand-laminated glass fibres/polyester/mineral filler composite)		50							131	125					9
GRP (polyester gelcoat & hand-laminated glass fibres/polyester/mineral filler composite)		75							154	85					9
Seat Cushion - Foam (individual component)		50	14						80	25			30		12
Seat Cushion - Interliner (individual component)		50	5						30	15			300		12
Seat Cushion - Fabric (individual component)		50	11						420	20			225		12
Seat Cushion - PVC (individual component)		50	7						360	10			770		12
Seat Cushion - Foam 2 (individual component)		50	14						80	25			30		12
Seat Cushion - Interliner 2 (individual component)		50	5						30	15			300		12
Seat Cushion - Fabric 2 (individual component)		50	8						265	30			400		12
Seat Cushion - Graphite-filled foam (individual component)		50	7						65	20			40		12
Seat Support Diaphragm - Chloroprene		50	31						295	50			1400		12
Seat Support Diaphragm - FR cotton muslin		50	7						190	15			490		12
Seat Shroud - PVC/Acrylic		50	28						110	350			490		12
Armrest pad, coach seat (foam on metal support)		50	54						610	55			780		12
Seat footrest cover - Chloroprene elastomer		50	45						400	70			960		12
Seat track cover - Chloroprene elastormer		50	26						190	100			1100		12
Mattress & bed pad - Foam		50	9						80	20			40		12

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Mattress & bed pad - Interliner		50	5						25	10			70		12
Mattress & bed pad - Fabric		50	7						150	10			70		12
Wall Finishing - Wool Carpet		50	30						655	95			510		12
Wall Finishing - Wool Fabric		50	21						745	35			260		12
Space Divider - Polycarbonate		50	105						270	155			1000		12
Wall Material - FRP/PVC		50	23						120	40			1000		12
Wall Panel - FRP		50	18						270	40			530		12
Window Glazing - Polycarbonate		50	115						330	150			1000		12
Window Mask - FRP		50	53						210	95					12
Drapery Curtain/Fabric - Wool/nylon		50	13						310	25			380		12
Drapery Fabric - Polyester		50	20						175	30			810		12
Blanket Fabric - Wool		50	11						170	15			560		12
Blanket - Modacrylic fabric		50	17						18	25					12
Pillow - Cotton cover/polyester filler		50	24						340	60			570		12
Carpet - Nylon		50	10						245	75			350		12
Rubber Mat - Styrene butadiene		50	35						300	90			1400		12
Café/Lounge Table - Phenolic/wood laminate		50	44						250	55			80		12
Air Duct - Neoprene		50	30						140	55			810		12
Pipe insulation - foam		50	7						95	10			700		12
Window Gasketing - Chloroprene elastomer		50	33						210	305			1100		12
Door Gasketing - Chloroprene elastomer		50	38						200	275			1200		12
Seat Cushion (assembled)		50	12						420	25			170		12
Seat Cushion (assembled)		50	7						260	35			360		12
Seat Cushion (assembled)		50	7						360	10			510		12
Seat Cushion (assembled)		50	12						255	15			320		12
Seat Cushion (assembled)		50	7						270	30			290		12
Seat Cushion (assembled)		50	12						365	23			260		12

Sample ID	Thick-ness (mm)	Heat Flux (kW/m²)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m²)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m²)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m²)	Avg. HRR - Test (kW/m²)	Smoke SEA (m²/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Seat Cushion (assembled)		50	7						260	35			400		12
Seat Cushion (assembled)		50	6						370	15			510		12
Seat Cushion (assembled)		50	12						400	25			370		12
Seat Cushion (assembled)		50	8						270	35			290		12
Seat Cushion (assembled)		50	12						400	25			90		12
Seat Cushion (assembled)		50	8						275	35			220		12
Seat Cushion (assembled)		50	6						400	15			470		12
Mattress (assembled)		50	7						170	10			40		12
Bed Pad (assembled)		50	7						170	10			30		12
Pillow (assembled)		50	7						160	10			560		12
2729 - Back of Seat	2.6	25	596	33.2	78	434	14.9	5.8	40	774		30	206		15
2729 - Back of Seat	2.6	50	101	32.7	81	407	21.6	8.2	72	121		48	967		15
2729 - Back of Seat	2.6	75	16	33.6	29	9	0.5	0.5	53	22		39	4572		15
2729 - Armrest	3	25	626	41.0	68	358	12.1	4.1	43	794		32	262		15
2729 - Armrest	3	50	248	41.7	79	443	27.8	8.4	77	277		44	333		15
2729 - Armrest	3	75	17	40.9	30	11	0.9	0.8	85	25		63	4621		15
2729 - Seat	56	25	29	89.7	6	68	3.3	6.6	95	39		60	6029		15
2729 - Seat	56	50	7	91.1	21	279	16.2	8.5	163	19		57	625		15
2729 - Seat	56	75	4	89.8	32	406	23.3	8.1	165	17		57	549		15
2729 - Window	12	35	289	141.1	69	2709	230.4	23.6	211	347		86	229		15
2729 - Window	12	50	115	142.1	72	3283	263.9	26.2	192	829		80	244		15
2729 - Window	12	75	52	140.6	60	1084	153.4	18.3	221	294		142	1017		15
2729 - Printed Wall Lining	2.4	25	92	32.2	76	285	28.7	11.7	175	215		99	230		15
2729 - Printed Wall Lining	2.4	50	49	32.8	80	233	30.6	11.7	216	131		130	636		15
2729 - Printed Wall Lining	2.4	75	24	31.8	83	132	30.0	11.3	327	78		225	1387		15
2729 - Aisle Light Diffuser	3.4	50	91	39.4	78	265	57.9	18.9	336	85		221	3946		15
2729 - Ad Board	6.3	35	188	75.6	80	1272	133.8	22.3	287	230		107	950		15

Sample ID	Thick-ness (mm)	Heat Flux (kW/m²)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m²)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m²)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m²)	Avg. HRR - Test (kW/m²)	Smoke SEA (m²/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
2729 - Ad Board	6.3	50	77	75.1	84	784	112.5	17.8	253	157		144	1083		15
2729 - Ad Board	6.3	75	35	75.0	85	615	115.5	18.1	353	101		188	1758		15
2729 - Entrance Light Diffuser		50	12	48.4	80	367	78.9	20.4	348	68		214	1230		15
2729 - Brown Ceiling Panel	3.3	25	95	41.3	88	396	37.5	10.3	186	331		93	132		15
2729 - Brown Ceiling Panel	3.3	50	35	41.6	89	239	40.0	10.8	249	177		166	432		15
2729 - Brown Ceiling Panel	3.3	75	20	41.1	88	181	38.1	10.5	340	138		208	863		15
2729 - End Cap	5.5	25	126	82.4	9	47	3.8	4.9	95	152		70	8684		15
2729 - End Cap	5.5	50	24	79.9	73	553	61.5	10.6	148	267		111	2582		15
2729 - End Cap	5.5	75	8	82.6	74	502	60.6	9.9	171	28		121	2996		15
2729 - Brown Wall Lining	1.3	25	55	22.7	25	65	6.0	10.7	161	86		88	3739		15
2729 - Brown Wall Lining	1.3	50	21	22.6	27	59	6.7	11.0	186	49		110	4910		15
2729 - Brown Wall Lining	1.3	75	14	22.4	27	38	6.3	10.5	226	37		159	8038		15
2729 - Ceiling Panel	1.7	25	50	24.1	20	77	7.8	16.0	164	93		99	10799		15
2729 - Ceiling Panel	1.7	50	19	24.5	23	59	8.5	14.9	243	50		139	12425		15
2729 - Ceiling Panel	1.7	75	12	23.7	23	77	8.0	15.0	248	36		102	12105		15
2729 - Rubber Bellow		50	27	87.7	61	663	78.7	14.6	205	224		118	1700		15
2729 - Floor Tile		50	34	58.7	36	338	41.4	19.6	206	40		123	2708		15
2280 - Seat (White Foam Backing)	48	25	22	75.2	33	1548	66.9	27.3	228	14		43	258		16
2280 - Seat (White Foam Backing)	48	50	7	86.0	50	1319	96.0	22.2	191	14		73	459		16
2280 - Seat (White Foam Backing)	48	75	4	76.6	48	1031	94.1	25.5	259	12		91	986		16
2280 - Seat (Grey Foam Backing)	41	25	21	72.7	13	137	9.9	10.6	189	15		72	2968		16
2280 - Seat (Grey Foam Backing)	41	50	7	77.0	32	476	26.6	11.2	221	14		56	462		16
2280 - Seat (Grey Foam Backing)	41	75	4	73.3	52	905	46.8	12.2	227	15		52	292		16
2280 - Back of Seat	4.9	25	295	79.6	60	1034	111.3	23.3	158	559		108	621		16
2280 - Back of Seat	4.9	50	65	77.7	63	705	80.5	16.4	203	416		115	1141		16
2280 - Back of Seat	4.9	75	27	71.8	63	398	69.2	15.2	256	296		173	2381		16
2280 - Toilet Wall	5.05	25	211	80.6	49	1069	70.2	17.8	115	229		66	576		16

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2280 - Toilet Wall	5.05	50	56	77.5	51	639	62.5	15.7	194	41		97	1012		16
2280 - Toilet Wall	5.05	75	29	77.6	49	489	59.5	15.5	210	16		121	1534		16
2280 - Toilet Partition	15.4	25	559	135.4	29	1186	50.9	15.0	83	195		42	211		16
2280 - Toilet Partition	15.4	50	145	145.0	36	1062	62.0	14.3	109	439		58	457		16
2280 - Toilet Partition	15.4	75	12	127.0	57	1657	99.0	14.8	167	229		71	301		16
2280 - Central Panel	9.45	50	31	72.5	17	368	27.4	22.4	156	166		77	1716		16
2280 - Cove Panel	2.6	35	66	52.9	6	50	1.8	5.1	52	34		34	870		16
2280 - Cove Panel	2.6	50	47	56.6	7	57	3.3	8.7	88	14		52	1732		16
2280 - Cove Panel	2.6	75	27	57.3	8	56	3.7	7.7	123	12		61	1411		16
2280 - Flooring	2.8	50	31	35.7	59	791	59.2	28.3	255	39		75	1015		16
2280 - Console Panel	3.15	25	115	52.1	47	518	56.6	23.3	171	286		109	1052		16
2280 - Console Panel	3.15	50	33	49.2	51	357	52.2	20.7	279	81		146	1900		16
2280 - Console Panel	3.15	75	20	51.1	52	304	49.6	18.6	281	49		164	2370		16
2281 - Wainscot	3	30	77	44.6	1	294	13.8	5.0	127	197		45	375		17
2281 - Wainscot	3	50	41	44.6	1	212	26.8	9.4	236	72		125	670		17
2281 - Wainscot	3	75	20	44.5	1	200	30.8	10.1	279	4		153	476		17
2281 - Access Panel	2.6	35	66	52.9	6	50	1.8	5.1	52	34		34	870		17
2281 - Access Panel	2.6	50	47	56.6	7	57	3.3	8.7	88	14		52	1732		17
2281 - Access Panel	2.6	75	27	57.3	8	56	3.7	7.7	123	12		61	1411		17
2281 - Wall Lining FSM	3.15	25	115	52.1	47	518	56.6	23.3	171	286		109	1052		17
2281 - Wall Lining FSM	3.15	50	33	49.2	51	357	52.2	20.7	279	81		146	1900		17
2281 - Wall Lining FSM	3.15	75	20	51.1	52	304	49.6	18.6	281	49		164	2370		17
2281 - Wall Lining CFM	3.7	25	134	51.5	63	603	80.2	24.6	234	321		133	1093		17
2281 - Wall Lining CFM	3.7	50	23	51.4	66	467	71.7	21.1	269	270		154	1865		17
2281 - Wall Lining CFM	3.7	75	10	50.3	63	343	65.3	20.5	301	200		191	3044		17
2281 - Window	12	35	289	141.1	69	2709	230.4	23.6	211	347		86	229		17
2281 - Window	12	50	115	142.1	72	3283	263.9	26.2	192	829		80	244		17

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2281 - Window	12	75	52	140.6	60	1084	153.4	18.3	221	294		142	1017		17
2281 - Ceiling	9.45	50	31	72.5	17	368	27.4	22.4	156	166		77	1716		17
2281 - Seat	5	25	330	86.7	0	504	35.7	10.7	105	50		68	765		17
2281 - Seat	5	50	99	89.8	0	514	38.9	10.8	129	20		76	994		17
2281 - Seat	5	75	56	92.4	0	451	46.8	13.1	167	17		103	772		17
2281 - Flooring	4	25	255	83.1	0	570	36.5	11.8	149	24		63	1642		17
2281 - Flooring	4	50	66	84.2	0	565	42.7	12.9	118	325		75	1762		17
2281 - Gasket	15	50	33	52.6	0	2204	196.6	37.4	208	305		90	714		17
2281 - Light Diffuser	3.4	50	91	39.4	78	265	57.9	18.9	336	85		221	3946		17
2282 - Floor Material with Metal Backing	5.5	25	176	136.6	19	900	71.2	27.9	150	134		79	1150		18
2282 - Floor Material with Metal Backing	5.5	50	51	133.4	22	726	72.2	25.0	181	267		100	1931		18
2282 - Floor Material with Metal Backing	5.5	75	23	135.1	23	606	76.1	24.6	214	130		126	1736		18
2282 - Seat Material	5	25	357	94.1	39	1188	70.4	19.2	83	526		59	241		18
2282 - Seat Material	5	50	100	92.0	41	892	68.7	18.1	135	210		78	485		18
2282 - Seat Material	5	75	67	94.3	40	714	65.5	17.4	153	14		92	652		18
2282 - Window (PC)	5.9	50	68	73.0	81	577	123.0	20.9	406	133		218	1417		18
2282 - Window (PC)	5.9	75	21	73.8	84	579	130.6	21.0	502	114		232	1228		18
2282 - Window (PC)	5.9	90	14	73.5	82	463	116.8	19.4	477	95		254	2025		18
Acoustic Insulation - Dophin Hydroarmor 7735	1	35	27	41.7	8	50	--	22.5	398	44	22.6	43	1018	11.96	19
Acoustic Insulation - Aeroflex 200-STS P/N's A07856000, A07856001	24	50	6	12.6	17	15	0.1	2.7	9	--	0.5	--	--	1.65	19
Acoustic Insulation - Aquaplas DL-10 HV	4	50	89	247.5	1	214	4.3	13.0	75	132	14.5	36	39	5	19
Adhesive - Proflex 35-AA		50	26				83.1	20.5	188	302		84	645	31	19
Adhesive/Sealing 99-J52-S0041-1		50	11				62.3	23.6	408	92		186	666	228	19
Advanted Polymer - PRIMEF 7002/9000	15.1	50	543	356.8	8	2304	118.3	40.9	86	--	53.43	49	1276	4.52	19
Air Spring - 201C AIRSPRING		50	22				159.4	24.0	294	377		153	1285		19
Anti-skid coating material - HP1430		--	43				--	23.4	127	54		77	136		19

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Anti-skid epoxy flooring - Tekdata HP1430	3	50	24	--	--	--	9.8	23.4	127	55	32.7	77	136	*0.88	19
Articulation Bellows - Hubner Reinforced Elastomeric Comp.	1.6	50	53	20.8	55	307	22.1	19.3	267	83	73.8	87	796	8.5	19
Articulation Bellows - Minne. Ts5/1.6 reinforced elastomeric compound		50	30				21.4	19.0	207	97		68	829	5	19
Backshell, Post Shroud, Armrest - FRP with Tedlar		50	37				39.0	18.0	146	365		67	460	8	19
Battery case - UDEL P1700 Polysulfone	5	50	97	65.7	96	4270	116.0	21.6	267	130	182.4	98	392	35	19
Battery case - UDEL P1720 Polysulfone	2	50	69	27.9	70	433	46.2	22.7	268	140	129.4	107	75	15	19
Battery Case Shim - Delmat Polyester 68020	2	50	58	35.9	46	448	27.3	15.3	220	77	82.6	62	329	20	19
Battery Cell Container - Lidel P1700 Polysulfone		50	71				83.3	21.4	367	121		225	431	7	19
Bellows - FR Bellows		50	80				105.2	13.5	87	112		30	485		19
Cab Console - FRP + Tedlar Dimension Composites	3.5	50	37	59.8	37	585	39.0	18.0	146	365	72.7	67	574	8	19
Cab Curtain - PES material		50	25				1.6	11.9	100	30		42	92		19
Cab-Door Window Gasket - Rubber Compound 24045, Duro 60+-5		50	20				19.4	24.0	128	150		56	431	5	19
Cab-Low Ceiling+Crew Locker Panel - Aluminum Honeycomb Core Panel	9.5	50	20	47.8	17	363	19.4	24.0	128	150	61.8	56	431	1	19
Caulking - FSP 1000		50	53				22.1	19.3	267	83		87	796		19
Ceiling Ducting - Geta Fiberglass Coated Silicone	1.3	50	49	17.2	51	269	23.5	26.5	229	95	81	105	1203	15	19
Ceiling Panel - Honeycomb Core Ceiling Panel Composite	9.5	50	20	47.9	16	343	19.4	24.0	128	150	61.8	56	431	1	19
Ceiling panels - Melamine aluminum honeycomb		50	20				19.4	24.0	128	150		56	431	0	19
Chevron Spring - TIAVS-32X60		50	21				495.2	33.1	445	38		138	1254		19
Chloroprene Adhesive - 3M Scotch Grip 1357		50	--				0.5	--	5	155		0	--	5	19
Circuit Breaker - BMC 200		50	82				33.8	13.7	113	213		55	293	11	19
Circuit Breaker - Glastic 1454		50	101				28.2	10.9	119	300		48	79	7	19
Circuit Breaker panels - Glastic 1454 Composite (CBs)		50	101				28.2	10.9	119	300		48	79	7	19

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Circuit Breakers - Solvay Advanced Polymers Primef 7002/9000		50	542				118.3	40.9	86	na		na	1276	4.5	19
Coating - Aquaplas DL-10HV		50	89				4.3	13.0	75	132		36	39	5	19
Coating Material - Aquaplas DL-10HV		50	89				4.3	13.0	75	132		36	39	5	19
Composite - 545 Balsa with Phenolic Skin		50	65				5.9	6.1	118	--		41	--		19
Composite - GRP	12.35	50	107	239.5	59	3135	152.1	15.5	115	162	84.15	84	72	**0	19
Composite Floor - MCI .591" Phenolic Floor Panel (.05" Biaxial E-glass Skins & Balsa Core)	15	50	93	118.5	17	266	17.1	11.1	163	158	54.89	86	112	0	19
Composite Floor - MCI 3/4" Phenolic Floor Panel	18.9	50	121	183.3	19	470	10.8	4.0	89	198	26.95	31	280	3.48	19
Composite Floor - MCI 3/4" Phenolic Floor Panel	19	50	138	188.4	8	219	3.0	3.8	63	170	10.11	17	574	1.7	19
Composite Floor - MCI 3/4" Phenolic Floor Panel	18.5	50	156	153.4	8	500	10.5	2850.0	63	213	29.3	32	163	<5	19
Composite Laminate Material - 0.25 MR10 GE+FR65 0.01 GE+468MP 0.005	6.5	50	88	78.0	91	3032	152.3	21.4	270	130	186.4	52	854	60	19
Composite Panel - Honeycomb Core Composite Panel		50	472				57.0	25.5	189	765		74	552	1	19
Conduit/Neoflex - KCR-12		50	60				54.0	13.1	97	77		33	312	6.3	19
Connector seals - Veam Rubber Compound 55/1	3	50	33	44.3	56	1080	85.1	26.1	168	65	108	62	250	1	19
Counter Splash Guard/Top+Basin - FRP Fiberglass Vinyl Ester+10% MMA+50%ATH		50	53				164.5	13.8	115	87		43	38	35	19
Coupler rubber - WABCO Rubber Compound 20060		50	29				276.1	29.1	317	48		122	1164	18	19
Cushioing Composite - LS 200 Foam		50	88				1.0	2.4	35	110		29	10		19
Destination Sign Curtain - Noryl Xtra Compound	1.8	50	19	20.0	79	834	38.3	24.3	122	42	86.4	47	1220	--	19
Door Edges - 24051 Rubber Compound		50	45				86.3	17.6	126	58		68	1280	11	19
Door/Nose Rubber - PE 700213	1.3	35	114	170.9	76	--	113.0	23.0	152	158	87.1	93	--	--	19
Duct Liner - Owens Corning Type 200	--	50	2	--	--	8	--	--	--	--	--	--	--	25.78	19
Ducting - Flexible Technologies Model MK-C		50	14				0.5	5.9	49	26		31	47	2	19
Ducting - Owens Cornering 475 Duct Board		50	--				0.2	--	2	1110		0	--	1	19

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Emergency Ladder rungs - Extrn, Series 525 (Dimension Composites pultrusion)		50	62				44.0	10.8	137	308		84	1002	20	19
End Caps - Dimension Comp. Gel Coated FRP 5mm IC-315 resin		50	55				88.0	17.4	139	472		85	533	30	19
End Caps - Testori Gelcoated FRP (M7)	5	50	50	88.3	54	956	65.8	16.4	138	103	90.8	69	460	9	19
End gate rub strips - Minne. Gray end plate plastic		50	68				86.1	25.3	742	177		222	167		19
End Molded Shells - SC-FR 9161 Polyester Gelcoat		50	38				49.0	18.9	126	90		71	593	22	19
EPDM - NF-16-101	25	50	72	404.8	16	3600	173.0	23.8	162	97	79.9	49	419	**1.77	19
EPDM Gasket Material - NF-16-101	25	50	72	404.8	16	3528	173.0	23.8	162	97	79.9	49	157	**1.8	19
EPDM Gasket Material - REIFF Gasket		50	8				162.6	34.5	217	78		79	758		19
Epoxy coating - Epoxy Coating System		50	61				57.1	25.1	312	147		178	674	65	19
Exterior-Number Sign Gasket - Neoprene Compound 24045B		50	50				42.1	15.9	138	65		67	1280	4	19
Extruded Rubber - Chamberlin FLEX 35		50	33				143.5	18.7	143	763		86	894	30	19
Fabric - Entransit	1	50	17	4.3	86	106	4.4	11.1	219	38	14.8	50	358		19
Fabric - NDW Textiles Canvas/Natural	0.7	50	7	3.7	89	51	1.7	5.3	98	25	5.79	38	45	**5	19
Fiberglass Composite - Protectalite Backshell		50	71				27.5	12.3	142	95		81	636	10	19
Fiberglass Insulation - SG25 Plain		50	--				2.2	--	5	557		1	--	5	19
Flex-Conduit - Liquatite Electri-Flex CEA Conduit		35	--				103.0	--	84	--		--	--	22.8	19
Flex-Conduit - PCS/PCSL		50	80				138.9	28.2	983	258		336	135	5	19
Flexible ConduitZHLA/CEA Jacket Material	1	50	24	14.1	90	237	34.1	23.8	510	70	74.1	154	227	25	19
Flex-Conduit - PMA Theroplastic Material "VAM"	1	50	26	12.5	89	503	25.2	22.4	344	48	80.1	54	149	15	19
Flexible Air Duct Material - Reeves Brothers Inc. Neoprene on Fiberglass cloth		50	3				2.0	9.0	205			87	9	***2.4" - 0	19
Flexible Conduit - Neoflex Co. KCR-12 Rubber tubing		50	60				54.0	13.1	97	77		33	313	5	19
Flexible Conduit - PMA PCS/PCSL	4	50	80	46.3	95	413	138.9	28.2	983	258	456.3	336	256	5	19
Flexible Conduit - PMA Thermoplastic PCS		50	21				21.3	26.9	448	47		105	227	15	19

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Flexible Conduit - PMA Thermoplastic VAM	1	50	26	12.5	11	477	25.2	22.4	344	48	80.1	54	149	15	19
Flexible Silicone Hose - XP-16486		50	68				21.9	26.7	243	117		97	273		19
Floor Covering - 5112-01		50	88				17.5	7.0	116	265		62	--	10.36	19
Floor Covering - Abrastop/Fiber 24oz. Mat	5.2	20	488	93.2	30	635	46.6	17.5	155	538	117.2	74	433	*0.94	19
Floor Covering - Abrastop/Foam Composite	21	20	457	198.5	23	3600	96.0	20.5	92	485	46.5	31	519	--	19
Floor Covering - NORA 925	4	20	368	163.7	8	310	21.6	17.1	140	408	71	70	466	*0.85	19
Floor Covering - NORA Compound 925	9.9	50	35	206.6	17	310	75.2	22.5	981	170	250.83	404	190	*0.49	19
Floor Covering - NORA Degree 3.2mm	9.5	50	95	207.3	9	562	52.9	29.2	388	145	151.23	113	541	*1.04	19
Floor covering - NORA Noraplan Stone, Color 2763	3.2	50	48	173.3	18	965	58.5	18.2	212	63	101.7	64	733	*0.7	19
Floor Covering - Treadmaster TM7		50	111				62.3	13.7	197	--		103	96		19
Floor covering - Treadmaster TM7 Floor Covering		50	119				62.3	21.9	197	351		96	96	*1.1	19
Floor Marking Material - PER-0.40 L-HPPL	0.9	50	20	12.2	27	395	19.9	22.2	441	48	61.6	53	808	*0.5	19
Floor Panel - MCI 3/4", 0.05" skin, Balsa Core	19	50	78	123.2	--	180	9.3	6.0	169	--	30.85	--	61	4.03	19
Floor panels - Milwaukee Composite .75" 050 skin/foam core		50	10707				25.0	7.9	187	192		79	81	1.95	19
Floor panels - Milwaukee Composite .75" 085 skin/balsa core		50	156				10.5	6.6	63	213		32	163	10	19
Floor panels - TODCO Pylymetal Panel		50	595				66.9	9.0	126	1160		70	13	0	19
Floor panels/partitions - Rail Tech Plymetal Panel		50	655				60.5	9.0	157	1095		67	79	0	19
Florescent Light Diffuser Lens Bathroom - Lexan 90316	3	35	164	28.4	90	867	57.8	22.7	472	220	155.8	82	751	14	19
Foam - Flexible open cell (melamine resin) (BASOTECT G)	25	50	4	2.3	43	26	1.1	9.7	50	17	3.7	34	26	1.23	19
Foam - Polydamnp Low Emissivity (PLE-0125)	3	50	--	1.3	39	--	34.8	--	32	1642	8.3	19	130	0	19
FRP - Dimension Composite 3mm	3	50	48	45.9	34	455	40.7	19.5	368	63	128.1	100	875	**0	19
FRP - Dimension Composite IFRL Polyester Resin	4	50	60	86.8	46	881	69.0	17.4	161	118	100.8	78	469	2.5	19
FRP - Flexfab 1006	5	50	--	12.9	4	--	8.7	--	15	1205	1.6	5	220	0	19
FRP - NJB Project FRP Samples	4.5	50	61	69.8	60	899	77.7	18.6	156	480	130.5	93	940	30	19

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FRP - Silicone Reinforced Flexfab DF-2010	1.23	50	31	15.4	25	1231	8.2	21.4	157	--	23.88	39	--	5	19
FRP - Testori 1/8" Nominal Thick	3.5	50	42	59.9	54	631	49.8	15.5	151	135	123.5	85	625	10	19
FRP - Victall	10	50	51	115.2	42	1403	137.0	24.9	222	93	127	142	472	**0	19
FRP & Gelcoat - (ETERSET 2910PTI+gel-coat A400TV-F+Taishan Fiberglass)	4	50	61	67.0	43	900	39.0	12.1	117	365	77	74	496	31.4	19
FRP Laminate - Console Assembly	3.5	50	36	53.5	43	584	57.7	19.0	223	185	158	99	965	23	19
FRP Laminate - Dimension Composite	2.5	50	50	42.9	52	472	35.2	14.9	179	75	105.4	75	496	25	19
FRP Laminate - Dimension Compsite FRP	3	50	53	55.5	47	467	42.6	16.7	190	77	123.5	91	671	18	19
FRP Laminate - End Bonnet	2.6	50	79	--	--	452	31.6	15.7	155	--	94.5	96	908	34	19
FRP Laminate - End Cap Fibertech	3.7	50	88	62.5	42	--	17.5	7.0	116	265	58.04	62	175	10.36	19
FRP Laminate - End Roof Cap	3.5	50	37	50.5	45	568	53.1	18.8	257	193	155.9	94	966	13	19
FRP Laminate - Passenger Seat Shell, Blue Series 160-2	4	50	52	66.8	50	694	60.7	17.5	229	175	150.3	87	846	23	19
FRP Laminate - Performance Fabrication	9.5	50	34	166.3	61	1312	102.6	14.3	137	55	100	102	541	11.94	19
FRP Laminate Composite - FRP+Resin #5764A00200+Tedlar Indura GT from CMR 7311-D		50	39				71.4	20.4	259	250		92	863		19
FRP Laminate Material - 1/4" FRP with Gelcoat		50	86				99.5	18.8	192	593		108	805	10	19
FRP Laminate Material - 1/8" FRP with Gelcoat		50	63				51.4	17.9	244	238		100	866	15	19
FRP Laminate Material - FRP with Gelcoat (Coosa Core)		50	71				118.8	19.0	188	95		98	838	15	19
FRP Laminate Material - Gelcoat FRP Endcap Material		50	55				88.0	18.4	139	472		85	533	30	19
FRP Material - Permaglas MP 270		50	145				162.3	18.8	97	168		55	136		19
FRP Window Mask Laminate - Series 160-1	3.2	50	38	42.6	52	474	38.0	17.1	245	88	117.5	87	937	32	19
FRP, Gelcoat, & Foam - (ETERSET 2910PTI+gel-coat A400TV-F+Taishan Fiberglass+foam Diab P-100)	10	50	138	129.2	40	1500	73.0	13.1	113	478	67	73	433	31.25	19
Gasket - anti-squeak - Argus Industries .375" closed cell sponge SCE41NEO	9.8	50	11	15.1	45	255	9.5	16.8	57	63	30.9	41	388	9	19

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Gasket - anti-squeak - Nishiyama corp americal X1347L	10	50	47	168.5	42	922	72.8	9.9	194	443	83	86	982	**1	19
Gasket - AP Armaflex Sheet (AS-6073-46)	12.5	50	1	6.9	74	95	8.2	16.5	202	10	0	86	402	5	19
Gasket - REIFF EPDM	13	50	8	89.0	47	2078	162.6	34.5	217	78	141	79	540	**18.1	19
Gasket - Silicone BF-1000	26	50	13	53.3	20	1007	67.8	55.1	131	32	102.9	68	201	20	19
Gasket Filler/anti-squeak - ProFlex 35-AA with adhesive	20	50	26	319.0	40	3468	248.3	21.3	135	45	75.8	71	438	15	19
Gasket Filler/anti-squeak - ProFlex Flex 35 Rubber		50	33				143.5	18.7	143	763		86	894	**1.2	19
Gasket Light Fixture - Luminator Self-Adhesive Neoprene Foam		50	4				0.5	15.4	24	13		19	57	15	19
Glazed Rubber for Windows - #24051 rubber, nominal 1" thick	27	50	92	465.1	84	3508	122.4	16.4	81	123	41.5	35	417	**1.4	19
Glazed Rubber for Windows - 24051 22mm thick	22	50	54	374.7	77	3546	226.0	26.2	119	1248	59.4	64	749	**0.5	19
Glazing and door nose rubber - SAS Neoprene Compound 24045B	26	50	110	456.3	9	1161	53.0	12.8	104	142	58.5	42	371	**3.3	19
Glazing Protective Film - 3M Film 1004	6.2	50	46	148.1	4	210	12.2	19.4	193	65	27.3	58	494	5	19
Glazing Rubber - Centeral Sales & Service #RC94701	12.5	50	56	200.2	59	2188	165.0	18.6	148	72	85	75	577	**1.6	19
Glazing rubber - Nishiyama FCB-T24		50	53				72.4	14.5	174	385		85	821	**1.2	19
Glazing rubber - ProFlex Silicone 35	1.8	50	36	27.9	38	361	22.5	20.9	205	113	74.6	69	693	**1.3	19
Glazing/door nose rubber - Delford Rubber Compound 67271LS		50	41				160.4	17.1	135	528		54	542	**0.1	19
Heater Insulation (HVAC) - Permaglas MP 270		50	145				162.3	18.8	97	168		55	136		19
Honeycomb Panel - 3/8" Aluminum Honeycomb Sandwich Panel	9.4	50	65	51.6	16	257	12.8	15.4	129	135	42.7	67	430	0	19
HPL Board - Victall (Interior Panels)	1.2	100	6	19.2	12	192	25.2	14.6	--	--	78.96	114	--	Pass	19
HVAC Fiberglass Housing - " with Cook gel coat 944-AA444		35	133				489.0	15.3	221	143		--	437		19
Insulated Flexible duct - Flexible Technologies Model MK-C	25.4	50	14	7.1	18	30	0.5	5.9	49	26	1.6	31	47	2	19

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Insulated Wire - 110K-UP Wire MIL-W-16878/4 200C 600V 22 AWG		50	657				10.5	3.4	45	698		34	11		19
Insulating Wire - Polyrad XT 12 AWG 125° C	6	50	64	155.6	20	505	60.2	19.9	214	263	172.9	138	1175		19
Insulation - Armflex Insulation 6mm		50	2				6.7	19.1	96	5		51	335		19
Insulation - "KN110 2" KNAUF 5712		50	--				25.5	--	19	1418		9	--	1.5	19
Insulation - "KN110F 2" KNAUF 5712+FSK		50	--				9.7	--	11	1193		5	--	2.5	19
Insulation - AF 110 FSF		50	--				2.6	--	6	1255		1	--		19
Insulation - AF 110 FSK	25.4	50	--	6.4	22	--	2.8	--	3	740	0.6	2	--	--	19
Insulation - Aluminum Faced BASOTEC		50	--				14.0	--	19	1528		9	--		19
Insulation - AP Armflex Insulation	14	50	1	9.3	64	201	12.8	19.0	131	18	48.81	68	519	5	19
Insulation - Armaflex NH-Closed Cell Rubber	13.38	25	105	9.7	11	165	1.5	5.2	24	28	4.87	8	--	**0	19
Insulation - Artik 1" Fiberglass Insulation Board	25.4	50	DNI	11.0	57	--	--	--	--	--	--	--	--	0	19
Insulation - BASOTEC Isolator		50	--				16.2	--	19	1528		9	--	1	19
Insulation - Carbowool-Isulfrax SF	20	50	--	17.9	2	--	41.0	--	53	1535	2.4	23	--	2	19
Insulation - Cellofoam F800AC6-01	13.3	50	0	82.9	0	0	--	--	--	--	--	--	326	0.4	19
Insulation - Certain Teed Ultra Duct Black	25.4	50	--	18.7	--	--	--	--	--	--	--	--	--	0	19
Insulation - GPO3	6.3	50	136	115.4	53	1257	80.9	15.1	137	160	85.5	64	384	2	19
Insulation - Knauf KN 1.5#/Polyfail 5235	24	50	--	9.8	7	--	19.6	--	24	1785	3.8	11	4961	0	19
Insulation - KNAUF RPL, 3#, faced with FSK	25.4	50	--	12.0	10	--	0.3	--	3	8	0.3	0	--	2	19
Insulation - M22785/6B-12-9		50	217				87.1	16.8	254	423		181	3		19
Insulation - Moniflex	19	50	9	2.5	99	22	3.7	13.8	429	20	0	63	84	0	19
Insulation - NOMACO Kflex LS Insul tube/sheet 1"	25	50	1	15.9	75	267	20.7	17.2	121	8	62.1	80	44	6	19
Insulation - Polar SG25 w/ A1 Cloth	25.4	50	DNI	15.6	8	--	0.3	--	3	505	--	0	--	1	19
Insulation - Poltrat XT Wire Insulation		50	64				60.2	19.9	214	263		138	1175		19
Insulation - UMBI Sample 3-2		50	--				2.4	--	5	750		1	--	2.25	19
Intercar Diaphragm - Pro-Flex Rubber 35-AA		50	26				83.1	20.5	188	302		84	645	**1.0	19
Interior lining (phone cabinet) - Deflex FRP composite 4.5mm	4.5	50	64	72.4	52	768	62.9	16.4	173	90	114	82	539	3	19

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Interior linings - Bayer Bayblend MTG-Ag	3.2	50	80	46.3	55	1124	68.3	23.8	170	160	124	162	580	10	19
Interior linings - EL lkr partition - Testori 12.5mm mel/plymetal + Haysite	12.5	50	45	160.7	23	985	21.0	6.2	90	55	43.6	22	38	4	19
Interior linings - moldings - GE Ultem 9076 (extruded)	3	50	78	40.9	67	1806	76.0	28.6	81	185	62.5	44	352	2	19
Interior linings - Testori 3/8 alum. H/C panels		50	65				12.8	15.4	129	135		67	430	1.5	19
Interior linings - Testori FRP directional reinf 1/8"	3.6	50	63	56.2	51	575	51.4	17.9	244	238	153.6	100	866	15	19
Interior linings - Testori FRP panels IC-315 resin 0.125"	3.2	50	41	62.1	40	684	49.0	18.9	126	90	102.3	71	596	22	19
Interior linings - Testori Mel/al faced plymetal 12.9mm		50	69				49.4	10.4	187	483		71	16	2	19
Interior linings - Testori Mel/al/al faced plymetal 10mm		50	68				45.5	10.7	230	397		83	21	1	19
Interior linings - Testori Tedlar GT form 20 on IC 315 FRP 0.125"/Bostick		50	61				77.7	18.6	156	480		93	940	30	19
Interior linings - Texstars Phenolic composite 3mm	3	50	80	43.2	52	793	46.1	21.9	229	100	102.8	64	466	15	19
Interior linings - window masks - ADS Composite FRP		50	38				38.0	17.1	245	88		87	937	32	19
Interior Panel - Mel/al-al/ho-al	9.3	50	37	44.6	--	142	20.3	19.9	316	115	77.9	78	519	0	19
Interior Panels, Seating Components - Texstars Phenolic/FRP Composite		50	80				46.1	21.9	229	100		64	466	15	19
Laminate - 1/4" FRP w/ Gelcoat	7	50	86	110.2	47	1005	99.5	18.8	192	593	129.8	108	805	10	19
Laminate - 1/8" FRP w/ Gelcoat	3.6	50	63	57.1	51	575	51.4	17.9	244	283	153.6	100	866	15	19
Laminate - Composite Panel Solutions-HPL Laminated BBX Fir Plywood (Elec Locker)	13	50	107	101.4	44	818	21.8	4.4	57	428	30.58	32	223	1.34	19
Laminate - FRP w/ Gelcoat (Coosa Core)	11.5	50	71	125.2	51	1284	118.8	19.0	188	95	157.9	98	838	16.5	19
Laminate - HPL M964/Type 964 (High Ceiling Panel)	2.3	50	35	56.8	7	90	5.1	13.3	273	52	0	90	97	0	19
Lens Material - MAKROLON 1143		50	67				59.4	21.3	535	117		85	803		19
Lexan - Thin Gage Polycarbonate Material	2.3	50	61	27.5	86	463	48.3	20.4	445	118	150.1	121	751	25	19

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Light fixture end caps - GE Ultem 1010-1000 Polyetherimide	3	35	332	40.0	55	674	33.5	21.0	110	588	50.6	50	313	1	19
Light lens - Lexan 153	2.6	50	68	32.0	80	314	33.2	14.0	350	125	110.47	133	134	16.21	19
Light lens - Makrolon 1143-1124		50	75				70.8	23.6	382	362		97	1005	7	19
Light lens - Makrolon 1243	3	50	72	38.6	89	632	79.4	23.2	445	188	224.6	145	880	9	19
Light Lens - Makrolon 3227-550122	3.5	50	111	34.0	92	877	72.6	22.2	526	188	205	95	831	86.84	19
Lighting (Loc-Sockets) - Polycarbonate Ultem 1010-1000 Resin		35	332				33.5	21.0	110	588		50	504	1	19
Lighting Tape Foam - Self Adhesive Neoprene Foam		50	4				49.0	15.4	24	13		19	57	15	19
LLEPM HPPL decal - HPPL floor marking material		50	20				19.9	22.2	441	48		53	808	*1.1	19
Locker Lining - Haysite		50	130				62.6	12.6	159	135		35	646	12.63	19
Microphor Toilet Seat - #94354	6.5	50	44	102.8	96	2123	148.3	15.2	181	517	129.3	71	2	20	19
Neoprene - 60 Durometer RC94613	12	50	29	160.3	48	3600	237.2	28.8	238	53	91.6	67	659	**2	19
Neoprene - 65 Durometer 99650TNE	25.83	50	31	395.3	25	3600	160.0	14.6	129	43	60.54	73	222	**0.3	19
Neoprene - 70 Durometer Protac C70S0608-1	25.52	50	66	393.6	3	308	11.3	9.0	71	105	--	52	1	**0.5	19
Neoprene - 70 Durometer RC94701	12.5	50	56	200.2	41	2244	165.9	18.6	148	72	85	75	765	27	19
Neoprene - CR Compound 24045B	26	50	110	456.3	9	1271	53.0	12.8	104	142	70	42	638	**0.6	19
Neoprene - Proflex Flex 35 AA	11	50	80	166.5	27	2497	161.6	33.1	100	718	59.5	67	367	**0.9	19
Neoprene - SAS Rubber 24051	26	50	71	454.5	18	3600	181.4	19.6	125	105	63.2	51	765	7.4	19
Neoprene Closed Cell Rubber Strip	17	50	5	65.7	58	573	44.5	15.7	236	--	126.53	--	2578	**18	19
Neoprene Foam - 3/16" Closed Neoprene Sponge	6	50	1	3.4	65	36	2.7	12.3	106	18	9.2	79	115	65	19
Neoprene Foam Tape - Self-Adhesive Neoprene Foam	1.5	50	4	3.8	20	26	0.5	15.4	24	13	1.8	19	346	15	19
Neoprene RC94613	12	50	29	160.3	47	3571	237.2	28.8	238	53	91.6	67	542	**2.0	19
Ninyl Coated Fabric - Uniroyal Phoenix PH-65 Grey Perforated Vinyl	1.3	50	1	8.8	65	60	7.4	12.6	286	13	24.8	128	257	1.1	19
Operator Console Panels - IC-315 polyester+fiberglass+SCFR Gelcoat		50	53				42.6	16.7	190	77		91	671	18	19

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Paint - Haysite GPO-3 Panel		50	136				80.9	15.1	137	160		64	369	2	19
Paint - Sico Epoxy system		50	61				57.1	25.1	312	147		178	674	65	19
Paneling - Plymetal Panel		50	655				60.5	9.0	157	1095		67	79	0	19
Paneling - TODCO 5/8" BBCore w. Stainless Steel Faces	16	50	490	157.4	43	1330	67.1	9.9	145	1045	68.6	80	47	--	19
Paneling - TODCO PlyMetal Panel, 0.67" Thick, 5 ply plywood core, 0.016" SS Faces	17.5	50	595	185.0	40	1547	66.9	9.0	126	1160	64.1	70	13	5	19
Panels - 3/8" Melaminium Control #33846, Bond Hatch E6425	9.8	50	29	85.1	58	529	33.6	7.8	137	333	61.1	66	--	12.24	19
Panels - Aluminum Honeycomb Ceiling Panel	9	50	62	52.8	23	457	2144.0	16.9	154	188	68.28	55	398	1	19
Plastic Sheet Material - Kydex-6200LT RB10-29-1		50	35				40.2	13.5	174	45		80	431	25.5	19
Plastic Sheet Material - Kydex-6200LT RB10-29-2		50	57				39.7	13.6	199	70		90	434	17.23	19
Plastic - Kydex 5200 Laminate-Cab Sun Visor	1.2	50	28	--	--	362	43.2	10.2	258	--	138.2	202	1344	**0	19
Plastic Material - PCS/PCSL	4	50	57	42.3	94	388	100.3	24.9	642	213	329.9	263	224	5	19
Plug+Recepticle Connectors - Veam SRL Compound 55/1		50	33				65.1	26.1	168	65		62	6		19
Plymetal Panel - .5" Balanced Melamine Plymetal Sandwich Plate	12.9	50	69	101.0	49	763	49.4	10.4	187	483	77.4	71	16	2	19
Plymetal Panel - 3/8" Thick Plymetal Sandwich Panel	10	50	68	94.9	48	620	45.5	10.7	230	397	87.2	83	21	1.2	19
Plywood - Dricon Douglas Fir Plywood		35	34				43.3	8.8	101	540		38	5	4.1	19
Polyamide - EBM Industries-Impeller for R1G220-AB35-92	2.7	50	42	31.4	68	668	58.1	23.6	267	63	151.9	174	608	**6.5	19
Polycarbonate - Lexan 90316		35	164				57.8	22.7	472	220		82	751	15	19
Polycarbonate - Makrolon 1143-1124; Nominal thickness 6mm	6	50	75	74.1	98	1845	170.8	23.6	382	362	284.2	97	1005	47	19
Polycarbonate - MGM Electric-Cable Ducts	1.2	50	79	18.4	66	467	27.5	21.1	--	--	86.38	125	660	--	19
Polycarbonate - Tuffak CM-2	12.1	50	94	--	--	--	290.8	23.6	296	--	227.1	--	--	55	19
Polycarbonate Sheet - Lexan 2034	2.4	50	248	25.4	72	734	40.8	24.4	151	280	94.25	119	275	8.58	19
Polycarbonate Sheet - LEXAN MR10		50	146				247.9	26.6	232	180		72	844	48.5	19

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Polycarbonate Sheet - Sabic Lexan FRA460	12	50	247	151.1	74	3260	293.4	22.9	271	280	172.5	97	890	35	19
Polyetherimide - ULTEM 1010	3.2	50	96	42.1	45	752	32.6	17.6	107	113	78.9	50	564	5	19
Propulsion box seal - EPDM REIFF gasket material		50	8				162.6	34.5	217	78		79	758	**18	19
Propulsion Case Material - Veam Compound 55/1 (Rubber)	3	50	33	45.6	45	1047	65.1	26.1	168	65	108	62	250	--	19
Pultrusion-Rocking Carshell	3	50	54	65.9	68	473	45.7	20.0	175	95	123	178	539	6	19
PVC Acrylic - Kydex 6200 LT RB10-11-1	3	50	43	48.7	59	493	38.1	13.3	127	70	97	85	518	30	19
PVC Acrylic - Kydex 6200 Thermoplastic Sheet Material	3	50	13	41.3	84	584	38.2	11.0	104	83	96	67	527	4	19
Reinforced Plastic - 1/8" Nominal Fiberglass Reinforced Plastic		50	42				49.8	15.5	151	135		85	625	13	19
Rubber - FLEX REV E	1.7	50	22	30.2	39	242	17.9	14.7	219	47	59.9	82	990	**1.7	19
Rubber - TIF02		50	135				77.2	26.4	286	411		127	66		19
Rubber - TM7 Grey		50	135				77.2	26.4	--	--		132	--		19
Rubber Bumper - NK617		50	51				207.4	30.9	436	373		112	1341		19
Rubber Cleat - KAM 55		50	21				58.2	13.7	165	232		86	908	8.5	19
Rubber Cleat - Yasufakee YBF-X02	51	50	22	787.4	91	3578	92.0	13.7	69	42	41.8	26	43	0.2in	19
Rubber Compound - 20060	12.3	50	29	166.0	59	2320	276.1	29.1	317	48	159.3	122	1164	**18	19
Rubber Compound - 24051 Rubber Compound	22	50	54	371.9	23	3600	226.0	26.2	119	1248	59.4	64	749	27.38	19
Rubber Compound - 67271LS		50	41				160.4	17.1	135	528		54	542		19
Rubber Gasket - 65E1376		50	29				199.4	21.3	153	373		69	966		19
Rubber Gasket - Emka Gasket 1011-S19 EPDM A493	18	50	6	76.0	53	2149	127.5	30.7	157	33	111	60	334	**2.8	19
Rubber Gasket (HVAC) - Compound #65E1376 (West Amer. Rubber Co.)	13	50	29	186.2	51	2904	199.4	21.3	153	373	95.2	69	966	**1.1	19
Rubber Sheet with Adhesive - Nishiyama corp americal C-Splash A Daitac 8800CH (W)		50	51				226.4	23.6	159	77		64	1159	**1.37	19
Rubber Strips - OP1520		35	30				90.3	22.1	479	--		280	--		19
Rubber Strips - OP1555		35	54				71.4	18.5	420	--		225	--		19

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Rubber Strips - OP685		35	71				73.5	16.9	375	--		225	--		19
Rubber Strips - OP768		35	84				74.8	19.7	439	--		330	--		19
Rubber Strips - OP824		35	24				77.1	18.6	371	--		109	--		19
Rubber Tube - FCB T-23		50	25				47.9	12.2	150	252		66	581		19
Safenife Batery Case - 96-J52-S0661-1		50	97				164.4	26.1	223	425		39	1022		19
Sealant - 3M Fire Barrier CP2510B	13	50	29	146.9	12	3570	129.9	59.0	71	46	50.5	--	173	15	19
Sealant - RTV 20.01	4	35	95	173.4	9	901	0.5	30.4	211	--	--	--	--	30.57	19
Sealant - RTV 5243		35	29				8.5	--	95	--		--	--	--	19
Sealant - RTV GE 5243	2.3	35	29	24.1	33	257	8.5	17.9	95	--	28.3	95	325	**2	19
Sealant - Scotch-Seal 540	1	50	9	13.1	86	121	21.8	19.5	469	40	72.8	177	580	35	19
Sealant - Sikaflex 252	3	50	11	32.6	79	347	62.3	23.6	408	92	204	186	632	228	19
Seat (Cab) Bellows - USSC		50	80				105.2	13.5	87	112		30	485	**0.8	19
Seat Components - ADS composites S52-08-25 SMC (blue)		50	72				37.0	16.8	182	90		92	581	25	19
Seat Cushion - Chestnut Ridge LS 200 Neoprene foam		50	88				1.0	2.4	35	110		29	10	2	19
Seat Cushion - Chestnut Ridge Safeguard XL firm	25	50	1	33.6	22	258	8.4	11.5	69	15	28.3	33	52	4	19
Seat Cushion - Chestnut Ridge Safeguard XL Medium	50	50	48	53.2	15	252	7.3	8.6	46	60	32.1	30	85	1.4	19
Seat Cushion - LanXess	2.5	50	58	36.3	66	--	72.6	25.9	--	--	--	370	1020	**0	19
Seat Cushion - MFI 8055 Silicone Foam	24	50	5	--	--	--	18.7	51.1	--	--	27.1	--	42	23.3	19
Seat Cushion - MFI Silicone foam MFI 6535	50	35	8	46.5	7	400	18.3	--	--	--	--	--	--	15	19
Seat Cushion - MFI Silicone foam MFI 9075		50	5				18.7	51.1	44			27	42	19.3	19
Seat Cushion - Recaro FR Foam/FRX Foam	26.3	50	11	27.4	91	526	28.7	11.9	128	38	67.12	56	498	51	19
Seat Cushion - Safeguard XL Firm Cellular Silicone Foam	50	50	4	79.4	21	--	12.0	6.7	26	75	23	20	160	0.3	19
Seat Cushion - Safeguard XL Medium MF 1-55 Cellular Silicone Foam	26	50	9	27.3	23	665	38.3	56.3	128	20	93.4	58	41	25	19
Seat Shell - KTK Group	3	50	77	58.8	55	435	47.0	--	199	120	--	85	214	19.65	19

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Seat Shell - Kydex 6200 Thermoplastic Sheet		50	13				38.2	11.0	104	83		67	527	4	19
Seat Shell - Kydex 6200LTR Thermoplastic Sheet (PVC/Acrylic)	3.2	50	45	62.7	58	794	61.5	15.7	131	55	109.4	82	434	15	19
Seat Shell (back) - Multina Tedlar covered FRP 5764A00200 resin	3.5	50	39	47.2	70	816	71.4	20.4	259	250	184.2	92	863	35	19
Seat Shells - ADS Composite FRP		50	52				60.7	17.5	229	175		87	846	23	19
Seat Shells - Boltaron 4800 thermoplastic sheet		50	24				1.2	4.0	85	30		54	41	3	19
Seat Shells - Dimension Composite 3 mm FRP panel		50	53				42.6	16.7	190	77		91	671	8	19
Seat Shells - Kleerdex 6200LTR		50	57				39.7	13.6	199	70		90	434	17	19
Seat Shells - Protectolite FR Fiberglass		50	71				27.5	12.3	142	95		81	636	10	19
Seat Suspension - Entransit	0.9	50	21	3.7	94	76	6.2	14.8	354	40	0	76	652	5	19
Seat Suspension - Mass Transit Seating-Entransit		25	76				4.1	11.5	150	95		60	258	2.3	19
Seat Suspension material - Entransit - Royersford Springs		50	17				4.4	11.1	219	38		50	358	***2.5 - 0	19
Seat Upholstery - Holdsworth 85/15 FAR treated 1001 Quality Matl		50	17				11.1	13.5	354	33		142	171	***1.7 - 6.6	19
Seat Upholstery - Holdsworth Vigor with FR Back Coating	4	50	28	8.9	93	79	11.0	14.5	355	50	0	132	358	***2.2" 1.7s	19
Seat Upholstery - Lantal 90/10 wool/nylon		50	9				5.5	14.7	198	27		84	102	***1.5" - 0	19
Seat Upholstery - Lantal 95/5 wool/nylon		50	10				4.9	14.1	139	32		63	136	***2.1" - 0	19
Seat Upholstery - Morbern Ambassador ULS-LOTTF-Dk. Blue	1	50	4	8.2	63	66	7.1	13.8	201	15	24	114	245	***1.66 - 0.33	19
Seat Upholstery - Morbern Diplomat ULS Doeskin #434765	0.7	50	6	8.1	87	55	6.5	11.3	227	22	21.9	120	165	***4.7 - 5.8	19
Seat Upholstery - Morbern M-432 Micro B-Lock Moisture barrier		50	2				7.9	12.4	225	15		126	278		19
Seat Upholstery - Naugahyde-Uniroyal PH-64 Vinyl		50	2				6.7	12.1	262	10		112	239	***4.2" - 1.0	19
Seating Foam - Chestnut Ridge Foam CR Safegaurd		50	1				8.4	11.5	69	15		33	52	4	19

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Sign (electronic) lens - Ge Lexan coated thin gage polycarbonate 0.093"	2.3	50	61	27.6	87	463	48.3	20.4	445	118	150.1	121	751	25	19
Sign face plate - Polycarbonate/Lexan		50	88				152.3	21.4	270	130		52	854	60	19
Silicone - Device Tech M0400-04	2.7	50	46	34.3	27	330	30.8	33.8	310	148	103.32	109	1175	**0.8	19
Silicone Foam - Bisco HT800 (Gray)	6	50	30	--	--	635	26.3	32.1	111	--	62.2	74	314	23.4	19
Silicone Foam Seating - KYDEX 6200LTR Ref. #RB13-106-1		50	45				61.5	15.7	131	55		82	434	15	19
Silicone Impregnated Fiberglass - BOM 1019	1	50	26	16.9	10	183	7.8	31.1	163	48	0	44	1025	5	19
Silicone Material - RTV 5229 Silicone		50	--				--	--	66	292		--	--	3	19
Silicone Rubber - Silicone 35		50	36				22.5	20.9	205	113		69	693		19
Silicone Rubber Sheet 1.5mm	1.5	50	15	21.9	44	293	30.1	37.4	206	--	100.5	95	--	***14 - 900	19
Silicone Rubber Sheet 6.6mm	6.6	50	37	90.1	32	1498	117.9	39.0	159	--	121.7	72	--	***13.6 - 900	19
SMC Composite Panel - S52-08-25 SMC (Blue)	3.2	50	72	59.8	35	474	37.0	16.8	182	90	114.9	92	581	25	19
Standard Edge Gasket - P/N 559.109		50	5				40.9	15.4	225	--		--	--		19
Tape - PLAS7NE	1	50	29	4.8	92	132	6.9	15.5	297	46	23.1	68	232	3	19
Teflon Insulation Wire - M22758/6B-12-9		50	217				87.1	16.8	254	423		181	3		19
Thermal Insulation - Armaflex piping insulation	12.7	50	2	8.9	48	141	6.7	15.5	72	33	22.6	49	248	5	19
Thermal Insulation - Basotech Aluminum Faced	13.2	50	--	2.8	36	--	16.2	--	19	1528	2.1	9	--	1	19
Thermal Insulation - Carbwool-Insulfrax FX		50	-				41.0	-	53	1535		23	-	2	19
Thermal Insulation - Isofab Cerwool FST		50	--				3.3	-	6	1368		2	-	5	19
Thermal Insulation - ISOFAB Fiberglass Insulatioin AF-110		50												1	19
Thermal Insulation - Johns Manville SG Series Spin-Glass		50	--				0.3	--	3	505		0	--	5	19
Thermal Insulation - Knauf Ecose (fiberglass)	24	50	--	9.8	7	--	19.6	-	24	1785	3.8	11	75	0	19
Thermal Insulation - Owens Corning 475 Duct Board	26	50	--	21.4	9	--	0.2	--	2	1110	0.1	0	--	1	19
Thermal Insulation - Rockcell Foam for stainless door cores		50	2				6.3	13.2	105				237	10	19

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Thermocouple Material - VAM		50	26				25.2	22.4	344	48		54	149	17	19
Thermoplastic Material - KYDEX 6200		50	13				38.2	11.0	104	83		67	527	4.5	19
Thermoplastic Material - KYDEX 6200LTR		50	43				38.1	13.3	127	70		85	518	25	19
Thermoplastic Material - PCS		50	21				21.3	26.7	448	47		105	227	14.3	19
Thermoplastic Sheet - Bayblend MTR AG	3.2	50	80	46.3	55	1124	68.3	23.8	170	180	124	133	580	10	19
Toilet module - Testori FRP Direction reinf 1/4"	7	50	86	111.3	48	1005	99.5	18.8	192	593	129.8	108	805	10	19
Toilet module - Testori FRP directional reinf 11.6mm Coosa Core	11.5	50	71	123.9	50	1284	118.8	19.0	188	95	157.9	98	838	15	19
Toilet Module Floor - Gelcoat FRP Endcap Material		50	50				65.8	16.4	138	103		69	562	9	19
Toilet module M8 - Testori Derkane 441-400 resin 18/08 bi-acial fabric	3.5	50	53	63.9	57	612	58.6	17.0	232	275	164	86	785	25	19
Toilet seat - Pressalit A/S Duroplast		50	44				148.3	15.2	181	517		71	2	20	19
Toilet Sink Counter top - SAFA Granicote FRP 17mm Thick	17	50	59	323.7	35	2940	223.5	20.0	213	85	113.9	78	658	10	19
Toyo Rubber Parts - Natural Rubber		50	29				293.6	28.7	594	517		180	849		19
Truck Air Spring - 201C Airspring Firestone Industrial products		50	22				159.4	24.0	294	377		153	1285	**13	19
Truck Chevron Spring - Trelleborg Ind. TIAVS-32X60 Rubber material		50	21				495.2	33.1	445	38		138	1254		19
Truck cleat - KAM55 Rubber material - Nishiyama		50	21				58.2	13.7	165	232		86	908	**2.3	19
Truck/coupler elastomer - GMT Belgium Rubber Strips OP 685		35	72				71.0	16.2	369	--		--	813	18	19
U/F box covers - Dimension Composite 2.5mm FRP Laminate		50	32				34.1	16.1	209	45		71	683		19
Underfloor Cable Cleat - YBF-X02 Extruded Rubber	51	50	22	797.4	91	3578	92.0	13.7	69	42	41.8	26	314	**0.2	19
Underfloor Cleat Blocks - Haysite Reinforced Plastic	6.1	50	130	104.3	52	1055	62.6	12.6	145	155	84.53	35	66	12.3	19
Upholstery - Ambassador ULS-LOTTDF-DK Blue	1	50	4	8.2	63	66	7.1	13.8	201	15	24	114	245		19
Upholstery - P/N 296032 Vinyl Material	1	50	2	9.3	70	72	8.6	12.9	241	15	28.9	124	296	**2.8	19

Sample ID	Thick-ness (mm)	Heat Flux (kW/m^2)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m^2)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m^2)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m^2)	Avg. HRR - Test (kW/m^2)	Smoke SEA (m^2/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Upholstery - P/N 296041 Vinyl Material	1	50	2	9.2	68	65	7.9	12.4	225	15	26.5	126	278	**2.5	19
Upholstery - Phoenix PH-64 Perforated Vinyl	1.3	50	1	8.8	65	60	7.4	12.6	186	13	24.8	128	257	**3	19
Upholstery - Ambassador ULS Ambass Nu Imperial Blue	1	50	6	8.3	80	76	7.9	12.5	310	20	39.4	110	357	**4.4	19
Upholstery - Holdsworth Velvet	4	50	24	9.0	83	137	10.0	14.9	275	55	--	87	270	--	19
Upholstery Fabric - FAR Treated 1001 Quality Material		50	17				11.1	13.5	354	33		142	171		19
UTR Glass - Glastic Grade 1130	6	50	109	112.0	46	1330	78.8	15.6	169	142	77.2	59	273	12	19
Weather seal - Luminator Self-Adhesive Neoprene Foam		50	4				0.5	15.4	24	13		19	57	15	19
Window Glass - Window Composite		50	70				23.4	23.6	242	165		85	307	33	19
Window glazing - Cab Windshield, 9/16 safety glass		50	181				85.6	26.2	466	287		158	190	64	19
Window glazing - GE Lexan MR10 Polycarbonate		50	146				247.9	26.6	232	180		72	844	50	19
Window glazing - GE MR5E Optical Quality Sheet		50	144				379.0	31.7	268	983		110	971	55	19
Window glazing - Palgard TG Polycarbonate 0.460"														40	19
Window glazing - Passenger safety glass 1/4"		50	70				23.4	23.6	242	165		85	307	33	19
Window glazing - Tuffak CM-2 AR Polycarbonate sheet		50					290.8	23.6	296					15	19
Windshield Glass - Windshield Composite		50	181				85.6	26.2	466	287		158	190	16	19
Wire - 1/C #16 AWG Exane- 15		50	36				8.4	7.9	208	62		112	--		19
Wire Insulation - Bach-Simpson Belden wire #83005		50	657				10.5	3.4	45	698		34	11	Pass	19
Wire Insulation - Huber & Suhner-Radox EI 109 EM 104	2.2	50	58	35.0	53	590	37.8	18.4	158	85	101.56	126	101	Pass	19
Wire Insulation - Polyrad XT-TX 12 AWG	3.2	50	91	94.1	19	258	9.7	5.6	104	128	33.63	55	189	Pass	19
Wire Insulation - Polyrad XT-TX 12 AWG	3.7	50	34	101.2	19	253	33.2	15.2	281	95	108.42	98	1115	--	19
Wire Insulation - Polyrat XT Wire Insulatioin		50	64				60.2	19.9	214	263		138	1175	Pass	19
Wire Insulation - PTFE Teflon ABR Exane M22759/6	2.2	50	346	82.4	33	301	37.6	14.5	144	425	89.7	77	264	Pass 1'6"	19

Sample ID	Thick-ness (mm)	Heat Flux (kW/m²)	Time to Ignition (sec)	Initial Sample Mass (g)	Percent Burned (%)	Flame-out (sec)	Total Heat Released (MJ/m²)	Avg. Eff. HOC (MJ/kg)	Peak HRR - Test (kW/m²)	Time of Peak - Test (sec)	Avg. HRR - 300 sec (kW/m²)	Avg. HRR - Test (kW/m²)	Smoke SEA (m²/kg)	E162 Flame Spread Rating, I_s * CRF ** Burn Length *** BL - FI Time	Ref
Wire Insulation - Rockbestos-Exane 1068A Irradiated Cross Linked Polyolefin	4.6	50	31	84.5	48	152	29.1	7.6	373	125	103.81	173	69	Pass	19
Wire Insulation - Rockbestos-Suprenant Exane	--	50	47	44.0	53	300	34.5	--	208	102	114	141	670	Pass	19
Wire Insulation - RSCC-1/C 12 AWG Teflon M22759-6	2.2	50	346	82.4	33	647	37.6	14.5	144	425	79.25	94	264	Pass	19
Wire Insulation - Teflon Insulation Wire M22758/6B-12-9	6	50	217	183.6	28	707	87.1	16.8	254	423	179.6	181	3	Pass	19
Wire Insulation - Tefzel	1.25	50	43	39.3	29	90	8.1	7.3	214	75	27.2	91	257	Pass	19

A.3. Heat Release Rate Data: Room Corner, Mockup, and Furniture Calorimeter Tests

The following table contains the heat release rate data from room corner, mockup, and furniture calorimeter tests.

Table A 3. HRR Data from Room Corner, Mockup, and Furniture Calorimeter Tests

Sample ID	Peak HRR (kW)	Avg. HRR (kW)	Test Configuration	Ref.
Double Seat	599	325	Furniture Calorimeter (Free burning)	7
Double Seat	623	388	ISO 9705 Room Test	7
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre (250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 - not vandalized	6.7	108	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre (250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 - Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	9.9	162	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre (250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 -Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	100.2	207	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre (250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 - Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	90.5	270	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre (250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02 - not vandalized	9.6	192	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5

Sample ID	Peak HRR (kW)	Avg. HRR (kW)	Test Configuration	Ref.
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02 -Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	8.4	195	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02-Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	198.9	414	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02-Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	211.1	234	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C03 - not vandalized	10.1	177	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C03- Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	40.7	1353	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C03- Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	68.4	705	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04 - not vandalized	4.7	93	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04- Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	4.6	138	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04-Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	148.9	525	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04-Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	199.4	558	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C05 - not vandalized	18.8	180	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C05 -Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	13.8	200	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C05 -Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	20.1	235	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5

Sample ID	Peak HRR (kW)	Avg. HRR (kW)	Test Configuration	Ref.
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C05 -Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	19	275	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C07 - not vandalized	8.7	235	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C07 - Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	18.3	225	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C07 -Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	341.2	385	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C07 -Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	256.8	350	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) See Product Description Tab - C08 - not vandalized	19.2	225	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) - See Product Description Tab - C08- Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	18.1	215	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) - See Product Description Tab - C08-Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	19	250	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) - See Product Description Tab - C08 - not vandalized	19	250	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) - See Product Description Tab - C09 - not vandalized	25.2	210	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) - See Product Description Tab - C09 - Vandalized Level 1 [a cut (cross shape) on the back and on the seat]	21.8	160	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) - See Product Description Tab - C09 - Vandalized Level 2 [a cut (cross shape) on the back and on the seat and the fabric (cover and interliner) pulled away from the foam.]	15.1	235	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) - See Product Description Tab - C09 - not vandalized	22.9	170	Furniture Calorimeter (NT FIRE 032) test with 7 kW burner	5
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 - not vandalized	28.6	230	Train-Car mockup under hood, with 7kW burner	6

Sample ID	Peak HRR (kW)	Avg. HRR (kW)	Test Configuration	Ref.
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 - Vandalized	214.2	250	Train-Car mockup under hood, with 7kW burner	6
Seat covering knitted velvet(500g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C01 -Vandalized	231	230	Train-Car mockup under hood, with 7kW burner	6
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02 - not vandalized	327.6	880	Train-Car mockup under hood, with 7kW burner	6
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02 -Vandalized	321.8	325	Train-Car mockup under hood, with 7kW burner	6
Seat covering "en drap"(800g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C02-Vandalized	317.5	255	Train-Car mockup under hood, with 7kW burner	6
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C03 - not vandalized	40.5	255	Train-Car mockup under hood, with 7kW burner	6
Seat covering in simulated leather(250g/m^2), inner layer polyacrylate-armide fibre(250g/m^2), Polyurethane foam (50 kg/m^3) See Product Description Tab - C03- Vandalized	341.8	365	Train-Car mockup under hood, with 7kW burner	6
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04 - not vandalized	29.6	260	Train-Car mockup under hood, with 7kW burner	6
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04- Vandalized	229.5	370	Train-Car mockup under hood, with 7kW burner	6
Seat covering wool/synthetic fibre(1000g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C04-Vandalized	249.4	325	Train-Car mockup under hood, with 7kW burner	6
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C05 - not vandalized	20.3	260	Train-Car mockup under hood, with 7kW burner	6
Seat covering synthetic fibre(550g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C05 -Vandalized	273.4	715	Train-Car mockup under hood, with 7kW burner	6
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C07 - not vandalized	23.6	235	Train-Car mockup under hood, with 7kW burner	6
Seat covering texoid(900g/m^2), inner layer polyacrylate-armide fibre (4mm,550g/m^2), Polyurethane foam (70 kg/m^3) See Product Description Tab - C07 - Vandalized	222.8	465	Train-Car mockup under hood, with 7kW burner	6
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) See Product Description Tab - C08 - not vandalized	35.2	270	Train-Car mockup under hood, with 7kW burner	6
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) See Product Description Tab - C08- Vandalized	29	480	Train-Car mockup under hood, with 7kW burner	6
Seat covering polyester fibre (600g/m^2), Polyurethane foam (85 kg/m^3) See Product Description Tab - C08-Vandalized	67	210	Train-Car mockup under hood, with 7kW burner	6

Sample ID	Peak HRR (kW)	Avg. HRR (kW)	Test Configuration	Ref.
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) See Product Description Tab - C09 - not vandalized	80.3	260	Train-Car mockup under hood, with 7kW burner	6
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) See Product Description Tab - C09 - Vandalized	91.9	215	Train-Car mockup under hood, with 7kW burner	6
Seat covering polyester fibre (600g/m^2), Seat covering wool/polyester fibre(400g/m^2) See Product Description Tab - C09 - Vandalized	37.6	250	Train-Car mockup under hood, with 7kW burner	6
Seating, Carpeting on Wall & Ceiling	4400	515	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	70	763	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	40	140	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	1600	302	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	60	230	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	170	140	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	80	120	AMTRAK Car Mockup with Newspaper Ignition	14
Seating, Carpeting on Wall & Ceiling	90	140	AMTRAK Car Mockup with Newspaper Ignition	14
Trash Bag	259	60	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	28	230	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	124	220	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	58	360	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	97	390	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	100	60	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	145	130	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	132	160	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	217	300	Furniture Calorimeter, 25kW sand burner	13
Trash Bag	184	240	Furniture Calorimeter, 25kW sand burner	13
Coach Seat (fully assembled)	10	50	Furniture Calorimeter	13
Coach Seat (fully assembled)	13	70	Furniture Calorimeter	13
Coach Seat (fully assembled)	~166	200	Furniture Calorimeter	13
Coach Seat (fully assembled)	~88	580	Furniture Calorimeter	13
Lower Bed w/ Bedding + Pillow	640	220	Furniture Calorimeter, 200 kW sand burner	13
Lower Bed w/ Bedding + Pillow	559	210	Furniture Calorimeter, 200 kW sand burner	13
Upper + Lower Bed w/ Bedding + Pillow	718	190	Furniture Calorimeter, 200 kW sand burner	13

Sample ID	Peak HRR (kW)	Avg. HRR (kW)	Test Configuration	Ref.
Wall Carpet on Wall	385	350	Furniture Calorimeter, 50kW sand burner	13
Wall Carpet on Wall	287	250	Furniture Calorimeter, 50kW sand burner	13
Wall Carpet on Wall & Ceiling	801	210	Furniture Calorimeter, 50kW sand burner	13
Wall Carpet on Wall & Ceiling	433	210	Furniture Calorimeter, 50kW sand burner	13
Window Drape - Extended	54	170	Furniture Calorimeter	13
Window Drape - Contracted	113	120	Furniture Calorimeter	13
Window Drape - Contracted	42	100	Furniture Calorimeter	13
Privacy Curtain - Extended	127	180	Furniture Calorimeter	13
Privacy Curtain - Contracted	173	250	Furniture Calorimeter	13
Privacy Curtain - Contracted	161	200	Furniture Calorimeter	13
Window w/ Gaskets, Frame, & Mask	78	190	Furniture Calorimeter	13
Window w/ Gaskets, Frame, Mask, & Drapes	251	290	Furniture Calorimeter	13

Appendix B.
Cone Calorimeter and Radiant Panel Test Results
Introductory Paragraph

B.1 Radiant Panel Test Record

The following table contains a listing of all radiant panel tests conducted.

Table B 1. A List of All Radiant Panel Tests

Sample	Datafile	Laboratory	Date of Test (mm/dd/yyyy)
Sample 1	SAMPLE_1_E162	Commercial Testing Company	12/20/2017
Sample 2	SAMPLE_2_E162	Commercial Testing Company	12/15/2017
Sample 3	SAMPLE_3_E162	Commercial Testing Company	12/18/2017
Sample 4	SAMPLE_4_E162	Commercial Testing Company	12/26/2017
Sample 5	SAMPLE_5_E162	Commercial Testing Company	12/20/2017
Sample 6	SAMPLE_6_E162	Commercial Testing Company	12/18/2017
Sample 7	SAMPLE_7_E162	SGS Govmark	11/16/2017

B.2 Cone Calorimeter Test Record

Seven different materials representative of those commonly used in passenger railcars were selected for cone calorimeter tests at the JENSEN HUGHES laboratory. The cone calorimeter test results are presented in this section.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 10/13/2017	Ambient temperature (°C): 24.9
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 53.6
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 1_25**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.293
Preparation details: Retaining frame used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 60	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

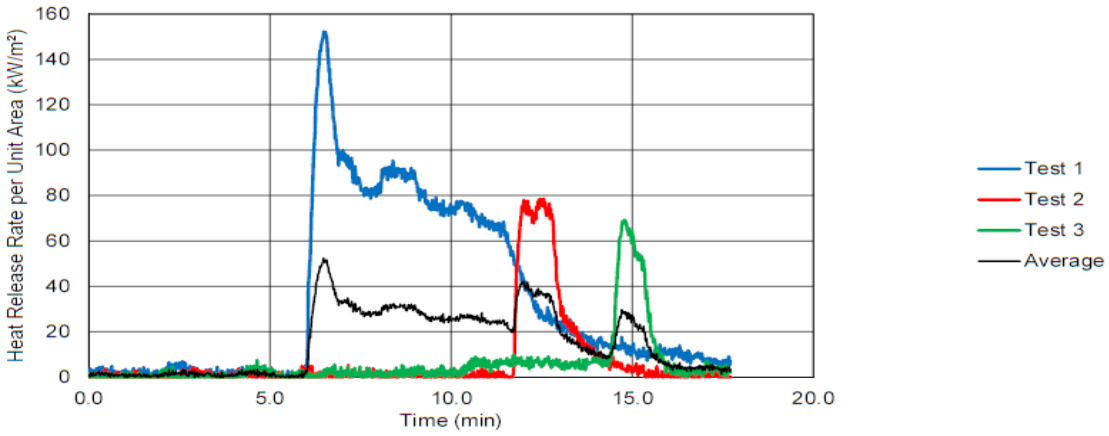
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	3.18	3.18	3.18	3.18
Specimen mass (g)	42	42.1	41.9	42
Heat flux (kW/m^2)	25	25	25	25
Exhaust flow rate (L/s)	19.28	19.21	19.2	19.23
Time to sustained flaming (s)	355	694	612	554
Time to flame-out (s)	1114	943	975	1011
Time to end-of-test (s)	1228	1063	1095	1129
Domain of interest (s):	355 - 1114	694 - 943	612 - 975	554 - 1011
Total mass loss, EOT (g/m^2)	1765	520	475	920
Total mass loss, DOI (g/m^2)	1617	330	275	741
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	3.22	0.71	0.5	1.47
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	1.47	0.57	0.49	0.84
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	2.14	1.36	0.79	1.43
$HRRPUA_{peak}$ (kW/m^2)	152.32	78.57	69.3	100.06
$HRRPUA_{avg,60}$ (kW/m^2)	99.97	55.83	5.02	53.6
$HRRPUA_{avg,180}$ (kW/m^2)	92.39	35.14	5.85	44.46
$HRRPUA_{avg,300}$ (kW/m^2)	85.73	21.91	13.32	40.32
$HRRPUA_{avg,EOT}$ (kW/m^2)	29.88	6.75	5.65	14.09
$HRRPUA_{avg,DOI}$ (kW/m^2)	46.56	26.26	14.04	28.95
$THRPUA_{EOT}$ (MJ/m^2)	36.72	7.18	6.19	16.7
$THRPUA_{DOI}$ (MJ/m^2)	35.39	6.57	5.11	15.69
$EHC_{avg,EOT}$ (kJ/g)	20.81	13.79	13.04	15.88
$EHC_{avg,DOI}$ (kJ/g)	21.89	19.88	18.61	20.12
$SEA_{avg,EOT}$ (m^2/kg)	1584.62	1646.57	2522.86	1918.02
$SEA_{avg,DOI}$ (m^2/kg)	1380.59	1372.76	2145.57	1632.97

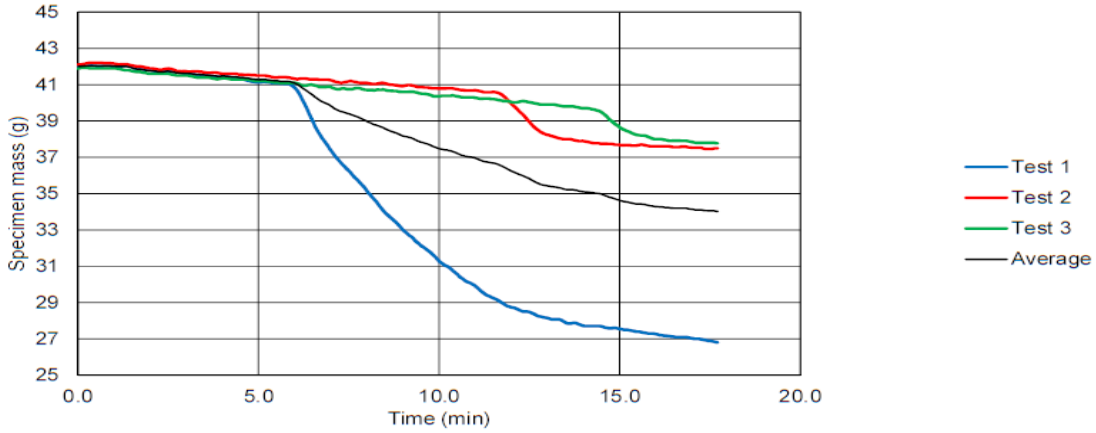
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Spacing is 60 mm (constant), with heat flux calibrated at the centreline (60 mm). Spark is in standard position (35 mm higher above the sample surface than in std config).

Test 2: Spacing is 60 mm (constant), with heat flux calibrated at the centreline (60 mm). Spark is in standard position (35 mm higher above the sample surface than in std config).

Test 3: Spacing is 60 mm (constant), with heat flux calibrated at the centreline (60 mm). Spark is in standard position (35 mm higher above the sample surface than in std config).

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: Volpe	Ambient pressure (psia): 14.8
Date of test: 09/08/2017	Ambient temperature (°C): 27.2
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 43.9
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: Sample 1_50	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.294
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

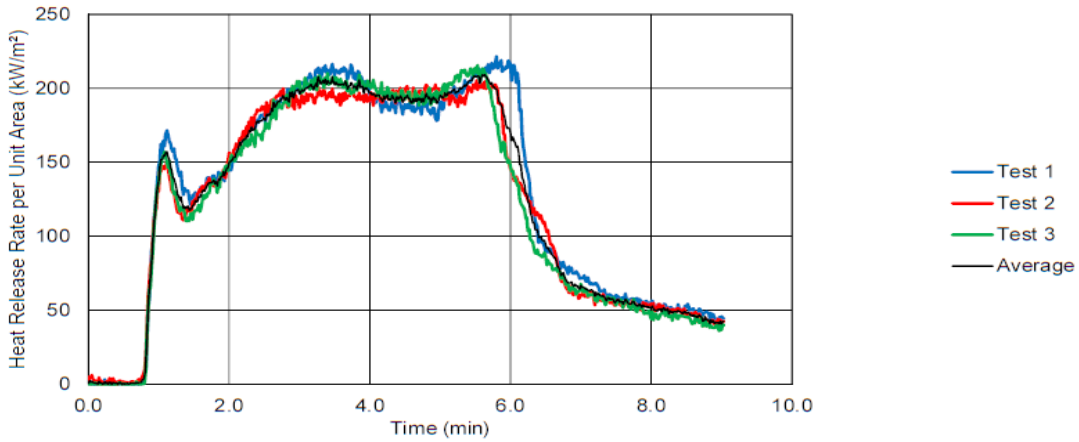
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	3.16	3.17	3.18	3.17
Specimen mass (g)	41.5	41.5	41.6	41.53
Heat flux (kW/m^2)	50	50	50	50
Exhaust flow rate (L/s)	21.45	21.33	21.25	21.34
Time to sustained flaming (s)	48	44	51	48
Time to flame-out (s)	436	422	464	441
Time to end-of-test (s)	556	542	584	561
Domain of interest (s):	48 - 436	44 - 422	51 - 464	48 - 441
Total mass loss, EOT (g/m^2)	3234	3158	3244	3212
Total mass loss, DOI (g/m^2)	3046	2970	3086	3034
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	8.92	8.89	9.23	9.02
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	5.82	5.82	5.56	5.73
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	7.83	7.84	7.45	7.71
$HRRPUA_{peak}$ (kW/m^2)	221.61	205.34	215.62	214.19
$HRRPUA_{avg,60}$ (kW/m^2)	129.13	110.71	123.64	121.16
$HRRPUA_{avg,180}$ (kW/m^2)	168.12	157.2	164.17	163.16
$HRRPUA_{avg,300}$ (kW/m^2)	179.21	172.7	178.1	176.67
$HRRPUA_{avg,EOT}$ (kW/m^2)	126.89	123.69	116.34	122.31
$HRRPUA_{avg,DOI}$ (kW/m^2)	165.62	160.78	152.04	159.48
$THRPUA_{EOT}$ (MJ/m^2)	70.66	67.14	68.04	68.61
$THRPUA_{DOI}$ (MJ/m^2)	64.39	60.9	62.89	62.73
$EHC_{avg,EOT}$ (kJ/g)	21.85	21.26	20.98	21.36
$EHC_{avg,DOI}$ (kJ/g)	21.14	20.51	20.38	20.68
$SEA_{avg,EOT}$ (m^2/kg)	1144.15	1257.88	1151.22	1184.41
$SEA_{avg,DOI}$ (m^2/kg)	1106.36	1317.95	1065	1163.1

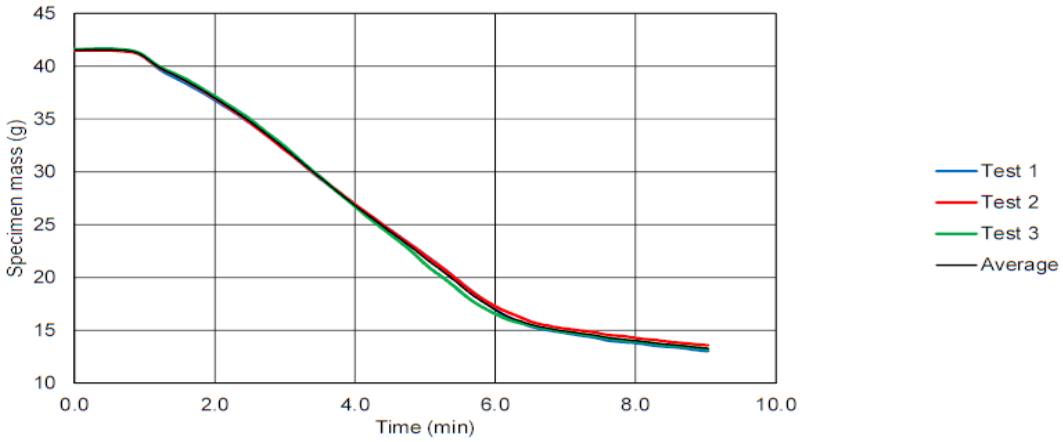
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Specimen exhibited intumescing behavior, rising up into the cone heater (did not contact the element).

Test 2: Specimen exhibited intumescing behavior, rising up into the cone heater (did not contact the element).

Test 3: Specimen exhibited intumescing behavior, rising up into the cone heater (did not contact the element).

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

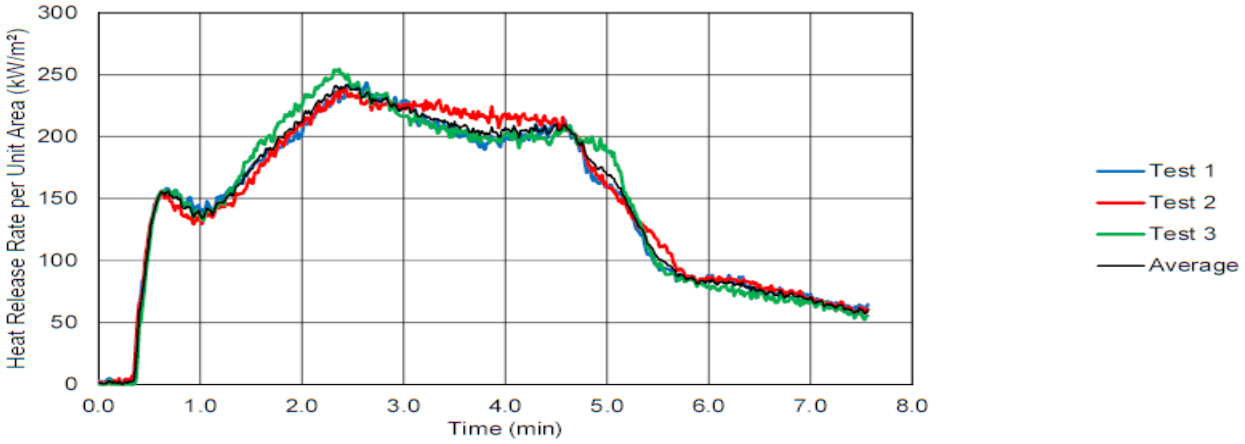
Client: Volpe	Ambient pressure (psia): 14.8
Date of test: 09/08/2017	Ambient temperature (°C): 27
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 44.7
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 1_75**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.298
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

Test Results

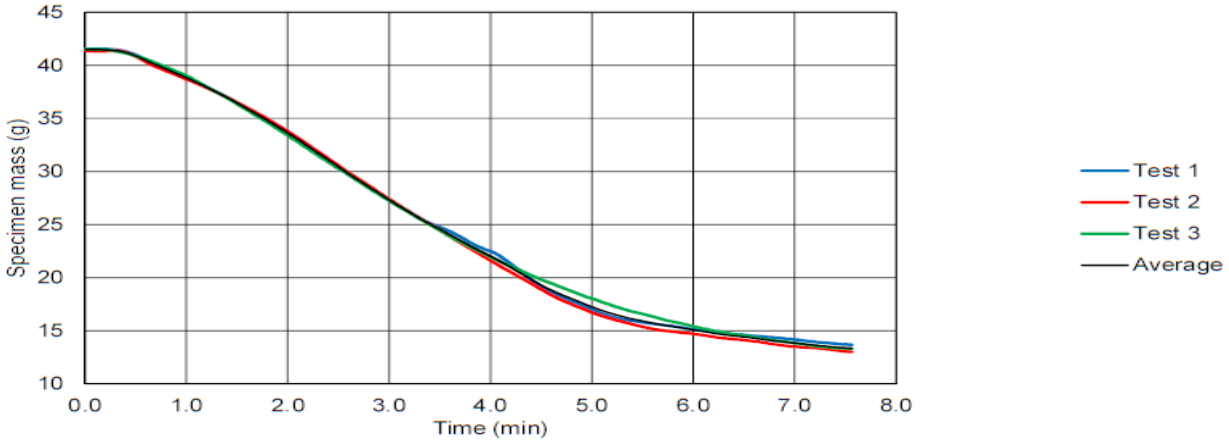
Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	3.16	3.15	3.16	3.16
Specimen mass (g)	41.5	41.4	41.5	41.47
Heat flux (kW/m^2)	75	75	75	75
Exhaust flow rate (L/s)	21.86	21.87	21.82	21.85
Time to sustained flaming (s)	24	23	24	24
Time to flame-out (s)	335	349	334	339
Time to end-of-test (s)	455	469	454	459
Domain of interest (s):	24 - 335	23 - 349	24 - 334	24 - 339
Total mass loss, EOT (g/m^2)	3149	3228	3189	3189
Total mass loss, DOI (g/m^2)	2898	2983	2797	2892
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	10.12	9.97	9.24	9.78
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	6.92	6.87	7.02	6.93
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	9.28	9.11	9	9.13
$HRRPUA_{peak}$ (kW/m^2)	243.72	238.87	254.6	245.73
$HRRPUA_{avg,60}$ (kW/m^2)	143.05	134.8	139.77	139.2
$HRRPUA_{avg,180}$ (kW/m^2)	189.81	186.79	193.87	190.16
$HRRPUA_{avg,300}$ (kW/m^2)	187.74	190.05	192.33	190.04
$HRRPUA_{avg,EOT}$ (kW/m^2)	146.48	146.17	148.27	146.97
$HRRPUA_{avg,DOI}$ (kW/m^2)	184.55	183.27	189.33	185.72
$THRPUA_{EOT}$ (MJ/m^2)	66.77	68.67	67.43	67.62
$THRPUA_{DOI}$ (MJ/m^2)	57.5	59.86	58.81	58.72
$EHC_{avg,EOT}$ (kJ/g)	21.2	21.27	21.15	21.21
$EHC_{avg,DOI}$ (kJ/g)	19.84	20.07	21.03	20.31
$SEA_{avg,EOT}$ (m^2/kg)	1150.57	1097.34	996.33	1081.41
$SEA_{avg,DOI}$ (m^2/kg)	1194.44	1138.93	1074.17	1135.85

Cone Calorimeter Test Results

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Specimen exhibited intumescing behavior, rising up into the cone heater (did not contact the element).

Test 2: Specimen exhibited intumescing behavior, rising up into the cone heater (did not contact the element).

Test 3: Specimen exhibited intumescing behavior, rising up into the cone heater (did not contact the element).

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.7
Date of test: 10/26/2017	Ambient temperature (°C): 24.5
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 37.7
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 2**_35	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 0.815
Preparation details: Retaining frame used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: Last recorded value.	

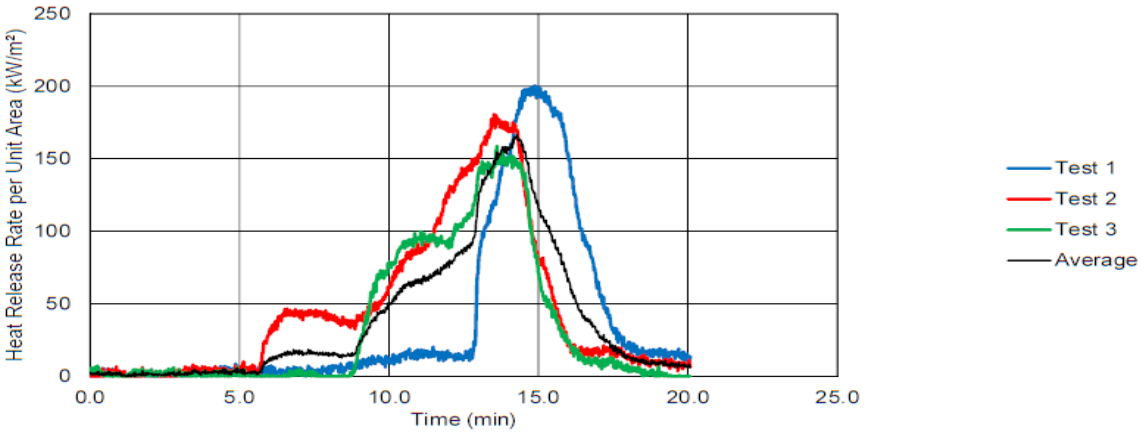
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	12.73	12.67	12.68	12.69
Specimen mass (g)	109.6	109.5	109.4	109.5
Heat flux (kW/m^2)	35	35	35	35
Exhaust flow rate (L/s)	21.21	21.14	21.33	21.23
Time to sustained flaming (s)	762	336	529	542
Time to flame-out (s)	1376	1292	1108	1259
Time to end-of-test (s)	1496	1412	1205	1371
Domain of interest (s):	762 - 1376	336 - 1292	529 - 1108	542 - 1259
Total mass loss, EOT (g/m^2)	6370	6029	5916	6105
Total mass loss, DOI (g/m^2)	3064	5103	4056	4074
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	7.71	7.69	7.3	7.57
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	4.29	4.31	4.92	4.51
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	5.02	5.35	6.99	5.79
$HRRPUA_{peak}$ (kW/m^2)	200.52	180.74	158.88	180.05
$HRRPUA_{avg,60}$ (kW/m^2)	85.7	29.17	43.17	52.68
$HRRPUA_{avg,180}$ (kW/m^2)	148.59	37.37	73.7	86.55
$HRRPUA_{avg,300}$ (kW/m^2)	125.23	43.69	93.02	87.31
$HRRPUA_{avg,EOT}$ (kW/m^2)	30.96	39.63	34.76	35.12
$HRRPUA_{avg,DOI}$ (kW/m^2)	67.62	57.32	71.01	65.32
$THRPUA_{EOT}$ (MJ/m^2)	46.34	56	41.92	48.09
$THRPUA_{DOI}$ (MJ/m^2)	41.58	54.86	41.18	45.87
$EHC_{avg,EOT}$ (kJ/g)	7.28	9.29	7.09	7.88
$EHC_{avg,DOI}$ (kJ/g)	13.57	10.75	10.15	11.49
$SEA_{avg,EOT}$ (m^2/kg)	413.77	264.38	325.04	334.4
$SEA_{avg,DOI}$ (m^2/kg)	234.85	211.14	148.47	198.15

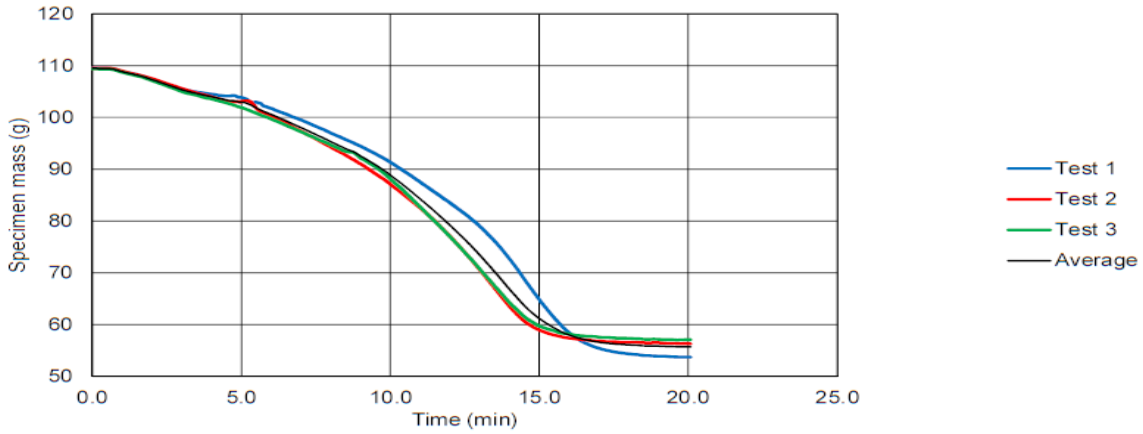
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 2: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 3: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.8
Date of test: 10/23/2017	Ambient temperature (°C): 25.8
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 60.3
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 2_50**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 0.819
Preparation details: Retaining frame used (laminated composite material).	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

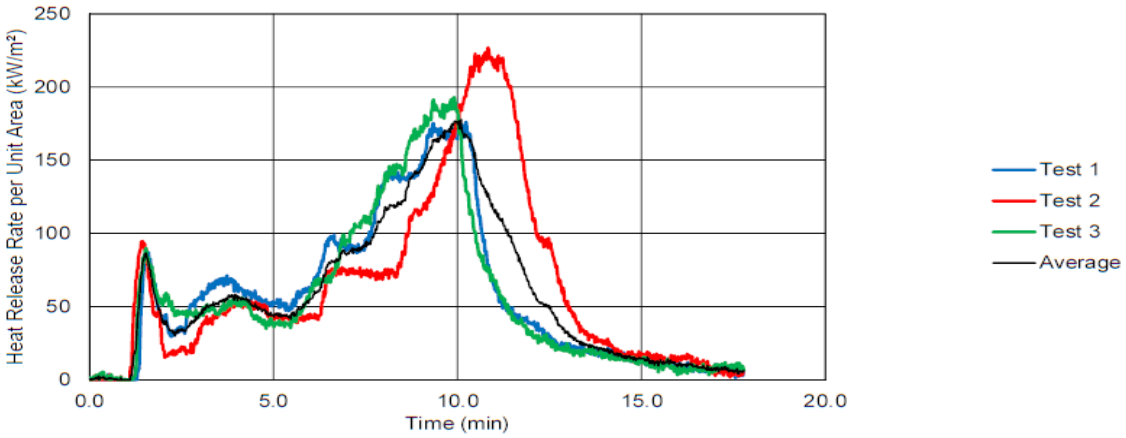
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	12.74	12.76	12.67	12.72
Specimen mass (g)	105.9	119.9	107.2	111
Heat flux (kW/m^2)	50	50	50	50
Exhaust flow rate (L/s)	21.36	21.45	21.68	21.5
Time to sustained flaming (s)	75	64	70	70
Time to flame-out (s)	1063	1011	947	1007
Time to end-of-test (s)	1183	1131	1067	1127
Domain of interest (s):	75 - 1063	64 - 1011	70 - 947	70 - 1007
Total mass loss, EOT (g/m^2)	6036	7134	6041	6404
Total mass loss, DOI (g/m^2)	5765	6885	5783	6144
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	9.66	10.69	9.88	10.08
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	5.16	6.32	5.69	5.72
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	5.85	7.27	6.59	6.57
$HRRPUA_{peak}$ (kW/m^2)	176.12	227.04	193.17	198.78
$HRRPUA_{avg,60}$ (kW/m^2)	49.48	53.2	57.73	53.47
$HRRPUA_{avg,180}$ (kW/m^2)	53.75	40.44	51.44	48.54
$HRRPUA_{avg,300}$ (kW/m^2)	54.84	42.46	48.92	48.74
$HRRPUA_{avg,EOT}$ (kW/m^2)	52	60.55	55.77	56.11
$HRRPUA_{avg,DOI}$ (kW/m^2)	61.56	71.66	66.65	66.62
$THRPUA_{EOT}$ (MJ/m^2)	61.57	68.54	59.56	63.22
$THRPUA_{DOI}$ (MJ/m^2)	60.88	67.92	58.51	62.44
$EHC_{avg,EOT}$ (kJ/g)	10.2	9.61	9.86	9.89
$EHC_{avg,DOI}$ (kJ/g)	10.56	9.87	10.12	10.18
$SEA_{avg,EOT}$ (m^2/kg)	262.54	305.39	86.89	218.27
$SEA_{avg,DOI}$ (m^2/kg)	191.77	266.17	73.97	177.31

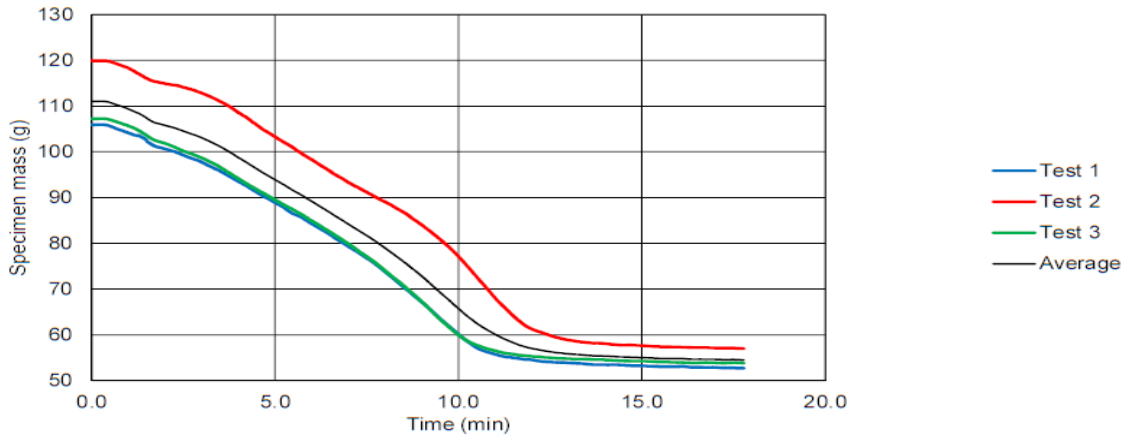
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 2: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 3: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.7
Date of test: 10/20/2017	Ambient temperature (°C): 26.8
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 36.6
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 2_75**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 0.858
Preparation details: Retaining frame used, fastened tigh to prevent explosive delamination.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

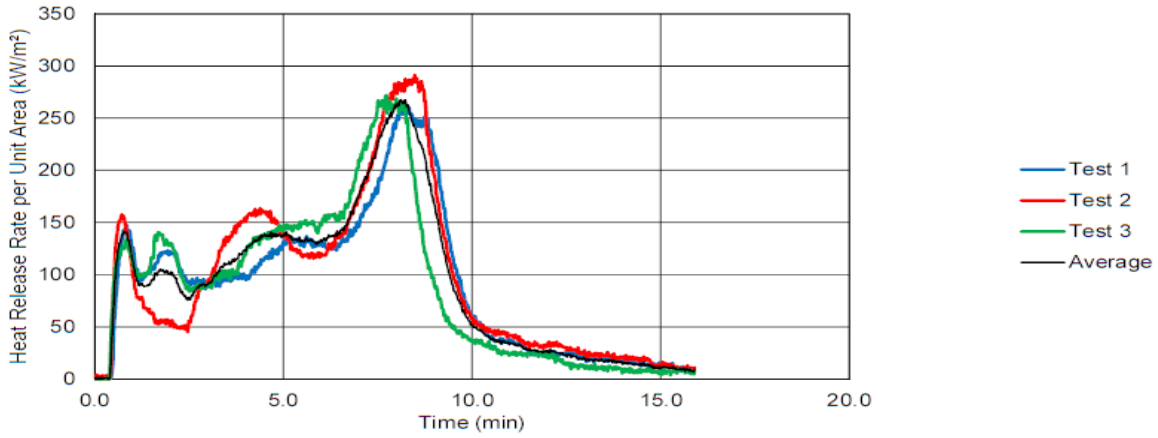
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	12.75	12.74	12.72	12.74
Specimen mass (g)	116.4	116.8	115.3	116.17
Heat flux (kW/m^2)	75	75	75	75
Exhaust flow rate (L/s)	21.77	21.8	21.93	21.83
Time to sustained flaming (s)	28	24	22	25
Time to flame-out (s)	936	888	834	886
Time to end-of-test (s)	1056	1008	954	1006
Domain of interest (s):	28 - 936	24 - 888	22 - 834	25 - 886
Total mass loss, EOT (g/m^2)	7284	7590	7081	7319
Total mass loss, DOI (g/m^2)	7127	7431	6993	7184
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	12.83	13.96	13.65	13.48
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	6.92	7.53	7.43	7.29
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	7.87	8.6	8.61	8.36
$HRRPUA_{peak}$ (kW/m^2)	260.81	291.47	272.08	274.79
$HRRPUA_{avg,60}$ (kW/m^2)	107.83	102.5	100.93	103.75
$HRRPUA_{avg,180}$ (kW/m^2)	104.42	81.99	104.33	96.91
$HRRPUA_{avg,300}$ (kW/m^2)	108.16	107.5	113.91	109.86
$HRRPUA_{avg,EOT}$ (kW/m^2)	82.91	90.9	88.68	87.5
$HRRPUA_{avg,DOI}$ (kW/m^2)	95.39	104.49	103.06	100.98
$THRPUA_{EOT}$ (MJ/m^2)	87.64	91.71	84.69	88.01
$THRPUA_{DOI}$ (MJ/m^2)	86.7	90.38	83.78	86.95
$EHC_{avg,EOT}$ (kJ/g)	12.03	12.08	11.96	12.02
$EHC_{avg,DOI}$ (kJ/g)	12.17	12.16	11.98	12.1
$SEA_{avg,EOT}$ (m^2/kg)	196.55	322.94	146.85	222.12
$SEA_{avg,DOI}$ (m^2/kg)	174.9	301.16	127.81	201.29

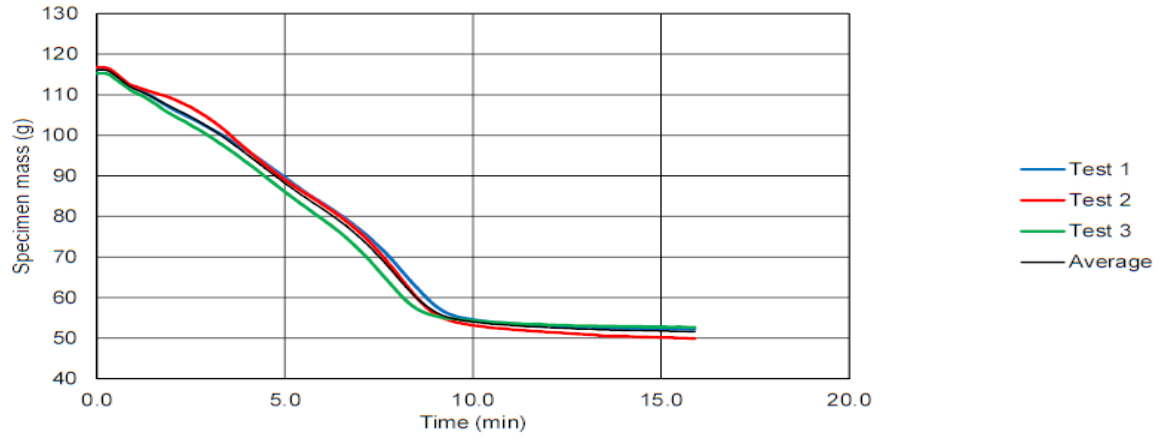
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 2: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 3: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

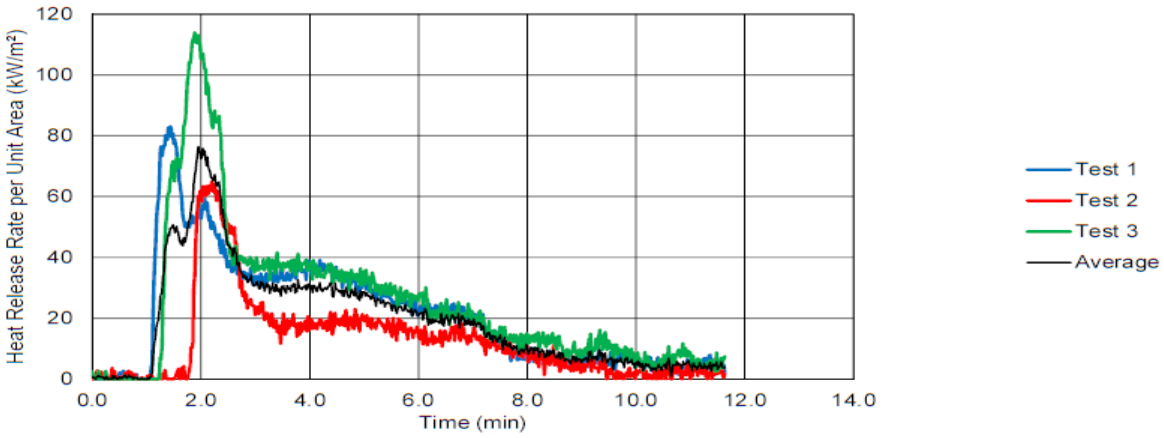
Client: FRA/Volpe	Ambient pressure (psia): 14.7
Date of test: 10/24/2017	Ambient temperature (°C): 26.2
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 48.2
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 3_35**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 0.467
Preparation details: Retaining frame used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

Test Results

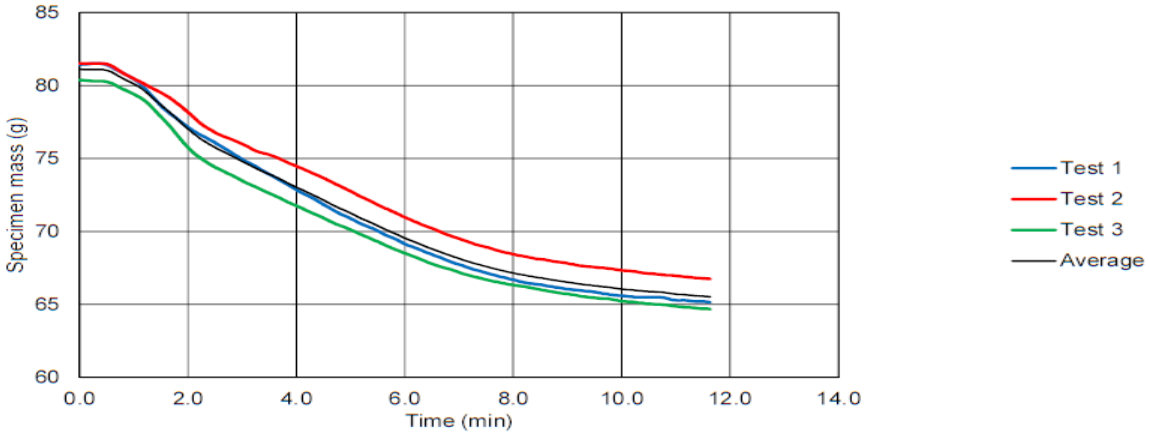
Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	16.25	16.26	16.25	16.25
Specimen mass (g)	81.4	81.5	80.4	81.1
Heat flux (kW/m^2)	35	35	35	35
Exhaust flow rate (L/s)	19.13	20.28	20.31	19.91
Time to sustained flaming (s)	59	90	71	73
Time to flame-out (s)	718	578	887	728
Time to end-of-test (s)	838	698	1007	848
Domain of interest (s):	59 - 718	90 - 578	71 - 887	73 - 728
Total mass loss, EOT (g/m^2)	1878	1669	1900	1816
Total mass loss, DOI (g/m^2)	1731	1359	1720	1603
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	3.55	3.14	2.93	3.21
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	2.28	2.39	1.88	2.18
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	2.64	2.78	2.11	2.51
$HRRPUA_{peak}$ (kW/m^2)	83.06	64.93	113.94	87.31
$HRRPUA_{avg,60}$ (kW/m^2)	54.06	37.34	75.76	55.72
$HRRPUA_{avg,180}$ (kW/m^2)	43.48	27.39	54.32	41.73
$HRRPUA_{avg,300}$ (kW/m^2)	38.26	23.15	45	35.47
$HRRPUA_{avg,EOT}$ (kW/m^2)	18.19	12.63	18.92	16.58
$HRRPUA_{avg,DOI}$ (kW/m^2)	22.68	17.43	23	21.04
$THRPUA_{EOT}$ (MJ/m^2)	15.26	8.83	19.06	14.38
$THRPUA_{DOI}$ (MJ/m^2)	14.97	8.53	18.79	14.09
$EHC_{avg,EOT}$ (kJ/g)	8.13	5.29	10.03	7.82
$EHC_{avg,DOI}$ (kJ/g)	8.65	6.27	10.92	8.61
$SEA_{avg,EOT}$ (m^2/kg)	309.47	478.68	403.5	397.22
$SEA_{avg,DOI}$ (m^2/kg)	267.03	400.48	353.72	340.41

Cone Calorimeter Test Results

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 2: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 3: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.8
Date of test: 10/23/2017	Ambient temperature (°C): 26.3
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 56
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 3_50**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 0.462
Preparation details: Retaining frame used (laminated composite material).	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

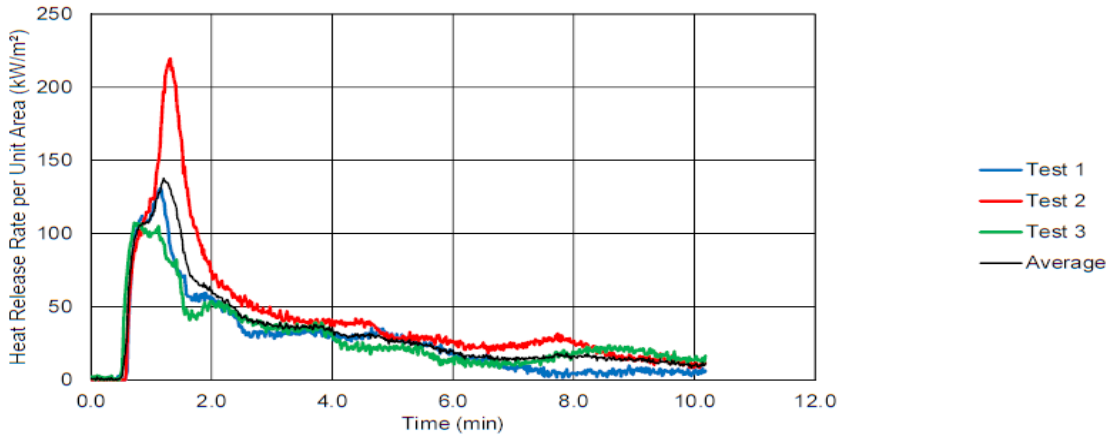
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	16.24	16.28	16.26	16.26
Specimen mass (g)	82	78.3	81.2	80.5
Heat flux (kW/m^2)	50	50	50	50
Exhaust flow rate (L/s)	21.22	21.24	21.03	21.16
Time to sustained flaming (s)	34	34	30	33
Time to flame-out (s)	491	712	948	717
Time to end-of-test (s)	611	832	1068	837
Domain of interest (s):	34 - 491	34 - 712	30 - 948	33 - 717
Total mass loss, EOT (g/m^2)	2070	1899	1912	1960
Total mass loss, DOI (g/m^2)	1876	1782	1821	1826
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	4.44	4.21	3.58	4.08
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	3.39	2.34	1.84	2.52
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	4.1	2.69	2.03	2.94
$HRRPUA_{peak}$ (kW/m^2)	130.86	219.71	107.52	152.7
$HRRPUA_{avg,60}$ (kW/m^2)	93.33	136.26	86.73	105.44
$HRRPUA_{avg,180}$ (kW/m^2)	58.63	86.28	57.27	67.39
$HRRPUA_{avg,300}$ (kW/m^2)	47.03	65.88	44.63	52.51
$HRRPUA_{avg,EOT}$ (kW/m^2)	27.05	32.07	19.12	26.08
$HRRPUA_{avg,DOI}$ (kW/m^2)	34.64	38.58	21.82	31.68
$THRPUA_{EOT}$ (MJ/m^2)	16.55	26.71	20.43	21.23
$THRPUA_{DOI}$ (MJ/m^2)	15.86	26.19	20.05	20.7
$EHC_{avg,EOT}$ (kJ/g)	8	14.07	10.69	10.92
$EHC_{avg,DOI}$ (kJ/g)	8.46	14.7	11.01	11.39
$SEA_{avg,EOT}$ (m^2/kg)	366.76	396.89	426.79	396.82
$SEA_{avg,DOI}$ (m^2/kg)	295.42	365.15	400.79	353.79

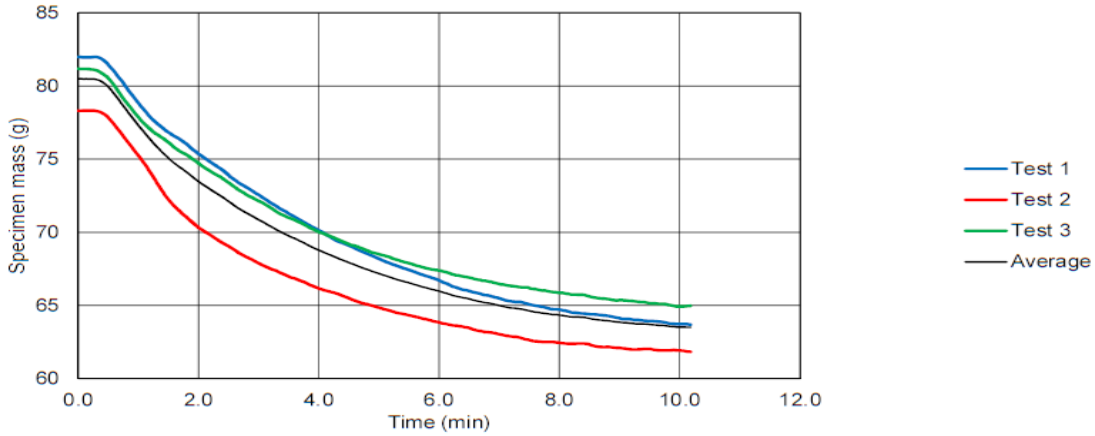
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 2: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 3: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.6
Date of test: 10/24/2017	Ambient temperature (°C): 26.5
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 51.1
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 3_75**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 0.472
Preparation details: Retaining frame used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

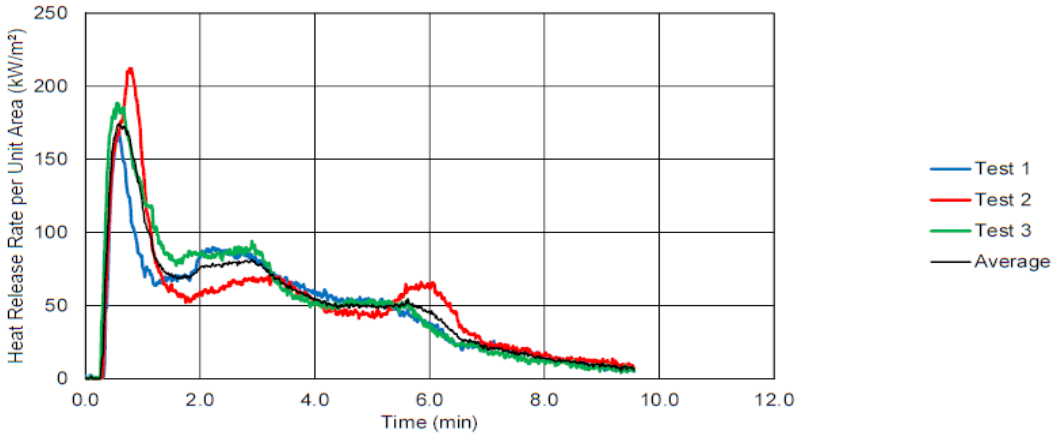
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	16.15	16.25	16.3	16.23
Specimen mass (g)	81.4	82.5	82.5	82.13
Heat flux (kW/m^2)	75	75	75	75
Exhaust flow rate (L/s)	19.87	19.89	19.87	19.88
Time to sustained flaming (s)	19	18	17	18
Time to flame-out (s)	491	483	454	476
Time to end-of-test (s)	611	603	574	596
Domain of interest (s):	19 - 491	18 - 483	17 - 454	18 - 476
Total mass loss, EOT (g/m^2)	2165	2308	2306	2260
Total mass loss, DOI (g/m^2)	2063	2217	2204	2161
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	5.95	5.9	6.91	6.25
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	3.54	3.84	4.04	3.81
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	4.35	4.75	5.04	4.72
$HRRPUA_{peak}$ (kW/m^2)	169.48	212.44	188.63	190.18
$HRRPUA_{avg,60}$ (kW/m^2)	99.62	139.2	139.53	126.12
$HRRPUA_{avg,180}$ (kW/m^2)	85.93	88.47	103.08	92.49
$HRRPUA_{avg,300}$ (kW/m^2)	74.55	73.55	83.29	77.13
$HRRPUA_{avg,EOT}$ (kW/m^2)	45.95	49.12	52.61	49.23
$HRRPUA_{avg,DOI}$ (kW/m^2)	57.16	60.88	66.47	61.5
$THRPUA_{EOT}$ (MJ/m^2)	28.12	29.67	30.25	29.34
$THRPUA_{DOI}$ (MJ/m^2)	27.03	28.36	29.09	28.16
$EHC_{avg,EOT}$ (kJ/g)	12.99	12.86	13.11	12.99
$EHC_{avg,DOI}$ (kJ/g)	13.1	12.79	13.2	13.03
$SEA_{avg,EOT}$ (m^2/kg)	261.53	356.7	342.35	320.19
$SEA_{avg,DOI}$ (m^2/kg)	214.06	328.65	294.26	278.99

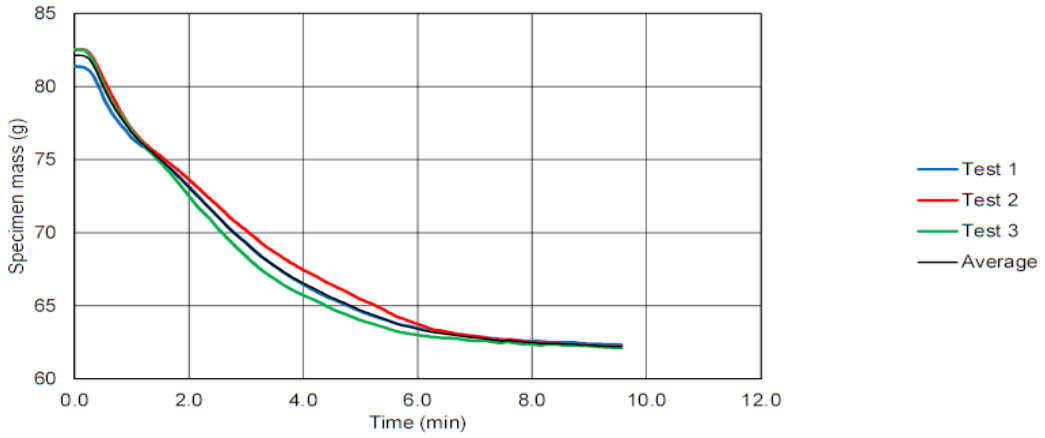
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 2: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Test 3: Cracking and delamination of the surface metal layer ocurred as the underlying wood and glue decomposed, eventually leading to flaming ignition.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 11/02/2017	Ambient temperature (°C): 25.9
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 47.1
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: Sample 4_25	Exposed specimen area (cm²): 88.4
	Specimen bulk density (g/cm³): 1.176
Preparation details: Plastic specimen wrapped in aluminum foil. Retaining frame and 25 mm spacing used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

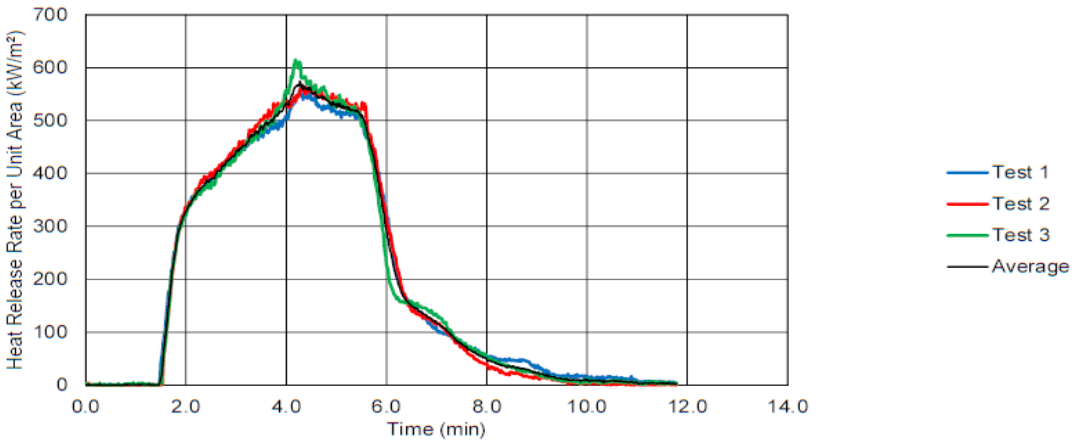
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	4.22	4.16	4.17	4.18
Specimen mass (g)	50.3	50.2	50.2	50.23
Heat flux (kW/m²)	25	25	25	25
Exhaust flow rate (L/s)	21.59	21.53	21.63	21.58
Time to sustained flaming (s)	81	82	83	82
Time to flame-out (s)	671	587	621	626
Time to end-of-test (s)	791	707	741	746
Domain of interest (s):	81 - 671	82 - 587	83 - 621	82 - 626
Total mass loss, EOT (g/m²)	5577	5577	5543	5566
Total mass loss, DOI (g/m²)	5572	5550	5531	5551
$MLRPUA_{avg,10/90\%}$ (g/s·m²)	18.36	19.31	18.32	18.67
$MLRPUA_{avg,EOT}$ (g/s·m²)	7.06	7.87	7.49	7.47
$MLRPUA_{avg,DOI}$ (g/s·m²)	9.44	10.97	10.26	10.22
$HRRPUA_{peak}$ (kW/m²)	558.6	567.73	615.36	580.56
$HRRPUA_{avg,60}$ (kW/m²)	232.92	233.45	236.68	234.35
$HRRPUA_{avg,180}$ (kW/m²)	385.9	396.71	397.44	393.35
$HRRPUA_{avg,300}$ (kW/m²)	410.19	420.72	411.01	413.97
$HRRPUA_{avg,EOT}$ (kW/m²)	175.08	195.17	185.58	185.28
$HRRPUA_{avg,DOI}$ (kW/m²)	233.96	272.59	254.46	253.67
$THRPUA_{EOT}$ (MJ/m²)	138.66	138.18	137.7	138.18
$THRPUA_{DOI}$ (MJ/m²)	138.27	137.93	137.15	137.78
$EHC_{avg,EOT}$ (kJ/g)	24.86	24.78	24.84	24.83
$EHC_{avg,DOI}$ (kJ/g)	24.82	24.85	24.8	24.82
$SEA_{avg,EOT}$ (m²/kg)	846.53	635.81	574.59	685.64
$SEA_{avg,DOI}$ (m²/kg)	640.06	497.78	443.1	526.98

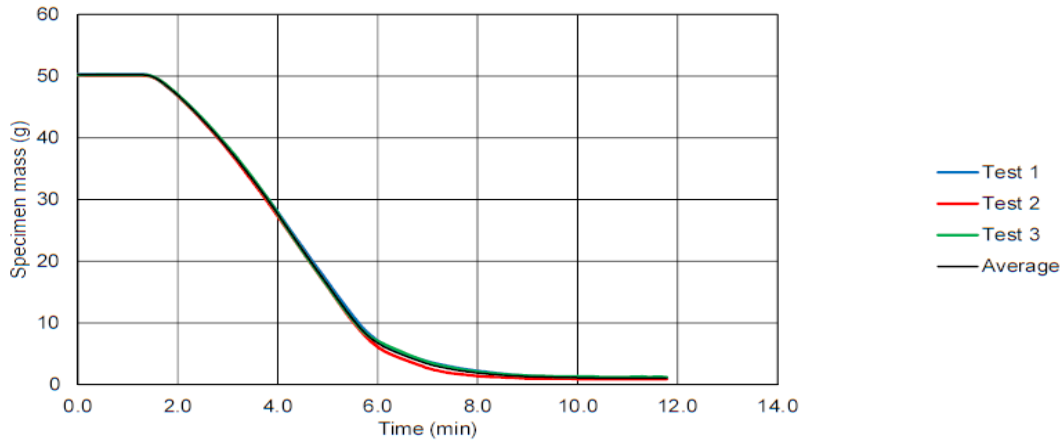
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Specimen burned cleanly without warping, leaking, or other notable events.

Test 2: Specimen burned cleanly without warping, leaking, or other notable events.

Test 3: Specimen burned cleanly without warping, leaking, or other notable events.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

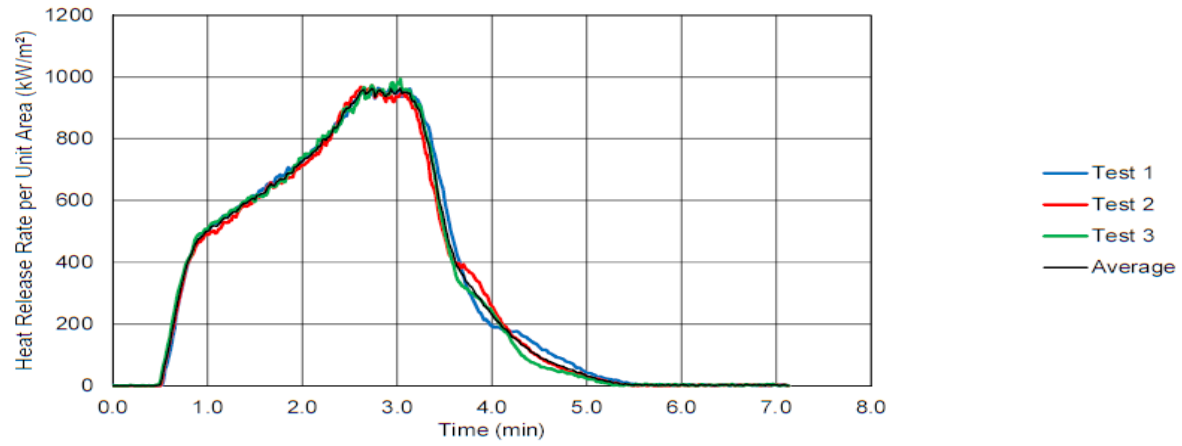
Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 11/02/2017	Ambient temperature (°C): 25.7
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 45.9
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 4**_50	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.174
Preparation details: Plastic specimen wrapped in aluminum foil. Retaining frame and 25 mm spacing used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

Test Results

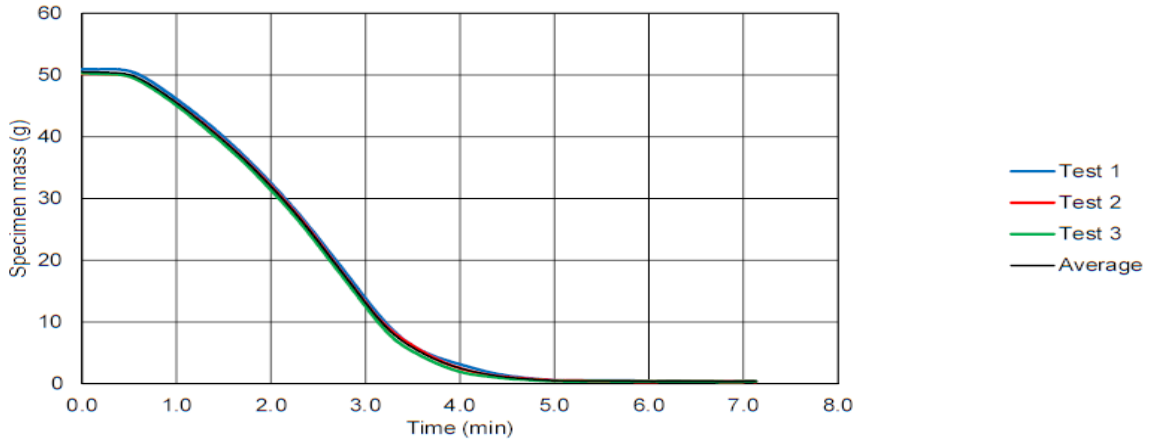
Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	4.2	4.2	4.2	4.2
Specimen mass (g)	50.9	50.2	50.3	50.47
Heat flux (kW/m^2)	50	50	50	50
Exhaust flow rate (L/s)	23.25	23.26	23.44	23.32
Time to sustained flaming (s)	27	26	25	26
Time to flame-out (s)	329	322	308	320
Time to end-of-test (s)	449	442	428	440
Domain of interest (s):	27 - 329	26 - 322	25 - 308	26 - 320
Total mass loss, EOT (g/m^2)	5713	5638	5645	5665
Total mass loss, DOI (g/m^2)	5689	5604	5614	5636
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	29.87	29.1	30.11	29.69
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	12.72	12.76	13.18	12.89
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	18.76	18.85	19.75	19.12
$HRRPUA_{peak}$ (kW/m^2)	968.14	972.75	994.42	978.44
$HRRPUA_{avg,60}$ (kW/m^2)	399.76	385.29	395.23	393.43
$HRRPUA_{avg,180}$ (kW/m^2)	677.87	659.87	672.12	669.95
$HRRPUA_{avg,300}$ (kW/m^2)	474.31	462.18	463.85	466.78
$HRRPUA_{avg,EOT}$ (kW/m^2)	317.92	314.43	326.13	319.49
$HRRPUA_{avg,DOI}$ (kW/m^2)	471.22	468.36	491.29	476.96
$THRPUA_{EOT}$ (MJ/m^2)	143.06	139.29	139.91	140.76
$THRPUA_{DOI}$ (MJ/m^2)	142.78	139.1	139.52	140.47
$EHC_{avg,EOT}$ (kJ/g)	25.04	24.71	24.79	24.85
$EHC_{avg,DOI}$ (kJ/g)	25.1	24.82	24.85	24.92
$SEA_{avg,EOT}$ (m^2/kg)	318.88	524.9	465.31	436.36
$SEA_{avg,DOI}$ (m^2/kg)	197.1	358.74	318.41	291.41

Cone Calorimeter Test Results

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Specimen burned cleanly without warping, leaking, or other notable events.

Test 2: Specimen burned cleanly without warping, leaking, or other notable events.

Test 3: Specimen burned cleanly without warping, leaking, or other notable events.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 11/02/2017	Ambient temperature (°C): 25.2
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 44.8
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 4_75**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.183
Preparation details: Plastic specimen wrapped in aluminum foil. Retaining frame and 25 mm spacing used.	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

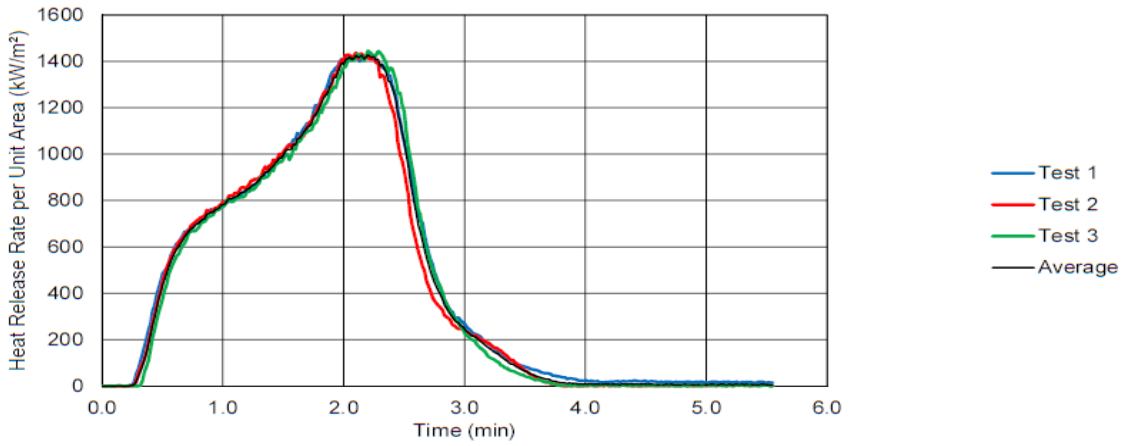
Test Results

Test ID	Test 1	Test 2	Test 3	Average
Specimen thickness (mm)	4.16	4.16	4.2	4.17
Specimen mass (g)	50.6	50.6	50.9	50.7
Heat flux (kW/m^2)	75	75	75	75
Exhaust flow rate (L/s)	23.45	23.86	24.18	23.83
Time to sustained flaming (s)	15	14	15	15
Time to flame-out (s)	235	213	217	222
Time to end-of-test (s)	355	333	337	342
Domain of interest (s):	15 - 235	14 - 213	15 - 217	15 - 222
Total mass loss, EOT (g/m^2)	5718	5701	5735	5718
Total mass loss, DOI (g/m^2)	5683	5658	5689	5676
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	40.48	41.46	42.09	41.35
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	16.07	17.07	16.97	16.7
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	25.67	28.25	27.99	27.3
$HRRPUA_{peak}$ (kW/m^2)	1428.4	1437.39	1445.83	1437.21
$HRRPUA_{avg,60}$ (kW/m^2)	595.26	576.73	554.36	575.45
$HRRPUA_{avg,180}$ (kW/m^2)	807.12	778.95	786.82	790.96
$HRRPUA_{avg,300}$ (kW/m^2)	500.45	476.6	478.64	485.23
$HRRPUA_{avg,EOT}$ (kW/m^2)	425	429.69	426.41	427.03
$HRRPUA_{avg,DOI}$ (kW/m^2)	674.61	715.34	707.87	699.27
$THRPUA_{EOT}$ (MJ/m^2)	151.29	143.51	144.13	146.31
$THRPUA_{DOI}$ (MJ/m^2)	149.07	143.04	143.68	145.27
$EHC_{avg,EOT}$ (kJ/g)	26.46	25.17	25.13	25.59
$EHC_{avg,DOI}$ (kJ/g)	26.23	25.28	25.26	25.59
$SEA_{avg,EOT}$ (m^2/kg)	593.85	517.74	216.23	442.61
$SEA_{avg,DOI}$ (m^2/kg)	397.63	250.17	151.56	266.45

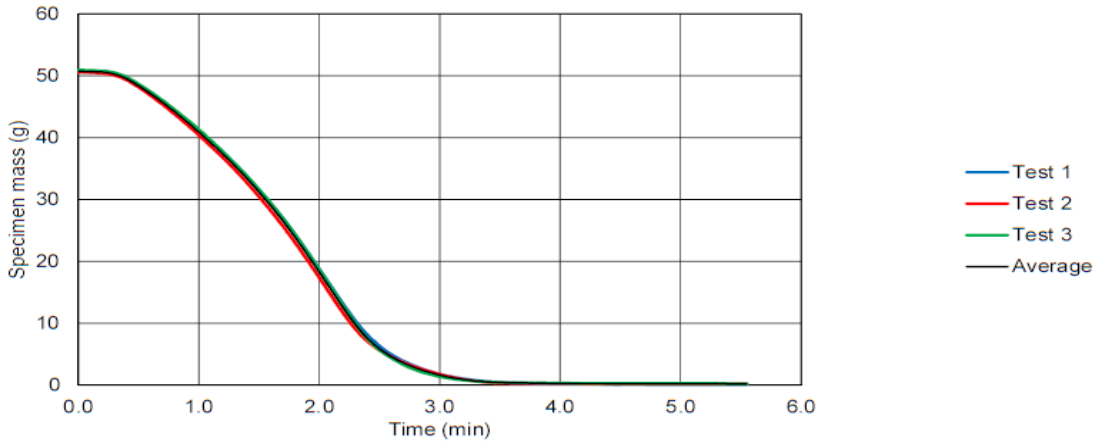
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Specimen burned cleanly without warping, leaking, or other notable events.

Test 2: Specimen burned cleanly without warping, leaking, or other notable events.

Test 3: Specimen burned cleanly without warping, leaking, or other notable events.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

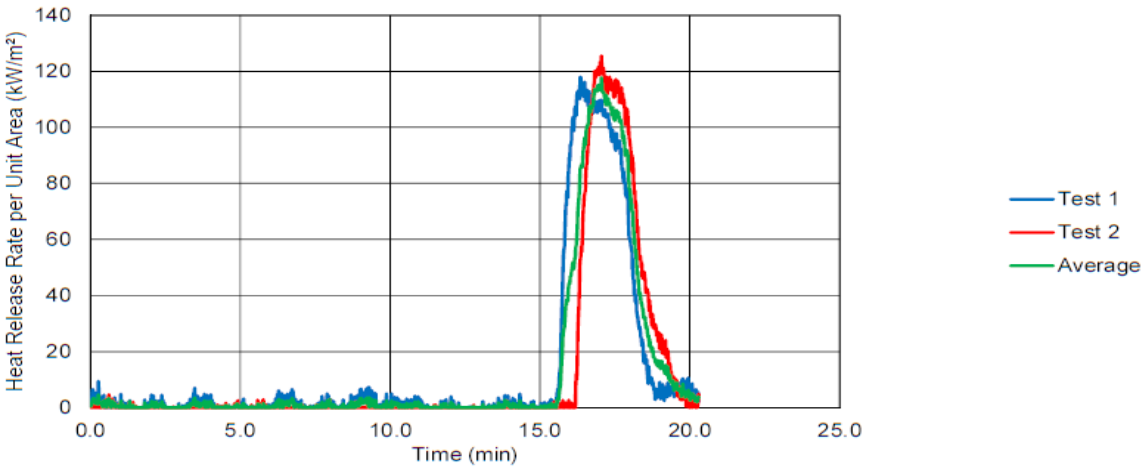
Client: FRA/Volpe	Ambient pressure (psia): 15
Date of test: 01/02/2018	Ambient temperature (°C): 24.5
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.3
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 5**_25	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.313
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 60	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

Test Results

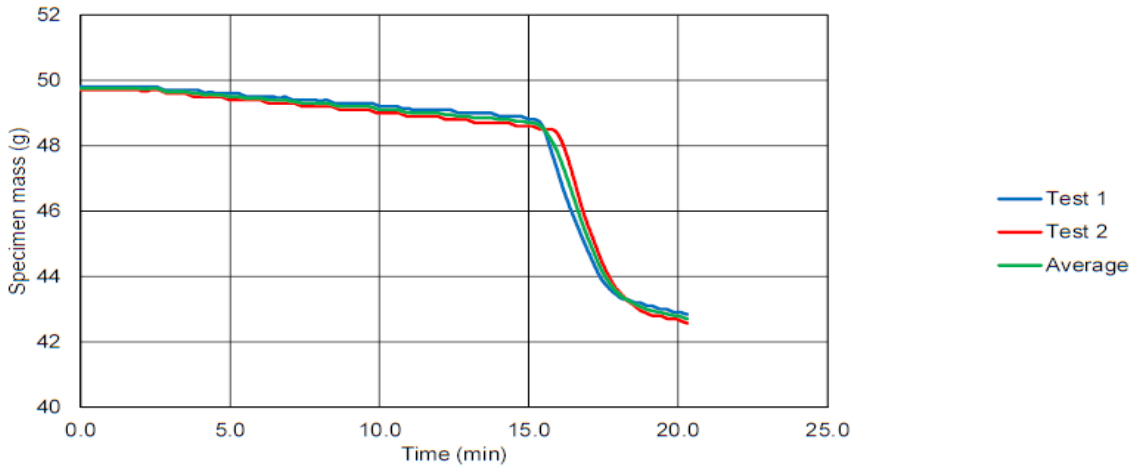
Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	3.77	3.78	3.78
Specimen mass (g)	49.8	49.7	49.75
Heat flux (kW/m^2)	25	25	25
Exhaust flow rate (L/s)	22.33	22.19	22.26
Time to sustained flaming (s)	907	951	929
Time to flame-out (s)	1098	1156	1127
Time to end-of-test (s)	1218	1276	1247
Domain of interest (s):	907 - 1098	951 - 1156	929 - 1127
Total mass loss, EOT (g/m^2)	788	826	807
Total mass loss, DOI (g/m^2)	622	642	632
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	1.56	1.42	1.49
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	0.65	0.65	0.65
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	3.25	3.11	3.18
$HRRPUA_{peak}$ (kW/m^2)	117.98	125.63	121.8
$HRRPUA_{avg,60}$ (kW/m^2)	32.04	49.44	40.74
$HRRPUA_{avg,180}$ (kW/m^2)	75.9	75.02	75.46
$HRRPUA_{avg,300}$ (kW/m^2)	50.31	48.31	49.31
$HRRPUA_{avg,EOT}$ (kW/m^2)	13.26	11.48	12.37
$HRRPUA_{avg,DOI}$ (kW/m^2)	73.65	68.75	71.2
$THRPUA_{EOT}$ (MJ/m^2)	16.16	14.66	15.41
$THRPUA_{DOI}$ (MJ/m^2)	14.13	14.15	14.14
$EHC_{avg,EOT}$ (kJ/g)	20.52	17.75	19.13
$EHC_{avg,DOI}$ (kJ/g)	22.7	22.05	22.38
$SEA_{avg,EOT}$ (m^2/kg)	11606.06	13090.41	12348.24
$SEA_{avg,DOI}$ (m^2/kg)	2240.46	4227.55	3234

Cone Calorimeter Test Results

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Significant intumescing, 60 mm spacing required to avoid igniter contact.

Test 2: Significant intumescing, 60 mm spacing required to avoid igniter contact.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 15
Date of test: 01/02/2018	Ambient temperature (°C): 24.7
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.5
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 5_50**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.31
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

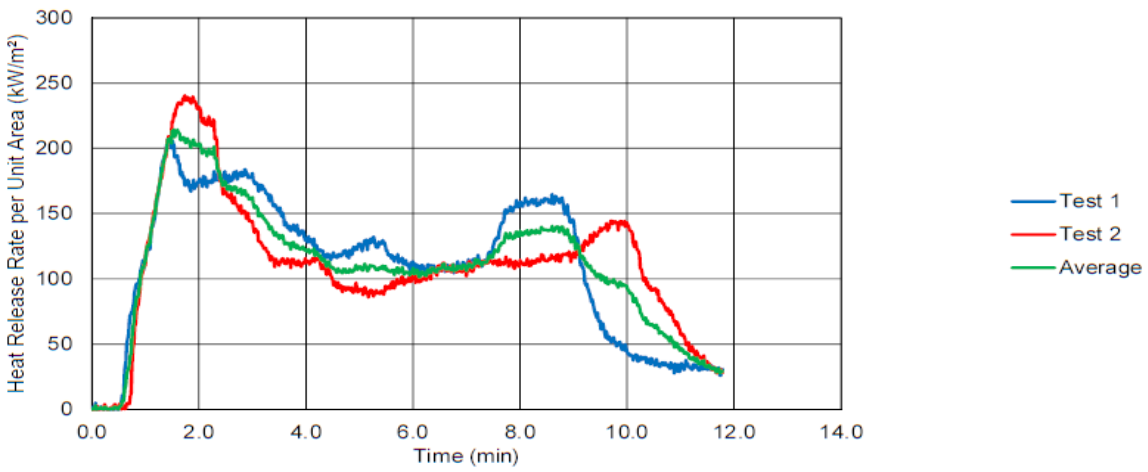
Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	3.77	3.72	3.75
Specimen mass (g)	49.4	48.8	49.1
Heat flux (kW/m^2)	50	50	50
Exhaust flow rate (L/s)	22.87	22.95	22.91
Time to sustained flaming (s)	29	39	34
Time to flame-out (s)	587	727	657
Time to end-of-test (s)	707	847	777
Domain of interest (s):	29 - 587	39 - 727	34 - 657
Total mass loss, EOT (g/m^2)	3348	3292	3320
Total mass loss, DOI (g/m^2)	3160	3113	3137
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	6.03	5.08	5.56
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	4.73	3.88	4.31
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	5.66	4.53	5.1
$HRRPUA_{peak}$ (kW/m^2)	206.9	240.51	223.71
$HRRPUA_{avg,60}$ (kW/m^2)	112.95	139.78	126.37
$HRRPUA_{avg,180}$ (kW/m^2)	154.32	159.9	157.11
$HRRPUA_{avg,300}$ (kW/m^2)	143.66	136.09	139.87
$HRRPUA_{avg,EOT}$ (kW/m^2)	111.3	96.71	104
$HRRPUA_{avg,DOI}$ (kW/m^2)	133.23	114.86	124.05
$THRPUA_{EOT}$ (MJ/m^2)	78.78	82	80.39
$THRPUA_{DOI}$ (MJ/m^2)	74.45	79.12	76.79
$EHC_{avg,EOT}$ (kJ/g)	23.53	24.91	24.22
$EHC_{avg,DOI}$ (kJ/g)	23.56	25.42	24.49
$SEA_{avg,EOT}$ (m^2/kg)	1607.31	3020.37	2313.84
$SEA_{avg,DOI}$ (m^2/kg)	1297.35	2747.88	2022.61

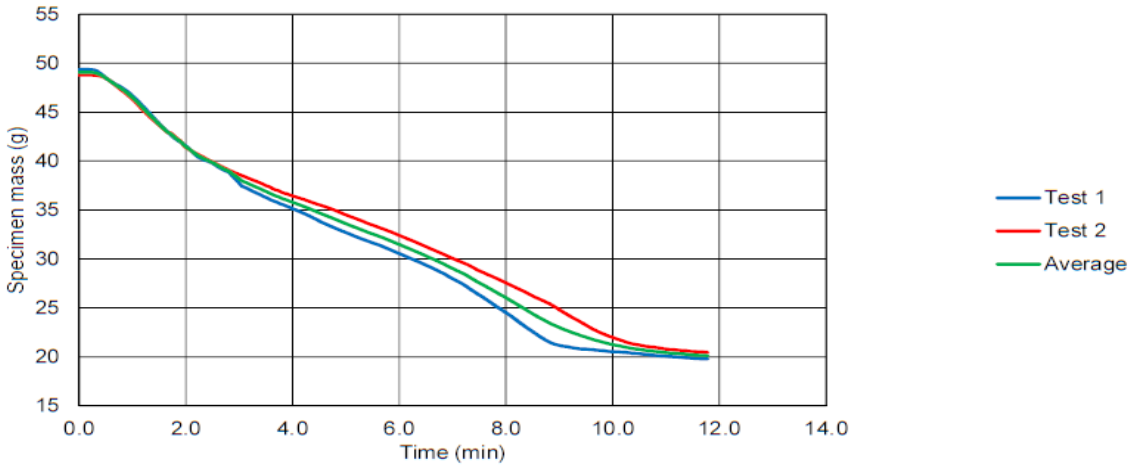
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Significant intumescing, char layer rose up into cone heater (no contact).

Test 2: Significant intumescing, char layer rose up into cone heater (no contact).

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

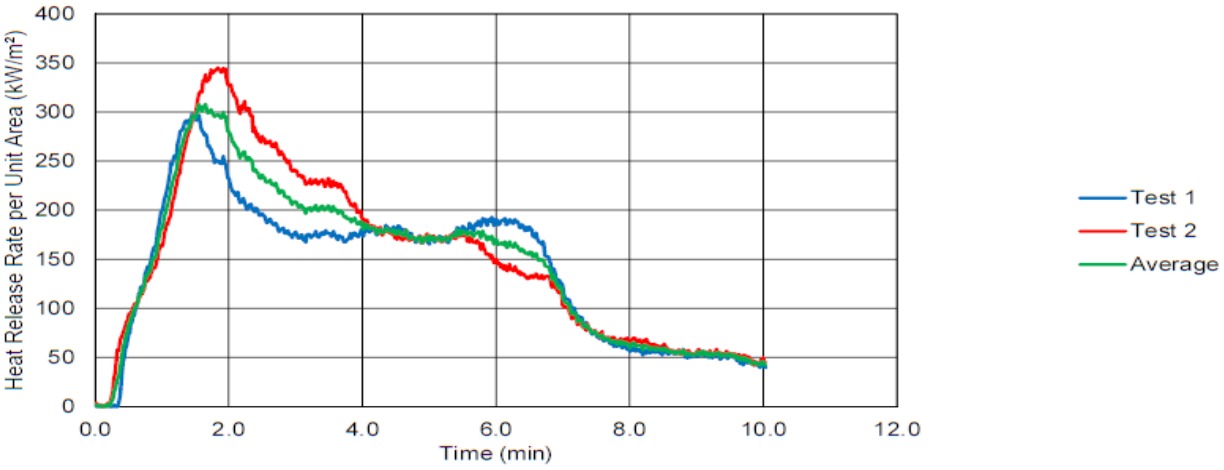
Client: FRA/Volpe	Ambient pressure (psia): 15
Date of test: 01/02/2018	Ambient temperature (°C): 25.6
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 17.5
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 5_75**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.306
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

Test Results

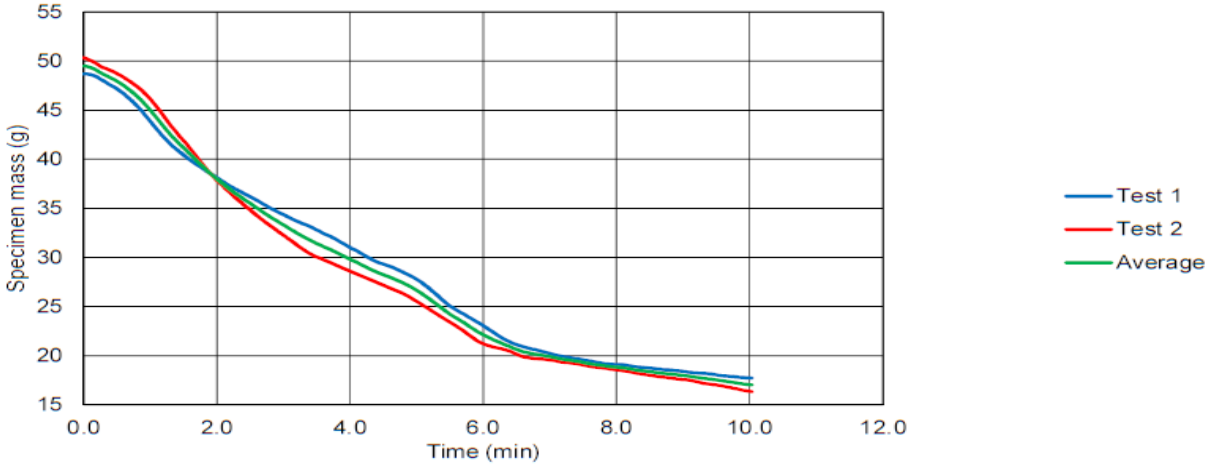
Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	3.75	3.83	3.79
Specimen mass (g)	48.7	50.4	49.55
Heat flux (kW/m^2)	75	75	75
Exhaust flow rate (L/s)	23.31	23.46	23.39
Time to sustained flaming (s)	18	13	16
Time to flame-out (s)	482	594	538
Time to end-of-test (s)	602	714	658
Domain of interest (s):	18 - 482	13 - 594	16 - 538
Total mass loss, EOT (g/m^2)	3505	3978	3742
Total mass loss, DOI (g/m^2)	3265	3748	3507
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	7.94	7.69	7.82
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	5.81	5.58	5.7
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	7.03	6.45	6.74
$HRRPUA_{peak}$ (kW/m^2)	298.26	345.01	321.64
$HRRPUA_{avg,60}$ (kW/m^2)	146.5	120.02	133.26
$HRRPUA_{avg,180}$ (kW/m^2)	194.02	229.95	211.98
$HRRPUA_{avg,300}$ (kW/m^2)	186.42	214.98	200.7
$HRRPUA_{avg,EOT}$ (kW/m^2)	140.93	135.12	138.02
$HRRPUA_{avg,DOI}$ (kW/m^2)	169.37	157.49	163.43
$THRPUA_{EOT}$ (MJ/m^2)	84.96	96.59	90.78
$THRPUA_{DOI}$ (MJ/m^2)	78.73	91.63	85.18
$EHC_{avg,EOT}$ (kJ/g)	24.24	24.28	24.26
$EHC_{avg,DOI}$ (kJ/g)	24.11	24.45	24.28
$SEA_{avg,EOT}$ (m^2/kg)	1785.17	1196.79	1490.98
$SEA_{avg,DOI}$ (m^2/kg)	1498.54	999.29	1248.92

Cone Calorimeter Test Results

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Significant intumescing, char layer rose up into cone heater (no contact).

Test 2: Significant intumescing, char layer rose up into cone heater (no contact).

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 01/03/2018	Ambient temperature (°C): 24.2
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.8
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 6_25**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.508
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: Last recorded value.	

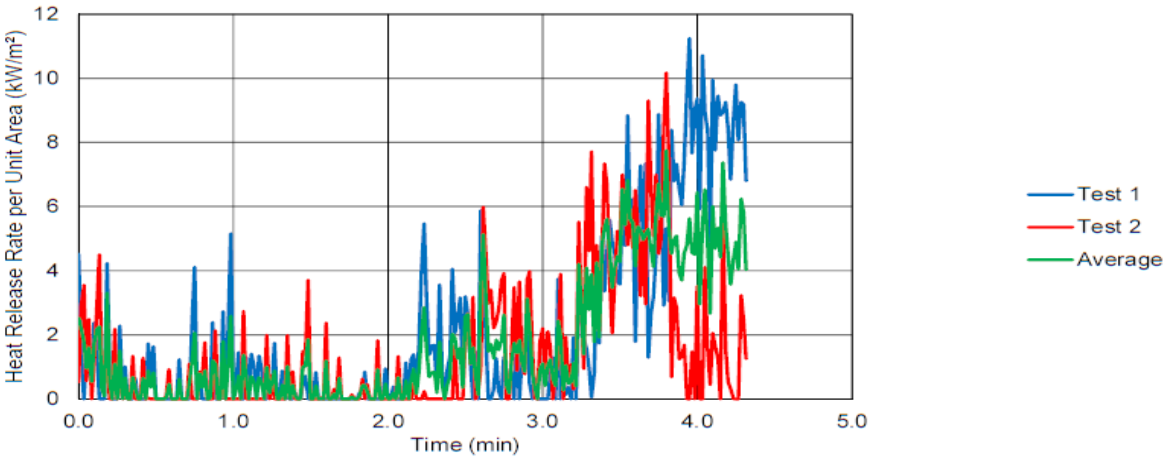
Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	7.14	7.08	7.11
Specimen mass (g)	113.7	113.3	113.5
Heat flux (kW/m^2)	25	25	25
Exhaust flow rate (L/s)	21.73	21.75	21.74
Time to sustained flaming (s)	176	172	174
Time to flame-out (s)	225	199	212
Time to end-of-test (s)	345	259	302
Domain of interest (s):	176 - 225	172 - 199	174 - 212
Total mass loss, EOT (g/m^2)	331	191	261
Total mass loss, DOI (g/m^2)	97	63	80
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	1.65	1.25	1.45
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	0.99	0.81	0.9
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	1.95	2.23	2.09
$HRRPUA_{peak}$ (kW/m^2)	8.88	7.71	8.3
$HRRPUA_{avg,60}$ (kW/m^2)	3.43	3.75	3.59
$HRRPUA_{avg,180}$ (kW/m^2)	0	0	0
$HRRPUA_{avg,300}$ (kW/m^2)	0	0	0
$HRRPUA_{avg,EOT}$ (kW/m^2)	2.2	1.45	1.82
$HRRPUA_{avg,DOI}$ (kW/m^2)	2.79	2.1	2.45
$THRPUA_{EOT}$ (MJ/m^2)	0.76	0.38	0.57
$THRPUA_{DOI}$ (MJ/m^2)	0.14	0.05	0.09
$EHC_{avg,EOT}$ (kJ/g)	2.29	1.97	2.13
$EHC_{avg,DOI}$ (kJ/g)	1.4	0.87	1.13
$SEA_{avg,EOT}$ (m^2/kg)	8679.94	5090.53	6885.24
$SEA_{avg,DOI}$ (m^2/kg)	9054.99	1303.63	5179.31

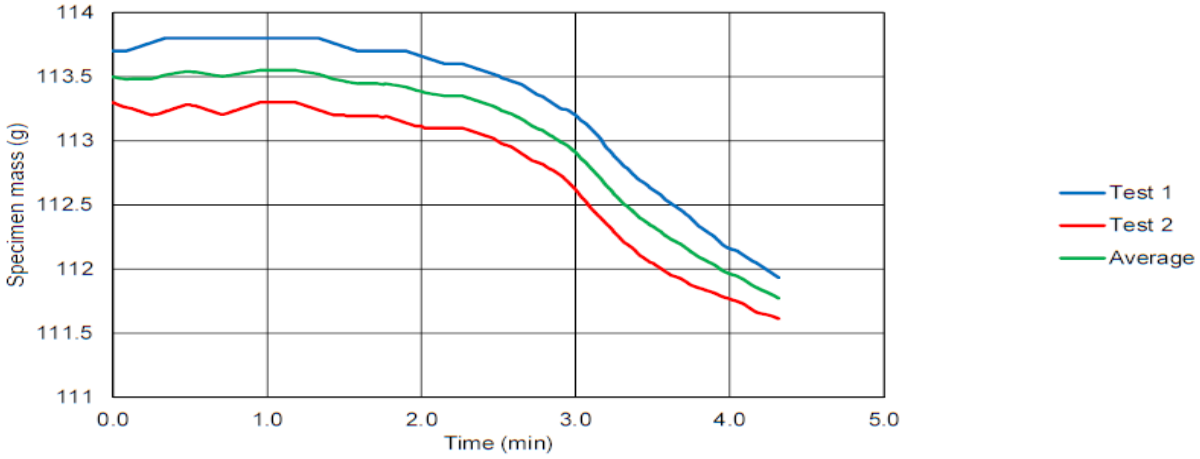
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Flame extinction occurred less than 60 s after ignition. At this time the igniter was placed back into position in an atttempt to initiate reignition. No reignition occurred through the end-of-test.

Test 2: Flame extinction occurred less than 60 s after ignition. At this time the igniter was placed back into position in an atttempt to initiate reignition. No reignition occurred through the end-of-test.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 01/03/2018	Ambient temperature (°C): 23.8
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.2
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Samples 6_50**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.536
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

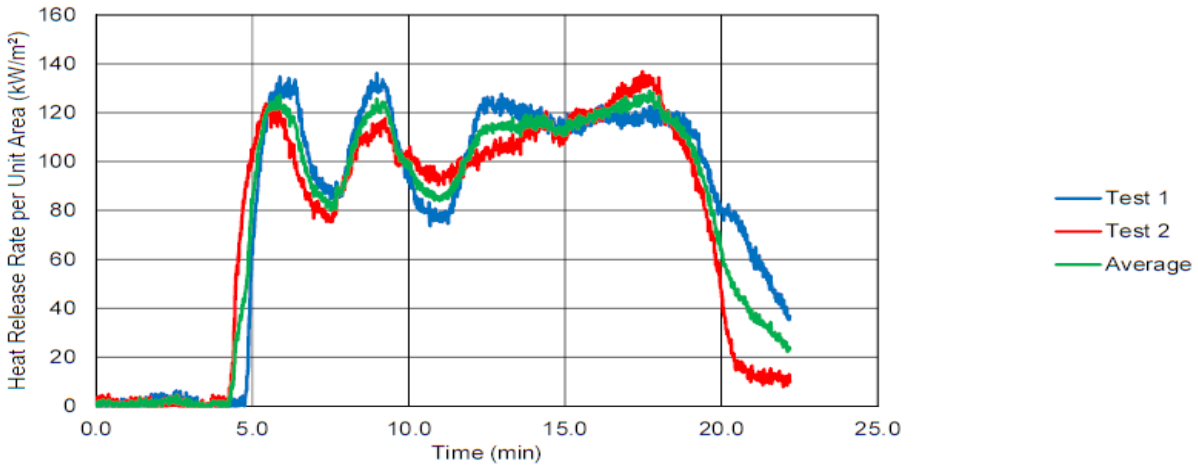
Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	6.92	6.56	6.74
Specimen mass (g)	110.3	105.2	107.75
Heat flux (kW/m^2)	50	50	50
Exhaust flow rate (L/s)	22.62	22.65	22.64
Time to sustained flaming (s)	285	253	269
Time to flame-out (s)	1367	1211	1289
Time to end-of-test (s)	1487	1331	1409
Domain of interest (s):	285 - 1367	253 - 1211	269 - 1289
Total mass loss, EOT (g/m^2)	6239	5882	6061
Total mass loss, DOI (g/m^2)	5471	5214	5343
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	5.62	5.76	5.69
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	4.19	4.42	4.3
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	5.05	5.44	5.25
$HRRPUA_{peak}$ (kW/m^2)	136.26	136.92	136.59
$HRRPUA_{avg,60}$ (kW/m^2)	86.85	70.68	78.77
$HRRPUA_{avg,180}$ (kW/m^2)	101.01	92.09	96.55
$HRRPUA_{avg,300}$ (kW/m^2)	107.06	94.41	100.73
$HRRPUA_{avg,EOT}$ (kW/m^2)	73.73	75.66	74.69
$HRRPUA_{avg,DOI}$ (kW/m^2)	100.13	103.03	101.58
$THRPUA_{EOT}$ (MJ/m^2)	109.71	100.77	105.24
$THRPUA_{DOI}$ (MJ/m^2)	108.43	98.79	103.61
$EHC_{avg,EOT}$ (kJ/g)	17.58	17.13	17.36
$EHC_{avg,DOI}$ (kJ/g)	19.82	18.95	19.38
$SEA_{avg,EOT}$ (m^2/kg)	2183.67	1454.16	1818.92
$SEA_{avg,DOI}$ (m^2/kg)	1854.97	1274.47	1564.72

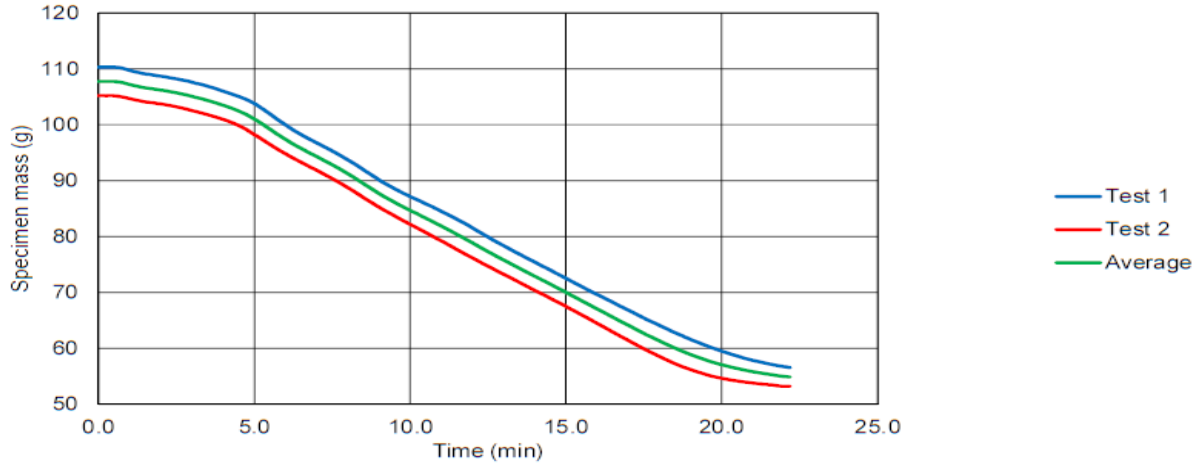
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Char layer caused flame extinction shortly after ignition -- reignition occurred subsequently.

Test 2: Char layer caused flame extinction shortly after ignition -- reignition occurred subsequently.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 01/03/2018	Ambient temperature (°C): 26.3
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 17.9
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: Miles_75	Exposed specimen area (cm^2): 88.4
Manufacturer: Miles	Specimen bulk density (g/cm^3): 1.524
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

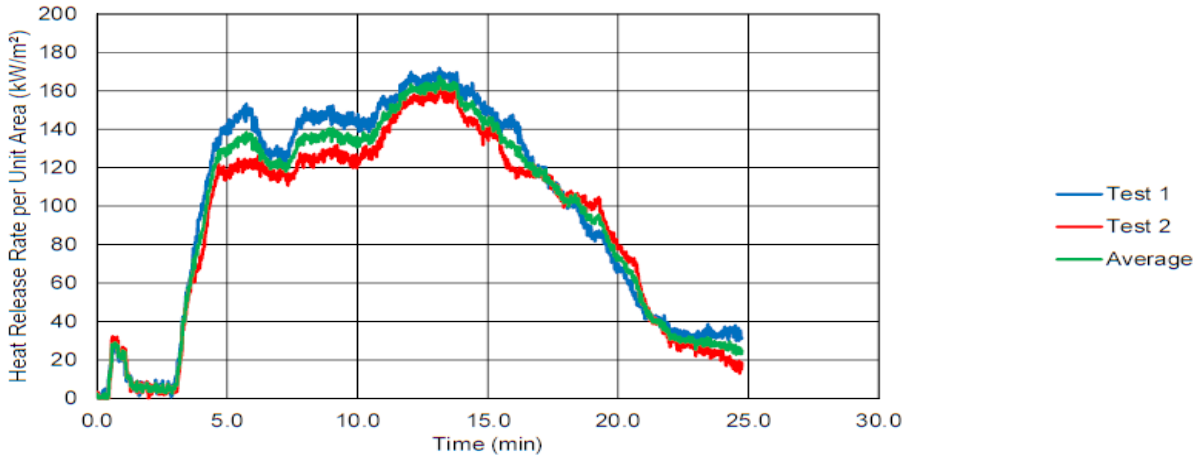
Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	7.26	7.19	7.23
Specimen mass (g)	118	117.7	117.85
Heat flux (kW/m^2)	75	75	75
Exhaust flow rate (L/s)	23.23	23.25	23.24
Time to sustained flaming (s)	55	175	115
Time to flame-out (s)	1365	1374	1370
Time to end-of-test (s)	1485	1494	1490
Domain of interest (s):	55 - 1365	175 - 1374	115 - 1370
Total mass loss, EOT (g/m^2)	7014	6991	7002
Total mass loss, DOI (g/m^2)	6768	6511	6640
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	6.7	6.47	6.58
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	4.72	4.68	4.7
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	5.16	5.43	5.3
$HRRPUA_{peak}$ (kW/m^2)	172.07	163.12	167.59
$HRRPUA_{avg,60}$ (kW/m^2)	9.78	39.66	24.72
$HRRPUA_{avg,180}$ (kW/m^2)	21.13	86.99	54.06
$HRRPUA_{avg,300}$ (kW/m^2)	65.99	99.55	82.77
$HRRPUA_{avg,EOT}$ (kW/m^2)	99.09	90.25	94.67
$HRRPUA_{avg,DOI}$ (kW/m^2)	108.79	108.96	108.87
$THRPUA_{EOT}$ (MJ/m^2)	147.24	134.91	141.07
$THRPUA_{DOI}$ (MJ/m^2)	142.59	130.74	136.67
$EHC_{avg,EOT}$ (kJ/g)	20.99	19.3	20.15
$EHC_{avg,DOI}$ (kJ/g)	21.07	20.08	20.57
$SEA_{avg,EOT}$ (m^2/kg)	1841.68	904.54	1373.11
$SEA_{avg,DOI}$ (m^2/kg)	1812.76	886.16	1349.46

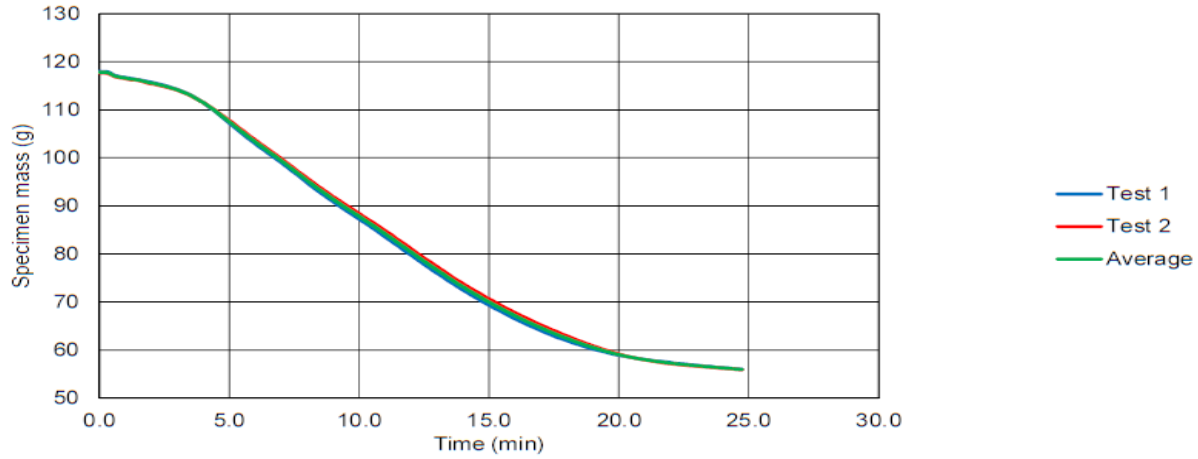
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Ignition was followed by extinction in less than 1 minute as the char layer formed. Re-ignition occurred subseqently.

Test 2: Ignition was followed by extinction in less than 1 minute as the char layer formed. Re-ignition occurred subseqently.

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 01/03/2018	Ambient temperature (°C): 24.1
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.2
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 7_35**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.824
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

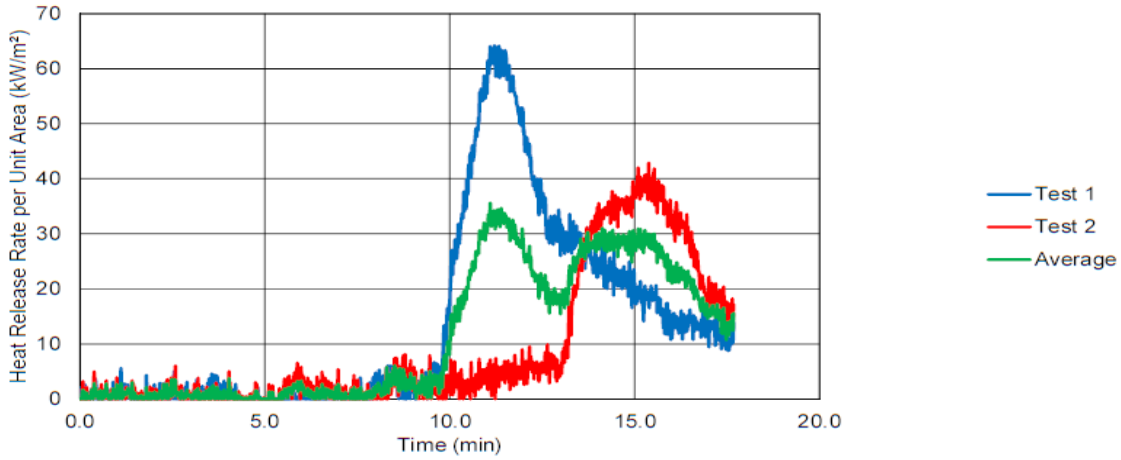
Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	3.25	3.27	3.26
Specimen mass (g)	60	60.1	60.05
Heat flux (kW/m^2)	35	35	35
Exhaust flow rate (L/s)	22.07	22.02	22.05
Time to sustained flaming (s)	574	769	672
Time to flame-out (s)	941	1048	995
Time to end-of-test (s)	1061	1168	1115
Domain of interest (s):	574 - 941	769 - 1048	672 - 995
Total mass loss, EOT (g/m^2)	1157	1176	1167
Total mass loss, DOI (g/m^2)	480	330	405
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	1.21	1.09	1.15
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	1.1	1.01	1.05
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	1.31	1.18	1.24
$HRRPUA_{peak}$ (kW/m^2)	64.22	42.92	53.57
$HRRPUA_{avg,60}$ (kW/m^2)	21.18	16.56	18.87
$HRRPUA_{avg,180}$ (kW/m^2)	41.41	29.4	35.4
$HRRPUA_{avg,300}$ (kW/m^2)	35.82	27.1	31.46
$HRRPUA_{avg,EOT}$ (kW/m^2)	13.38	9.19	11.28
$HRRPUA_{avg,DOI}$ (kW/m^2)	32.87	27.93	30.4
$THRPUA_{EOT}$ (MJ/m^2)	14.2	10.74	12.47
$THRPUA_{DOI}$ (MJ/m^2)	12.08	7.81	9.95
$EHC_{avg,EOT}$ (kJ/g)	12.27	9.13	10.7
$EHC_{avg,DOI}$ (kJ/g)	25.16	23.69	24.42
$SEA_{avg,EOT}$ (m^2/kg)	8446.25	6968.17	7707.21
$SEA_{avg,DOI}$ (m^2/kg)	3848.6	4676.41	4262.5

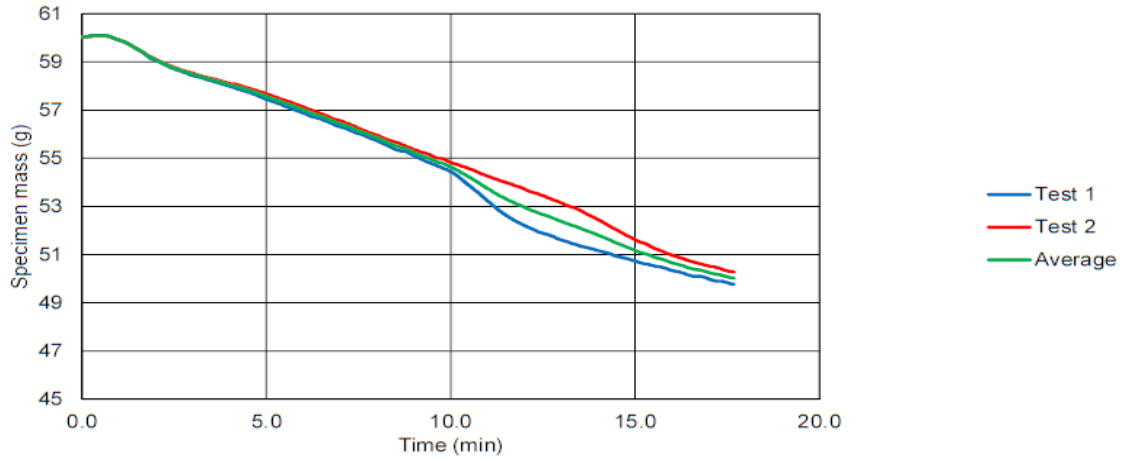
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Delamination in the first minute caused by a gas bubble forming under the top layer of fiberglass, and subsequently popping open with a loud "crack".

Test 2: Delamination in the first minute caused by a gas bubble forming under the top layer of fiberglass, and subsequently popping open with a loud "crack".

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 01/03/2018	Ambient temperature (°C): 25.5
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.8
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample** 7_50	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.836
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: Last recorded value.	

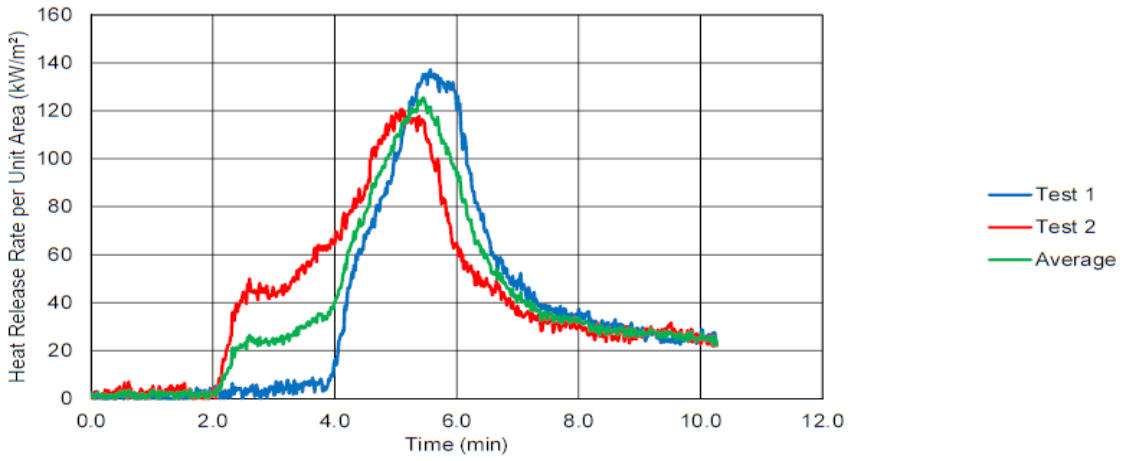
Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	3.28	3.23	3.26
Specimen mass (g)	60.3	60.2	60.25
Heat flux (kW/m^2)	50	50	50
Exhaust flow rate (L/s)	22.38	22.43	22.41
Time to sustained flaming (s)	226	116	171
Time to flame-out (s)	496	958	727
Time to end-of-test (s)	616	958	787
Domain of interest (s):	226 - 496	116 - 958	171 - 727
Total mass loss, EOT (g/m^2)	1128	1489	1309
Total mass loss, DOI (g/m^2)	828	1296	1062
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	2.99	1.94	2.47
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	1.86	1.55	1.71
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	3.06	1.54	2.3
$HRRPUA_{peak}$ (kW/m^2)	137.2	120.76	128.98
$HRRPUA_{avg,60}$ (kW/m^2)	43.78	30.62	37.2
$HRRPUA_{avg,180}$ (kW/m^2)	84.01	57.34	70.68
$HRRPUA_{avg,300}$ (kW/m^2)	65.37	65.14	65.26
$HRRPUA_{avg,EOT}$ (kW/m^2)	36.56	34.23	35.39
$HRRPUA_{avg,DOI}$ (kW/m^2)	69.27	38.63	53.95
$THRPUA_{EOT}$ (MJ/m^2)	22.54	32.82	27.68
$THRPUA_{DOI}$ (MJ/m^2)	18.75	32.56	25.65
$EHC_{avg,EOT}$ (kJ/g)	19.98	22.04	21.01
$EHC_{avg,DOI}$ (kJ/g)	22.66	25.12	23.89
$SEA_{avg,EOT}$ (m^2/kg)	2441.86	3317.54	2879.7
$SEA_{avg,DOI}$ (m^2/kg)	1195.98	2943.96	2069.97

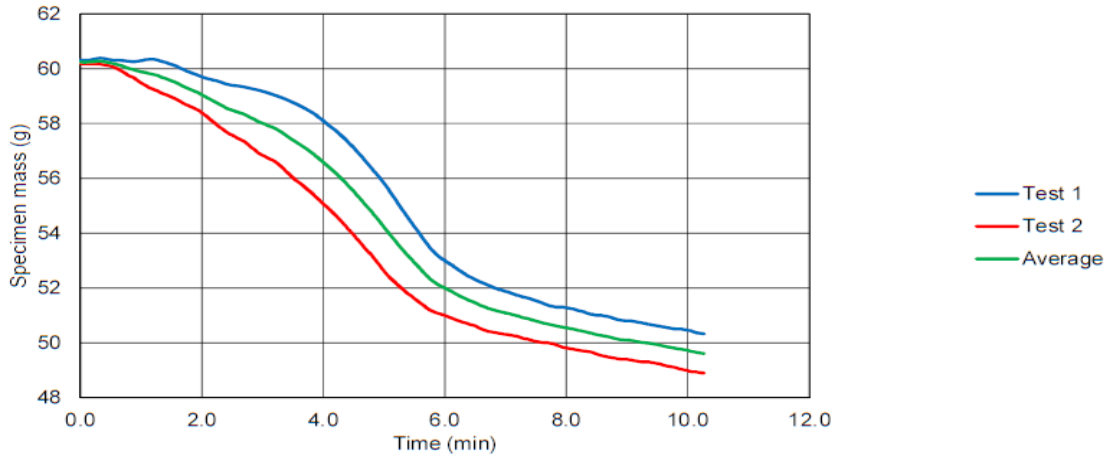
Cone Calorimeter Test Results

JENSEN HUGHES

Heat Release Rate per Unit Area



Specimen Mass



Additional Remarks

Test 1: Delamination in the first minute caused by a gas bubble forming under the top layer of fiberglass, and subsequently popping open with a loud "crack".

Test 2: Delamination in the first minute caused by a gas bubble forming under the top layer of fiberglass, and subsequently popping open with a loud "crack".

Cone Calorimeter Test Results

JENSEN HUGHES

Test Information

Client: FRA/Volpe	Ambient pressure (psia): 14.9
Date of test: 01/03/2018	Ambient temperature (°C): 25.7
Test engineer: Matt DiDomizio	Ambient relative humidity (%): 18.3
Test standard: ASTM E1345	Number of specimens: 3
Specimen ID: **Sample 7_75**	Exposed specimen area (cm^2): 88.4
	Specimen bulk density (g/cm^3): 1.825
Preparation details:	
Orientation: Horizontal	Retaining frame/grid: Yes
Spacing (mm): 25	Spark igniter: Yes
End-of-test criterion: 2-min after flaming or other signs of combustion have ceaced.	

Test Results

Test ID	Test 1	Test 2	Average
Specimen thickness (mm)	3.28	3.26	3.27
Specimen mass (g)	60.1	60.3	60.2
Heat flux (kW/m^2)	75	75	75
Exhaust flow rate (L/s)	22.98	22.9	22.94
Time to sustained flaming (s)	40	40	40
Time to flame-out (s)	338	338	338
Time to end-of-test (s)	458	458	458
Domain of interest (s):	40 - 338	40 - 338	40 - 338
Total mass loss, EOT (g/m^2)	1437	1324	1380
Total mass loss, DOI (g/m^2)	1249	1189	1219
$MLRPUA_{avg,10/90\%}$ ($g/s \cdot m^2$)	4.45	4.64	4.55
$MLRPUA_{avg,EOT}$ ($g/s \cdot m^2$)	3.13	2.89	3.01
$MLRPUA_{avg,DOI}$ ($g/s \cdot m^2$)	4.17	3.98	4.07
$HRRPUA_{peak}$ (kW/m^2)	154.15	189.11	171.63
$HRRPUA_{avg,60}$ (kW/m^2)	85.32	37.62	61.47
$HRRPUA_{avg,180}$ (kW/m^2)	111.41	103.99	107.7
$HRRPUA_{avg,300}$ (kW/m^2)	87.77	84.18	85.98
$HRRPUA_{avg,EOT}$ (kW/m^2)	66.74	63.73	65.23
$HRRPUA_{avg,DOI}$ (kW/m^2)	88.09	84.48	86.28
$THRPUA_{EOT}$ (MJ/m^2)	30.62	29.24	29.93
$THRPUA_{DOI}$ (MJ/m^2)	26.32	25.24	25.78
$EHC_{avg,EOT}$ (kJ/g)	21.31	22.09	21.7
$EHC_{avg,DOI}$ (kJ/g)	21.07	21.24	21.16
$SEA_{avg,EOT}$ (m^2/kg)	2193.67	3292.77	2743.22
$SEA_{avg,DOI}$ (m^2/kg)	1973.81	2516.49	2245.15

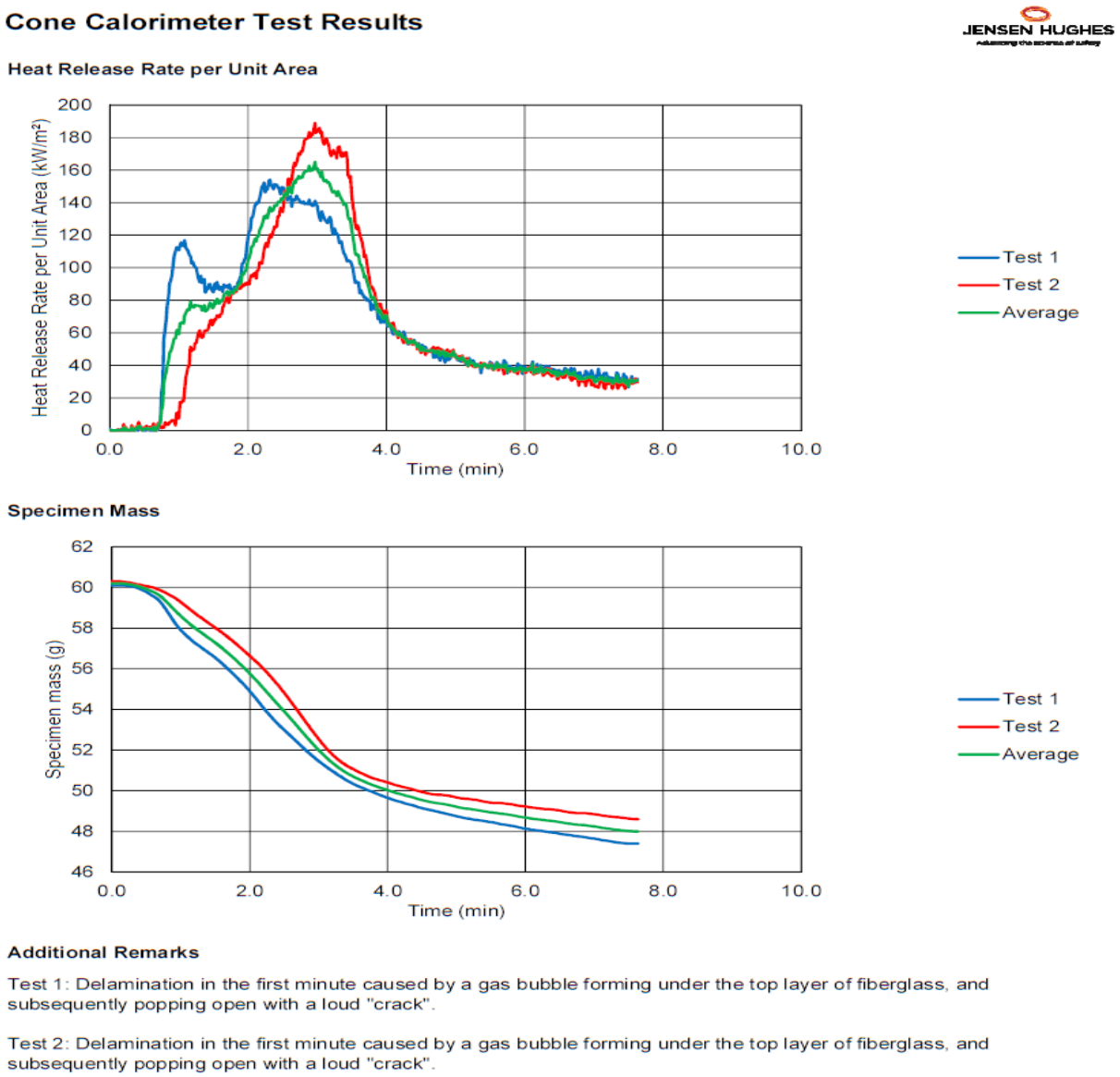


Figure B 1. Seven Different Materials Representative of Commonly Used in Passenger Railcars

B.3 Radiant Panel Test Results

Radiant panel tests were conducted in accordance with test standard ASTM E162 at external laboratories that routinely perform this testing. All the radiant panel test results are provided in this section.

COMMERCIAL TESTING COMPANY
1215 South Hamilton Street · Dalton, Georgia 30720
Telephone (706) 278–3935 · Facsimile (706) 278–3936

Standard Method of Test for
Surface Flammability of Materials
Using a Radiant Heat Energy Source

ASTM E162–16

Sample 1

Report Number 17–12277

Test Number 5157–6414
December 20, 2017

Jensen Hughes
Baltimore, Maryland

Commercial Testing Company

Deviane Jackson

(Authorized Signature)

INTRODUCTION

This report is a presentation of test results on a material submitted by Jensen Hughes, Baltimore, Maryland. The test was conducted in accordance with the ASTM International fire-test response-standard E162–16, *Surface Flammability of Materials Using a Radiant Heat Energy Source*. The method provides a laboratory procedure for measuring and comparing surface flammability of materials when exposed to a prescribed level of radiant heat energy. It is intended for research and development only and should not be used as a basis of ratings for building codes. ASTM E162 is an American National Standard (ANSI) and has been approved for use by agencies of the Department of Defense.

This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of materials, products, or assemblies under actual fire conditions.

No consideration is made for results that may be obtained if the material being evaluated were tested in combination with other materials.

PURPOSE

Surface flammability is measured using a vertically mounted propane gas and air fueled radiant heat energy source and a 6-inch by 18-inch test specimen. The specimen orientation is at an inverted angle of 30° to the vertical surface of the radiant panel with ignition forced near its upper edge and the flame progressing downward. A pilot burner, fueled with an acetylene–air mixture, impinges on the specimen near its top edge and provides ignition. A factor derived from the rate of progress of the flame front, and another derived from the rate of heat liberated by the material being tested, are combined to provide the final test result, the Radian Panel Index.

TEST PROCEDURE

A minimum of four specimens with a maximum thickness of one inch is pre–conditioned for 24 hours in a circulating air oven maintained at 60°C. The dry specimens are then conditioned to equilibrium in an atmosphere with the temperature maintained between 21 and 23°C and the relative humidity at 50 ± 5 percent. The conditioned specimens are wrapped with aluminum foil with only the face exposed, placed in a specimen holder, and backed with 13 mm thick inorganic millboard. When necessary, a 25 mm hexagonal wire mesh is placed across the face of the mounted specimens to maintain their integrity during testing.

The radiant heat energy panel is ignited and allowed to preheat at least 1.5 hours prior to of testing. Stack temperature measurements in the range of 180 to 230°C indicate proper operating conditions. The thermal output of the radiant panel is verified to be within the specified operating range of 670 ± 4°C by measurements made on a 250 mm diameter area in the center of the panel using a Honeywell radiation pyrometer. Periodic calibration using a special burner fueled with methane gas provides data (ß factor) necessary for calculation of the final test result. The pilot burner is adjusted to give a flame approximately two to three inches in length. The prepared specimen is placed on the supporting framework in front of the panel and the timer started simultaneously. The time that the flame front on the surface of the specimen arrives at each 76 mm mark, and the maximum temperature rise measured in the exhaust stack thermopile, are recorded during a 15–minute test exposure.

CALCULATIONS

Test results are calculated and expressed as the Radiant Panel Index, *Is*. The Radiant Panel Index is the product of the Flame Spread Factor, *Fs*,, a factor derived from the rate of progress of the flame front, and the Heat Evolution Factor, *Q*, a factor relating to the rate of heat liberation by the material. The Flame Spread Factor is calculated as:

$$F_s = 1 + \frac{1}{t_3 - t_0} + \frac{1}{t_6 - t_3} + \frac{1}{t_9 - t_6} + \frac{1}{t_{12} - t_9} + \frac{1}{t_{15} - t_{12}}$$

Where:

F_s = flame spread factor
t_x = time until arrival of the flame at the 76 mm distance marks

If there are any segments of the curve where the slope increases, the increase is eliminated by segmenting the curve from the previous to the succeeding point, thus becoming a "skip point." These points are treated in the formula *Fs* by dropping the terms involving single curve points and replacing them with the single term $K/(Tf - Tb)$ where *K* is an integer related to the number of skip points, *Tf* is the time at the first curve point after the skip, and *Tb* is the time at the last curve point before a skip point.

The Radiant Panel Index is calculated as $Is = FsQ$ and the Heat Evolution Factor as $Q = CT/ß$ where:

- C = arbitrary constant 5.7
- T = observed maximum stack temperature rise in °C between the specimen and that for a similar curve of fiber-reinforced cement board
- $ß$ = mean stack temperature rise for unit heat input rate in °C/kW, a constant for a particular test instrument

Only sustained flame fronts, i.e., when a flame front advances from the igniting burner to the first 3-inch or subsequent marks at a rate that so that at least 3 seconds have passed since it reached the mark, are taken into account for calculating the Flame Spread Factor, *Fs*. Flashing, i.e., a flame front with a duration of 3 seconds or less, shall be reported but not used for calculation of the Flame Spread Factor, *Fs*. If flashing occurs, the fact shall be mentioned in parentheses following the Radiant Panel Index, *Is*, and reported in the form, for example, *Is* = 100 [Flashing (F)].

MATERIAL TESTED

Identification: Sample 1
Type Material: Thermoplastic Sheet
Nominal Thickness: 1.5mm
Color: White

TEST DATA

Specimen	1	2	3	4
Flame Spread Factor, *Fs*	1.31	1.32	1.19	1.37
Temperature Rise, °C	10.0	16.7	13.9	12.2
Heat Evolution Factor, *Q*	1.69	2.82	2.35	2.07
Flaming Drippings Time	None	None	None	None
Test Duration, m:s	15:00	15:00	15:00	15:00
Radiant Panel Index, *Is*	2.22	3.72	2.80	2.84

TEST RESULT

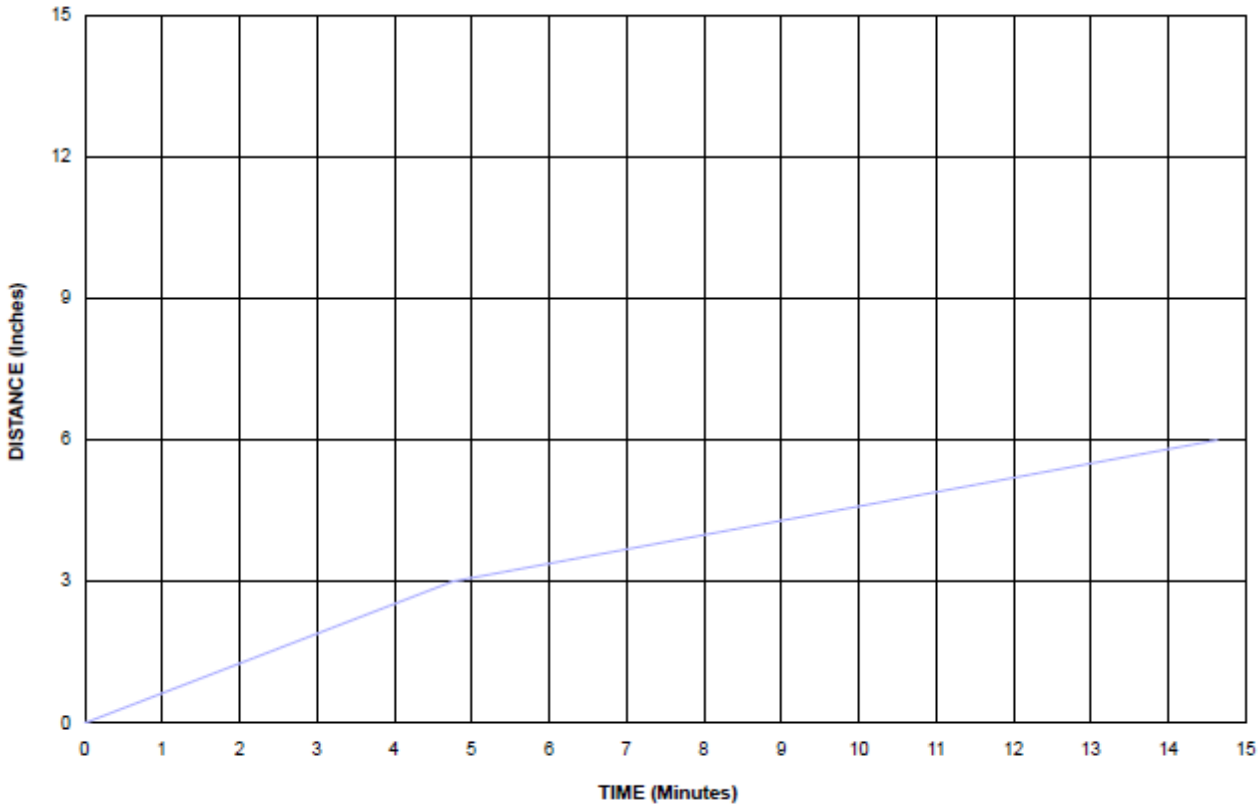
The test result, the average *Is*, is rounded to the nearest multiple of five as required by Section 12.1 of the Standard. Graphic presentation of individual test data is included at the end of this report.

Specimen	1	2	3	4	Average
Radiant Panel Index, *Is*	2.22	3.72	2.80	2.84	5

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6414
Date: December 20, 2017
Specimen Number: 1

Flame Spread Factor, Fs: 1.31
Temperature Rise, °C: 10.0
Heat Evolution Factor, Q: 1.69
Radiant Panel Index, Is: 2.22

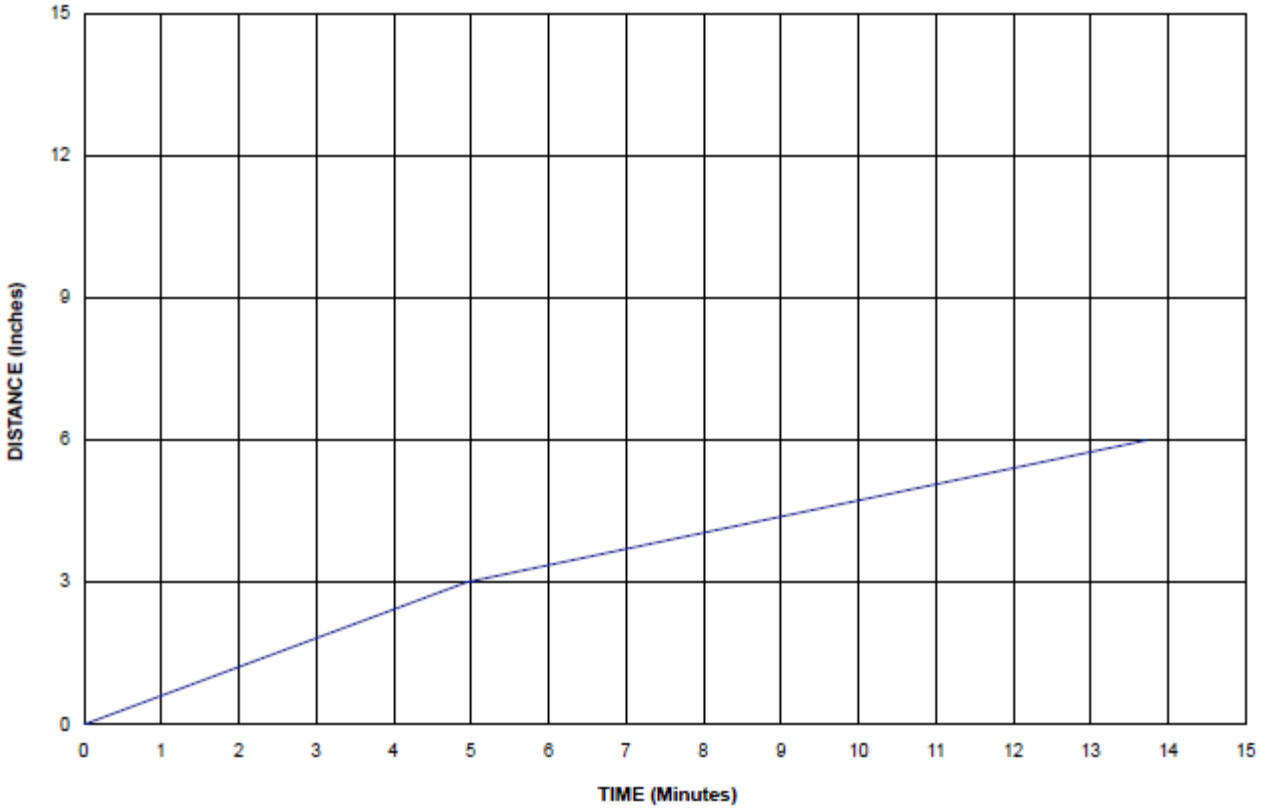


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6414
Date: December 20, 2017
Specimen Number: 2

Flame Spread Factor, Fs: 1.32
Temperature Rise, °C: 16.7
Heat Evolution Factor, Q: 2.82
Radiant Panel Index, Is: 3.72

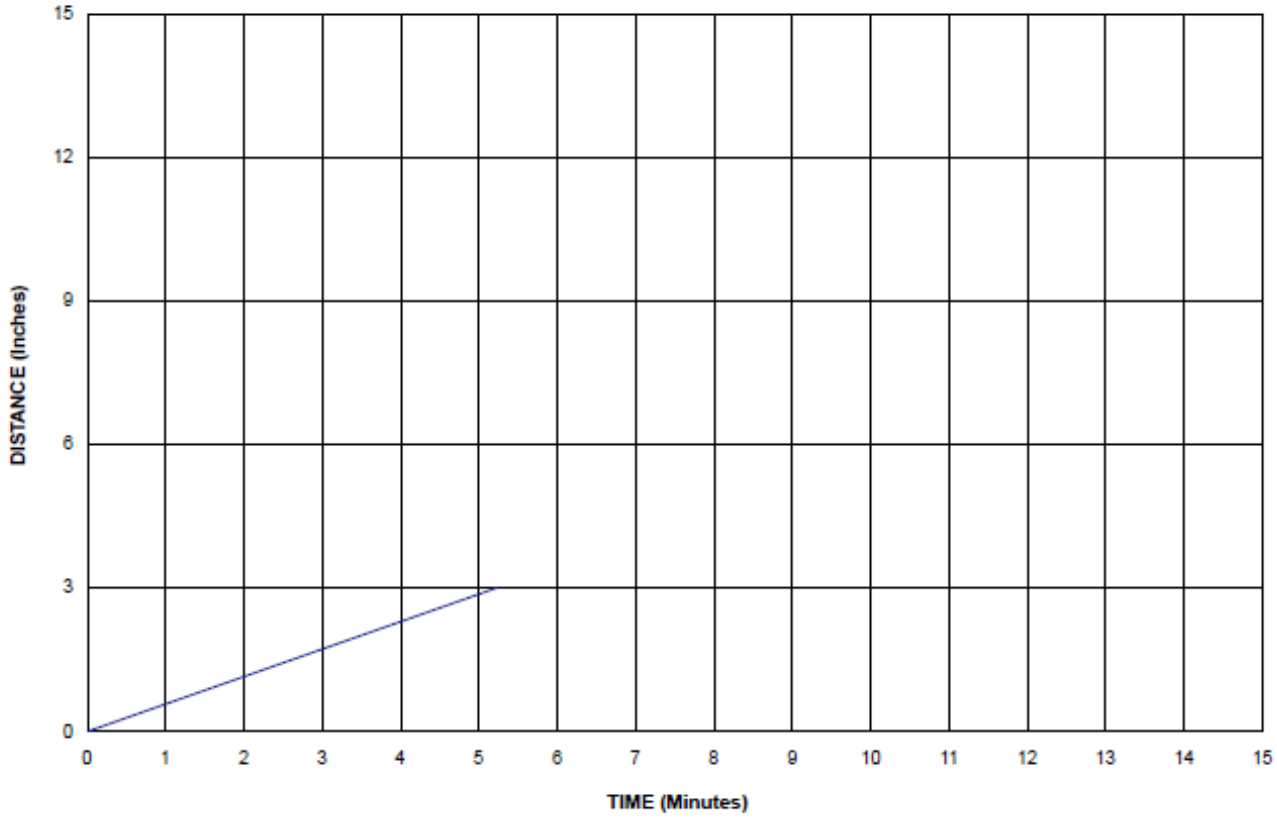


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6414
Date: December 20, 2017
Specimen Number: 3

Flame Spread Factor, Fs: 1.19
Temperature Rise, °C: 13.9
Heat Evolution Factor, Q: 2.35
Radiant Panel Index, Is: 2.80

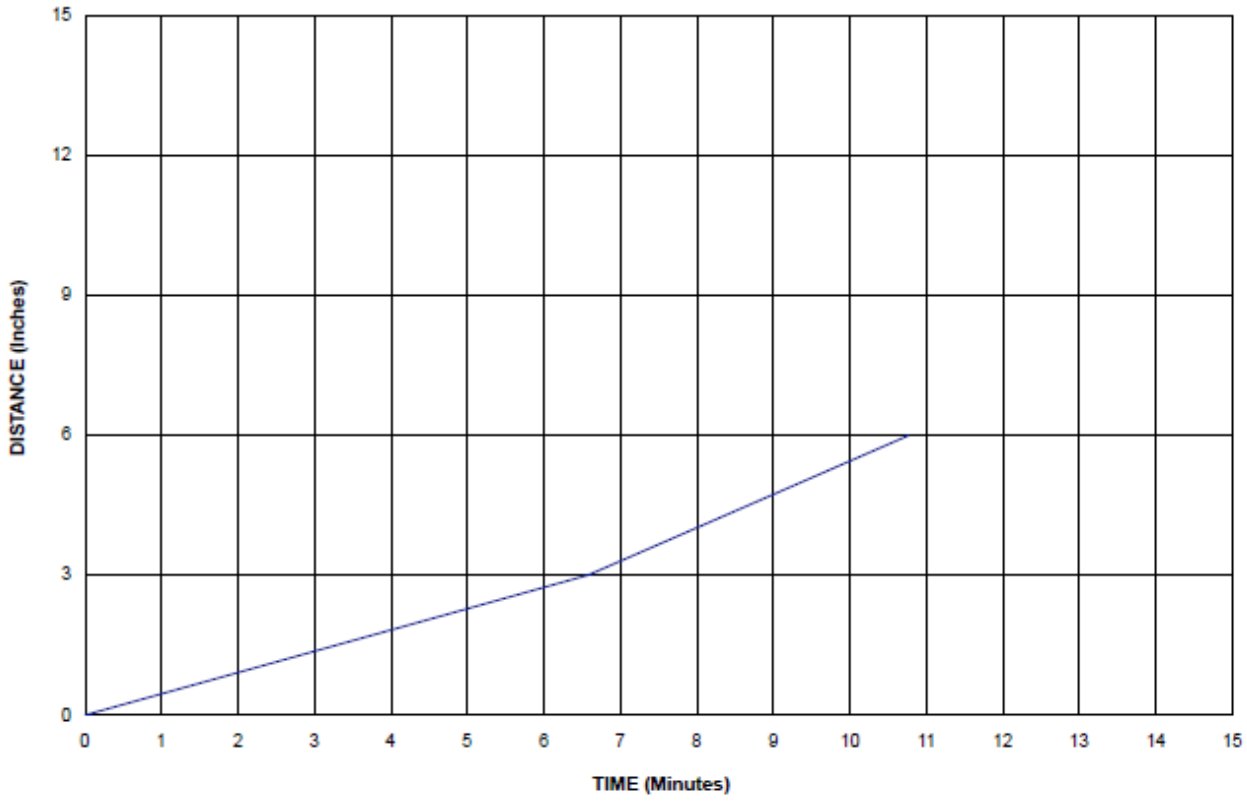


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6414
Date: December 20, 2017
Specimen Number: 4

Flame Spread Factor, Fs: 1.37
Temperature Rise, °C: 12.2
Heat Evolution Factor, Q: 2.07
Radiant Panel Index, Is: 2.84



Skip Points Location: 3 inches

COMMERCIAL TESTING COMPANY
1215 South Hamilton Street · Dalton, Georgia 30720
Telephone (706) 278–3935 · Facsimile (706) 278–3936

Standard Method of Test for
Surface Flammability of Materials
Using a Radiant Heat Energy Source

ASTM E162–16

Sample 2 - 9.8mm Panel

Report Number 17–12276

Test Number 5154–6353
December 15, 2017

Jensen Hughes
Baltimore, Maryland

Commercial Testing Company

Deviane Jackson

(Authorized Signature)

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Since 1974

INTRODUCTION

This report is a presentation of test results on a material submitted by Jensen Hughes, Baltimore, Maryland. The test was conducted in accordance with the ASTM International fire-test response-standard E162–16, *Surface Flammability of Materials Using a Radiant Heat Energy Source*. The method provides a laboratory procedure for measuring and comparing surface flammability of materials when exposed to a prescribed level of radiant heat energy. It is intended for research and development only and should not be used as a basis of ratings for building codes. ASTM E162 is an American National Standard (ANSI) and has been approved for use by agencies of the Department of Defense.

This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of materials, products, or assemblies under actual fire conditions.

No consideration is made for results that may be obtained if the material being evaluated were tested in combination with other materials.

PURPOSE

Surface flammability is measured using a vertically mounted propane gas and air fueled radiant heat energy source and a 6-inch by 18-inch test specimen. The specimen orientation is at an inverted angle of 30° to the vertical surface of the radiant panel with ignition forced near its upper edge and the flame progressing downward. A pilot burner, fueled with an acetylene–air mixture, impinges on the specimen near its top edge and provides ignition. A factor derived from the rate of progress of the flame front, and another derived from the rate of heat liberated by the material being tested, are combined to provide the final test result, the Radian Panel Index.

TEST PROCEDURE

A minimum of four specimens with a maximum thickness of one inch is pre–conditioned for 24 hours in a circulating air oven maintained at 60°C. The dry specimens are then conditioned to equilibrium in an atmosphere with the temperature maintained between 21 and 23°C and the relative humidity at 50 ± 5 percent. The conditioned specimens are wrapped with aluminum foil with only the face exposed, placed in a specimen holder, and backed with 13 mm thick inorganic millboard. When necessary, a 25 mm hexagonal wire mesh is placed across the face of the mounted specimens to maintain their integrity during testing.

The radiant heat energy panel is ignited and allowed to preheat at least 1.5 hours prior to of testing. Stack temperature measurements in the range of 180 to 230°C indicate proper operating conditions. The thermal output of the radiant panel is verified to be within the specified operating range of 670 ± 4°C by measurements made on a 250 mm diameter area in the center of the panel using a Honeywell radiation pyrometer. Periodic calibration using a special burner fueled with methane gas provides data (β factor) necessary for calculation of the final test result. The pilot burner is adjusted to give a flame approximately two to three inches in length. The prepared specimen is placed on the supporting framework in front of the panel and the timer started simultaneously. The time that the flame front on the surface of the specimen arrives at each 76 mm mark, and the maximum temperature rise measured in the exhaust stack thermopile, are recorded during a 15–minute test exposure.

CALCULATIONS

Test results are calculated and expressed as the Radiant Panel Index, *Is*. The Radiant Panel Index is the product of the Flame Spread Factor, *Fs*,, a factor derived from the rate of progress of the flame front, and the Heat Evolution Factor, *Q*, a factor relating to the rate of heat liberation by the material. The Flame Spread Factor is calculated as:

$$F_s = 1 + \frac{1}{t_3 - t_0} + \frac{1}{t_6 - t_3} + \frac{1}{t_9 - t_6} + \frac{1}{t_{12} - t_9} + \frac{1}{t_{15} - t_{12}}$$

Where:

F_s = flame spread factor
t_x = time until arrival of the flame at the 76 mm distance marks

If there are any segments of the curve where the slope increases, the increase is eliminated by segmenting the curve from the previous to the succeeding point, thus becoming a "skip point." These points are treated in the formula *Fs* by dropping the terms involving single curve points and replacing them with the single term $K/(Tf - Tb)$ where *K* is an integer related to the number of skip points, *Tf* is the time at the first curve point after the skip, and *Tb* is the time at the last curve point before a skip point.

The Radiant Panel Index is calculated as $Is = FsQ$ and the Heat Evolution Factor as $Q = CT/ß$ where:

C = arbitrary constant 5.7
T = observed maximum stack temperature rise in °C between the specimen and that for a similar curve of fiber-reinforced cement board
ß = mean stack temperature rise for unit heat input rate in °C/kW, a constant for a particular test instrument

Only sustained flame fronts, i.e., when a flame front advances from the igniting burner to the first 3-inch or subsequent marks at a rate that so that at least 3 seconds have passed since it reached the mark, are taken into account for calculating the Flame Spread Factor, *Fs*. Flashing, i.e., a flame front with a duration of 3 seconds or less, shall be reported but not used for calculation of the Flame Spread Factor, *Fs*. If flashing occurs, the fact shall be mentioned in parentheses following the Radiant Panel Index, *Is*, and reported in the form, for example, *Is* = 100 [Flashing (F)].

MATERIAL TESTED

Identification: Sample 2 - 9.8mm Panel
Type Material: Aluminum/Plywood
Color: Mottled Brown

TEST DATA

Specimen	1	2	3	4
Flame Spread Factor, *Fs*	2.01	1.44	1.75	1.82
Temperature Rise, °C	38.9	16.1	81.1	82.8
Heat Evolution Factor, *Q*	6.59	2.73	13.75	14.03
Flaming Drippings Time	None	None	None	None
Test Duration, m:s	15:00	15:00	15:00	15:00
Radiant Panel Index, *Is*	13.22	3.92 (F)	24.12	25.51

TEST RESULT

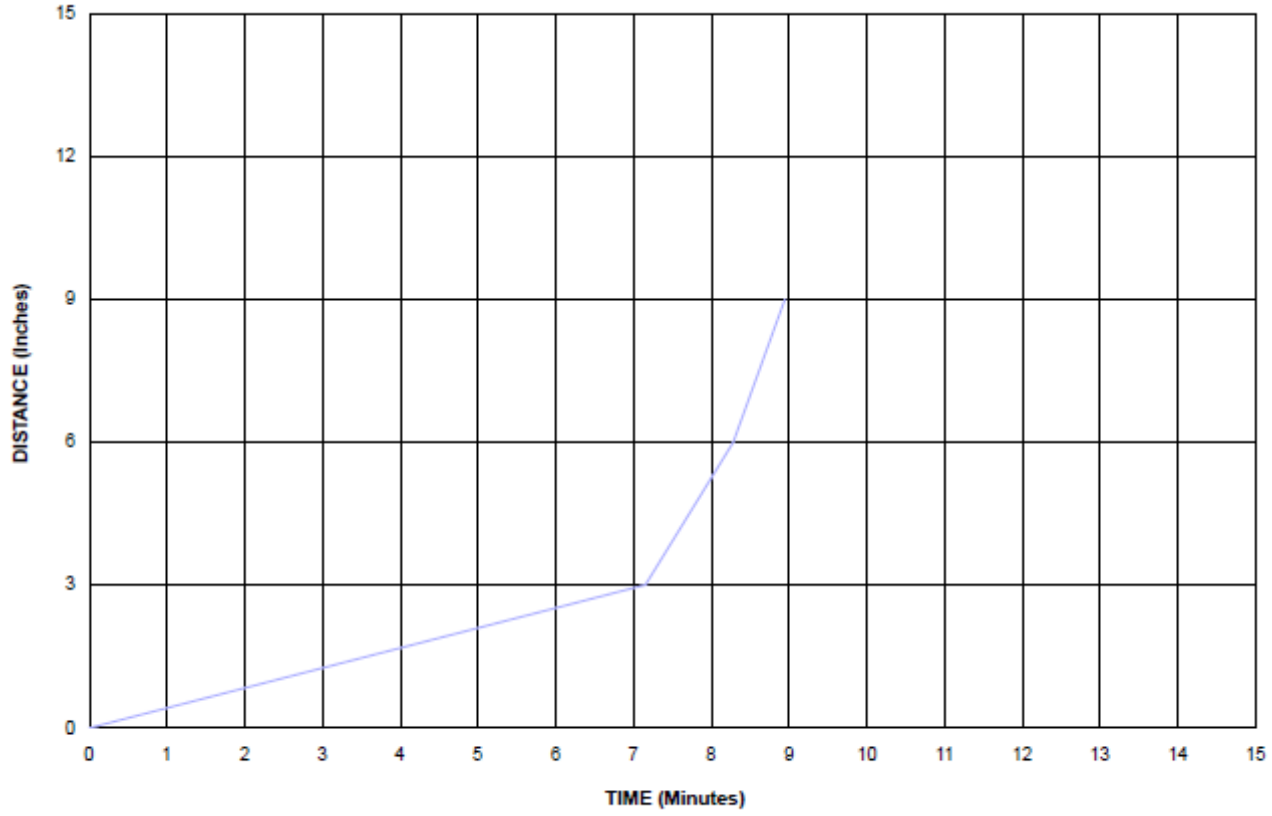
The test result, the average *Is*, is rounded to the nearest multiple of five as required by Section 12.1 of the Standard. Graphic presentation of individual test data is included at the end of this report.

Specimen	1	2	3	4	Average
Radiant Panel Index, *Is*	13.22	3.92	24.12	25.51	**15 (Flashing)**

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6353
Date: December 15, 2017
Specimen Number: 1

Flame Spread Factor, Fs: 2.01
Temperature Rise, °C: 38.9
Heat Evolution Factor, Q: 6.59
Radiant Panel Index, Is: 13.22

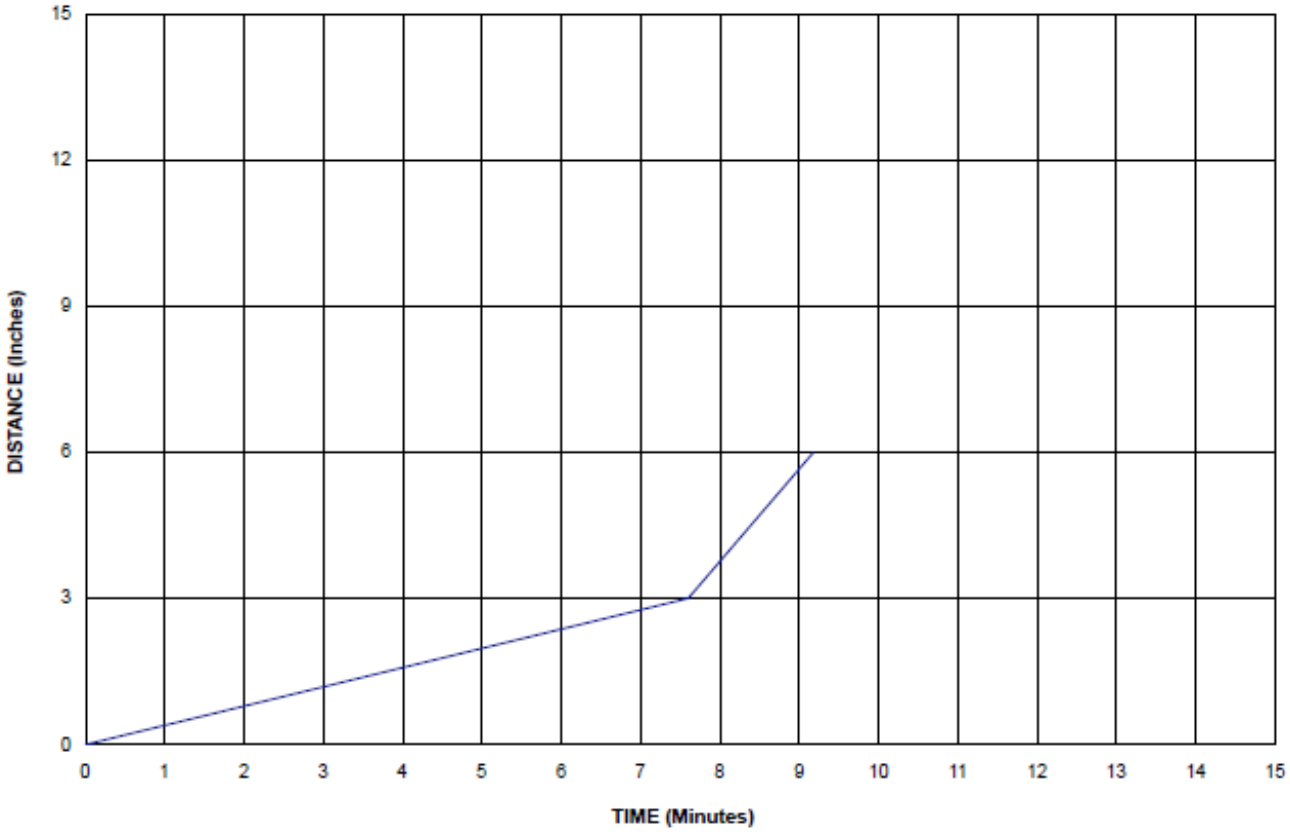


Skip Points Location: 3, 6 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6353
Date: December 15, 2017
Specimen Number: 2

Flame Spread Factor, Fs: 1.44
Temperature Rise, °C: 16.1
Heat Evolution Factor, Q: 2.73
Radiant Panel Index, Is: 3.9 (Flashing to 9")

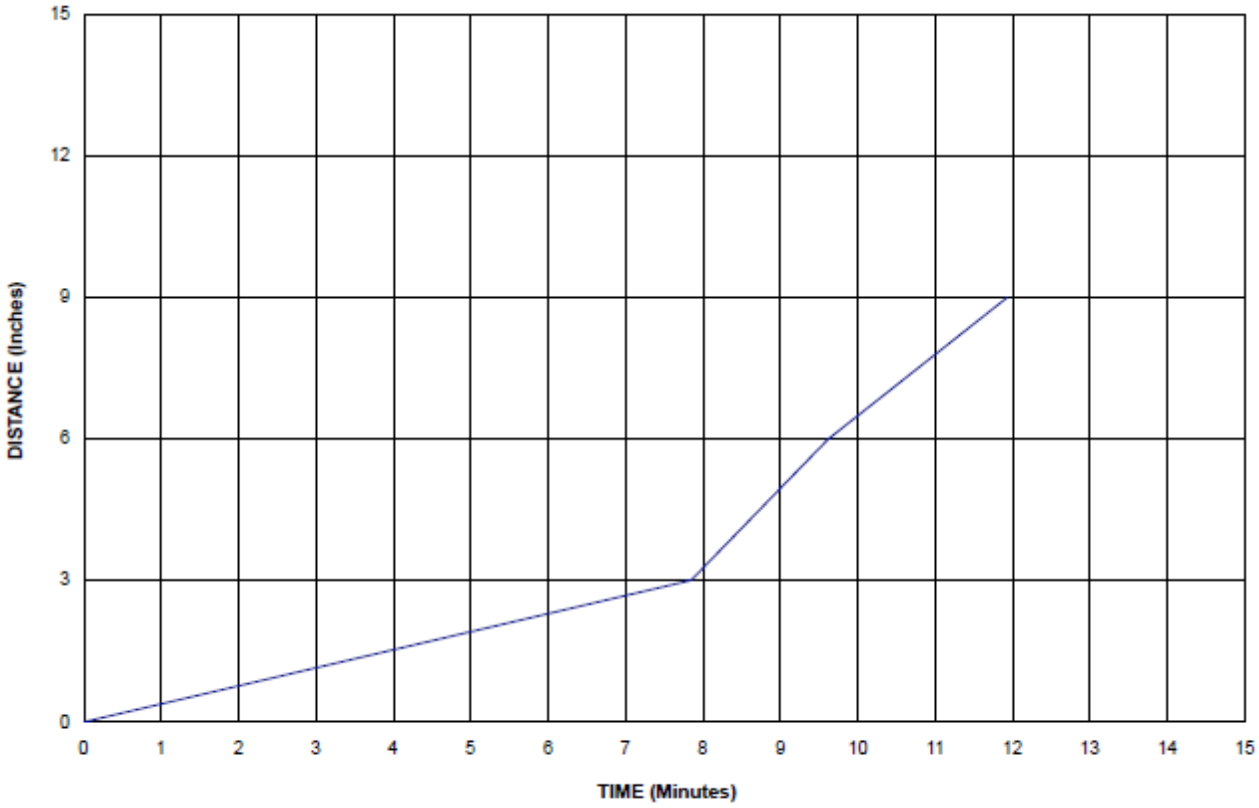


Skip Points Location: 3 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6353
Date: December 15, 2017
Specimen Number: 3

Flame Spread Factor, Fs: 1.75
Temperature Rise, °C: 81.1
Heat Evolution Factor, Q: 13.75
Radiant Panel Index, Is: 24.12

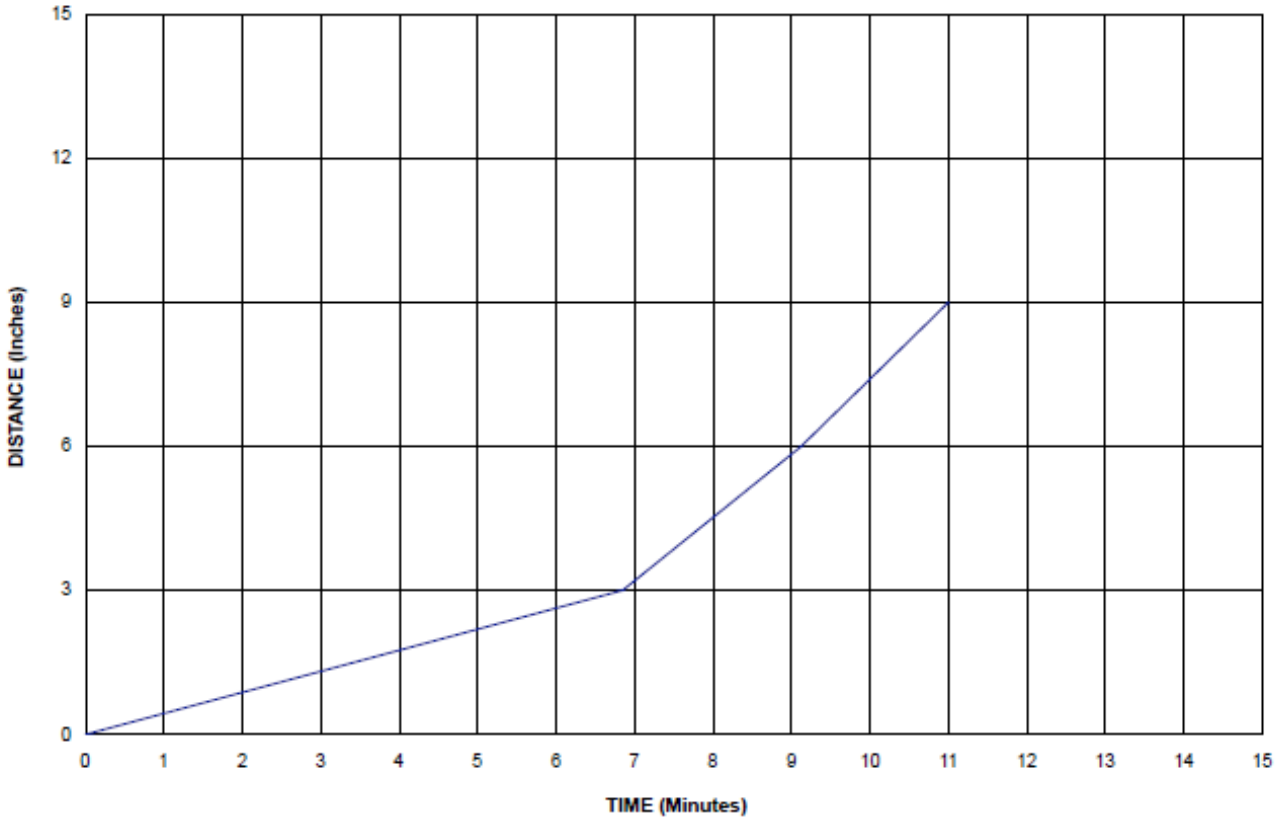


Skip Points Location: 3, 6 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6353
Date: December 15, 2017
Specimen Number: 4

Flame Spread Factor, Fs: 1.82
Temperature Rise, °C: 82.8
Heat Evolution Factor, Q: 14.03
Radiant Panel Index, Is: 25.51



Skip Points Location: 3, 6 inches

COMMERCIAL TESTING COMPANY
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Telephone (706) 278–3935 · Facsimile (706) 278–3936

Standard Method of Test for
Surface Flammability of Materials
Using a Radiant Heat Energy Source

ASTM E162–16

Sample 3 - 16.5mm Panel

Report Number 17–12275

Test Number 5154–6351
December 18, 2017

Jensen Hughes
Baltimore, Maryland

Commercial Testing Company

Deviane Jackson

(Authorized Signature)

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INTRODUCTION

This report is a presentation of test results on a material submitted by Jensen Hughes, Baltimore, Maryland. The test was conducted in accordance with the ASTM International fire-test response-standard E162–16, *Surface Flammability of Materials Using a Radiant Heat Energy Source*. The method provides a laboratory procedure for measuring and comparing surface flammability of materials when exposed to a prescribed level of radiant heat energy. It is intended for research and development only and should not be used as a basis of ratings for building codes. ASTM E162 is an American National Standard (ANSI) and has been approved for use by agencies of the Department of Defense.

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No consideration is made for results that may be obtained if the material being evaluated were tested in combination with other materials.

PURPOSE

Surface flammability is measured using a vertically mounted propane gas and air fueled radiant heat energy source and a 6-inch by 18-inch test specimen. The specimen orientation is at an inverted angle of 30° to the vertical surface of the radiant panel with ignition forced near its upper edge and the flame progressing downward. A pilot burner, fueled with an acetylene–air mixture, impinges on the specimen near its top edge and provides ignition. A factor derived from the rate of progress of the flame front, and another derived from the rate of heat liberated by the material being tested, are combined to provide the final test result, the Radian Panel Index.

TEST PROCEDURE

A minimum of four specimens with a maximum thickness of one inch is pre–conditioned for 24 hours in a circulating air oven maintained at 60°C. The dry specimens are then conditioned to equilibrium in an atmosphere with the temperature maintained between 21 and 23°C and the relative humidity at 50 ± 5 percent. The conditioned specimens are wrapped with aluminum foil with only the face exposed, placed in a specimen holder, and backed with 13 mm thick inorganic millboard. When necessary, a 25 mm hexagonal wire mesh is placed across the face of the mounted specimens to maintain their integrity during testing.

The radiant heat energy panel is ignited and allowed to preheat at least 1.5 hours prior to of testing. Stack temperature measurements in the range of 180 to 230°C indicate proper operating conditions. The thermal output of the radiant panel is verified to be within the specified operating range of 670 ± 4°C by measurements made on a 250 mm diameter area in the center of the panel using a Honeywell radiation pyrometer. Periodic calibration using a special burner fueled with methane gas provides data (ß factor) necessary for calculation of the final test result. The pilot burner is adjusted to give a flame approximately two to three inches in length. The prepared specimen is placed on the supporting framework in front of the panel and the timer started simultaneously. The time that the flame front on the surface of the specimen arrives at each 76 mm mark, and the maximum temperature rise measured in the exhaust stack thermopile, are recorded during a 15–minute test exposure.

CALCULATIONS

Test results are calculated and expressed as the Radiant Panel Index, *Is*. The Radiant Panel Index is the product of the Flame Spread Factor, *Fs*,, a factor derived from the rate of progress of the flame front, and the Heat Evolution Factor, *Q*, a factor relating to the rate of heat liberation by the material. The Flame Spread Factor is calculated as:

$$F_s = 1 + \frac{1}{t_3 - t_0} + \frac{1}{t_6 - t_3} + \frac{1}{t_9 - t_6} + \frac{1}{t_{12} - t_9} + \frac{1}{t_{15} - t_{12}}$$

Where:

F_s = flame spread factor
t_x = time until arrival of the flame at the 76 mm distance marks

If there are any segments of the curve where the slope increases, the increase is eliminated by segmenting the curve from the previous to the succeeding point, thus becoming a "skip point." These points are treated in the formula *Fs* by dropping the terms involving single curve points and replacing them with the single term $K/(Tf - Tb)$ where *K* is an integer related to the number of skip points, *Tf* is the time at the first curve point after the skip, and *Tb* is the time at the last curve point before a skip point.

The Radiant Panel Index is calculated as $Is = FsQ$ and the Heat Evolution Factor as $Q = CT/ß$ where:

C = arbitrary constant 5.7
T = observed maximum stack temperature rise in °C between the specimen and that for a similar curve of fiber-reinforced cement board
ß = mean stack temperature rise for unit heat input rate in °C/kW, a constant for a particular test instrument

Only sustained flame fronts, i.e., when a flame front advances from the igniting burner to the first 3-inch or subsequent marks at a rate that so that at least 3 seconds have passed since it reached the mark, are taken into account for calculating the Flame Spread Factor, *Fs*. Flashing, i.e., a flame front with a duration of 3 seconds or less, shall be reported but not used for calculation of the Flame Spread Factor, *Fs*. If flashing occurs, the fact shall be mentioned in parentheses following the Radiant Panel Index, *Is*, and reported in the form, for example, *Is* = 100 [Flashing (F)].

MATERIAL TESTED

Identification: Sample 3 - 16.5mm Panel
Type Material: Aluminum/Balsa
Color: Mottled Grey

TEST DATA

Specimen	1	2	3	4
Flame Spread Factor, *Fs*	1.35	1.35	1.59	1.75
Temperature Rise, °C	29.4	36.7	29.4	19.4
Heat Evolution Factor, *Q*	4.99	6.21	4.99	3.30
Flaming Drippings Time	None	None	None	None
Test Duration, m:s	15:00	15:00	15:00	15:00
Radiant Panel Index, *Is*	6.74 (F)	8.40 (F)	7.92 (F)	5.76 (F)

TEST RESULT

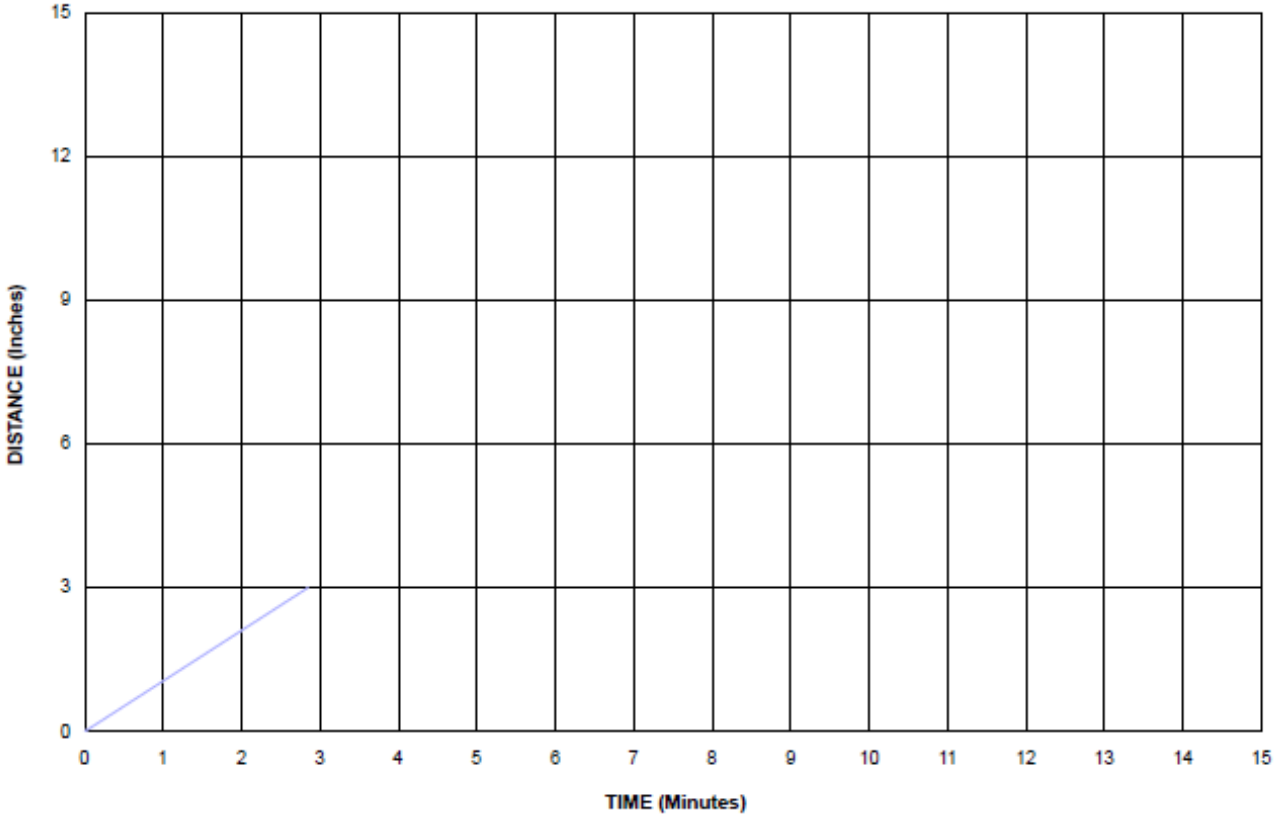
The test result, the average *Is*, is rounded to the nearest multiple of five as required by Section 12.1 of the Standard. Graphic presentation of individual test data is included at the end of this report.

Specimen	1	2	3	4	Average
Radiant Panel Index, *Is*	6.74	8.40	7.92	5.76	**5 (Flashing)**

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6351
Date: December 18, 2017
Specimen Number: 1

Flame Spread Factor, Fs: 1.35
Temperature Rise, °C: 29.4
Heat Evolution Factor, Q: 4.99
Radiant Panel Index, Is: 6.74 (Flashing to 6")

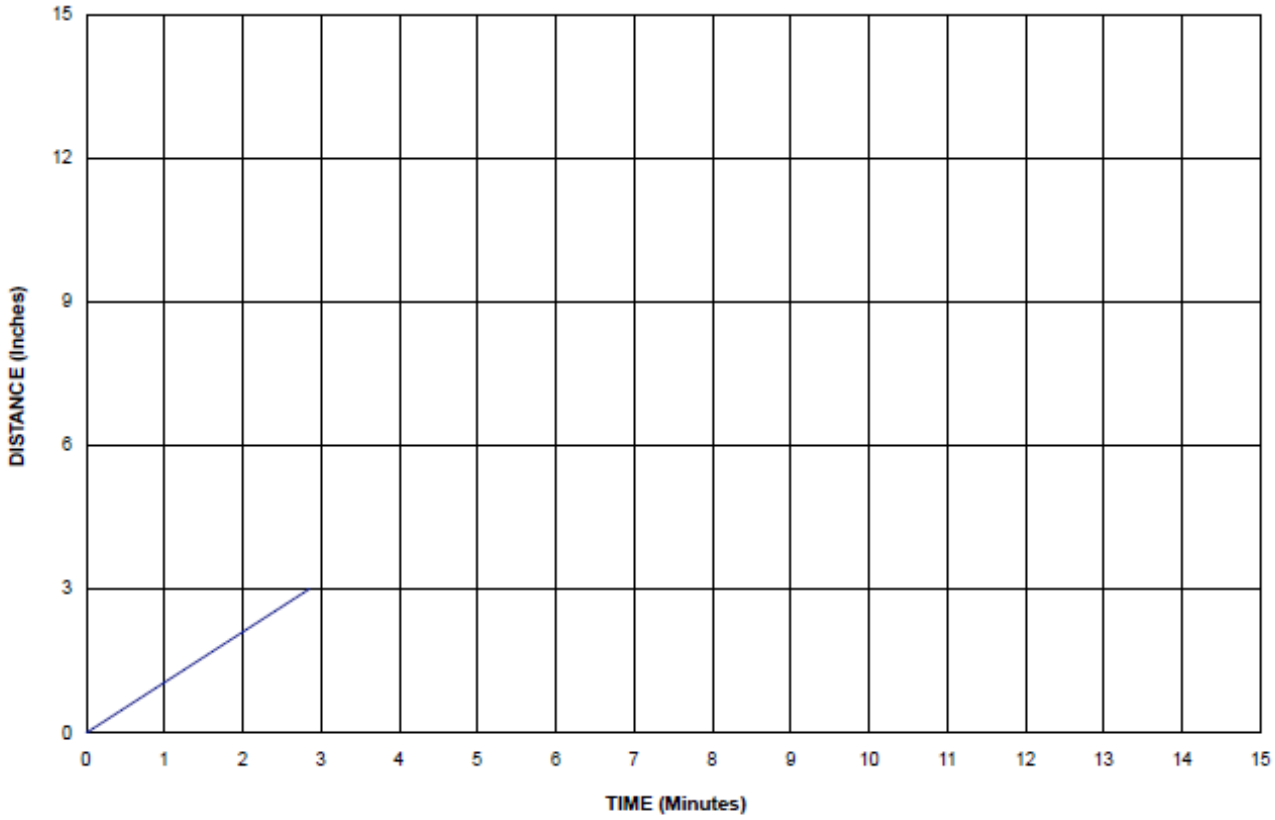


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6351
Date: December 18, 2017
Specimen Number: 2

Flame Spread Factor, Fs: 1.35
Temperature Rise, °C: 36.7
Heat Evolution Factor, Q: 6.21
Radiant Panel Index, Is: 8.4 (F)

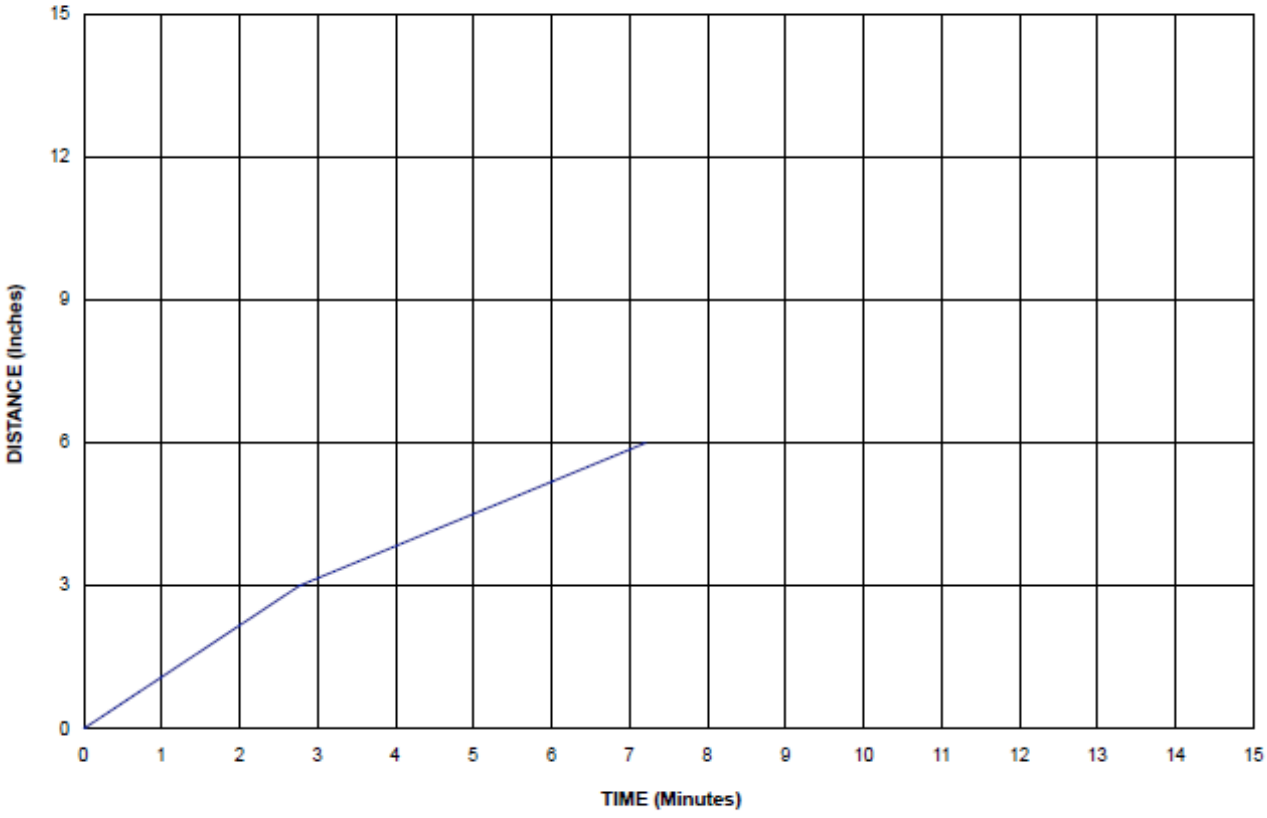


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6351
Date: December 18, 2017
Specimen Number: 3

Flame Spread Factor, Fs: 1.59
Temperature Rise, °C: 29.4
Heat Evolution Factor, Q: 4.99
Radiant Panel Index, Is: 7.92 (F)

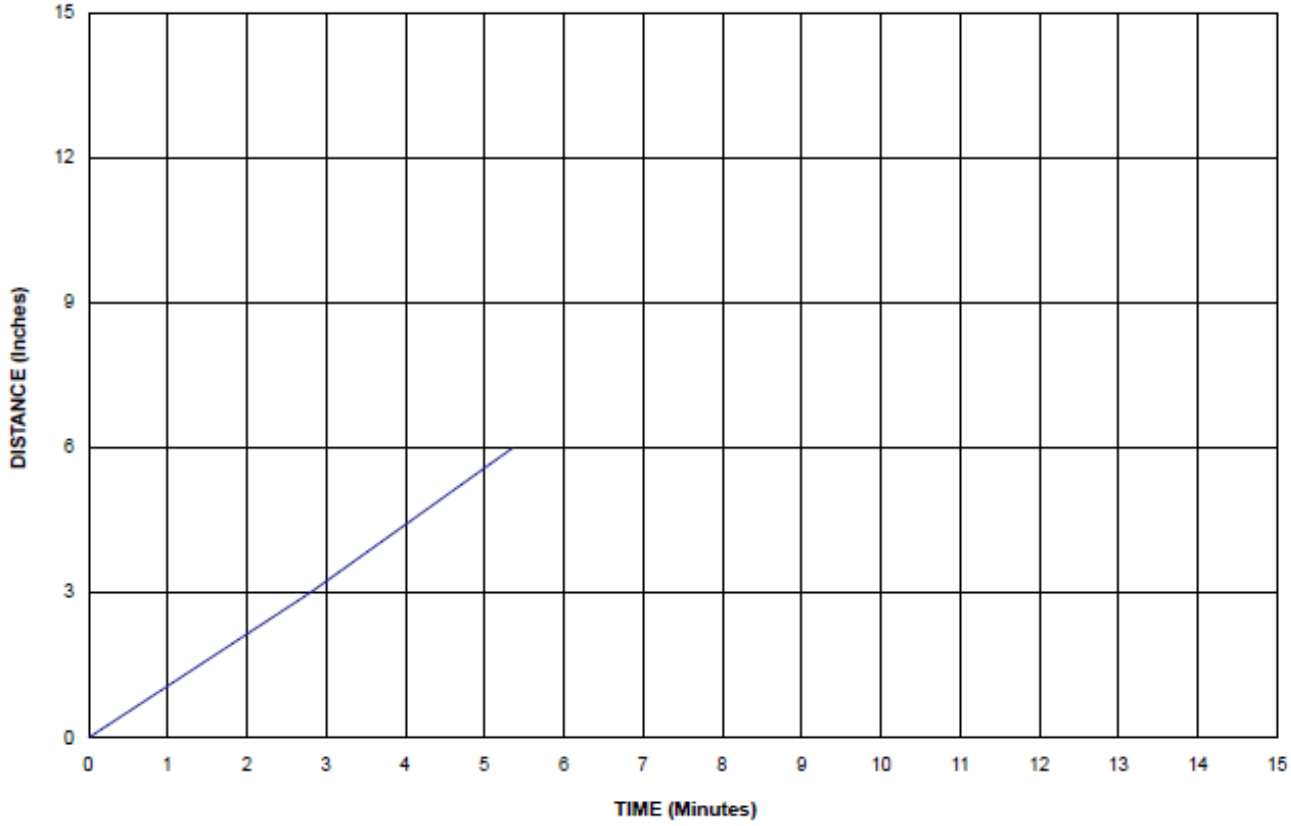


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6351
Date: December 18, 2017
Specimen Number: 4

Flame Spread Factor, Fs: 1.75
Temperature Rise, °C: 19.4
Heat Evolution Factor, Q: 3.30
Radiant Panel Index, Is: 5.76 (F)



Skip Points Location: 3 inches

COMMERCIAL TESTING COMPANY
1215 South Hamilton Street · Dalton, Georgia 30720
Telephone (706) 278–3935 · Facsimile (706) 278–3936

Standard Method of Test for
Surface Flammability of Materials
Using a Radiant Heat Energy Source

ASTM E162–16

Sample 4 - 4.9mm

Report Number 17–12280

Test Number 5154–6352
December 26, 2017

Jensen Hughes
Baltimore, Maryland

Commercial Testing Company

(Authorized Signature)

INTRODUCTION

This report is a presentation of test results on a material submitted by Jensen Hughes, Baltimore, Maryland. The test was conducted in accordance with the ASTM International fire-test response-standard E162–16, *Surface Flammability of Materials Using a Radiant Heat Energy Source*. The method provides a laboratory procedure for measuring and comparing surface flammability of materials when exposed to a prescribed level of radiant heat energy. It is intended for research and development only and should not be used as a basis of ratings for building codes. ASTM E162 is an American National Standard (ANSI) and has been approved for use by agencies of the Department of Defense.

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No consideration is made for results that may be obtained if the material being evaluated were tested in combination with other materials.

PURPOSE

Surface flammability is measured using a vertically mounted propane gas and air fueled radiant heat energy source and a 6-inch by 18-inch test specimen. The specimen orientation is at an inverted angle of 30° to the vertical surface of the radiant panel with ignition forced near its upper edge and the flame progressing downward. A pilot burner, fueled with an acetylene–air mixture, impinges on the specimen near its top edge and provides ignition. A factor derived from the rate of progress of the flame front, and another derived from the rate of heat liberated by the material being tested, are combined to provide the final test result, the Radian Panel Index.

TEST PROCEDURE

A minimum of four specimens with a maximum thickness of one inch is pre–conditioned for 24 hours in a circulating air oven maintained at 60°C. The dry specimens are then conditioned to equilibrium in an atmosphere with the temperature maintained between 21 and 23°C and the relative humidity at 50 ± 5 percent. The conditioned specimens are wrapped with aluminum foil with only the face exposed, placed in a specimen holder, and backed with 13 mm thick inorganic millboard. When necessary, a 25 mm hexagonal wire mesh is placed across the face of the mounted specimens to maintain their integrity during testing.

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CALCULATIONS

Test results are calculated and expressed as the Radiant Panel Index, *Is*. The Radiant Panel Index is the product of the Flame Spread Factor, *Fs*,, a factor derived from the rate of progress of the flame front, and the Heat Evolution Factor, *Q*, a factor relating to the rate of heat liberation by the material. The Flame Spread Factor is calculated as:

$$F_s = 1 + \frac{1}{t_3 - t_0} + \frac{1}{t_6 - t_3} + \frac{1}{t_9 - t_6} + \frac{1}{t_{12} - t_9} + \frac{1}{t_{15} - t_{12}}$$

Where:

F_s = flame spread factor
t_x = time until arrival of the flame at the 76 mm distance marks

If there are any segments of the curve where the slope increases, the increase is eliminated by segmenting the curve from the previous to the succeeding point, thus becoming a "skip point." These points are treated in the formula *Fs* by dropping the terms involving single curve points and replacing them with the single term $K/(Tf - Tb)$ where *K* is an integer related to the number of skip points, *Tf* is the time at the first curve point after the skip, and *Tb* is the time at the last curve point before a skip point.

The Radiant Panel Index is calculated as $Is = FsQ$ and the Heat Evolution Factor as $Q = CT/\beta$ where:

C = arbitrary constant 5.7
T = observed maximum stack temperature rise in °C between the specimen and that for a similar curve of fiber-reinforced cement board
β = mean stack temperature rise for unit heat input rate in °C/kW, a constant for a particular test instrument

Only sustained flame fronts, i.e., when a flame front advances from the igniting burner to the first 3-inch or subsequent marks at a rate that so that at least 3 seconds have passed since it reached the mark, are taken into account for calculating the Flame Spread Factor, *Fs*. Flashing, i.e., a flame front with a duration of 3 seconds or less, shall be reported but not used for calculation of the Flame Spread Factor, *Fs*. If flashing occurs, the fact shall be mentioned in parentheses following the Radiant Panel Index, *Is*, and reported in the form, for example, *Is* = 100 [Flashing (F)].

MATERIAL TESTED

Identification: Sample 4
Type Material: Acrylic Sheet
Color: White

TEST DATA

Specimen	1	2	3	4
Flame Spread Factor, *Fs*	4.30	4.87	4.37	4.45
Temperature Rise, °C	242.8	221.7	242.8	246.7
Heat Evolution Factor, *Q*	41.15	37.57	41.15	41.81
Flaming Drippings Time	5.48	2.95	4.88	2.95
Test Duration, m:s	15:00	15:00	15:00	15:00
Radiant Panel Index, *Is*	177.01	182.94	179.64	186.01

TEST RESULT

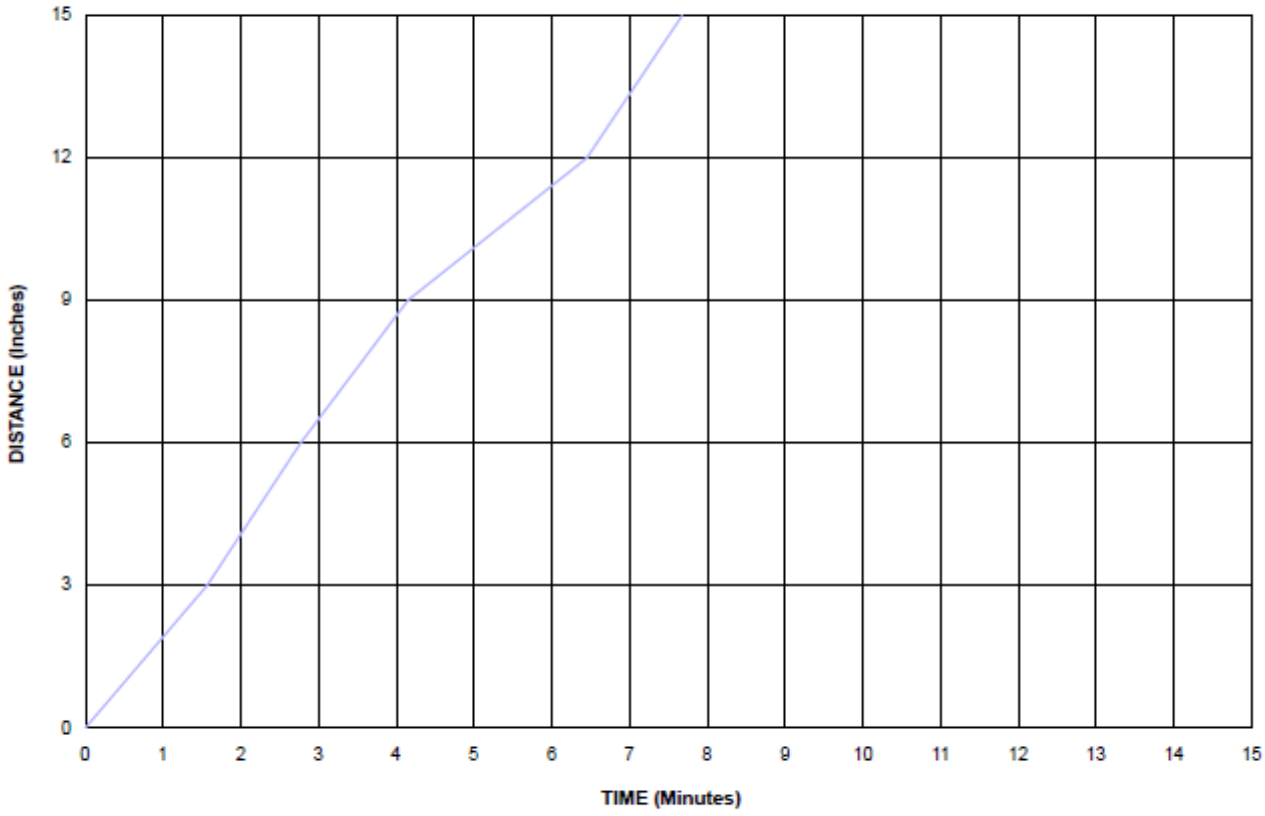
The test result, the average *Is*, is rounded to the nearest multiple of five as required by Section 12.1 of the Standard. Graphic presentation of individual test data is included at the end of this report.

Specimen	1	2	3	4	Average
Radiant Panel Index, *Is*	177.01	182.94	179.64	186.01	**180**

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6352
Date: December 26, 2017
Specimen Number: 1

Flame Spread Factor, Fs: 4.30
Temperature Rise, °C: 242.8
Heat Evolution Factor, Q: 41.15
Radiant Panel Index, Is: 177.01

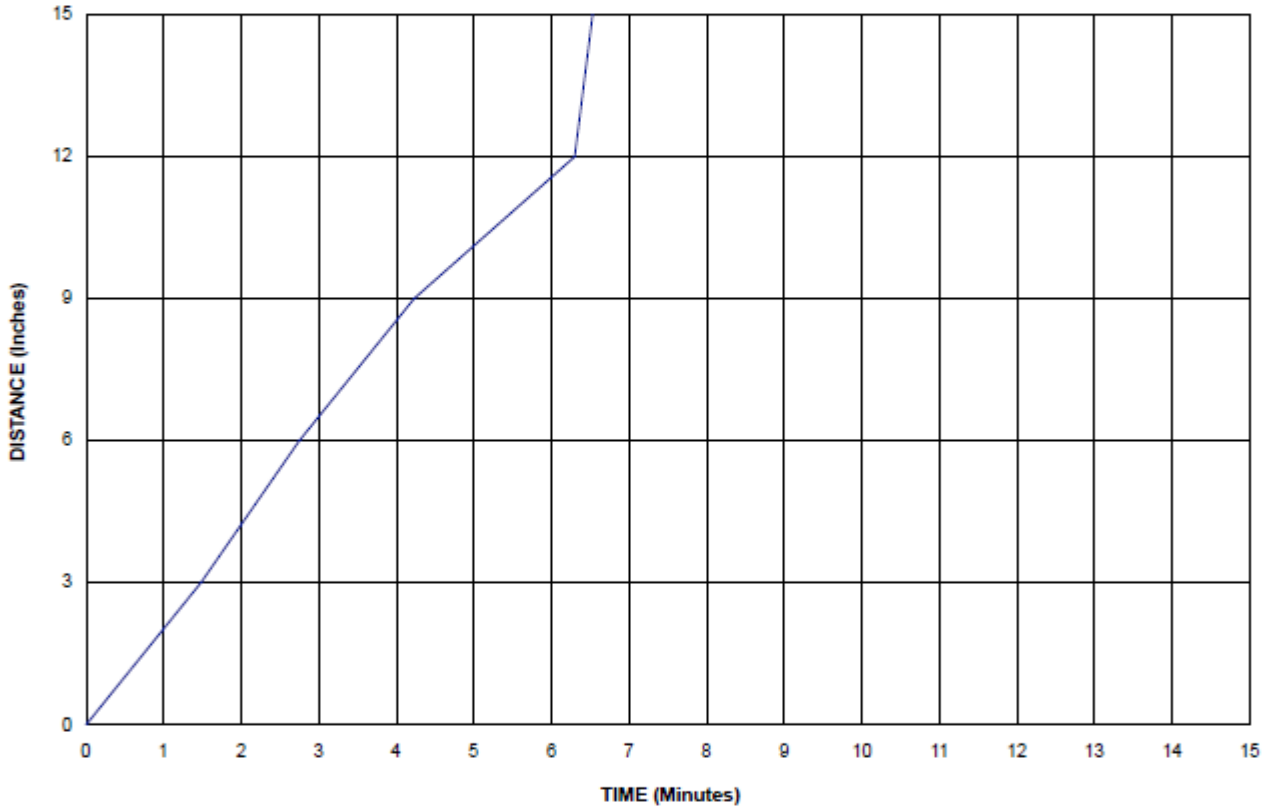


Skip Points Location: 3, 6, 12 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6352
Date: December 26, 2017
Specimen Number: 2

Flame Spread Factor, Fs: 4.87
Temperature Rise, °C: 221.7
Heat Evolution Factor, Q: 37.57
Radiant Panel Index, Is: 182.94

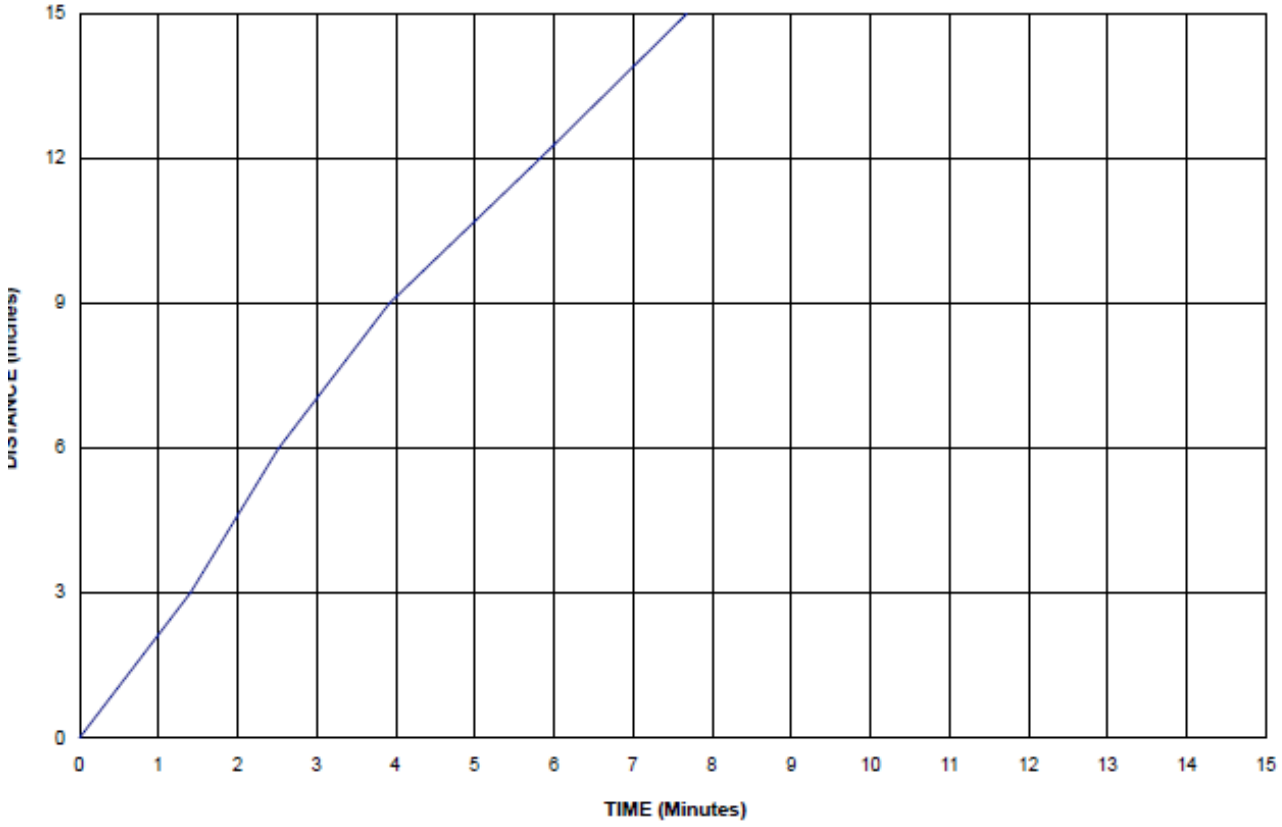


Skip Points Location: 3, 12 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6352
Date: December 26, 2017
Specimen Number: 3

Flame Spread Factor, Fs: 4.37
Temperature Rise, °C: 242.8
Heat Evolution Factor, Q: 41.15
Radiant Panel Index, Is: 179.64

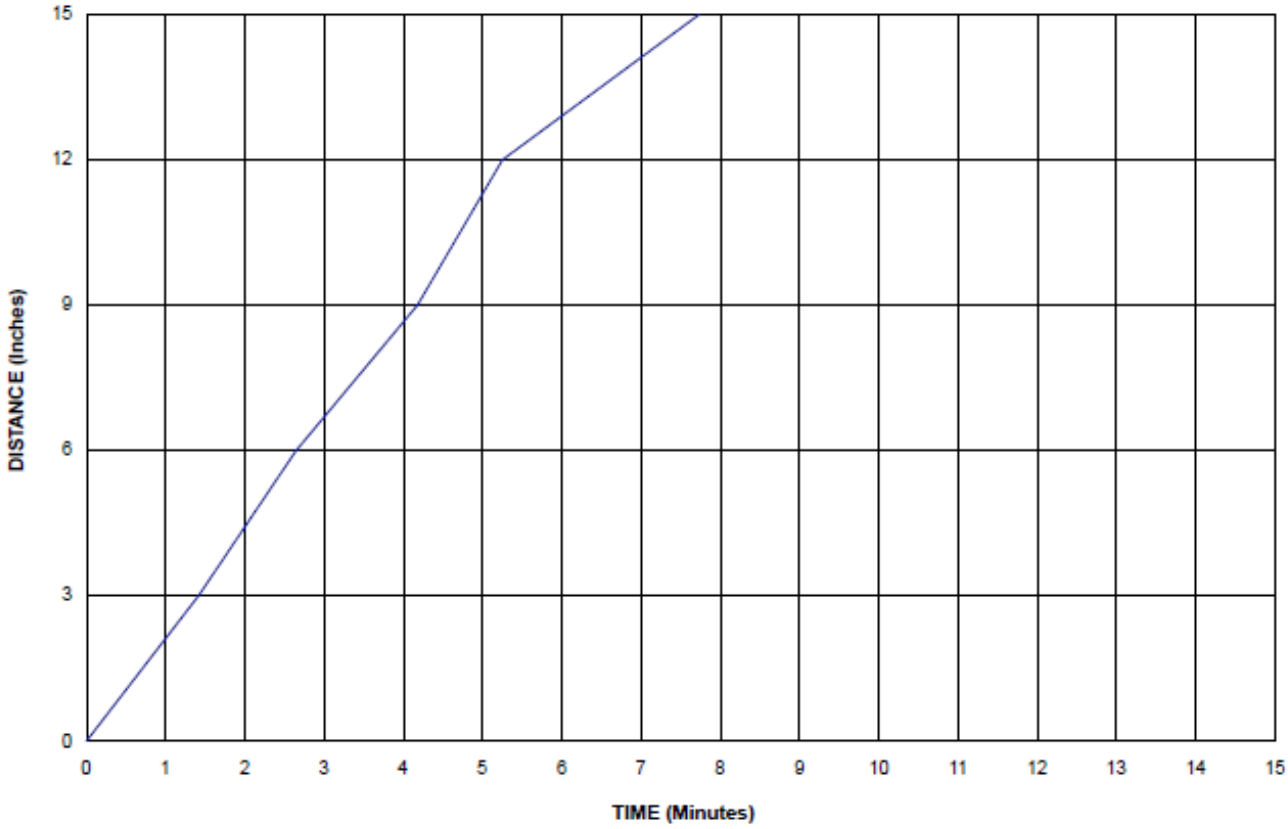


Skip Points Location: 3 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5154-6352
Date: December 26, 2017
Specimen Number: 4

Flame Spread Factor, Fs: 4.45
Temperature Rise, °C: 246.7
Heat Evolution Factor, Q: 41.81
Radiant Panel Index, Is: 186.01



Skip Points Location: 3, 6, 9 inches

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Standard Method of Test for
Surface Flammability of Materials
Using a Radiant Heat Energy Source

ASTM E162–16

Sample 5

Report Number 17–12278

Test Number 5157–6415
December 20, 2017

Jensen Hughes
Baltimore, Maryland

Commercial Testing Company

Deviane Jackson

(Authorized Signature)

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INTRODUCTION

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Surface flammability is measured using a vertically mounted propane gas and air fueled radiant heat energy source and a 6-inch by 18-inch test specimen. The specimen orientation is at an inverted angle of 30° to the vertical surface of the radiant panel with ignition forced near its upper edge and the flame progressing downward. A pilot burner, fueled with an acetylene–air mixture, impinges on the specimen near its top edge and provides ignition. A factor derived from the rate of progress of the flame front, and another derived from the rate of heat liberated by the material being tested, are combined to provide the final test result, the Radian Panel Index.

TEST PROCEDURE

A minimum of four specimens with a maximum thickness of one inch is pre–conditioned for 24 hours in a circulating air oven maintained at 60°C. The dry specimens are then conditioned to equilibrium in an atmosphere with the temperature maintained between 21 and 23°C and the relative humidity at 50 ± 5 percent. The conditioned specimens are wrapped with aluminum foil with only the face exposed, placed in a specimen holder, and backed with 13 mm thick inorganic millboard. When necessary, a 25 mm hexagonal wire mesh is placed across the face of the mounted specimens to maintain their integrity during testing.

The radiant heat energy panel is ignited and allowed to preheat at least 1.5 hours prior to of testing. Stack temperature measurements in the range of 180 to 230°C indicate proper operating conditions. The thermal output of the radiant panel is verified to be within the specified operating range of 670 ± 4°C by measurements made on a 250 mm diameter area in the center of the panel using a Honeywell radiation pyrometer. Periodic calibration using a special burner fueled with methane gas provides data (ß factor) necessary for calculation of the final test result. The pilot burner is adjusted to give a flame approximately two to three inches in length. The prepared specimen is placed on the supporting framework in front of the panel and the timer started simultaneously. The time that the flame front on the surface of the specimen arrives at each 76 mm mark, and the maximum temperature rise measured in the exhaust stack thermopile, are recorded during a 15–minute test exposure.

CALCULATIONS

Test results are calculated and expressed as the Radiant Panel Index, *Is*. The Radiant Panel Index is the product of the Flame Spread Factor, *Fs*,, a factor derived from the rate of progress of the flame front, and the Heat Evolution Factor, *Q*, a factor relating to the rate of heat liberation by the material. The Flame Spread Factor is calculated as:

$$F_s = 1 + \frac{1}{t_3 - t_0} + \frac{1}{t_6 - t_3} + \frac{1}{t_9 - t_6} + \frac{1}{t_{12} - t_9} + \frac{1}{t_{15} - t_{12}}$$

Where:

F_s = flame spread factor
t_x = time until arrival of the flame at the 76 mm distance marks

If there are any segments of the curve where the slope increases, the increase is eliminated by segmenting the curve from the previous to the succeeding point, thus becoming a "skip point." These points are treated in the formula *Fs* by dropping the terms involving single curve points and replacing them with the single term $K/(Tf - Tb)$ where *K* is an integer related to the number of skip points, *Tf* is the time at the first curve point after the skip, and *Tb* is the time at the last curve point before a skip point.

The Radiant Panel Index is calculated as $Is = FsQ$ and the Heat Evolution Factor as $Q = CT/\beta$ where:

- C = arbitrary constant 5.7
- T = observed maximum stack temperature rise in °C between the specimen and that for a similar curve of fiber-reinforced cement board
- β = mean stack temperature rise for unit heat input rate in °C/kW, a constant for a particular test instrument

Only sustained flame fronts, i.e., when a flame front advances from the igniting burner to the first 3-inch or subsequent marks at a rate that so that at least 3 seconds have passed since it reached the mark, are taken into account for calculating the Flame Spread Factor, *Fs*. Flashing, i.e., a flame front with a duration of 3 seconds or less, shall be reported but not used for calculation of the Flame Spread Factor, *Fs*. If flashing occurs, the fact shall be mentioned in parentheses following the Radiant Panel Index, *Is*, and reported in the form, for example, *Is* = 100 [Flashing (F)].

MATERIAL TESTED

Identification: Sample 5
Type Material: Thermoplastic Panel
Nominal Thickness: 1.3mm
Color: Dark Gray

TEST DATA

Specimen	1	2	3	4
Flame Spread Factor, *Fs*	1.13	1.87	1.32	1.86
Temperature Rise, °C	8.3	35.0	20.0	13.3
Heat Evolution Factor, *Q*	1.41	5.93	3.39	2.26
Flaming Drippings Time	None	None	None	None
Test Duration, m:s	15:00	15:00	15:00	15:00
Radiant Panel Index, *Is*	1.60	11.09	4.49	4.20

TEST RESULT

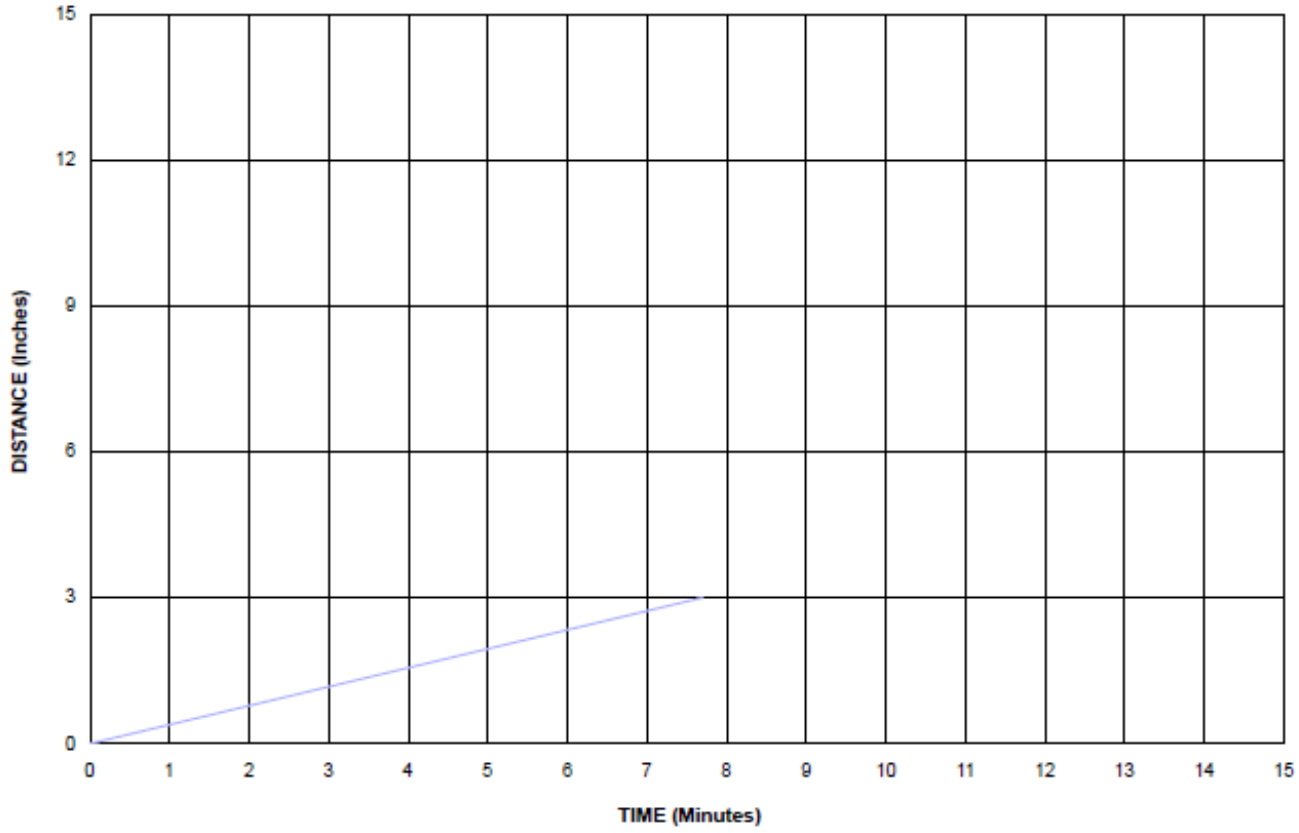
The test result, the average *Is*, is rounded to the nearest multiple of five as required by Section 12.1 of the Standard. Graphic presentation of individual test data is included at the end of this report.

Specimen	1	2	3	4	Average
Radiant Panel Index, *Is*	1.60	11.09	4.49	4.20	5

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6415
Date: December 20, 2017
Specimen Number: 1

Flame Spread Factor, Fs: 1.13
Temperature Rise, °C: 8.3
Heat Evolution Factor, Q: 1.41
Radiant Panel Index, Is: 1.60

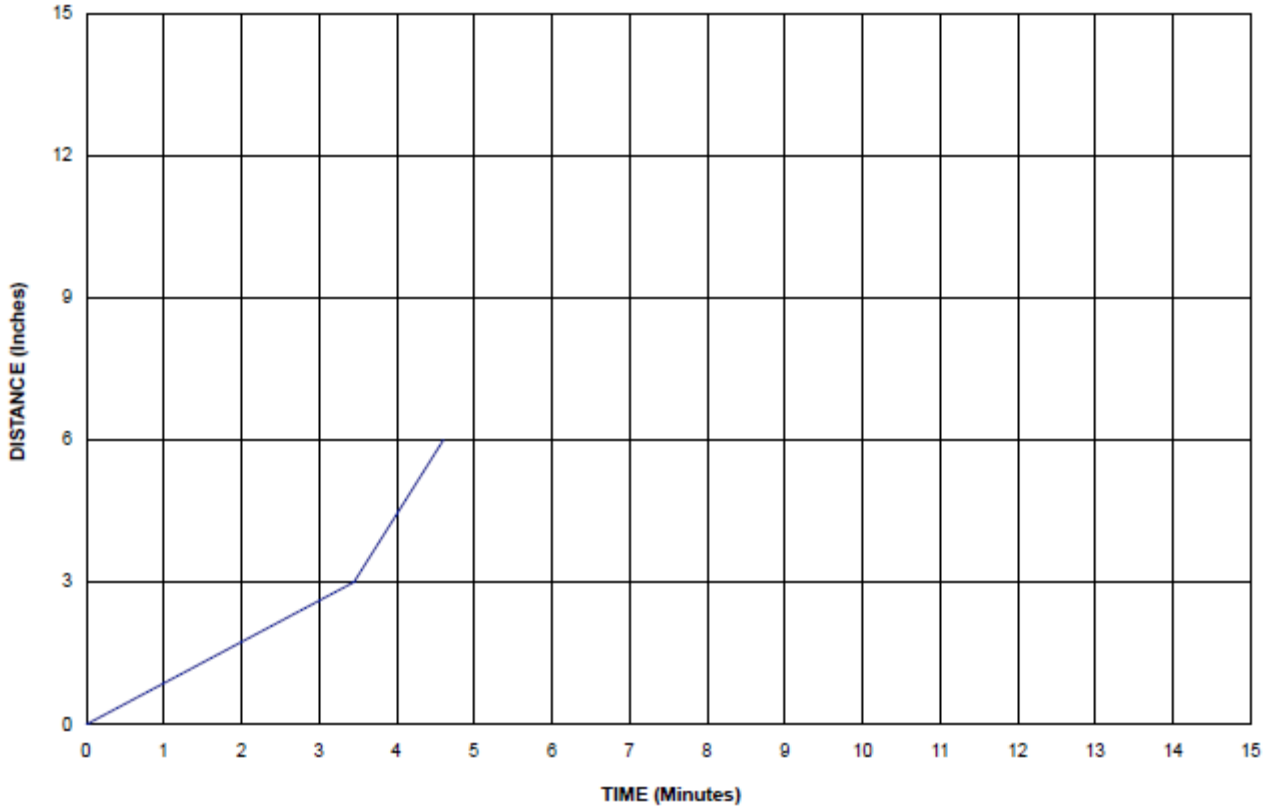


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6415
Date: December 20, 2017
Specimen Number: 2

Flame Spread Factor, Fs: 1.87
Temperature Rise, °C: 35.0
Heat Evolution Factor, Q: 5.93
Radiant Panel Index, Is: 11.09

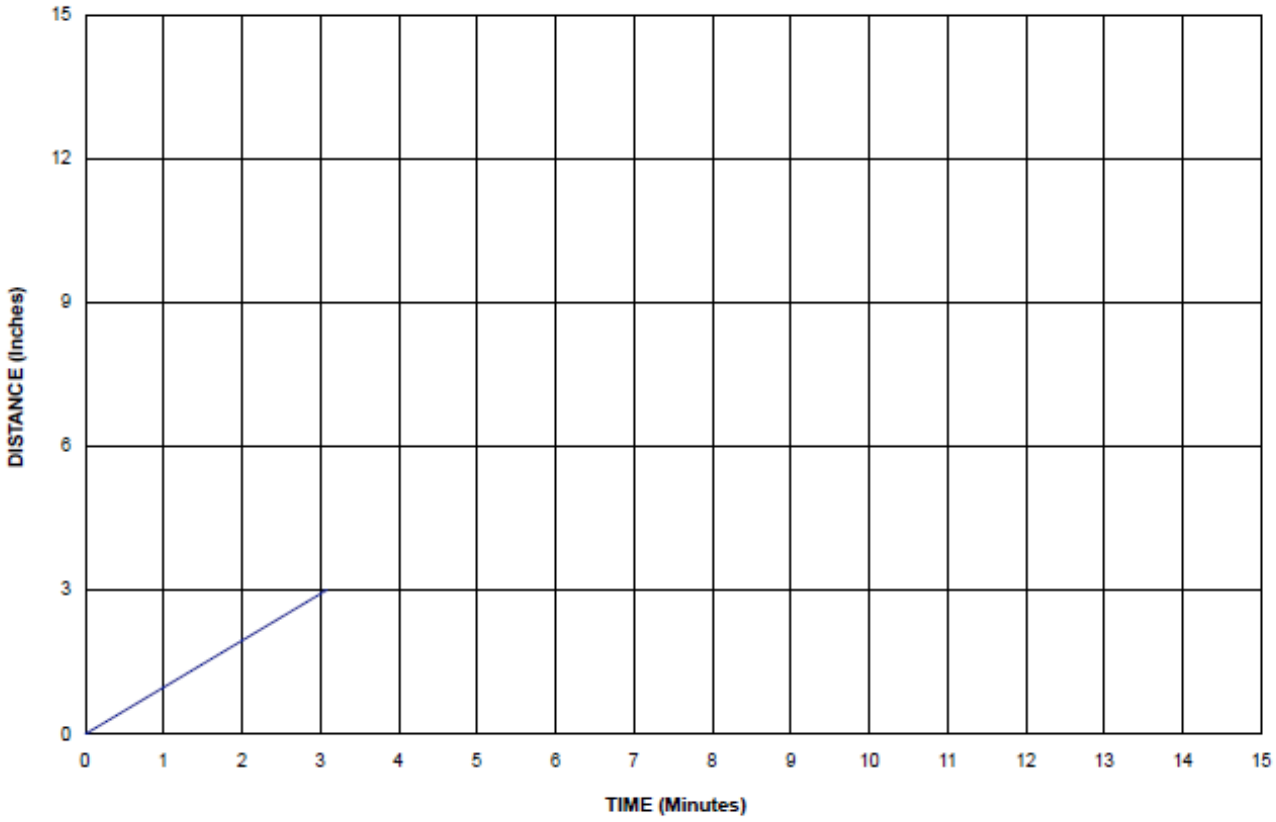


Skip Points Location: 3 inches

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6415
Date: December 20, 2017
Specimen Number: 3

Flame Spread Factor, Fs: 1.32
Temperature Rise, °C: 20.0
Heat Evolution Factor, Q: 3.39
Radiant Panel Index, Is: 4.49

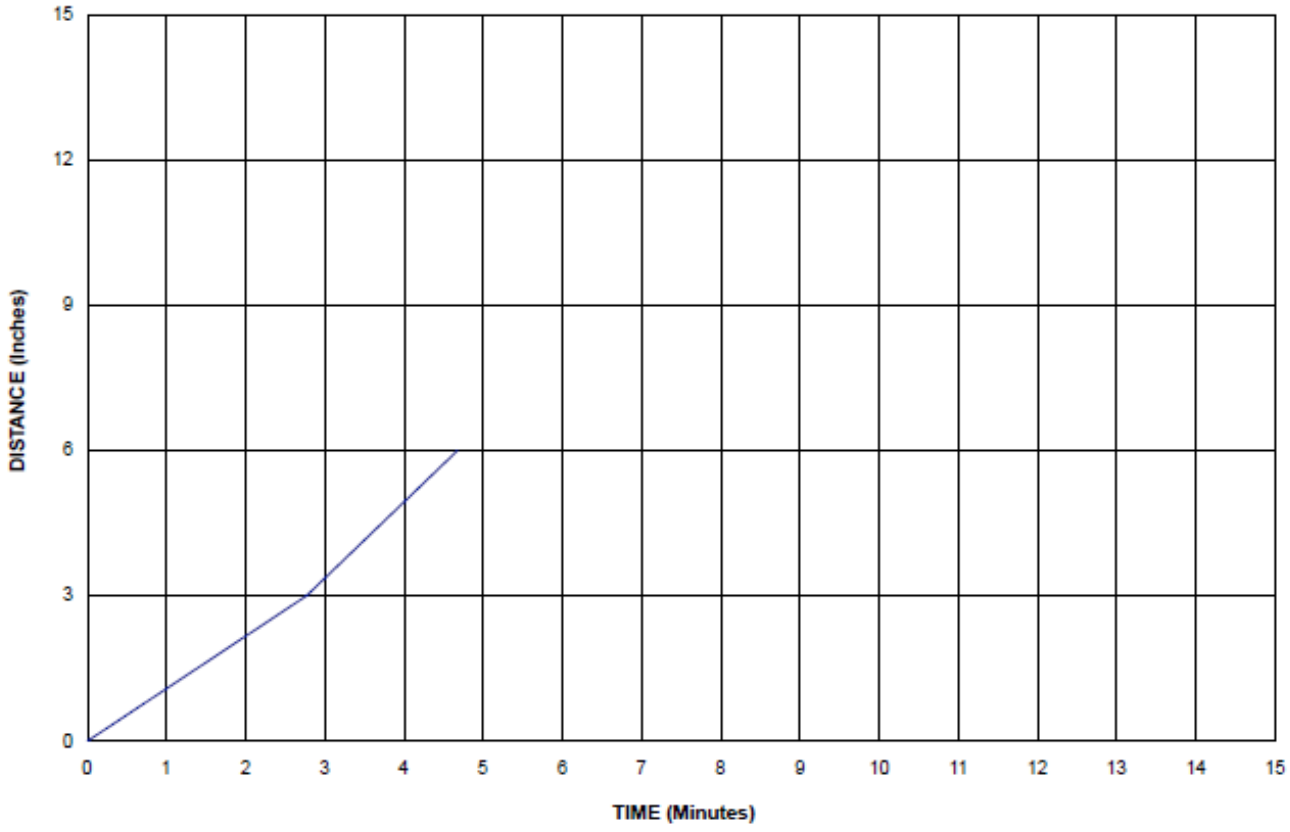


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6415
Date: December 20, 2017
Specimen Number: 4

Flame Spread Factor, Fs: 1.86
Temperature Rise, °C: 13.3
Heat Evolution Factor, Q: 2.26
Radiant Panel Index, Is: 4.20



Skip Points Location: 3 inches

COMMERCIAL TESTING COMPANY
1215 South Hamilton Street · Dalton, Georgia 30720
Telephone (706) 278–3935 · Facsimile (706) 278–3936

Standard Method of Test for
Surface Flammability of Materials
Using a Radiant Heat Energy Source

ASTM E162–16

Sample 6

Report Number 17–12279

Test Number 5157–6416
December 18, 2017

Jensen Hughes
Baltimore, Maryland

Commercial Testing Company

(Authorized Signature)

INTRODUCTION

This report is a presentation of test results on a material submitted by Jensen Hughes, Baltimore, Maryland. The test was conducted in accordance with the ASTM International fire-test response-standard E162–16, *Surface Flammability of Materials Using a Radiant Heat Energy Source*. The method provides a laboratory procedure for measuring and comparing surface flammability of materials when exposed to a prescribed level of radiant heat energy. It is intended for research and development only and should not be used as a basis of ratings for building codes. ASTM E162 is an American National Standard (ANSI) and has been approved for use by agencies of the Department of Defense.

This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of materials, products, or assemblies under actual fire conditions.

No consideration is made for results that may be obtained if the material being evaluated were tested in combination with other materials.

PURPOSE

Surface flammability is measured using a vertically mounted propane gas and air fueled radiant heat energy source and a 6-inch by 18-inch test specimen. The specimen orientation is at an inverted angle of 30° to the vertical surface of the radiant panel with ignition forced near its upper edge and the flame progressing downward. A pilot burner, fueled with an acetylene–air mixture, impinges on the specimen near its top edge and provides ignition. A factor derived from the rate of progress of the flame front, and another derived from the rate of heat liberated by the material being tested, are combined to provide the final test result, the Radian Panel Index.

TEST PROCEDURE

A minimum of four specimens with a maximum thickness of one inch is pre–conditioned for 24 hours in a circulating air oven maintained at 60°C. The dry specimens are then conditioned to equilibrium in an atmosphere with the temperature maintained between 21 and 23°C and the relative humidity at 50 ± 5 percent. The conditioned specimens are wrapped with aluminum foil with only the face exposed, placed in a specimen holder, and backed with 13 mm thick inorganic millboard. When necessary, a 25 mm hexagonal wire mesh is placed across the face of the mounted specimens to maintain their integrity during testing.

The radiant heat energy panel is ignited and allowed to preheat at least 1.5 hours prior to of testing. Stack temperature measurements in the range of 180 to 230°C indicate proper operating conditions. The thermal output of the radiant panel is verified to be within the specified operating range of 670 ± 4°C by measurements made on a 250 mm diameter area in the center of the panel using a Honeywell radiation pyrometer. Periodic calibration using a special burner fueled with methane gas provides data (ß factor) necessary for calculation of the final test result. The pilot burner is adjusted to give a flame approximately two to three inches in length. The prepared specimen is placed on the supporting framework in front of the panel and the timer started simultaneously. The time that the flame front on the surface of the specimen arrives at each 76 mm mark, and the maximum temperature rise measured in the exhaust stack thermopile, are recorded during a 15–minute test exposure.

CALCULATIONS

Test results are calculated and expressed as the Radiant Panel Index, *Is*. The Radiant Panel Index is the product of the Flame Spread Factor, *Fs*,, a factor derived from the rate of progress of the flame front, and the Heat Evolution Factor, *Q*, a factor relating to the rate of heat liberation by the material. The Flame Spread Factor is calculated as:

$$F_s = 1 + \frac{1}{t_3 - t_0} + \frac{1}{t_6 - t_3} + \frac{1}{t_9 - t_6} + \frac{1}{t_{12} - t_9} + \frac{1}{t_{15} - t_{12}}$$

Where:

F_S = flame spread factor
t_x = time until arrival of the flame at the 76 mm distance marks

If there are any segments of the curve where the slope increases, the increase is eliminated by segmenting the curve from the previous to the succeeding point, thus becoming a "skip point." These points are treated in the formula *Fs* by dropping the terms involving single curve points and replacing them with the single term $K/(Tf - Tb)$ where *K* is an integer related to the number of skip points, *Tf* is the time at the first curve point after the skip, and *Tb* is the time at the last curve point before a skip point.

The Radiant Panel Index is calculated as $Is = FsQ$ and the Heat Evolution Factor as $Q = CT/ß$ where:

- C = arbitrary constant 5.7
- T = observed maximum stack temperature rise in °C between the specimen and that for a similar curve of fiber-reinforced cement board
- $ß$ = mean stack temperature rise for unit heat input rate in °C/kW, a constant for a particular test instrument

Only sustained flame fronts, i.e., when a flame front advances from the igniting burner to the first 3-inch or subsequent marks at a rate that so that at least 3 seconds have passed since it reached the mark, are taken into account for calculating the Flame Spread Factor, *Fs*. Flashing, i.e., a flame front with a duration of 3 seconds or less, shall be reported but not used for calculation of the Flame Spread Factor, *Fs*. If flashing occurs, the fact shall be mentioned in parentheses following the Radiant Panel Index, *Is*, and reported in the form, for example, *Is* = 100 [Flashing (F)].

MATERIAL TESTED

Identification: Sample 6
Type Material: Coating Applied to Fiberglass Panel
Nominal Thickness: 7.3mm
Color: Light Beige

TEST DATA

Specimen	1	2	3	4
Flame Spread Factor, *Fs*	1.00	1.11	1.07	1.11
Temperature Rise, °C	21.7	28.9	27.8	18.9
Heat Evolution Factor, *Q*	3.67	4.90	4.71	3.20
Flaming Drippings Time	None	None	None	None
Test Duration, m:s	15:00	15:00	15:00	15:00
Radiant Panel Index, *Is*	3.67 (F)	5.42 (F)	5.04 (F)	3.55 (F)

TEST RESULT

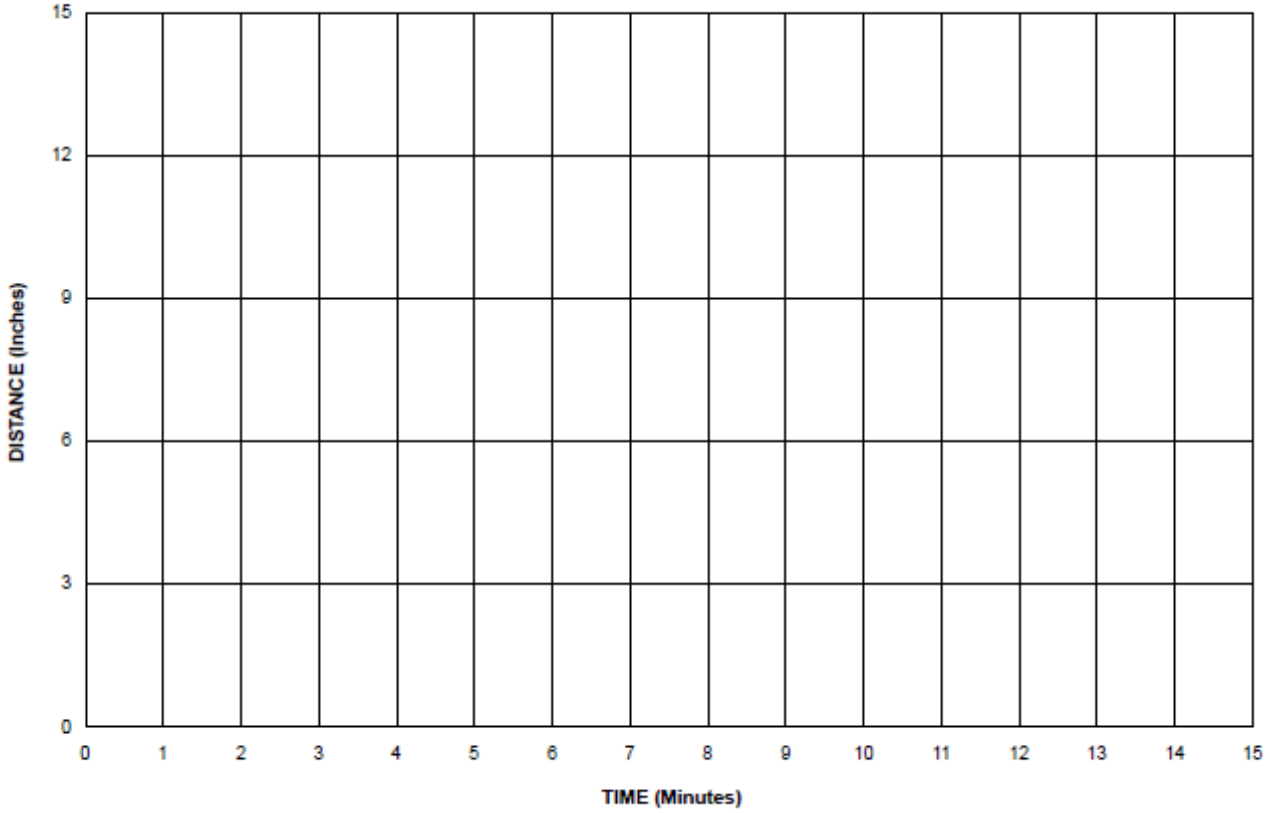
The test result, the average *Is*, is rounded to the nearest multiple of five as required by Section 12.1 of the Standard. Graphic presentation of individual test data is included at the end of this report.

Specimen	1	2	3	4	Average
Radiant Panel Index, *Is*	3.67	5.42	5.04	3.55	**5 (Flashing)**

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6416
Date: December 18, 2017
Specimen Number: 1

Flame Spread Factor, Fs: 1.00
Temperature Rise, °C: 21.7
Heat Evolution Factor, Q: 3.67
Radiant Panel Index, Is: 3.67 (F)

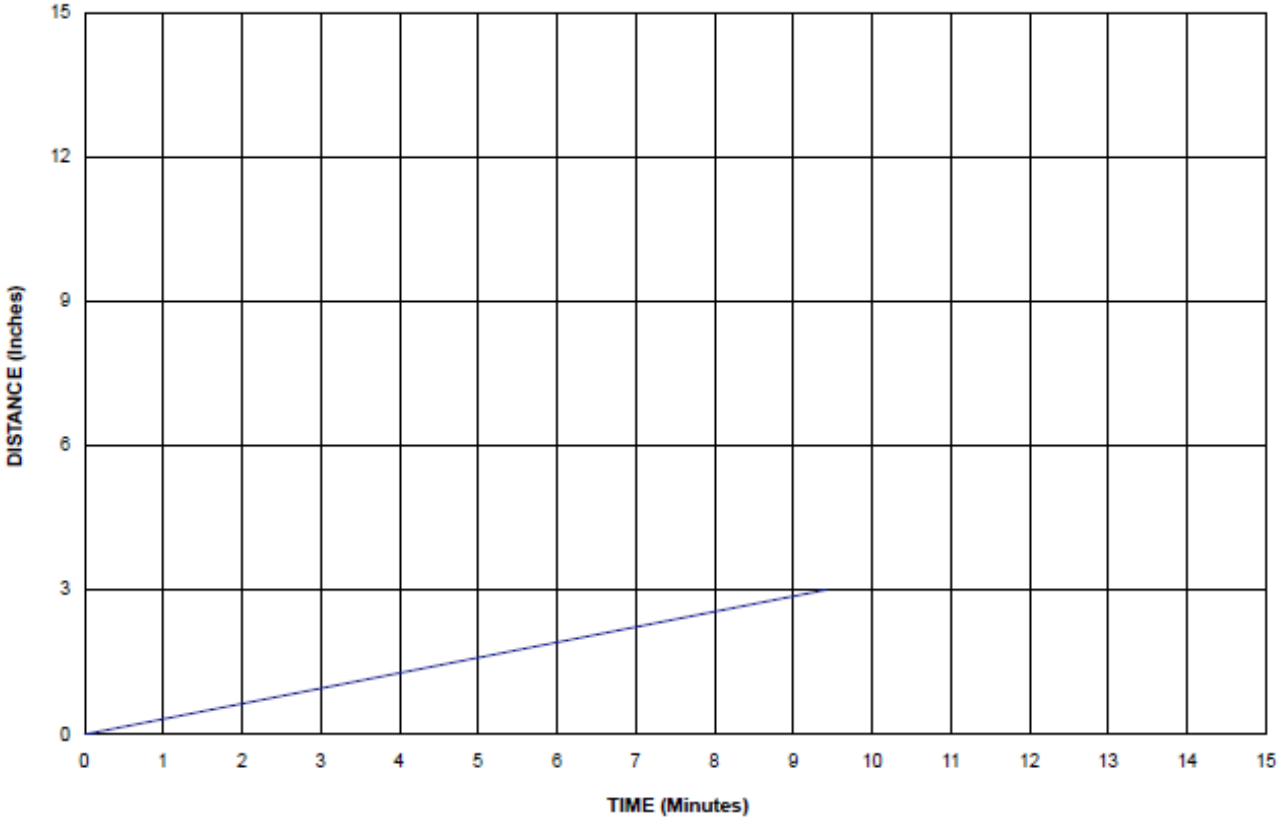


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6416
Date: December 18, 2017
Specimen Number: 2

Flame Spread Factor, Fs: 1.11
Temperature Rise, °C: 28.9
Heat Evolution Factor, Q: 4.90
Radiant Panel Index, Is: 5.42 (F)

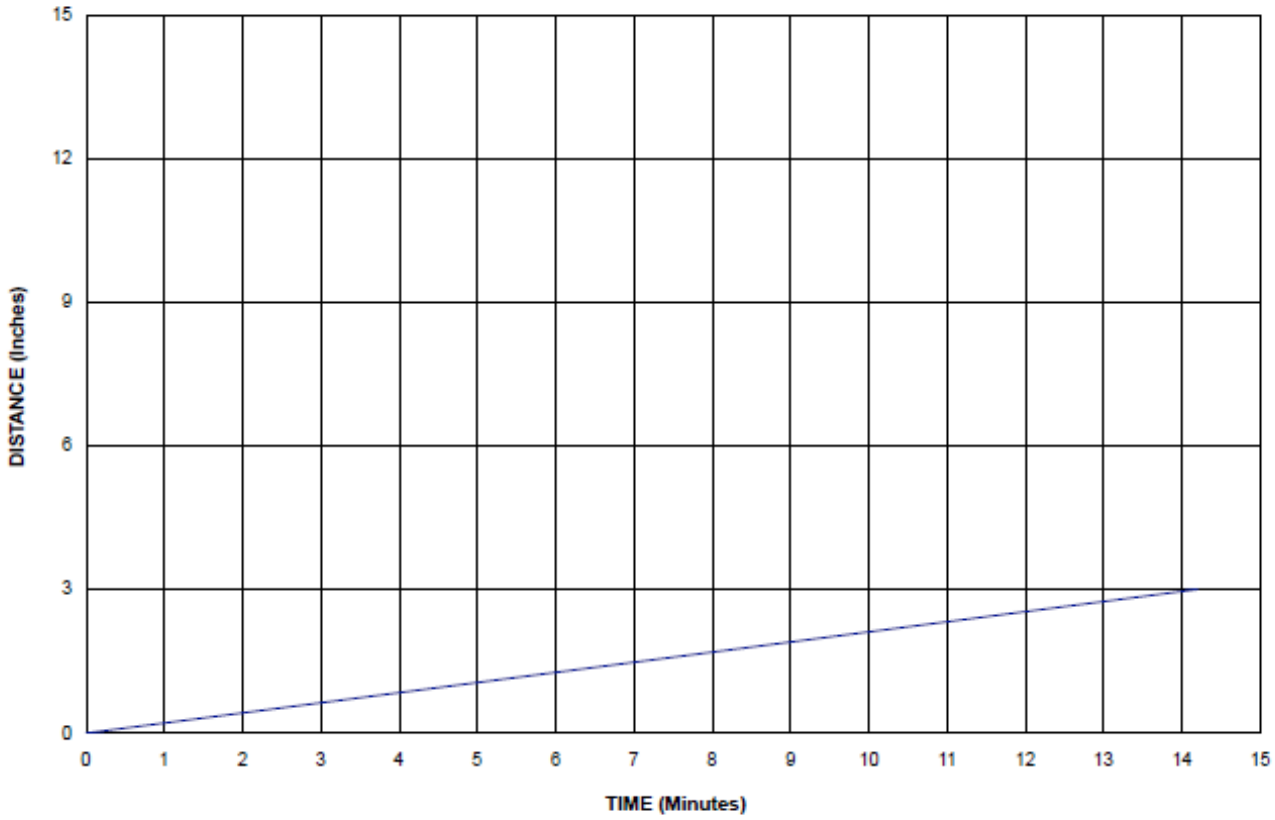


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6416
Date: December 18, 2017
Specimen Number: 3

Flame Spread Factor, Fs: 1.07
Temperature Rise, °C: 27.8
Heat Evolution Factor, Q: 4.71
Radiant Panel Index, Is: 5.04 (F)

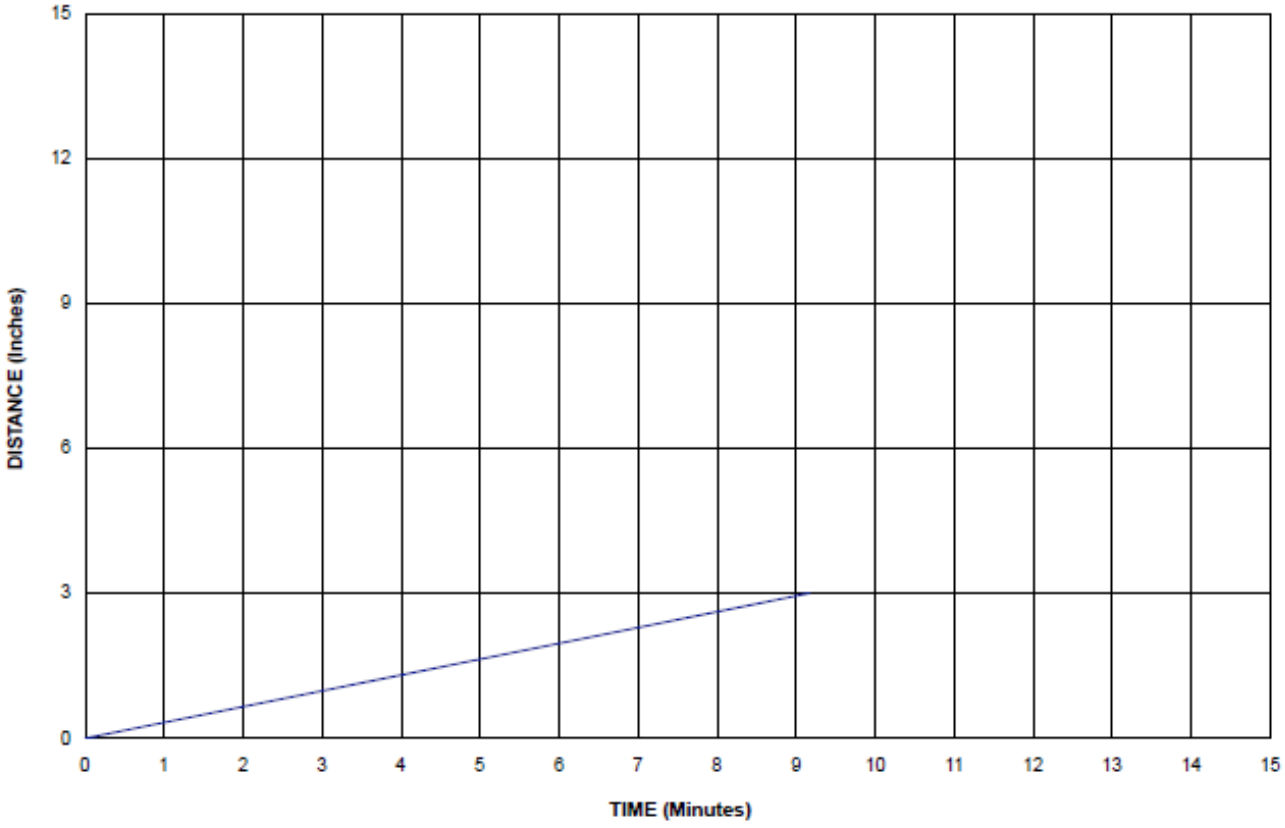


Skip Points Location: No Skip Points

E 162 Radiant Panel

Client: Jensen Hughes
Test Number: 5157-6416
Date: December 18, 2017
Specimen Number: 4

Flame Spread Factor, Fs: 1.11
Temperature Rise, °C: 18.9
Heat Evolution Factor, Q: 3.20
Radiant Panel Index, Is: 3.55 (F)



Skip Points Location: No Skip Points

Govmark

96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 11/13/2017	Completed: 11/16/2017	Letter: I	JB	P.O.#:	Test Report #: 3-22219-0-

Client's Identification	Composition: Woven glass fabric with high temperature phenolic resin. Weight: 7. Density: SG=1.80.

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: ASTM E162 775

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CLIENT'S IDENTIFICATION (continuation):

Thickness: 0.125".

Category:Radiant Panel Specifier:ASTM LE 2016; V 11/17 NTR 8/16 PC:24H+ME /dl SM/mg

TEST PERFORMED: ASTM E 162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source

APPROXIMATE [x] THICKNESS [ ] DIAMETER OF MATERIAL (as measured by Govmark); 0.140"

SPECIMEN:

[x] Rigid Material: 6" x 18"
[ ] Cellular Sheet Foam Materials: 6" x 18"
[ ] Fabric/Flexible Materials: 10" x 22"
[ ] Cable: 18" lengths were grouped to form 6" x 18" test specimens
[ ] Other: 6" x 18" perpared as follows:_____

SPECIMEN PREPARATION:

[ ] No backing required, as specimens exceeded 0.75" in thickness.

[x] The specimens were backed by a 0.5" Etera board (a cement asbestos substitute).

[ ] The specimens were backed with 1/4" high density reinforced cement board.

[x] The back and sides of each specimen were wrapped with 0.002" thick aluminum foil.

[ ] The face of each specimen was covered with a 1" hexagonal wire mesh screen.

[ ] The specimen was flexible material such that the top and bottom of the 10" x 22" specimen was wrapped around the back of the board with all slack removed.

CALIBRATION FACTORS:

Etera board correction factor: 18°C
Beta: 31.88
Flux: 2.9 - 1.8 - 0.9 (Flux Transducer # 184112)

-- See Page 2 for "Results" --

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e-mail: testing@govmark.com

Received: 11/13/2017	Completed: 11/16/2017	Letter: I	JB	P.O.#:	Test Report #:	3-22219-0-

Client's Identification: Composition: Woven glass fabric with high temperature phenolic resin
Weight: 7. Density: SG 1.80.

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: ASTM E162 775

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

RESULTS:

Specimen #	Flame Progression (mm:ss) 3.0"	6.0"	9.0"	12.0"	15.0"	Net Stack Rise°C	Q	FS	Flame Spread Index*	Flaming Dripping, or Flaming Running (yes/no)
1	FN	FN	FN	FN	FN	3.0	0.5	1.0	0.5	No
2	FN	FN	FN	FN	FN	28.0	5.0	1.0	5.0	No
3	FN	FN	FN	FN	FN	2.0	0.4	1.0	0.4	No
4	FN	FN	FN	FN	FN	2.0	0.4	1.0	0.4	No
								Avg:	1.6	

(Flame Spread Index rounded to nearest multiple of 5): Rounded:

* While the Standard calls out "Radiant Panel Index", Govmark reports "Flame Spread Index" since this is the terminology used in most Code specifications. "Flame Spread Index" and "Radiant Panel Index" are identical for the purposes of this report.

ABBREVIATIONS WHICH MAY BE USED:

F = Flashed beyond benchmark
FN = Flame front did not reach this benchmark
DNI = Did not ignite

WIRE MESH EVALUATION: If wire mesh was used, the flame front was attributable to the burning of the residue on the wire mesh: [ ] Yes; [ ] No

REMARKS: None.

ACCEPTANCE CRITERIA: None cited.

CONCLUSION: Not applicable.

-- See Page 3 for "Brief Description of Test" and "Observations" --

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Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 11/13/2017	Completed: 11/16/2017	Letter: I	JB	P.O.#:	Test Report #:	3-22219-0-
Client's Identification	Composition: Woven glass fabric with high temperature phenolic resin. Weight: 7. Density: SG=1.80.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: ASTM E162 775

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

BRIEF DESCRIPTION OF TEST: The test specimen faces a radiant heat source. At the beginning of the test period, an igniting flame impinges at the top of the specimen. Visual observation is made of the downward progression of the flame front. The test is completed when the flame front has progressed to the 15" mark or after an exposure time of 15 minutes, whichever occurs first. The heat given off by the burning specimen is automatically recorded. The formula takes into account the starting temperature and the peak temperature. The combination of the two factors, flame front progression and temperature rise, result in a Flame Spread Index. Flaming running and/or flaming dripping is also recorded.

OBSERVATIONS:

Specimen #	Non Sustained Flame Front Flashing** (yes/no)	Sustained Flame Front Ignition at (mm:ss)	All Flaming Out (mm:ss)	Test End (mm:ss)	Drips Flame on Test Floor (yes/no)
1	No	DNI	DNI	15:00	No
2	No	DNI	DNI	15:00	No
3	No	DNI	DNI	15:00	No
4	No	DNI	DNI	15:00	No

** Flashing is defined as a flame front of 3 seconds or less in duration. Where ANY flashing has occurred, an individual specimen's Flame Spread Index is understood to be qualified as "Flashing".

ABBREVIATIONS WHICH MAY BE USED IN "OBSERVATIONS":

DNI = Did not ignite
SB = Still burning at test end

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

Mr. Michael Magee

AUTHORIZED SIGNATURE
GOVMARK
/pm qB/

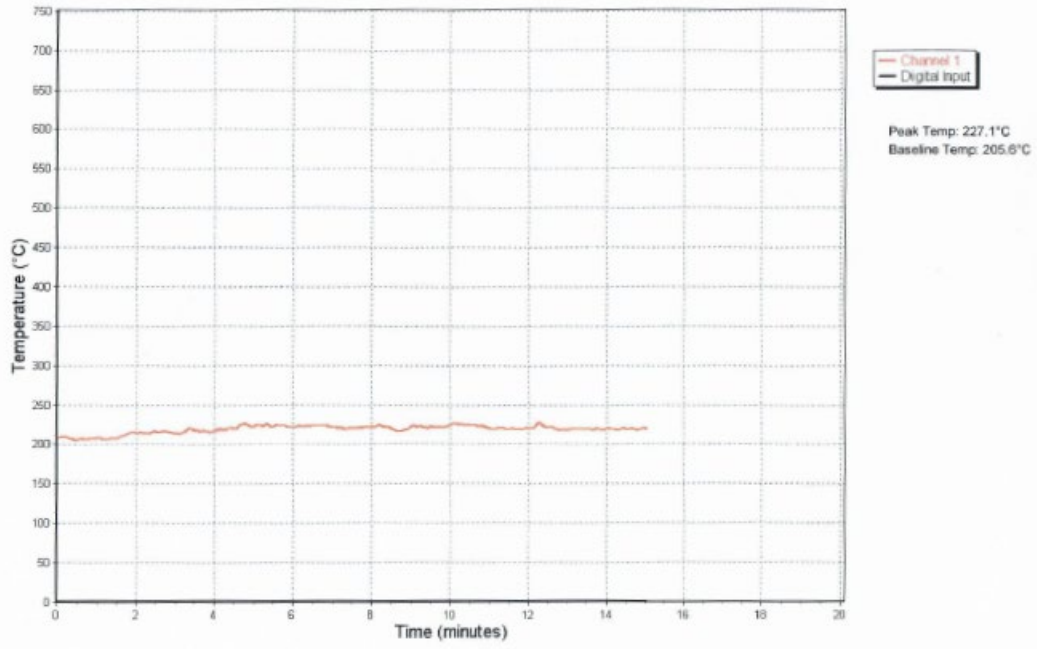
NOV 2 2 2017

Test : Radiant Panel ASTM E 162 / ASTM D 3675
Client : Jensen Hughes, Inc
Test Report # : 3-22219-0 i
Test Date : 11/16/17
Beta : 31.88 °C/ kW

Specimen	Burn Time (min:sec) 3.0'	6.0'	9.0'	12.0'	15.0'	Stack Temp Rise (°C)	Heat Evolution Factor (Q)	Flame Spread Factor	Flame Spread Index
1	FN	FN	FN	FN	FN	3.0	0.5	1.0	0.5
2	FN	FN	FN	FN	FN	28.0	5.0	1.0	5.0
3	FN	FN	FN	FN	FN	2.0	0.4	1.0	0.4
4	FN	FN	FN	FN	FN	2.0	0.4	1.0	0.4
Average									1.6

Govmark
96D Allen Blvd
Farmingdale, NY 11735
631-293-8944
www.govmark.com

Report Number : 3-22219-0 #1 ASTM E162 Test Date : 11/16/17



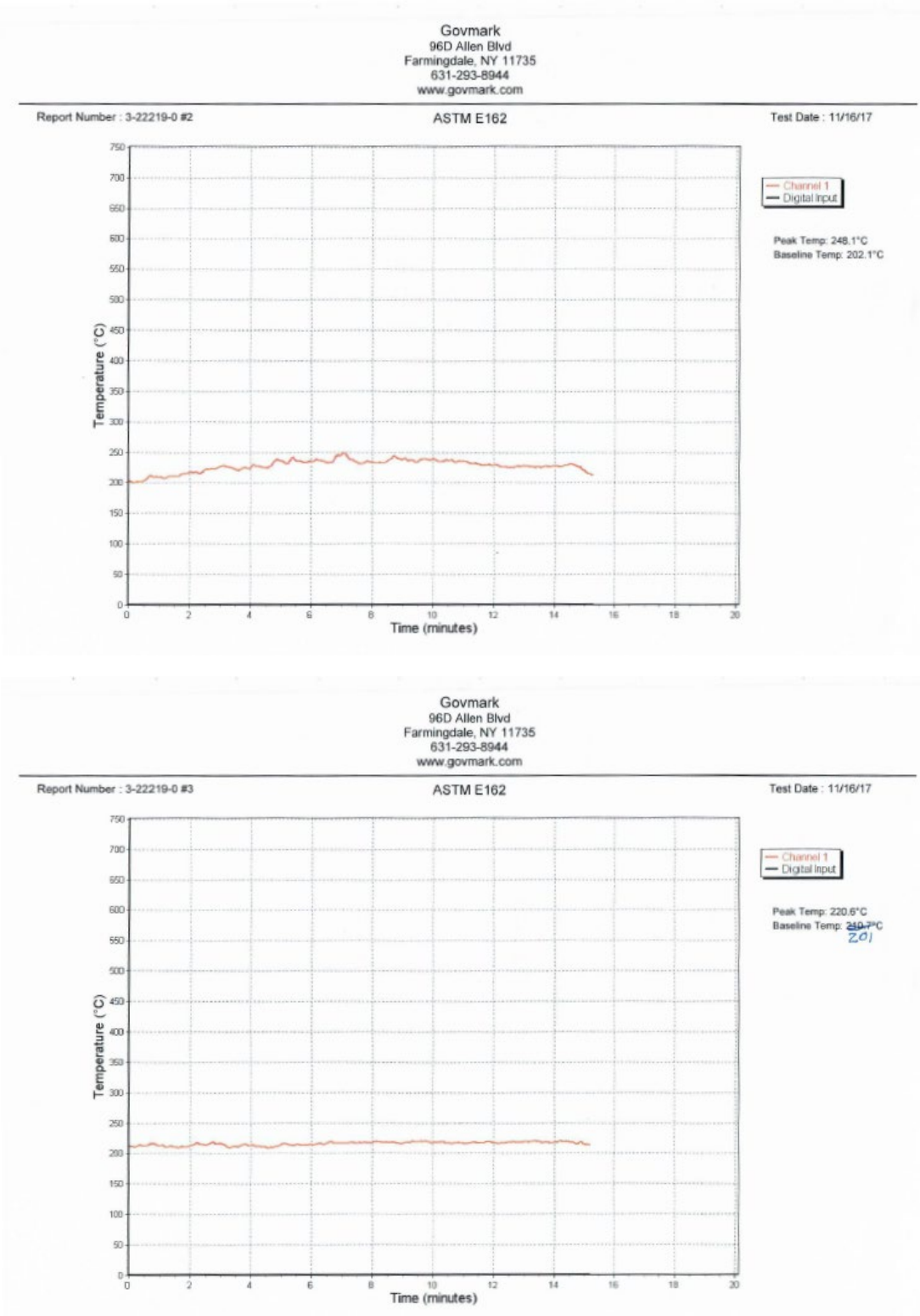


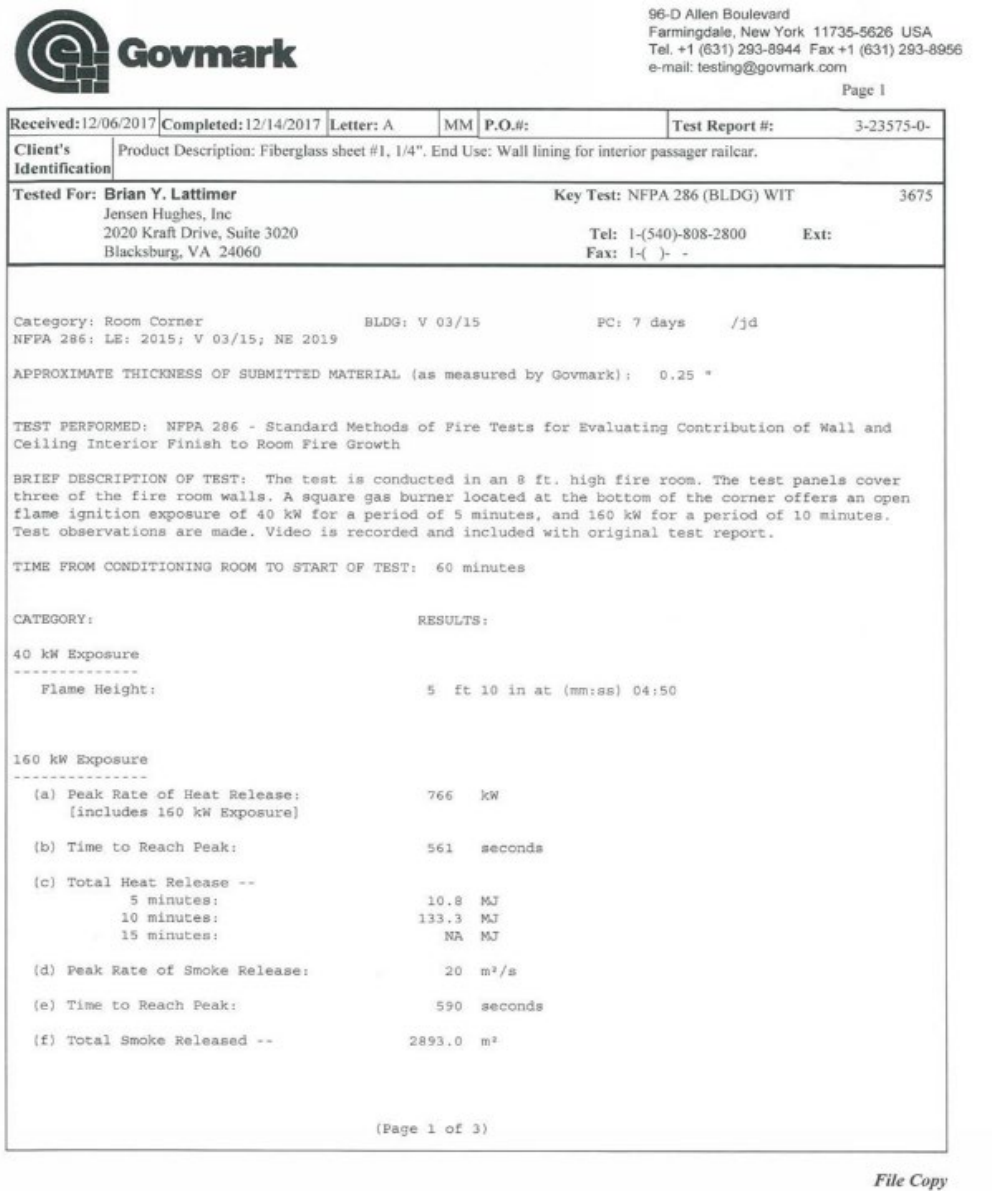
Figure B 2. All the radiant panel test results

Appendix C.
NFPA 286 Test Results of Rail Car Interior Materials

C.1 Govmark Testing Reports of NFPA 286 Tests

Seven materials were tested in accordance with NFPA 286. The testing was performed at SGS Govmark from December 11, 2017, to December 14, 2017. Official test reports are included in this section.

C.1.1 Test 1: Sample 6, FRP1 (Completed 12/11/2017)



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e-mail: testing@govmark.com

Page 1

Received: 12/06/2017	Completed: 12/14/2017	Letter: A	MM	P.O.#:	Test Report #:	3-23575-0-
Client's Identification	Product Description: Fiberglass sheet #1, 1/4". End Use: Wall lining for interior passager railcar.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675
Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.25 *

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 60 minutes

CATEGORY:	RESULTS:	
40 kW Exposure		
Flame Height:	5 ft 10 in at (mm:ss) 04:50	
160 kW Exposure		
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	766	kW
(b) Time to Reach Peak:	561	seconds
(c) Total Heat Release --		
5 minutes:	10.8	MJ
10 minutes:	133.3	MJ
15 minutes:	NA	MJ
(d) Peak Rate of Smoke Release:	20	m^3/s
(e) Time to Reach Peak:	590	seconds
(f) Total Smoke Released --	2893.0	m^3

(Page 1 of 3)

File Copy

Figure C 1. Test 1, sample 6

This test was completed on December 11, 2017, and the date on the report is in error.

Govmark

96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/14/2017	Letter: A	MM	P.O.#:	Test Report #:	3-23575-0-
Client's Identification	Product Description: Fiberglass sheet #1, 1/4". End Use: Wall lining for interior passager railcar.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:
160 kW Exposure (continued):	
(g) Peak Temperature Readings --	
Room midpoint:	1595 °F; 868 °C
Quadrant #1:	1994 °F; 1090 °C
Quadrant #2:	1466 °F; 797 °C
Quadrant #3:	1265 °F; 685 °C
Quadrant #4:	1326 °F; 719 °C
AVERAGE:	(1529) °F; (832) °C
(h) Peak Carbon Monoxide Reading:	4468 ppm
(i) Peak Carbon Dioxide Reading:	3 percent(%)
(j) Peak Heat Flux at Floor Level:	(22.6) kW/m²
(k) Ignition of Paper Monitors on Floor:	([x] Yes); [ ] No
(l) Lateral Flame Spread --	
8 ft. Wall:	8 ft 0 in
Near 12 ft. Wall:	10 ft 2 in
Far 12 ft. Wall:	2 ft 8 in
(m) Flames Exit Doorway:	([x] Yes); [ ] No
(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:	
(1) Flaming Droplets are observed:	[ ] Yes; [x] No
(2) A fire pool forms beneath the test item:	[ ] Yes; [x] No
(3) If a fire pool occurs, the level of intensity is described as:	[ ] Minor; [ ] Moderate; [ ] Intense
(o) OBSERVATIONS:	

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/14/2017	Letter: A	MM	P.O.#:	Test Report #:	3-23575-0-
Client's Identification	Product Description: Fiberglass sheet #1, 1/4". End Use: Wall lining for interior passager railcar.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Brian Y. Lattimer & Stefan Kraft (Jensen Hughes, Inc.)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [x] Fails

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

DEC 2 6 2017

AUTHORIZED SIGNATURE
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/ac /pm

Test Technician: Michael Magee

(Page 3 of 3)

Bobby Brown

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Figure C 2. December 11, 2017 completed testing

C.1.2 Test 2: Sample 1, Thermoplastic 1 (Completed 12/11/17)

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/11/2017	Letter: E	MM	P.O.#:	Test Report #:	3-23579-0-
Client's Identification	Product Description: Thermoplastic #1. End Use: Various interior pass-rail components.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LR: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.2 "

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 50 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	5 ft 2 in at (mm:ss) 04:42
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	240 kW
(b) Time to Reach Peak:	343 seconds
(c) Total Heat Release --	
5 minutes:	11.9 MJ
10 minutes:	70.2 MJ
15 minutes:	121.7 MJ
(d) Peak Rate of Smoke Release:	4 m^2/s
(e) Time to Reach Peak:	300 seconds
(f) Total Smoke Released --	970.2 m^2

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/11/2017	Letter: E	MM	P.O.#:	Test Report #:	3-23579-0-
Client's Identification	Product Description: Thermoplastic #1. End Use: Various interior pass-rail components.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

CATEGORY:	RESULTS:
160 kW Exposure (continued):	
(g) Peak Temperature Readings --	
Room midpoint:	804 °F; 429 °C
Quadrant #1:	1154 °F; 623 °C
Quadrant #2:	803 °F; 428 °C
Quadrant #3:	682 °F; 361 °C
Quadrant #4:	677 °F; 358 °C
AVERAGE:	824 °F; 440 °C
(h) Peak Carbon Monoxide Reading:	603 ppm
(i) Peak Carbon Dioxide Reading:	1 percent(%)
(j) Peak Heat Flux at Floor Level:	3.3 kW/m²
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No
(l) Lateral Flame Spread --	
0 ft. Wall:	3 ft 0 in
Near 12 ft. Wall:	4 ft 2 in
Far 12 ft. Wall:	0 ft 0 in
(m) Flames Exit Doorway:	[ ] Yes; [x] No
(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:	
(1) Flaming Droplets are observed:	[x] Yes; [ ] No
(2) A fire pool forms beneath the test item:	[x] Yes; [ ] No
(3) If a fire pool occurs, the level of intensity is described as:	[ ] Minor; [x] Moderate; [ ] Intense
(o) OBSERVATIONS:	

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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Received: 12/06/2017	Completed: 12/11/2017	Letter: E	MM	P.O.#:	Test Report #:	3-23579-0-
Client's Identification	Product Description: Thermoplastic #1. End Use: Various interior pass-rail components.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675
Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Brian Y. Lattime & Stefan Kraft (Jensen Hughes, Inc)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[x] Passes; [ ] Fails

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

DEC 2 6 2017

AUTHORIZED SIGNATURE
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/ac /pm

Test Technician: Michael Magee

(Page 3 of 3)

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Figure C 3. Test 2, sample 1

C.1.3 Test 3: Sample 2, Sandwich Composite 1 (Completed 12/12/17)

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/12/2017	Letter: B	MM	P.O.#:	Test Report #:	3-23576-0-

Client's Identification	Product Description: Sandwich panels #1 (Aluminum Plywood Steel) . End Use: Wall lining & Bulkheads in Railcar Passenger .

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.5 "

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 60 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	5 ft 0 in at (mm:ss) 04:40
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	653 kW
(b) Time to Reach Peak:	535 seconds
(c) Total Heat Release --	
5 minutes:	9.4 MJ
10 minutes:	NA MJ
15 minutes:	NA MJ
(d) Peak Rate of Smoke Release:	11 m^3/s
(e) Time to Reach Peak:	556 seconds
(f) Total Smoke Released --	697.1 m^3

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/12/2017	Letter: B	MM	P.O.#:	Test Report #:	3-23576-0-
Client's Identification	Product Description: Sandwich panels #1 (Aluminum Plywood Steel) . End Use: Wall lining & Bulkheads in Railcar Passenger .					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY: RESULTS:

160 kW Exposure (continued):

(g) Peak Temperature Readings --

Room midpoint:	1390 °F;	754 °C
Quadrant #1:	1723 °F;	939 °C
Quadrant #2:	1381 °F;	749 °C
Quadrant #3:	1270 °F;	688 °C
Quadrant #4:	1207 °F;	653 °C
AVERAGE:	(1394) °F;	(757) °C

(h) Peak Carbon Monoxide Reading: 4933 ppm

(i) Peak Carbon Dioxide Reading: 4 percent (%)

(j) Peak Heat Flux at Floor Level: (20.3) kW/m²

(k) Ignition of Paper Monitors on Floor: [ ] Yes; [x] No

(l) Lateral Flame Spread --

0 ft. Wall:	6 ft 8 in
Near 12 ft. Wall:	7 ft 4 in
Far 12 ft. Wall:	0 ft 0 in

(m) Flames Exit Doorway: [x] Yes; [ ] No

(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:

(1) Flaming Droplets are observed: [ ] Yes; [x] No
(2) A fire pool forms beneath the test item: [ ] Yes; [x] No
(3) If a fire pool occurs, the level of intensity is described as: [ ] Minor; [ ] Moderate; [ ] Intense

(o) OBSERVATIONS:

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/12/2017	Letter: B	MM	P.O.#:	Test Report #:	3-23576-0-
Client's Identification	Product Description: Sandwich panels #1 (Aluminum Plywood Steel) . End Use: Wall lining & Bulkheads in Railcar Passenger .					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675
Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Stefan Kraft (Jensen Hughes, Inc.)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [x] Fails

Bobby Brown

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

AUTHORIZED SIGNATURE
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/ac /pm

Test Technician: Michael Magee

DEC 26 2017

Figure C 4. Test 3, sample 2

C.1.4 Test 4: Sample 5, Thermoplastic 2 (Completed 12/12/17)

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Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/12/2017	Letter: C	MM	P.O.#:	Test Report #:	3-23577-0-
Client's Identification	Product Description: Thermoplastic #2. End Use: Various interior components for passenger railcars.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.150 *

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 50 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	8 ft 0 in at (mm:ss) 04:48
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	271 kW
(b) Time to Reach Peak:	320 seconds
(c) Total Heat Release --	
5 minutes:	15.3 MJ
10 minutes:	81.5 MJ
15 minutes:	136.1 MJ
(d) Peak Rate of Smoke Release:	6 m²/s
(e) Time to Reach Peak:	347 seconds
(f) Total Smoke Released --	962.4 m²

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Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/12/2017	Letter: C	MM	P.O.#:	Test Report #:	3-23577-0-
Client's Identification	Product Description: Thermoplastic #2. End Use: Various interior components for passenger railcars.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:
160 kW Exposure (continued):	
(g) Peak Temperature Readings --	
Room midpoint:	948 °F; 509 °C
Quadrant #1:	1367 °F; 742 °C
Quadrant #2:	883 °F; 473 °C
Quadrant #3:	737 °F; 392 °C
Quadrant #4:	722 °F; 383 °C
AVERAGE:	931 °F; 499 °C
(h) Peak Carbon Monoxide Reading:	1720 ppm
(i) Peak Carbon Dioxide Reading:	2 percent (%)
(j) Peak Heat Flux at Floor Level:	4.7 kW/m²
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No
(l) Lateral Flame Spread --	
8 ft. Wall:	5 ft 8 in
Near 12 ft. Wall:	6 ft 0 in
Far 12 ft. Wall:	0 ft 0 in
(m) Flames Exit Doorway:	[ ] Yes; [x] No
(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:	
(1) Flaming Droplets are observed:	[x] Yes; [ ] No
(2) A fire pool forms beneath the test item:	[x] Yes; [ ] No
(3) If a fire pool occurs, the level of intensity is described as:	[ ] Minor; [ ] Moderate; [x] Intense
(o) OBSERVATIONS:	

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/12/2017	Letter: C	MM	P.O.#:	Test Report #:	3-23577-0-
Client's Identification	Product Description: Thermoplastic #2. End Use: Various interior components for passenger railcars.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Stefan Kraft (Jensen Hughes, Inc)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [x] Fails

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above. DEC 26 2017

---------- Test Technician: Michael Magee
AUTHORIZED SIGNATURE
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/ac /pm

(Page 3 of 3)

Bobby Brown

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/13/2017	Letter: D	MM	P.O.#:	Test Report #:	3-23578-0-
Client's Identification	Product Description: Sandwich panel #2 alum-balsa-stainless. End Use: Cab ceiling panel.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.64 "

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 50 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	5 ft 0 in at (mm:ss) 04:50
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	931 kW
(b) Time to Reach Peak:	360 seconds
(c) Total Heat Release --	
5 minutes:	12.8 MJ
10 minutes:	NA MJ
15 minutes:	NA MJ
(d) Peak Rate of Smoke Release:	16 m^2/s
(e) Time to Reach Peak:	397 seconds
(f) Total Smoke Released --	612 m^2

(Page 1 of 3)

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Figure C 5. Test 4, sample 5

C.1.5 Test 5: Sample 3, Sandwich Composite 2 (Completed 12/13/17)

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Farmingdale, New York 11735-5628 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/13/2017	Letter: D	MM	P.O.#:	Test Report #:	3-23578-0-
Client's Identification	Product Description: Sandwich panel #2 alum-balsa-stainless. End Use: Cab ceiling panel.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:	
160 kW Exposure (continued):		
(g) Peak Temperature Readings --		
Room midpoint:	1321 °F;	716 °C
Quadrant #1:	1619 °F;	882 °C
Quadrant #2:	1345 °F;	729 °C
Quadrant #3:	1102 °F;	594 °C
Quadrant #4:	1205 °F;	652 °C
AVERAGE:	(1318) °F;	(714) °C
(h) Peak Carbon Monoxide Reading:	2294 ppm	
(i) Peak Carbon Dioxide Reading:	3 percent(%)	
(j) Peak Heat Flux at Floor Level:	(22.1) kW/m²	
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No	
(l) Lateral Flame Spread --		
8 ft. Wall:	6 ft 8 in	
Near 12 ft. Wall:	7 ft 4 in	
Far 12 ft. Wall:	0 ft 0 in	
(m) Flames Exit Doorway:	[x] Yes; [ ] No	
(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:		
(1) Flaming Droplets are observed:	[ ] Yes; [x] No	
(2) A fire pool forms beneath the test item:	[ ] Yes; [x] No	
(3) If a fire pool occurs, the level of intensity is described as:	[ ] Minor; [ ] Moderate; [ ] Intense	
(o) OBSERVATIONS:		

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

(Page 2 of 3)

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/13/2017	Letter: D	MM	P.O.#:	Test Report #:	3-23578-0-
Client's Identification	Product Description: Sandwich panel #2 alum-balsa-stainless. End Use: Cab ceiling panel.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Stefan Kraft (Jensen Hughes Inc.)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [x] Fails

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

DEC 2 6 2017

AUTHORIZED SIGNATURE
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/ac /pm

Test Technician: Michael Magee

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Bobby Brown

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Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/13/2017	Letter: G	MM	P.O.#:	Test Report #:	3-23581-0-
Client's Identification	Product Description: Thermoplastic #3. End Use: LED covering panel.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.177"

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 60 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	8 ft 0 in at (mm:ss) 02:15
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	(1016) kW
(b) Time to Reach Peak:	179 seconds
(c) Total Heat Release --	
5 minutes:	NA MJ
10 minutes:	NA MJ
15 minutes:	NA MJ
(d) Peak Rate of Smoke Release:	7 m^2/s
(e) Time to Reach Peak:	196 seconds
(f) Total Smoke Released --	191.5 m^2

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Figure C 6. Test 5, sample 3

C.1.6 Test 6: Sample 4, Thermoplastic 3 (Completed 12/13/17)

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Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8958
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/13/2017	Letter: G	MM	P.O.#:	Test Report #:	3-23581-0-
Client's Identification	Product Description: Thermoplastic #3. End Use: LED covering panel.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:	
160 kW Exposure (continued):		
(g) Peak Temperature Readings --		
Room midpoint:	1256 °F;	680 °C
Quadrant #1:	1674 °F;	912 °C
Quadrant #2:	1255 °F;	679 °C
Quadrant #3:	1033 °F;	556 °C
Quadrant #4:	1083 °F;	584 °C
AVERAGE:	1260 °F;	682 °C
(h) Peak Carbon Monoxide Reading:	1257 ppm	
(i) Peak Carbon Dioxide Reading:	2 percent(%)	
(j) Peak Heat Flux at Floor Level:	15.0 kW/m²	
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No	
(l) Lateral Flame Spread --		
0 ft. Wall:	7 ft 6 in	
Near 12 ft. Wall:	8 ft 0 in	
Far 12 ft. Wall:	0 ft 0 in	
(m) Flames Exit Doorway:	[x] Yes; [ ] No	

(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:

(1) Flaming Droplets are observed:	[x] Yes; [ ] No	
(2) A fire pool forms beneath the test item:	[x] Yes; [ ] No	
(3) If a fire pool occurs, the level of intensity is described as:	[x] Minor; [ ] Moderate; [ ] Intense	

(o) OBSERVATIONS:

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/13/2017	Letter: G	MM	P.O.#:	Test Report #:	3-23581-0-
Client's Identification	Product Description: Thermoplastic #3. End Use: LED covering panel.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

PLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Stefan Kraft (Jensen Hughes Inc.)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [x] Fails

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

AUTHORIZED SIGNATURE
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/ac /pm

Test Technician: Michael Mage DEC 26 2017

Bobby Brown

Govmark

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e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/14/2017	Letter: F	MM	P.O.#:	Test Report #:	3-23580-0-
Client's Identification	Product Description: Fiberglass #2. End Use: Interior panel.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: 7 days /jd
NFPA 286: LR: 2015; V 03/15; NE 2019

APPROXIMATE THICKNESS OF SUBMITTED MATERIAL (as measured by Govmark): 0.139 "

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 50 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	4 ft 6 in at (mm:ss) 04:35
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	191 kW
(b) Time to Reach Peak:	510 seconds
(c) Total Heat Release --	
5 minutes:	9.0 MJ
10 minutes:	61.0 MJ
15 minutes:	112.1 MJ
(d) Peak Rate of Smoke Release:	0 m^2/s
(e) Time to Reach Peak:	359 seconds
(f) Total Smoke Released --	121.9 m^2

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Figure C 7. Test 6, sample 4

C.1.7 Test 7: Sample 7, FRP2: (Completed 12/14/17)

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Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/14/2017	Letter: F	MM	P.O.#:	Test Report #:	3-23580-0-
Client's Identification	Product Description: Fiberglass #2. End Use: Interior panel.					

Tested For: Brian Y. Lattimer
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:	
160 kW Exposure (continued):		
(g) Peak Temperature Readings --		
Room midpoint:	779 °F;	415 °C
Quadrant #1:	965 °F;	518 °C
Quadrant #2:	799 °F;	426 °C
Quadrant #3:	654 °F;	346 °C
Quadrant #4:	691 °F;	366 °C
AVERAGE:	778 °F;	414° C
(h) Peak Carbon Monoxide Reading:	4 ppm	
(i) Peak Carbon Dioxide Reading:	1 percent(%)	
(j) Peak Heat Flux at Floor Level:	3.9 kW/m²	
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No	
(l) Lateral Flame Spread --		
8 ft. Wall:	3 ft 0 in	
Near 12 ft. Wall:	3 ft 2 in	
Far 12 ft. Wall:	0 ft 0 in	
(m) Flames Exit Doorway:	[ ] Yes; [x] No	

(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:

(1) Flaming Droplets are observed:	[ ] Yes; [x] No
(2) A fire pool forms beneath the test item:	[ ] Yes; [x] No
(3) If a fire pool occurs, the level of intensity is described as:	[ ] Minor; [ ] Moderate; [ ] Intense

(o) OBSERVATIONS:

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 12/06/2017	Completed: 12/14/2017	Letter: F	MM	P.O.#:	Test Report #:	3-23580-0-
Client's Identification	Product Description: Fiberglass #2. End Use: Interior panel.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) WIT 3675
Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

REMARKS: Test was conducted in the presence of Stefan Kraft (Jensen Hughes Inc.)

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[x] Passes; [ ] Fails

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

Bobby Brown

Test Technician: Michael Magee

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(Page 3 of 3)

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Figure C 8. Test 7, sample 7

C.2 NFPA 286 Test Data Plots

This section presents the test data plots for the seven materials tested in accordance with NFPA 286. The plots included the gas temperature, gas concentrations and floor heat flux for each test.

C.2.1 Test 1: Sample 6 (FRP1)

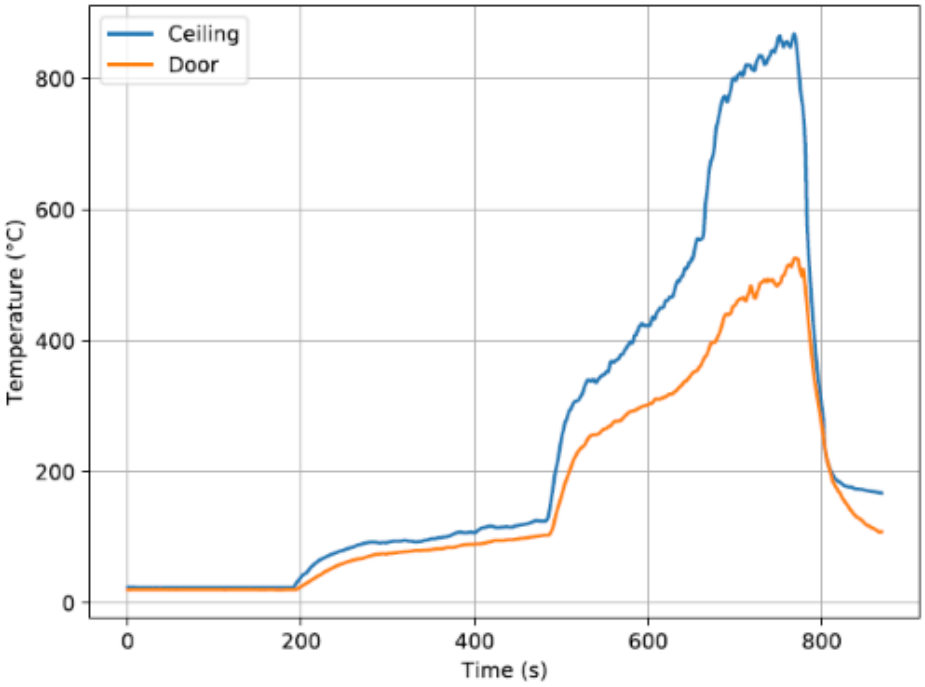

Figure C 9. Temperature vs. time for Sample 6

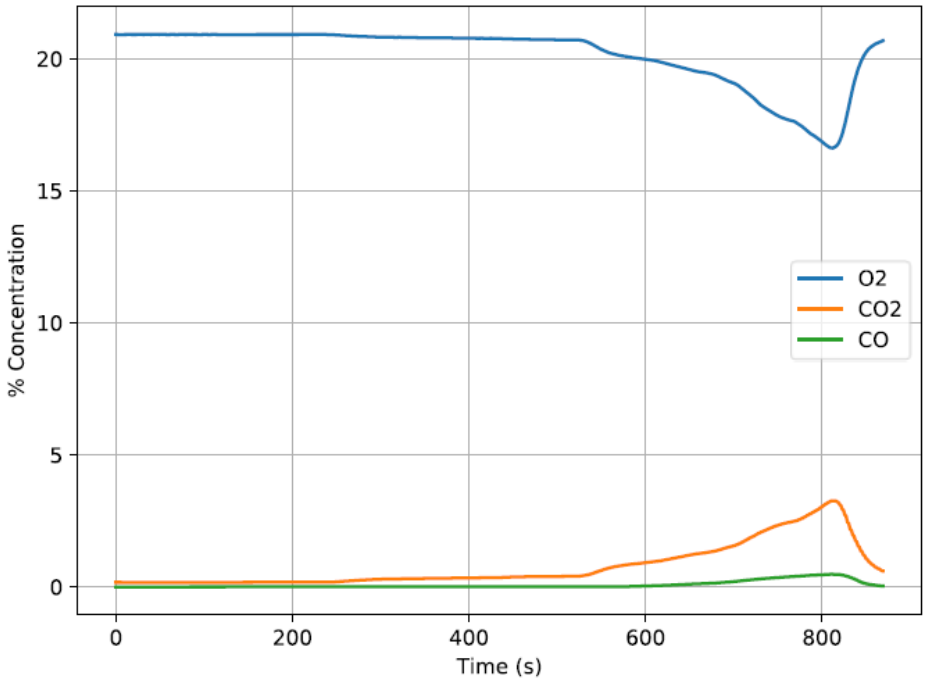

Figure C 10. Gas concentrations for Sample 6

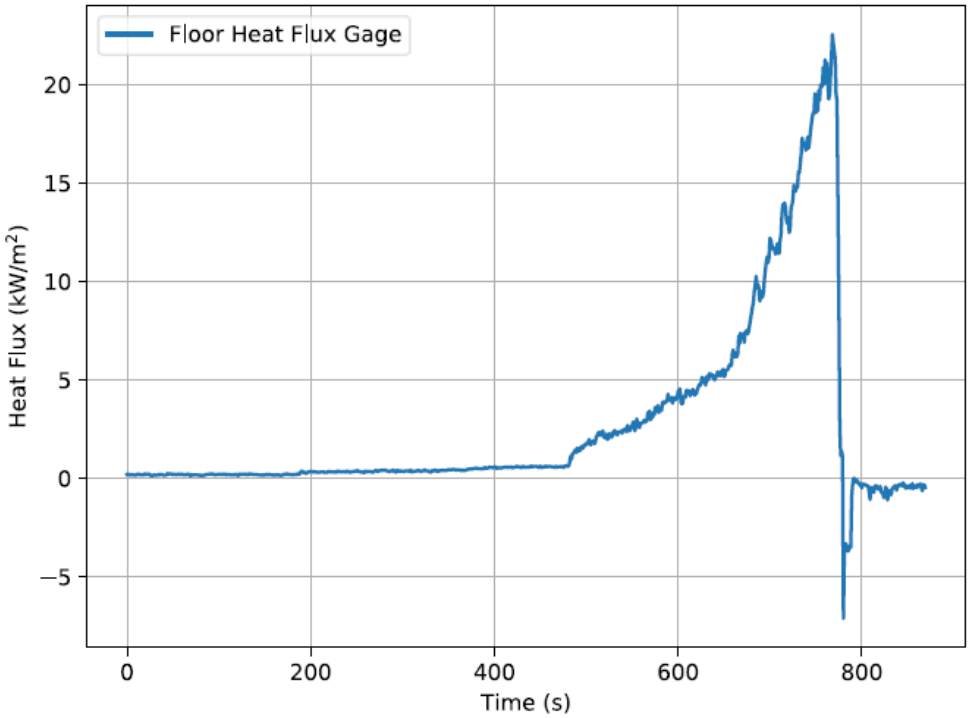

Figure C 11. Floor heat flux for Sample 6

C.2.2 Test 2: Sample 1 (Thermoplastic 1)

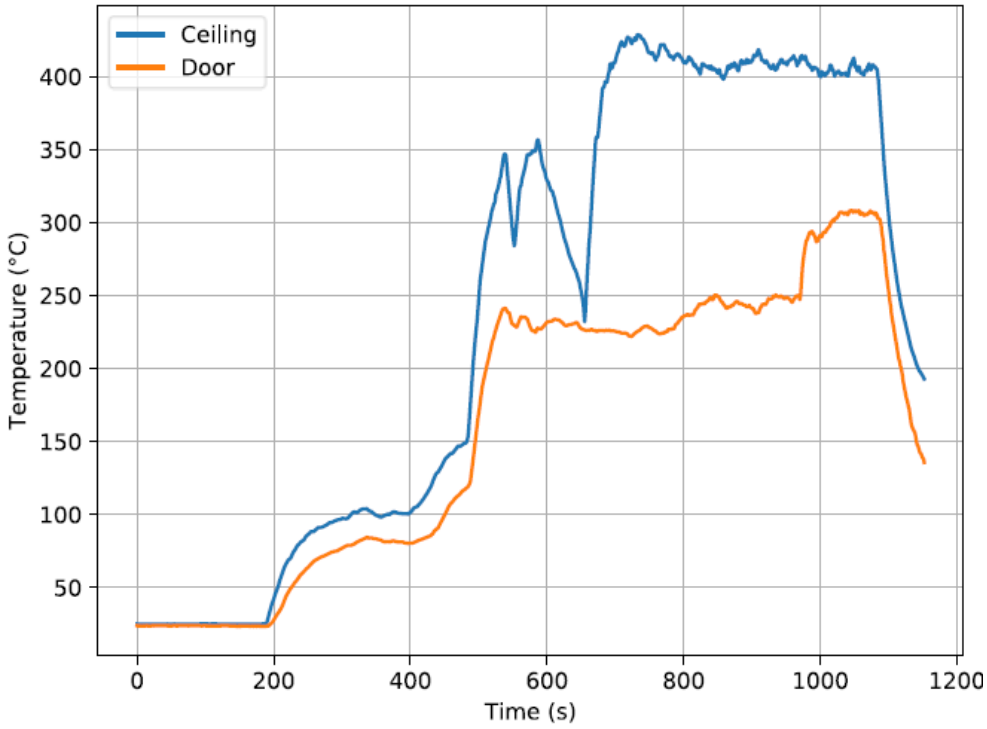

Figure C 12. Temperature vs. time for Sample 1

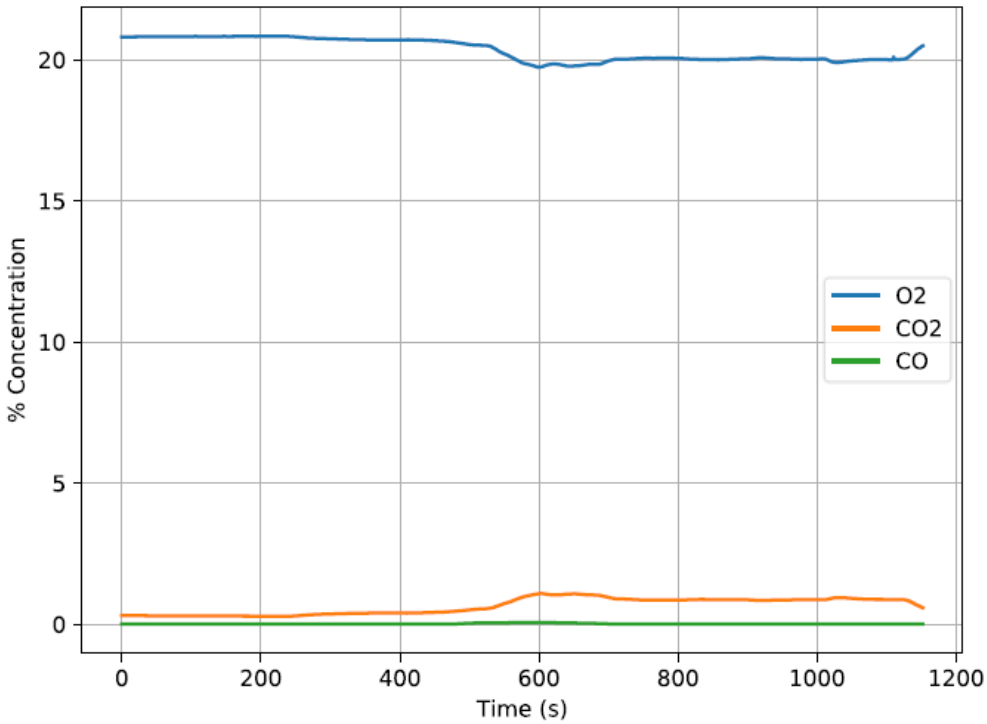

Figure C 13. Gas concentrations for Sample 1

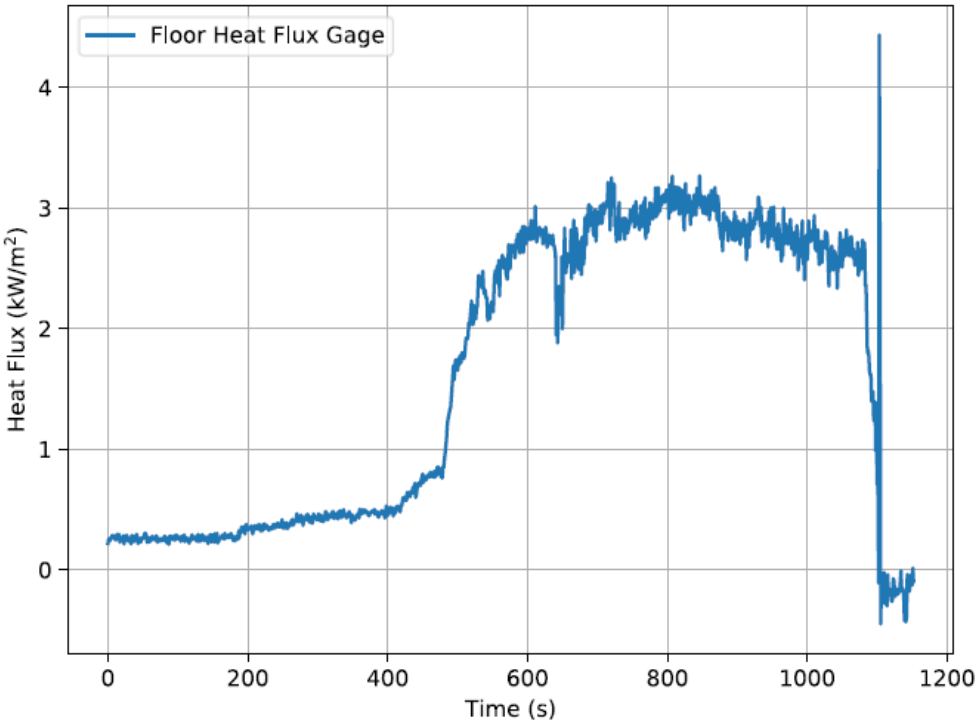

Figure C 14. Floor heat flux for Sample 1

C.2.3 Test 3: Sample 2 (Sandwich Composite 1)

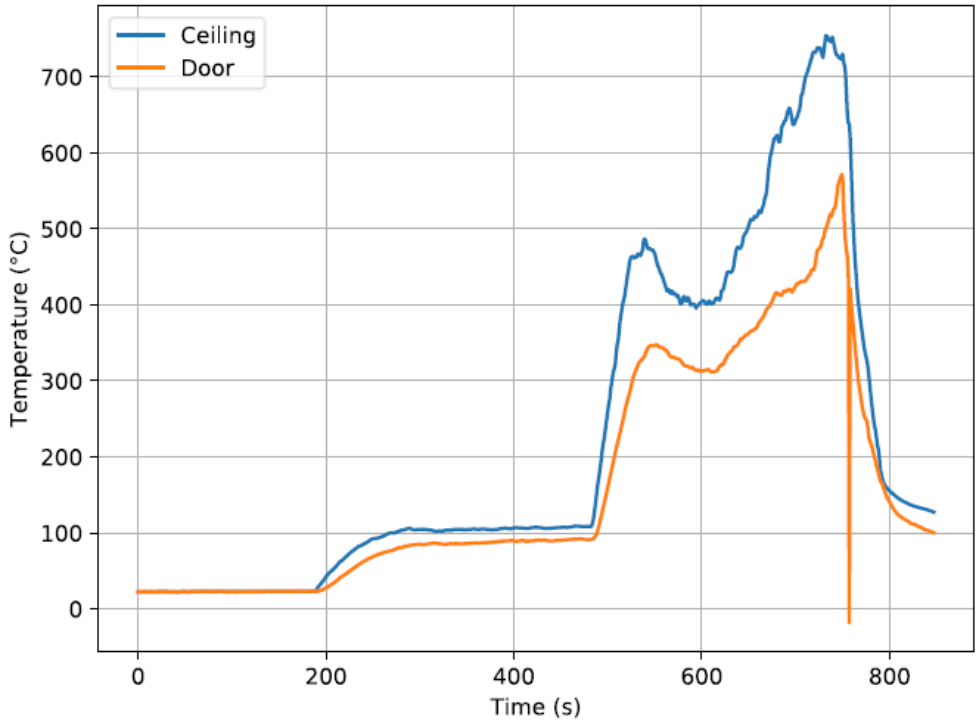

Figure C 15. Temperature vs. time for Sample 2

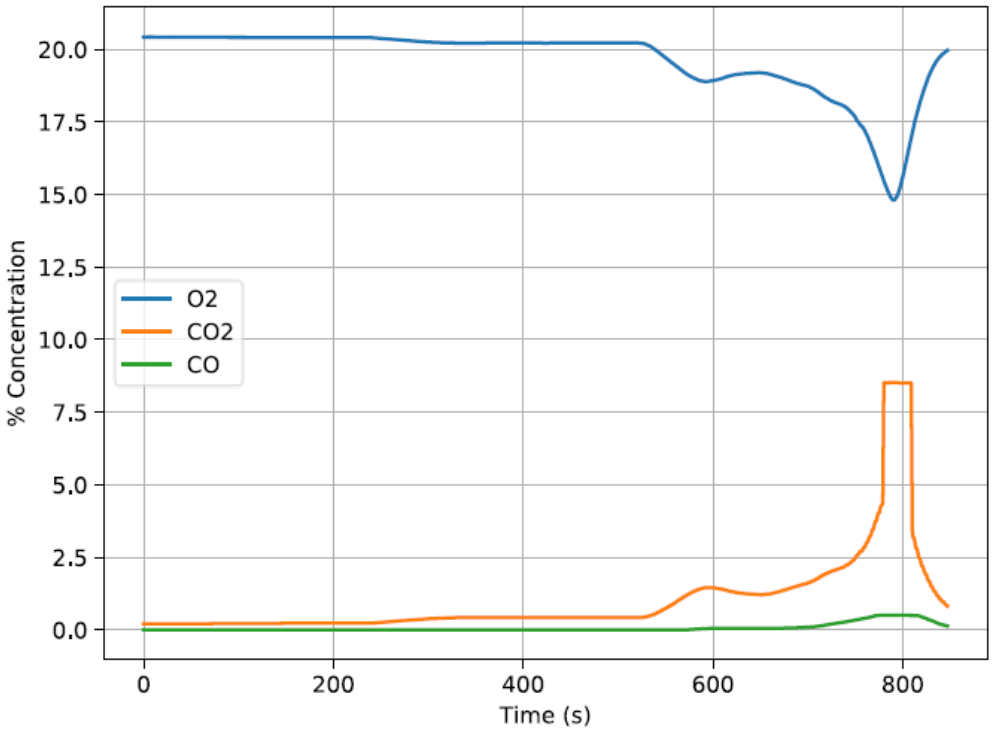

Figure C 16. Gas concentrations for Sample 2

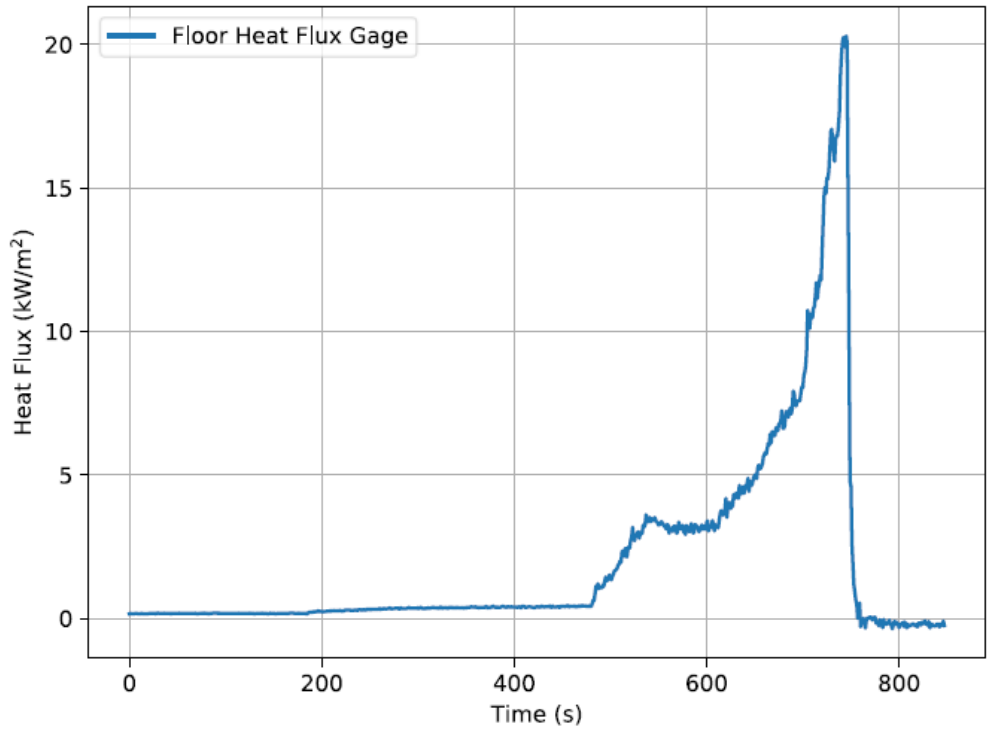

Figure C 17. Floor heat flux for Sample 2

C.2.4 Test 4: Sample 5 (Thermoplastic 2)

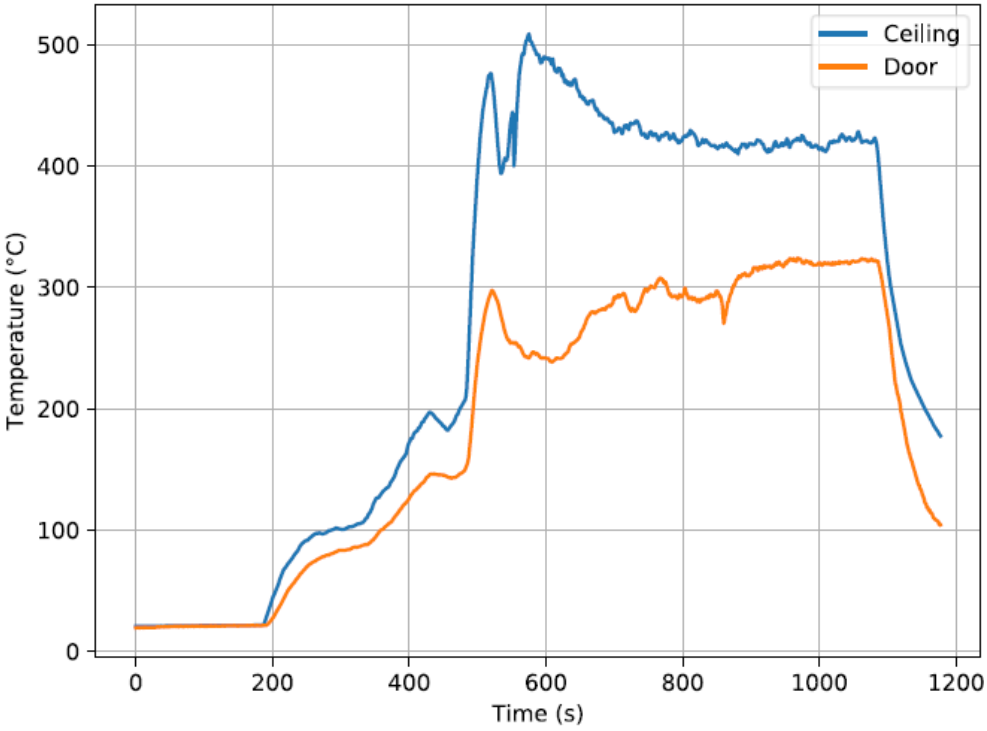

Figure C 18. Temperature vs. time for Sample 5

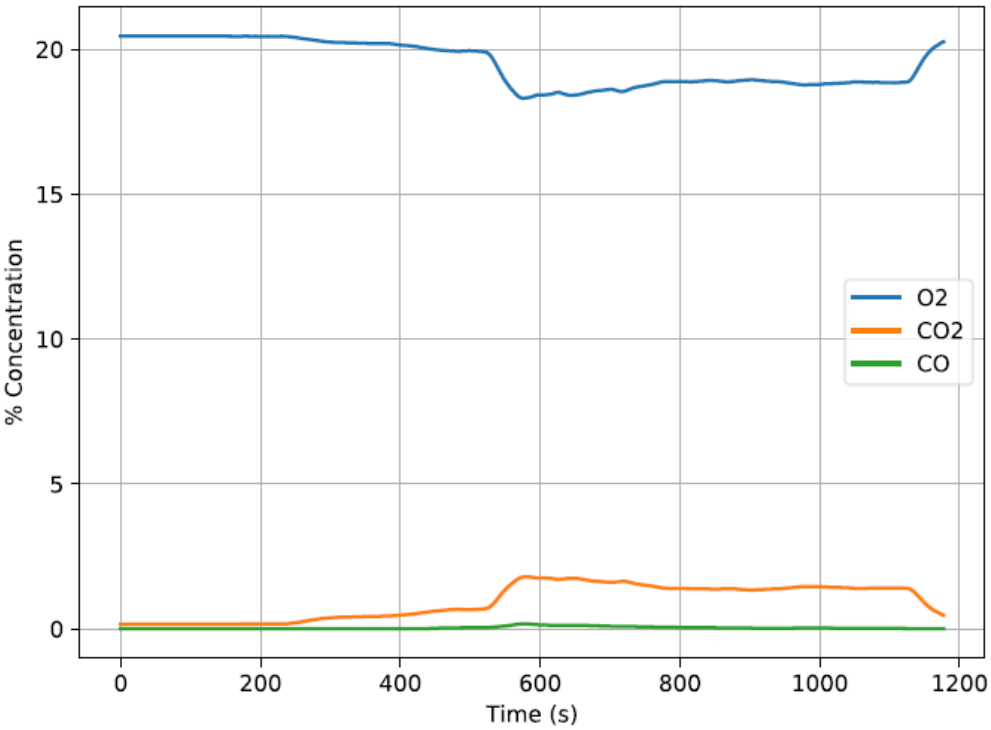

Figure C 19. Gas concentrations for Sample 5

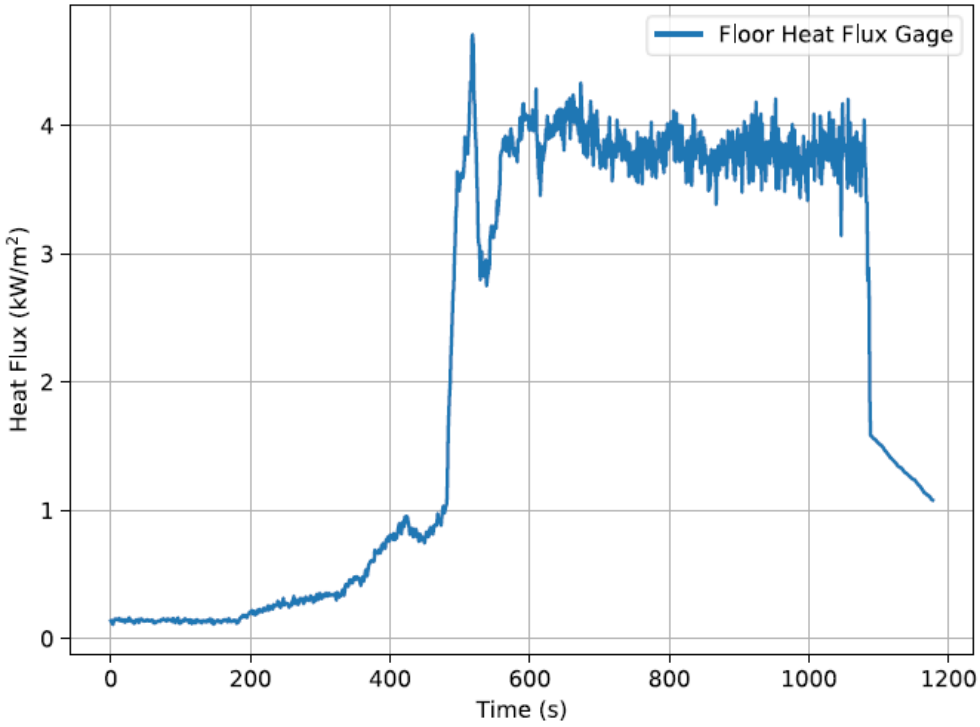

Figure C 20. Floor heat flux for Sample 5

C.2.5 Test 5: Sample 3 (Sandwich Composite 2)

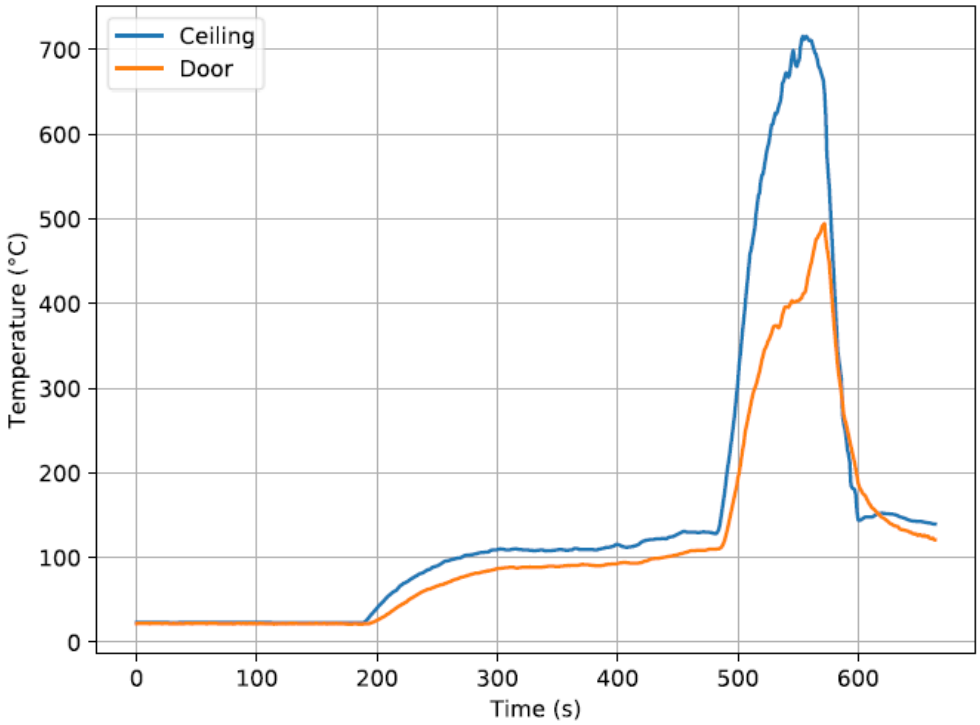

Figure C 21. Temperature vs. time for Sample 3

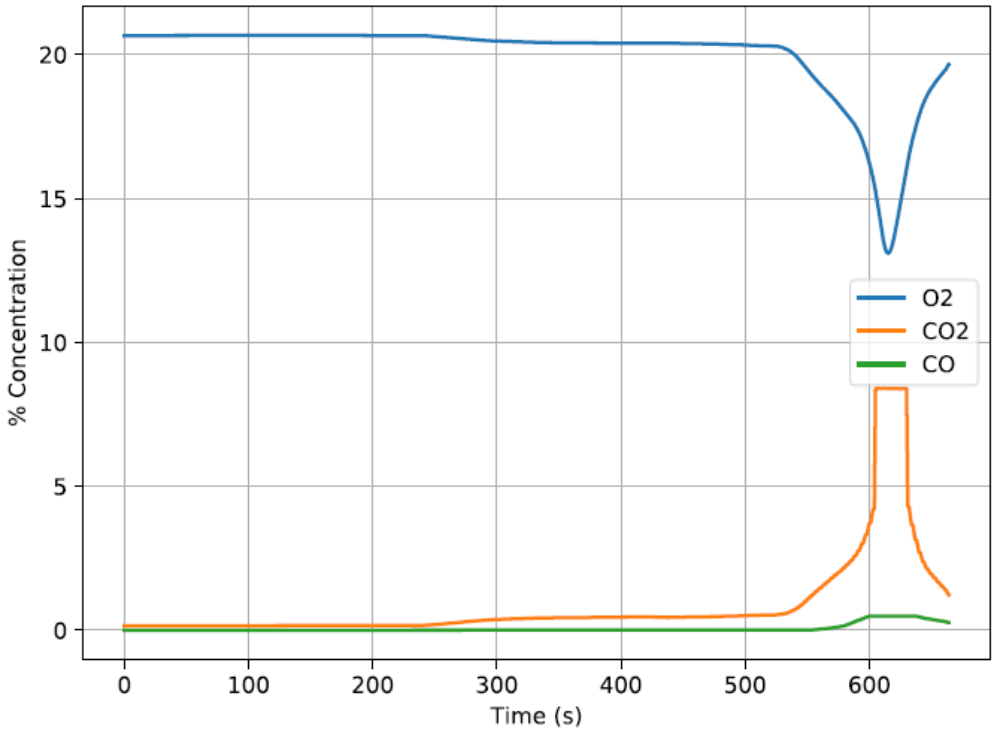

Figure C 22. Gas concentrations for Sample 3

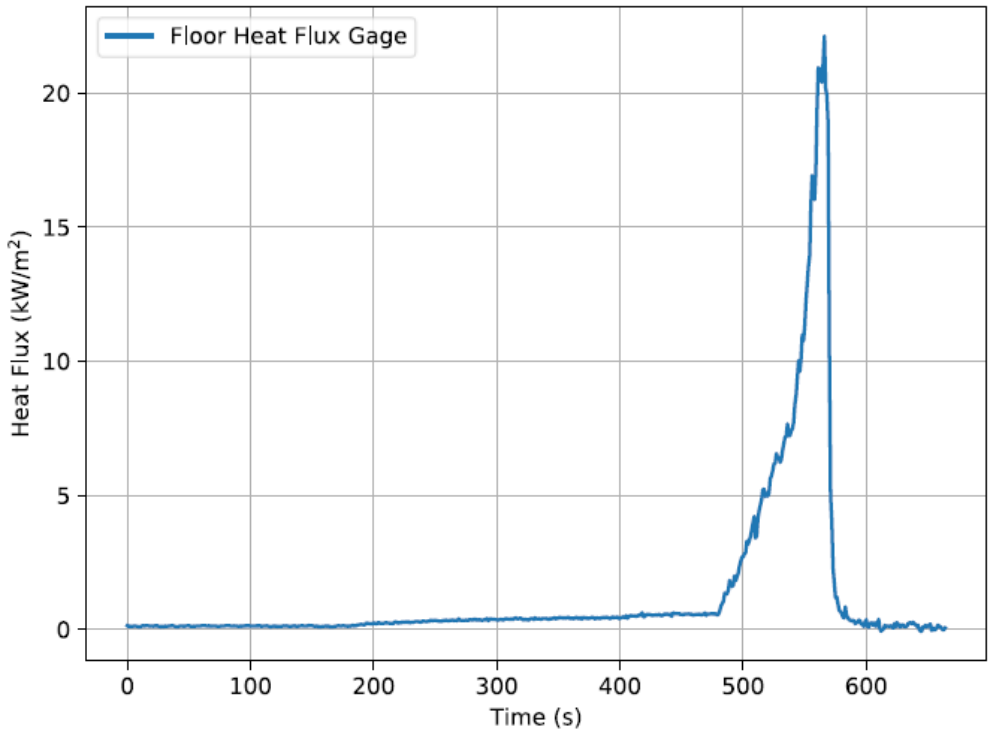

Figure C 23. Floor heat flux for Sample 3

C.2.6 Test 6: Sample 4 (Thermoplastic 3)

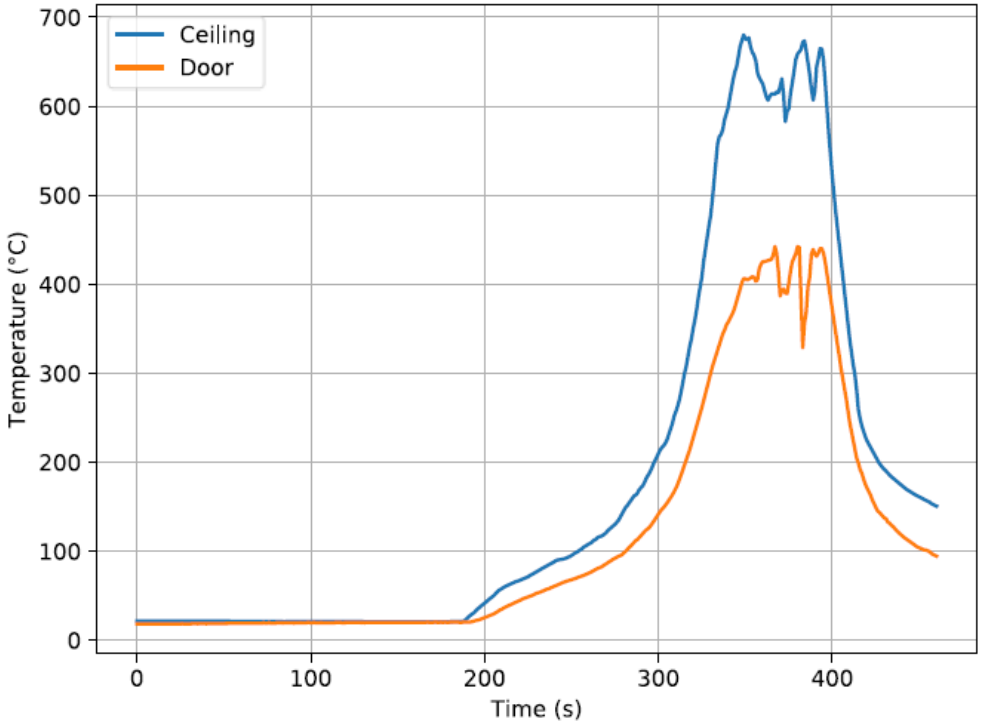

Figure C 24. Temperature vs. time for Sample 4

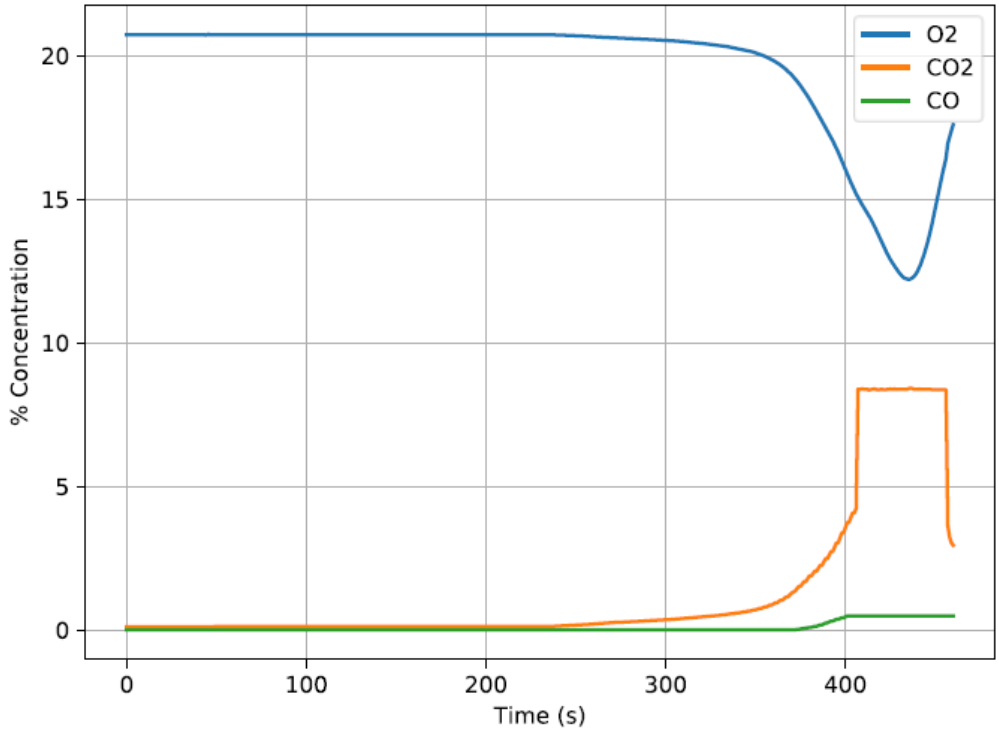

Figure C 25. Gas concentrations for Sample 4

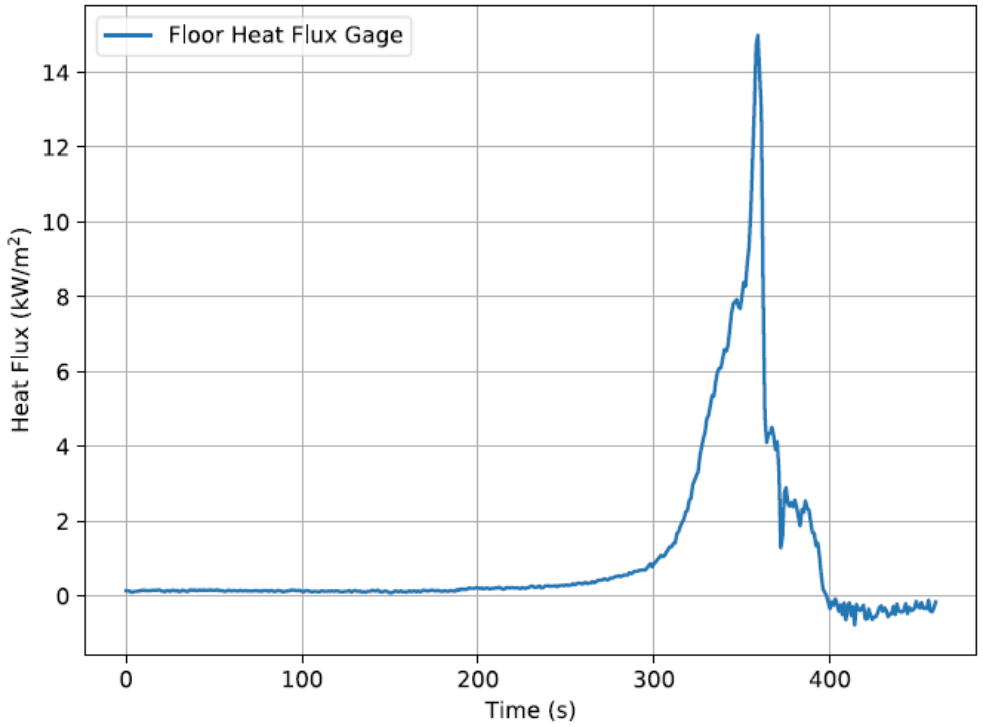

Figure C 26. Floor heat flux for Sample 4

C.2.7 Test 7: Sample 7 (FRP2)

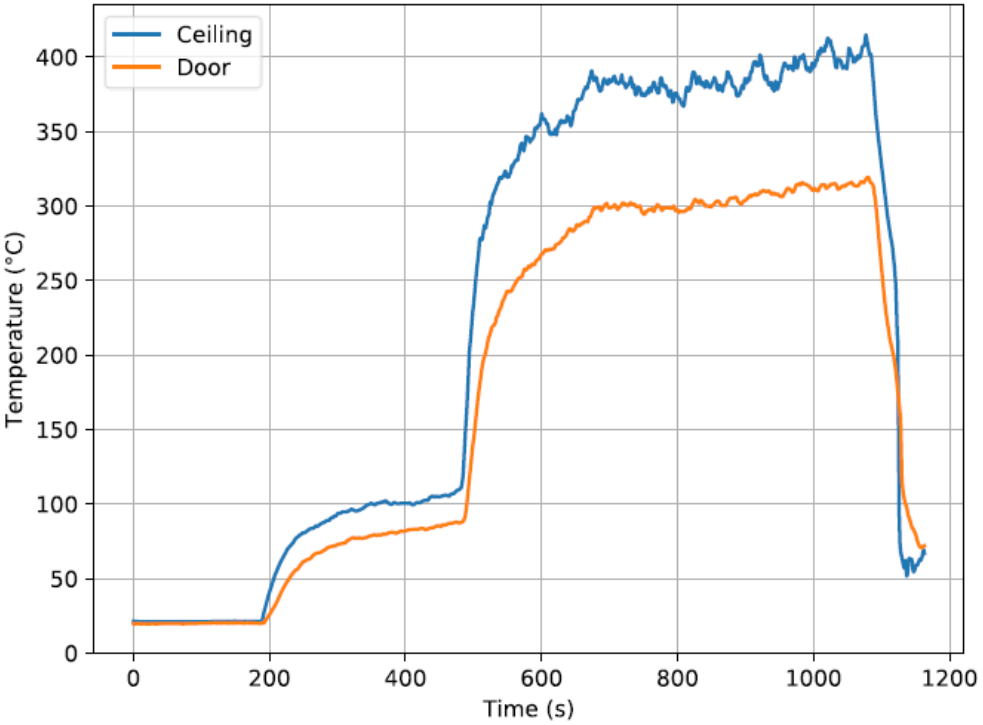

Figure C 27. Temperature vs. time for Sample 7

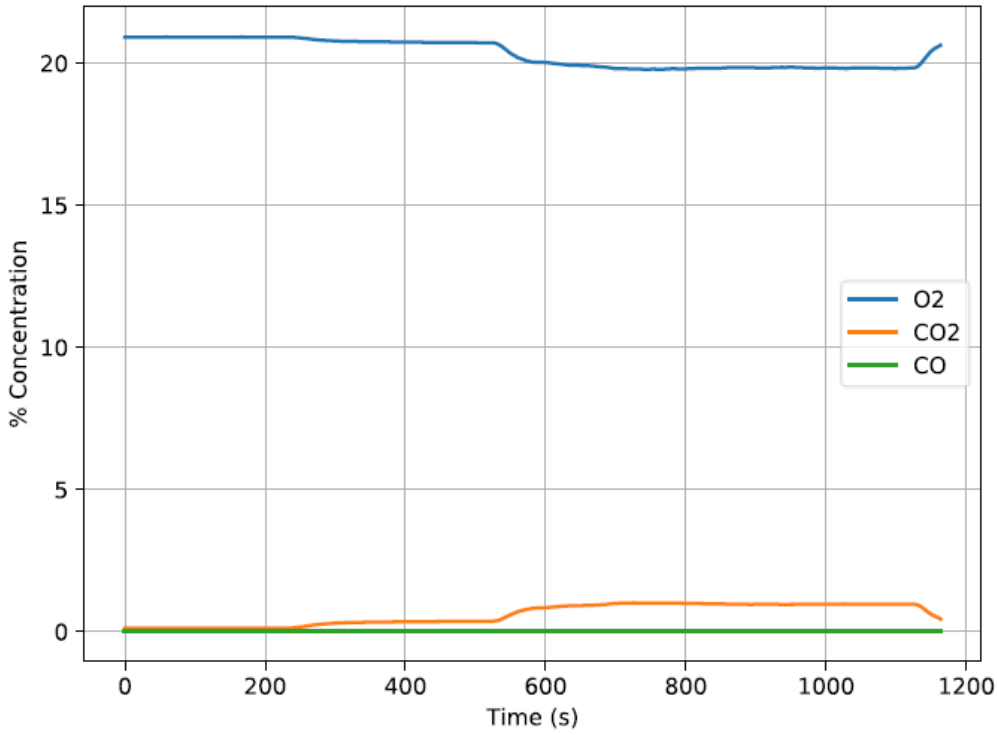

Figure C 28. Gas concentrations for Sample 7

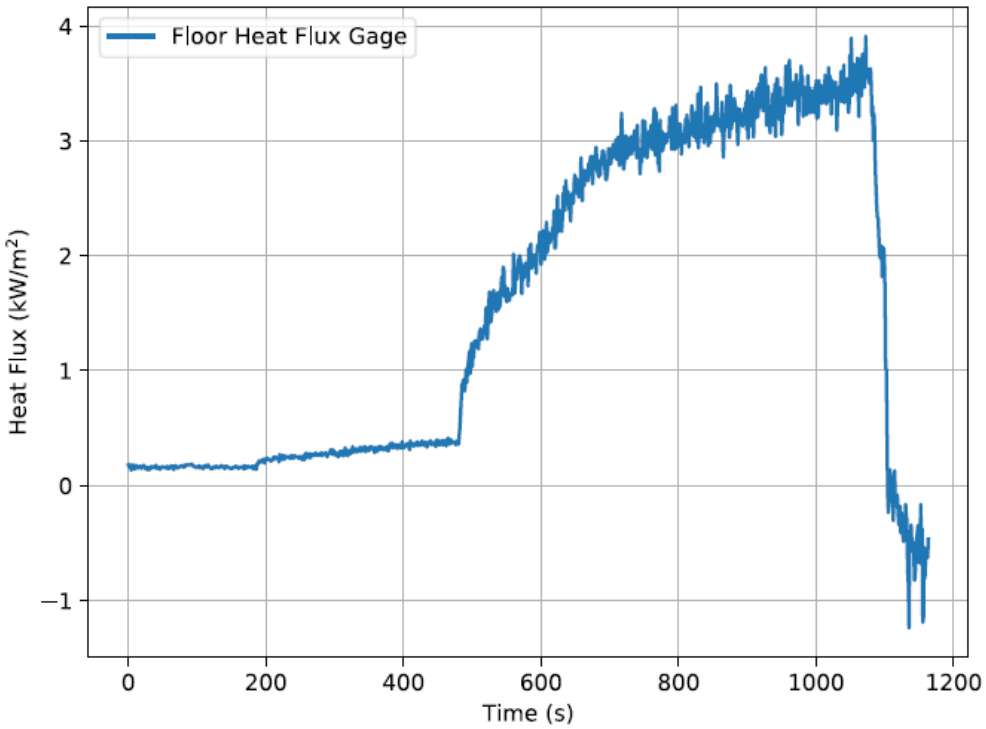

Figure C 29. Floor heat flux for Sample 7

C.3 NFPA 286 Test Photos

This section provides the photos that were taken before, during and after the NFPA 286 tests.

C.3.1 Test 1: Sample 6 (FRP1)

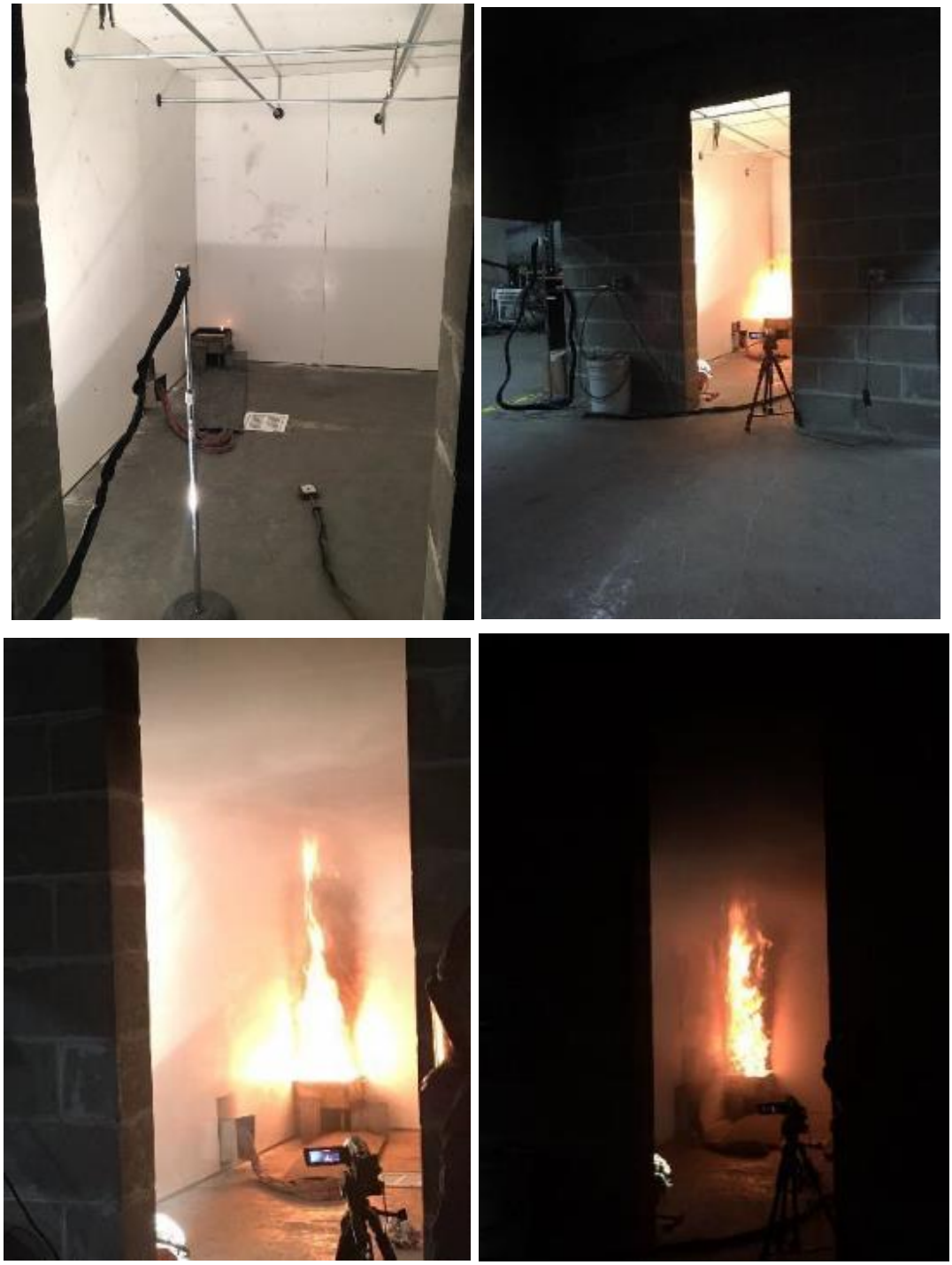

Figure C 30. Test 1, sample 6

C.3.2 Test 2: Sample 1 (Thermoplastic 1)

Figure C 31. Test 2, sample 1

C.3.3 Test 3: Sample 2 (Sandwich Composite 1)

Figure C 32. Test 3, sample 2

C.3.4 Test 4: Sample 5 (Thermoplastic 2)

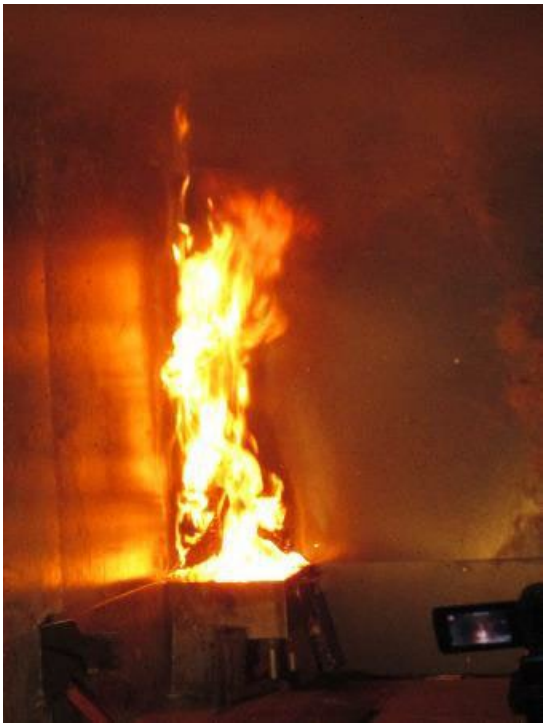

Figure C 33. Test 4, sample 5

C.3.5 Test 5: Sample 3 (Sandwich Composite 2)

Figure C 34. Test 5, sample 3

C.3.6 Test 6: Sample 4 (Thermoplastic 3)

Figure C 35. Test 6, sample 4

C.3.7 Test 7: Sample 7 (FRP 2)

Figure C 36. Test 7, sample 7

Appendix D.
FDS Prediction of Building Materials in NFPA 286 Room-corner Tests

The NFPA 286 room-corner tests of building materials were modeled, and the results are presented in this section. In the FDS modeling, a HRRPUA material burning model was used. The peak values and time history of HRRPUA from the 50 kW/m2 cone calorimeter tests were used to define the burning rate.[2] The prediction of heat release rate of the room and center ceiling temperature are presented and compared with experimental data.[3]

The 6mm (0.24 in) plywood, 5mm (0.2 in) wood panel, and 6mm (0.24 in) chipboard are all predicted to cause flashover in the room-corner tests. The predictions in HRR, center ceiling temperature and time-to-flashover are overall consistent experimental data, as shown in Figure D 1 through Figure D 5. There were two tests of 6mm plywood, and the data variation was substantial. FDS model predictions are bounded by the data from the two tests and closer to those of Test 1, in which the burning of plywood was more intense. The burning of 6mm chipboard was also very intense and the flashover occurred before 300s. The time-to-flashover was over-predicted by about 80s, as shown in Figure D 2.

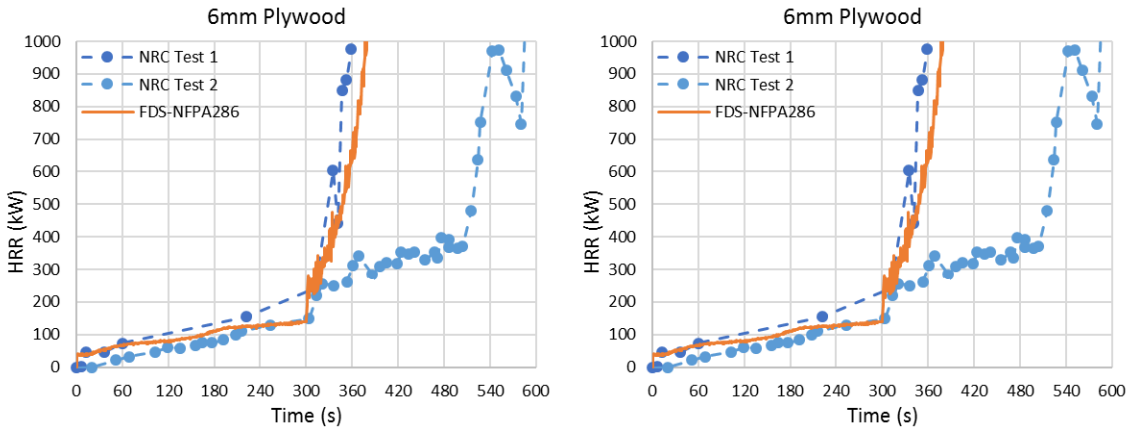

Figure D 1. Time history of HRR (left) and center ceiling temperature (right) of 6 mm plywood tested in NFPA 286 room and FDS

[2] A. Kim and R. Onno, "Results of Cone Calorimeter Tests Conducted at the NFL/IRC," 1992.

[3] A. Kim and R. Onno, "Inter-Laboratory Study for the Full Scale Room Fire Test: Results of Tests Conducted at the NFL/IRC," NRC-CNRC Intern. Rep. No. 634, 1992.

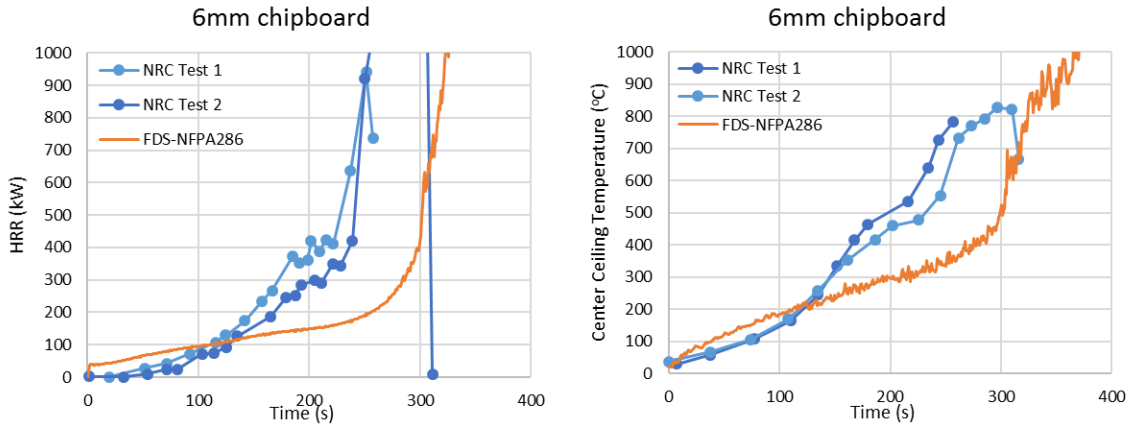

Figure D 2. Time history of HRR (left) and center ceiling temperature (right) of 6 mm chipboard tested in NFPA 286 room and FDS

No flashover was predicted to occur for both 12 mm (0.47 in) fire retarded plywood and 3 mm (0.12 in) wood panel in the room-corner tests. For 12 mm fire retarded plywood, the HRR and center ceiling temperature were predicted to increase after 300 s, as shown in Figure D 4. The materials ignited but not intense enough to cause flashover. For 3 mm wood panel, the materials were found to burn in the first 300 s of the test but did not last long enough to cause flashover. The contribution of the material during the first 300 s was not as pronounced in the FDS prediction, but in reasonable agreement from 300 to 600 s. The model predicted no flashover after a 600-s exposure, similar to the test data. The test was terminated at 600 s (see footnote 3).

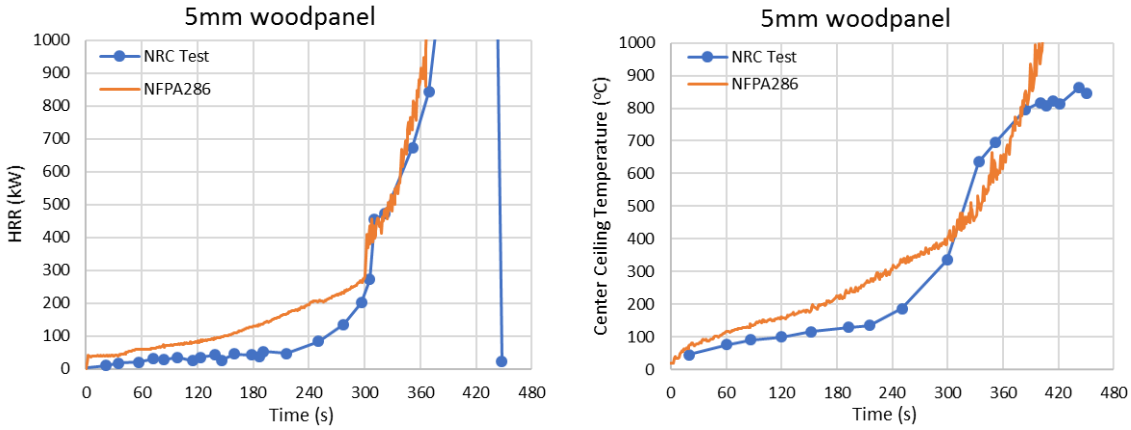

Figure D 3. Time history of HRR (left) and center ceiling temperature (right) of 5 mm wood panel tested in NFPA 286 room

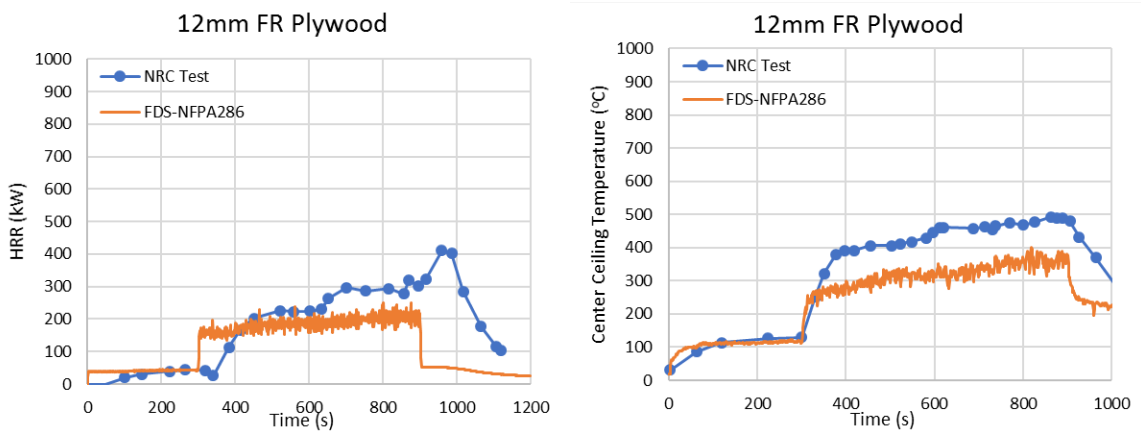

Figure D 4. Time history of HRR (left) and center ceiling temperature (right) of 12 mm fire retarded plywood tested in NFPA 286 room

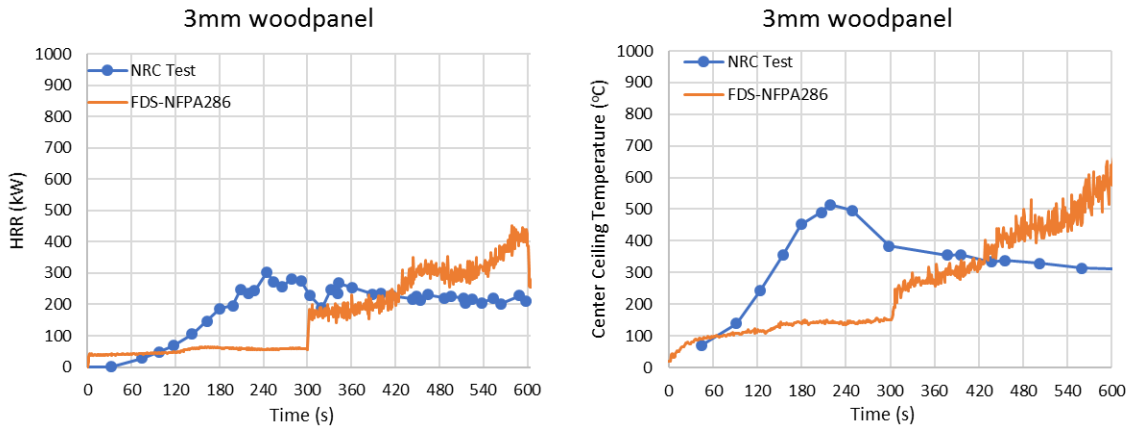

Figure D 5. Time history of HRR (left) and center ceiling temperature (right) of 3 mm wood panel tested in NFPA 286 room

Appendix E.
Calorimeter Test Results of Rail Car Seating Assemblies

E.1 Govmark Testing Reports of Calorimeter Tests

Large-scale calorimeter tests were performed for three types of seating assemblies inside a NFPA 286 standard room with inert wall and ceiling linings at SGS Govmark from June 11, 2018, to June 12, 2018. Official test reports are provided in this section.

E.1.2 Test 1: Sample 1 (Completed 06/11/2018)

Govmark

96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received:05/14/2018	Completed:06/11/2018	Letter: A	MM	P.O.#:	Test Report #:	3-26091-0-

Client's Identification	Product Identification: Two railcar full seating assemblies-type A.

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 Ext:
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: ME /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 0 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	Not Required
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	739 kW
(b) Time to Reach Peak:	438 seconds
(c) Total Heat Release --	
5 minutes:	30.5 MJ
10 minutes:	NA MJ
15 minutes:	NA MJ
(d) Peak Rate of Smoke Release:	8 m²/s
(e) Time to Reach Peak:	234 seconds
(f) Total Smoke Released --	1642 m²

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received:05/14/2018	Completed:06/11/2018	Letter: A	MM	P.O.#:	Test Report #:	3-26091-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type A.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:	
160 kW Exposure (continued):		
(g) Peak Temperature Readings --		
Room midpoint:	1373 °F;	745 °C
Quadrant #1:	1361 °F;	738 °C
Quadrant #2:	1359 °F;	737 °C
Quadrant #3:	1277 °F;	692 °C
Quadrant #4:	1419 °F;	771 °C
AVERAGE:	1358 °F;	737° C
(h) Peak Carbon Monoxide Reading:	5035 ppm	
(i) Peak Carbon Dioxide Reading:	9 ppm	
(j) Peak Heat Flux at Floor Level:	0.2 kW/m²	
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No	
(l) Lateral Flame Spread --		
8 ft. Wall:	No Lateral Flame	
Near 12 ft. Wall:	spread on	
Far 12 ft. Wall:	specimens	
(m) Flames Exit Doorway:	[x] Yes; [ ] No	

(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:

(1) Flaming Droplets are observed:	[x] Yes; [ ] No
(2) A fire pool forms beneath the test item:	[x] Yes; [ ] No
(3) If a fire pool occurs, the level of intensity is described as:	[x] Minor; [ ] Moderate; [ ] Intense

(o) OBSERVATIONS: Rail seats were set up in clients configuration. Burner was moved per client's request.

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received:05/14/2018	Completed:06/11/2018	Letter: A	MM	P.O.#:	Test Report #:	3-26091-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type A.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [ ] Fails; [x] Data Only Bobby Brown

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

AUTHORIZED SIGNATURE
SGS GOVMARK
/jb /tm

Test Technician: Michael Magee

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Figure E 1. Test 1, sample 1

E.1.3 Test 2: Sample 2 (Completed 06/11/2018)

Govmark

96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 05/14/2018	Completed: 06/11/2018	Letter: B	MM	P.O.#:	Test Report #:	3-26092-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type B.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: ME /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 0 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	Not Required
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	435 kW
(b) Time to Reach Peak:	354 seconds
(c) Total Heat Release --	
5 minutes:	14.0 MJ
10 minutes:	130.3 MJ
15 minutes:	217.7 MJ
(d) Peak Rate of Smoke Release:	12 m^2/s
(e) Time to Reach Peak:	358 seconds
(f) Total Smoke Released --	8737 m^2

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Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received:05/14/2018	Completed:06/11/2018	Letter: B	MM	P.O.#:	Test Report #:	3-26092-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type B.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:	
160 kW Exposure (continued):		
(g) Peak Temperature Readings --		
Room midpoint:	882 °F;	472 °C
Quadrant #1:	842 °F;	450 °C
Quadrant #2:	1068 °F;	576 °C
Quadrant #3:	760 °F;	404 °C
Quadrant #4:	904 °F;	484 °C
AVERAGE:	891 °F;	477 °C
(h) Peak Carbon Monoxide Reading:	1591 ppm	
(i) Peak Carbon Dioxide Reading:	2 ppm	
(j) Peak Heat Flux at Floor Level:	0.1 kW/m²	
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No	
(l) Lateral Flame Spread --		
8 ft. Wall:	No Lateral Flame	
Near 12 ft. Wall:	spread on	
Far 12 ft. Wall:	specimens	
(m) Flames Exit Doorway:	[ ] Yes; [x] No	

(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:

(1) Flaming Droplets are observed:	[x] Yes; [ ] No
(2) A fire pool forms beneath the test item:	[x] Yes; [ ] No
(3) If a fire pool occurs, the level of intensity is described as:	[x] Minor; [ ] Moderate; [ ] Intense

(o) OBSERVATIONS: Rail seats were set up in clients configuration. Burner was moved per client's request.

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 05/14/2018	Completed: 06/11/2018	Letter: B	MM	P.O.#:	Test Report #:	3-26092-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type B.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [ ] Fails; [x] Data Only

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

Bobby Brown

Test Technician: Michael Magee

AUTHORIZED SIGNATURE
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/jb /tm

(Page 3 of 3)

JUN 15 2018

Figure E 2. Test 2, sample 2

E.1.4 Test 3: Sample 3 (Completed 06/12/2018)

Govmark

96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received: 05/14/2018	Completed: 06/12/2018	Letter: C	MM	P.O.#:	Test Report #:	3-26093-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type C.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

Category: Room Corner BLDG: V 03/15 PC: ME /jd
NFPA 286: LE: 2015; V 03/15; NE 2019

TEST PERFORMED: NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

BRIEF DESCRIPTION OF TEST: The test is conducted in an 8 ft. high fire room. The test panels cover three of the fire room walls. A square gas burner located at the bottom of the corner offers an open flame ignition exposure of 40 kW for a period of 5 minutes, and 160 kW for a period of 10 minutes. Test observations are made. Video is recorded and included with original test report.

TIME FROM CONDITIONING ROOM TO START OF TEST: 0 minutes

CATEGORY:	RESULTS:
40 kW Exposure	
Flame Height:	Not Required
160 kW Exposure	
(a) Peak Rate of Heat Release: [includes 160 kW Exposure]	391 kW
(b) Time to Reach Peak:	382 seconds
(c) Total Heat Release --	
5 minutes:	10.9 MJ
10 minutes:	80.2 MJ
15 minutes:	134.4 MJ
(d) Peak Rate of Smoke Release:	10 m^2/s
(e) Time to Reach Peak:	413 seconds
(f) Total Smoke Released --	1191 m^2

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received:05/14/2018	Completed:06/12/2018	Letter: C	MM	P.O.#:	Test Report #:	3-26093-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type C.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

CATEGORY:	RESULTS:	
160 kW Exposure (continued):		
(g) Peak Temperature Readings --		
Room midpoint:	704 °F;	373 °C
Quadrant #1:	608 °F;	320 °C
Quadrant #2:	704 °F;	373 °C
Quadrant #3:	701 °F;	372 °C
Quadrant #4:	823 °F;	439 °C
AVERAGE:	708 °F;	376 °C
(h) Peak Carbon Monoxide Reading:	1375 ppm	
(i) Peak Carbon Dioxide Reading:	2 ppm	
(j) Peak Heat Flux at Floor Level:	0.0 kW/m²	
(k) Ignition of Paper Monitors on Floor:	[ ] Yes; [x] No	
(l) Lateral Flame Spread --		
8 ft. Wall:	No Lateral Flame	
Near 12 ft. Wall:	spread on	
Far 12 ft. Wall:	specimens	
(m) Flames Exit Doorway:	[ ] Yes; [x] No	

(n) Flaming Droplets are not factored into the Failure Criteria; however, they are reported as an observation:

(1) Flaming Droplets are observed:	[x] Yes; [ ] No
(2) A fire pool forms beneath the test item:	[x] Yes; [ ] No
(3) If a fire pool occurs, the level of intensity is described as:	[x] Minor; [ ] Moderate; [ ] Intense

(o) OBSERVATIONS: Rail seats were set up in clients configuration. Burner was moved per client's request.

Note: Parentheses ( ) are used to indicate a result that represents a flashover value.

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96-D Allen Boulevard
Farmingdale, New York 11735-5626 USA
Tel. +1 (631) 293-8944 Fax +1 (631) 293-8956
e-mail: testing@govmark.com

Received:05/14/2018	Completed:06/12/2018	Letter: C	MM	P.O.#:	Test Report #:	3-26093-0-
Client's Identification	Product Identification: Two railcar full seating assemblies-type C.					

Tested For: **Brian Y. Lattimer**
Jensen Hughes, Inc
2020 Kraft Drive, Suite 3020
Blacksburg, VA 24060

Key Test: NFPA 286 (BLDG) SP 1000

Tel: 1-(540)-808-2800 **Ext:**
Fax: 1-( )- -

FLASHOVER CRITERIA: Flashover is determined to have occurred when any two of the following conditions have been attained:

(1) The heat release rate exceeds 1 MW (1,000 kW)
(2) Heat flux at the floor exceeds 20 kW/m²
(3) The average upper layer temperature exceeds 600°C (1112°F)
(4) Flames exit the doorway
(5) Autoignition of a paper target on the floor occurs

ACCEPTANCE CRITERIA - As cited by:

(A) The 2015 Edition of NFPA 101 Life Safety Code, para. 10.2.3.7.2;
(B) The 2015 Edition of NFPA 5000 Building Construction and Safety Code, para. 10.4.5.2;
(C) The 2015 Edition, International Building Code, para. 803.1.2

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremity of the sample on any wall or ceiling.

(3) Flashover shall not occur.

(4) The Peak Heat Release Rate throughout the test shall not exceed 800 kW.

(5) The Total Smoke Released throughout the test shall not exceed 1,000 m².

CONCLUSION: Based on the above Results and Acceptance Criteria, the item tested:

[ ] Passes; [ ] Fails; [x] Data Only

CERTIFICATION: I certify that the above results were obtained after testing specimens in accordance with the procedures and equipment specified above.

Bobby Brown

Test Technician: Michael Magee

AUTHORIZED SIGNATURE
SGS GOVMARK
/jb

(Page 3 of 3)

JUN 15 2018

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Figure E 3. Test 3, sample 3

E.2 Calorimeter Test Data Plots

This section presents the test data plots for the three seating assemblies. The plots included the gas temperature, gas concentrations, floor heat flux and rate of smoke release for each test.

E.2.1 Test 1: Sample 1

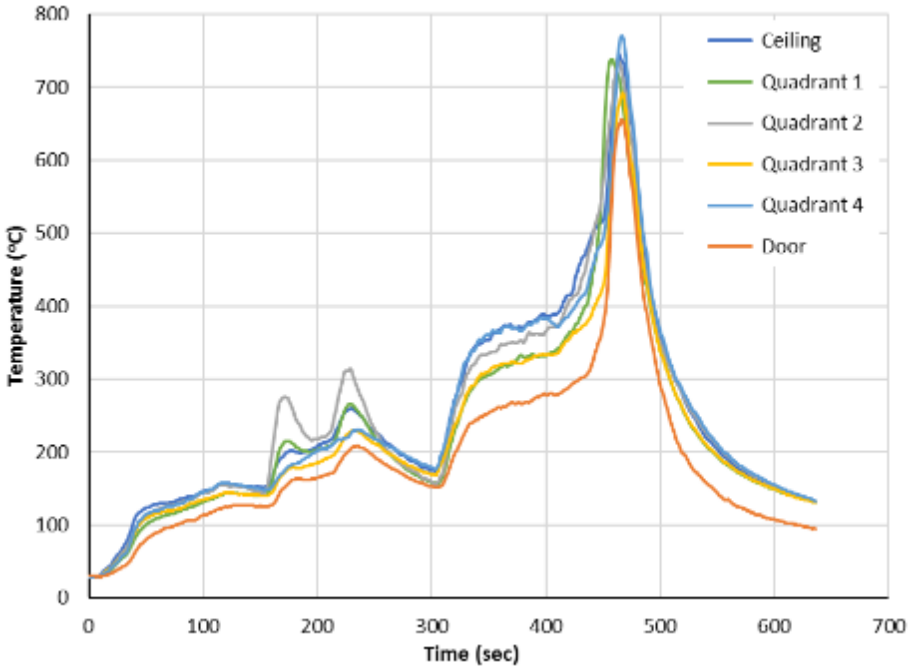

Figure E 4. Temperature vs. time for seating assembly Sample 1.

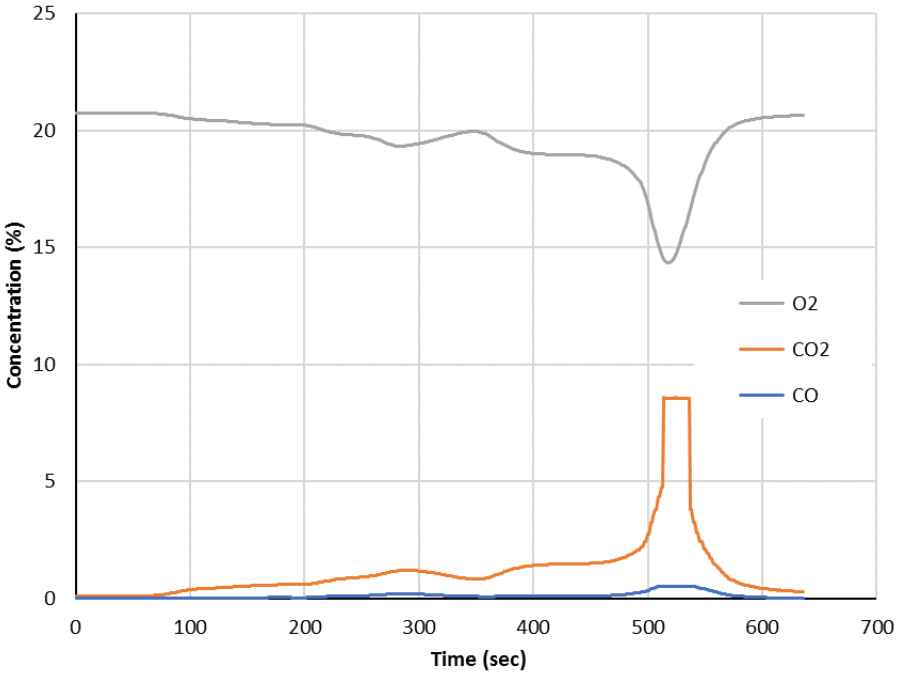

Figure E 5. Gas concentrations for seating assembly Sample 1.

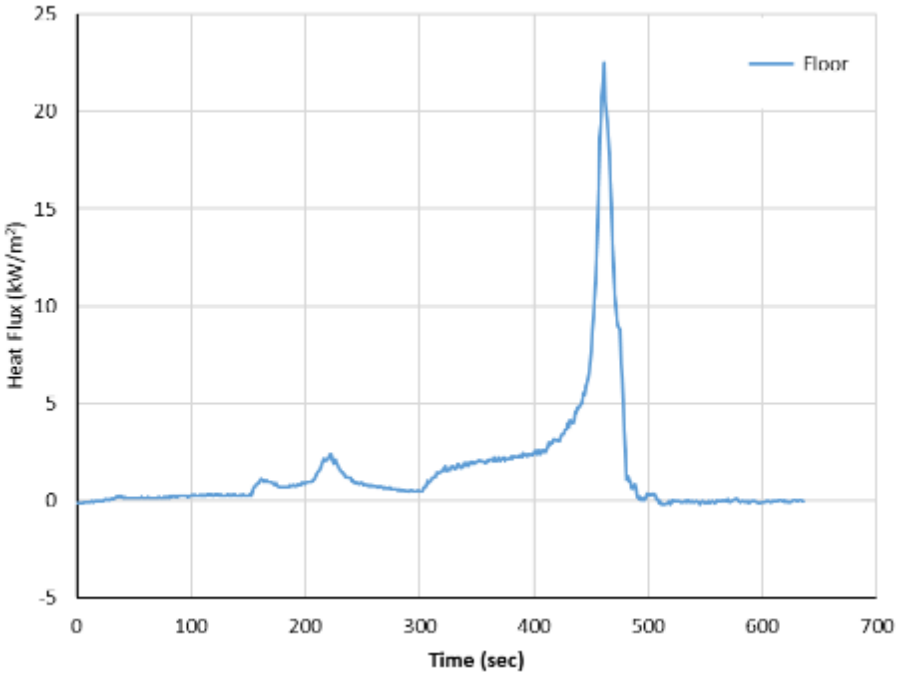

Figure E 6. Floor heat flux for seating assembly Sample 1.

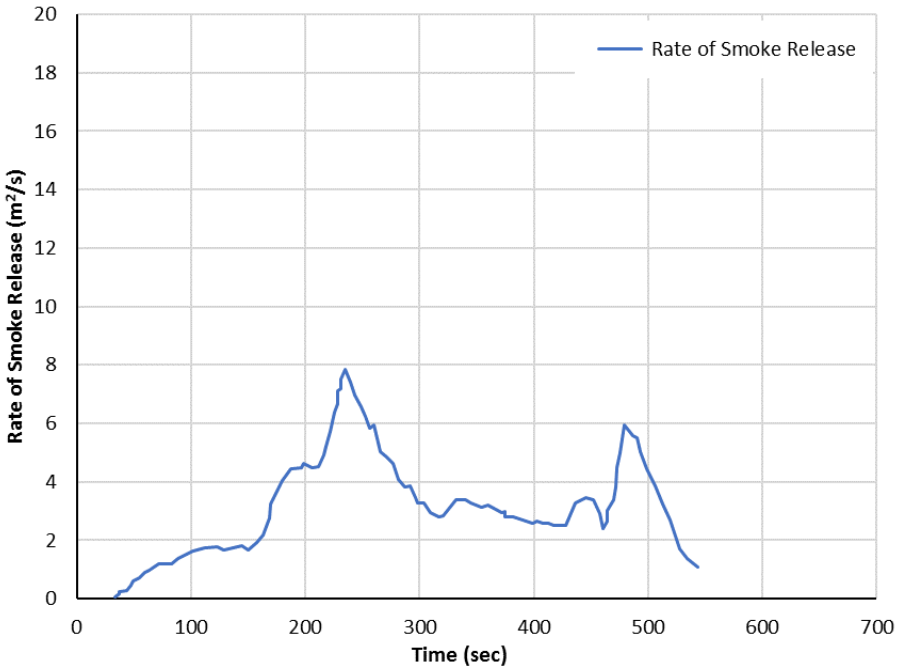

Figure E 7. Rate of smoke release for seating assembly Sample 1.

E.2.3 Test 2: Sample 2

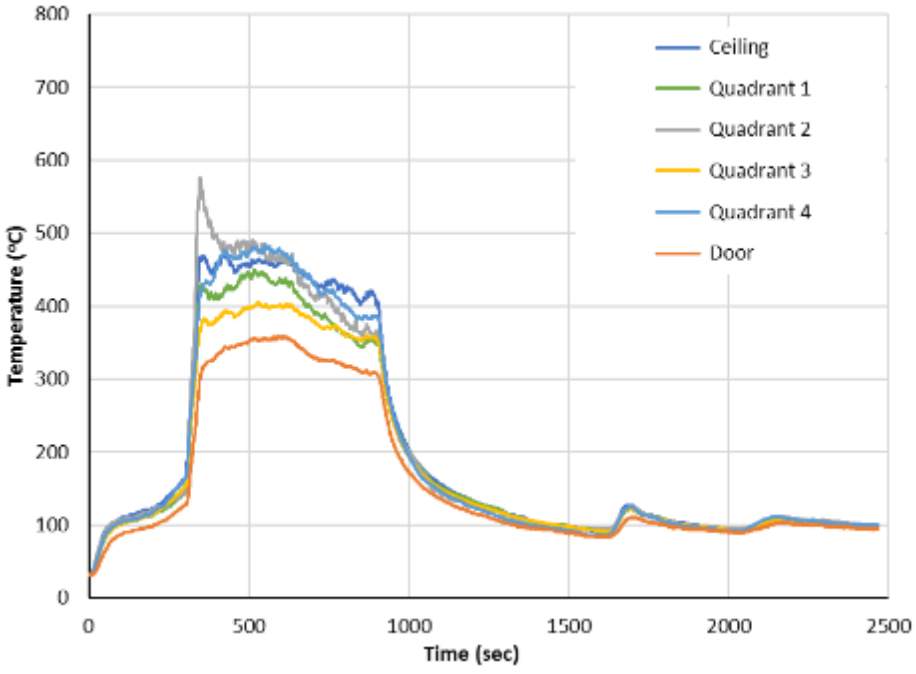

Figure E 8. Temperature vs. time for seating assembly Sample 2

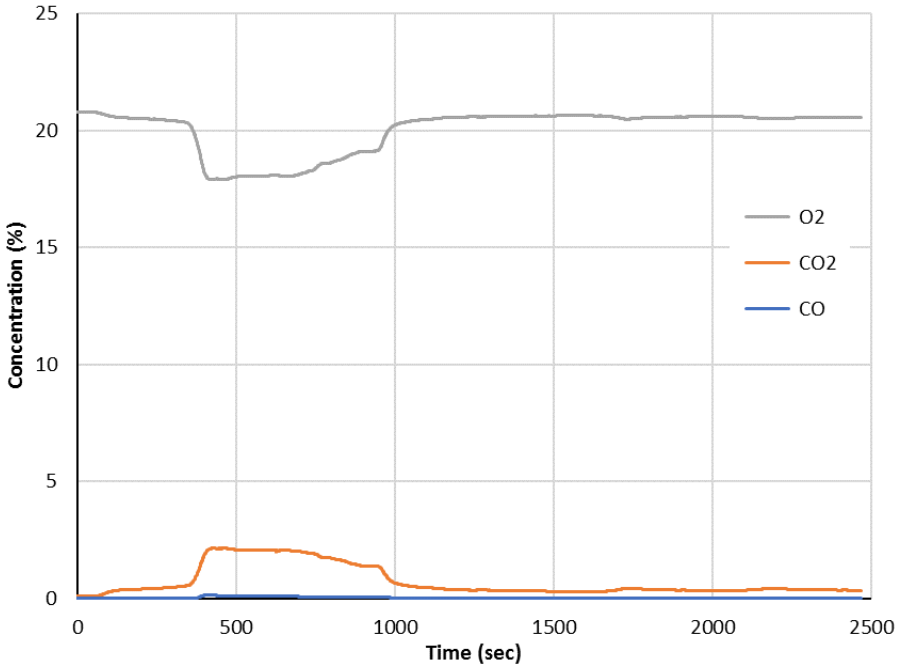

Figure E 9. Gas concentrations for seating assembly Sample 2

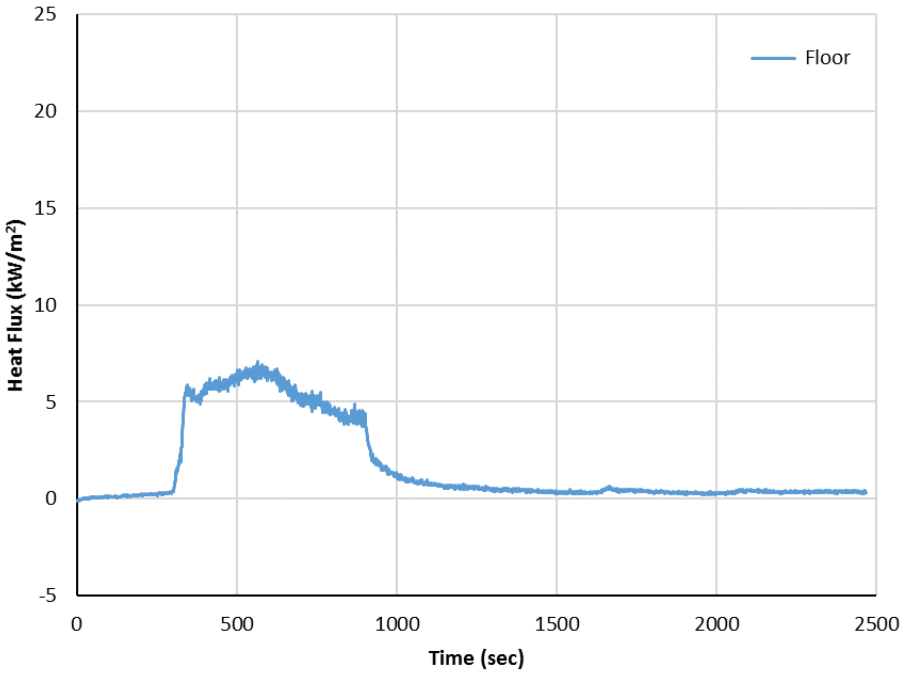

Figure E 10. Floor heat flux for seating assembly Sample 2

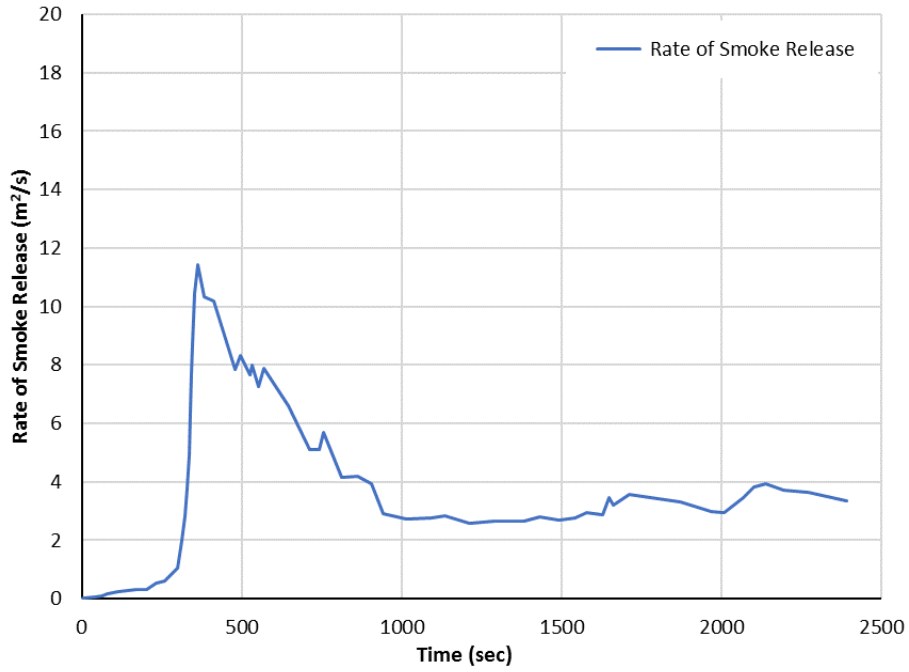

Figure E 11. Rate of smoke release for seating assembly Sample 2

E.2.4 Test 3: Sample 3

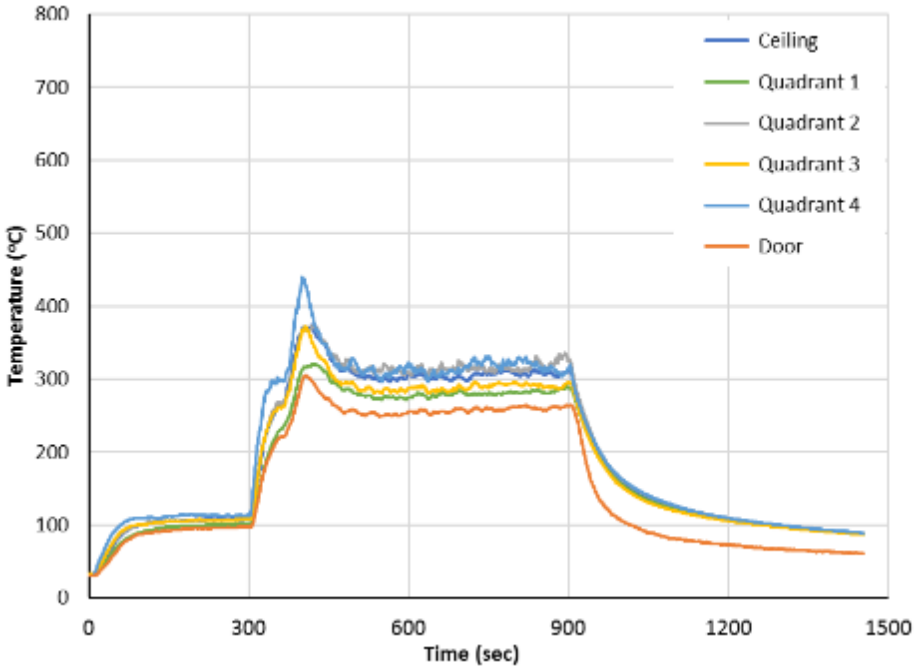

Figure E 12. Temperature vs. time for seating assembly Sample 3

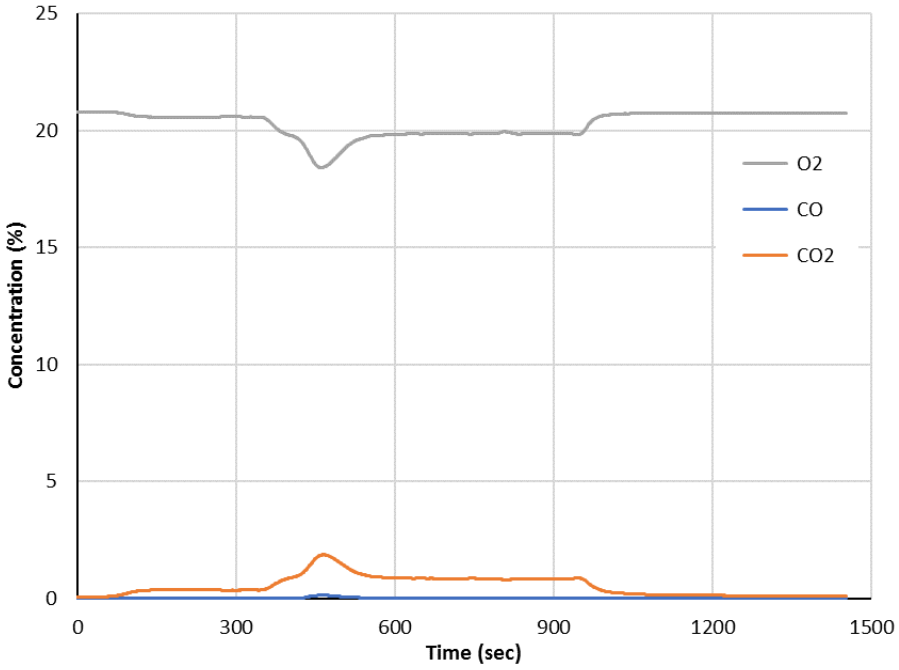

Figure E 13. Gas concentrations for seating assembly Sample 3

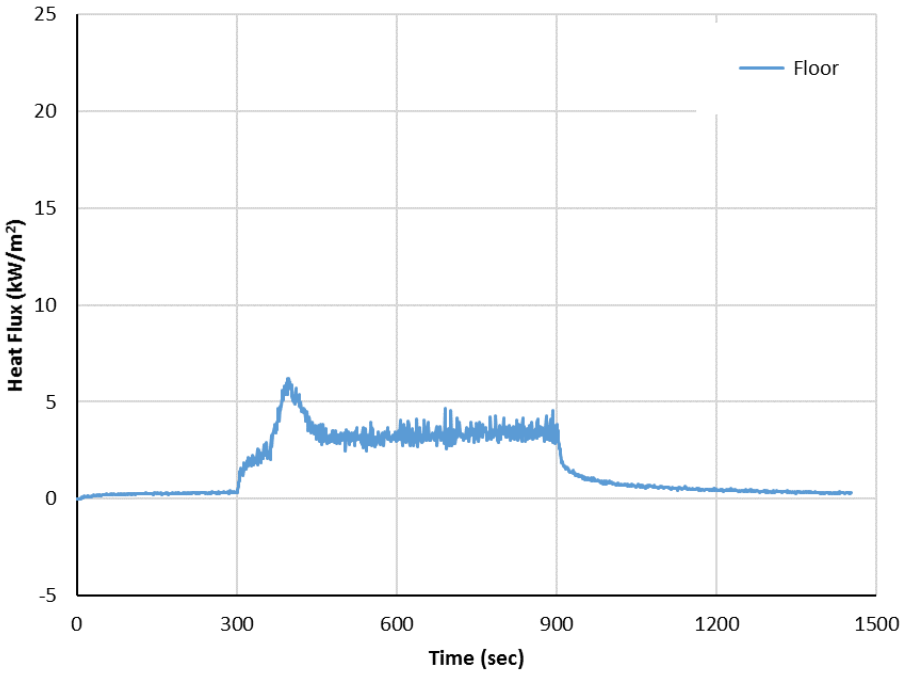

Figure E 14. Floor heat flux for seating assembly Sample 3

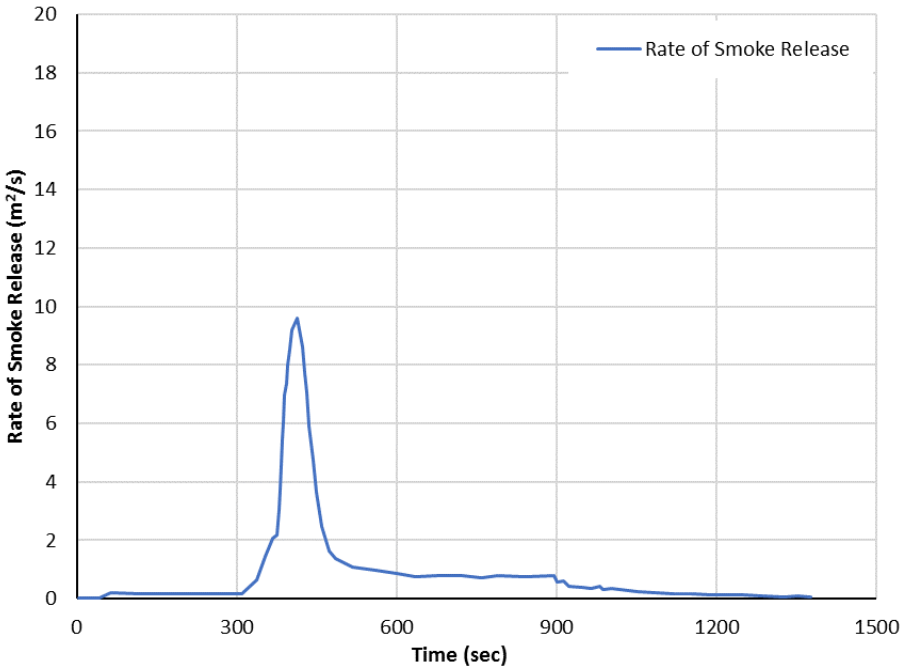

Figure E 15. Rate of smoke release for seating assembly Sample 3

E.3 Calorimeter Test Photos

This section provides the photos that were taken before, during and after the calorimeter tests.

E.3.1 Test 1: Sample 1

Figure E 16. Test 1, sample 1

E.3.2 Test 2: Sample 2




Figure E 17. Test 2, sample 2

E.3.3 Test 3: Sample 3

Figure E 18. Test 3, sample 3