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EVALUATING FIRE PERFORMANCE OF NAIL-LAMINATED TIMBER: SURFACE FLAMMABILITY

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Client: Forestry Innovation Investment Ltd.

ACKNOWLEDGEMENTS

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PROJECT NO. 301013024

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1. BACKGROUND

Nail-laminated timber (NLT) is a mass timber product that has historically been used in industrial and commercial heavy timber buildings in Canada. There is interest to expand the use of this product into modern larger and taller wood buildings, which has been demonstrated by the recent release of the Canadian [1] and American [2] NLT design guides. NLT is simple to construct, uses a large volume of low-grade lumber, and is as cost competitive as other prefabricated mass timber elements. It is commonly used in the construction of floors; although not commonly used for walls, it can be used in the construction of vertical shafts, such as for elevators or exit stairs.

NLT is recognized as solid wood construction in the National Building Code of Canada (NBCC) [3] under Appendix D-2.4; however, significant knowledge gaps exist related to its overall fire performance. The basis for the assigned fire resistance ratings for solid wood assemblies in the NBCC is unknown; therefore, there is a need to provide technical and scientific data to support the fire safe design of these mass timber assemblies. Similarly, flame spread rating (FSR) data is available for various wood species, but there is no known data for NLT assemblies specifically. Performance data and technical information needs to be generated so that designers have the tools to gain approvals, which will ultimately lead to greater adoption of mass timber construction.

2. OBJECTIVE

The objective of this project is to establish fundamental fire performance data for the design and specification of NLT assemblies; this project specially addresses determining FSRs for NLT. The goal of this project is to confirm that NLT, when used as a mass timber element, has a lower FSR than standard thickness SPF boards when tested individually and flatwise. The project also considers how the surface profiles, design details, and the direction of an assembly might influence flame spread. This includes the evaluation of typical architectural features, such as a ‘fluted’ profile.

Having this technical information will support project approvals for the use of NLT elements in larger and taller wood buildings, as well as provide scientific justification for Authorities Having Jurisdiction (AHJ) to review and accept this construction method. This research will provide the evidence for designers to demonstrate their design have met or exceeded fire safety requirements. Ultimately the intent is to expand the adoption of manufactured solid timber construction for larger and taller buildings, as well as for non-traditional wood markets (such as institutional or commercial buildings).

Other aspects of this project (in separate reports) include evaluating fire resistance of NLT [4], and assessing how NLT charring rates might be affected by gaps between boards [5].

3. TECHNICAL TEAM

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John Hoffman Principal Technologist, Advanced Wood Manufacturing

Cameron Hale Technician, Advanced Wood Manufacturing

Philip Eng Senior Technologist, Advanced Building Systems

Nelson Uy Senior Technologist, Fiber Production

4. INTRODUCTION

The NLT Design & Construction Guides [2] [3] provide comprehensive information on the design of NLT, however little detail is given related to the fire performance of this product. This is due to a lack of available fire test data for NLT assemblies. FPInnovations has previously evaluated the fire resistance of a screw laminated timber-concrete composite (TCC) floor [6], but little to no other data is available.

Having comprehensive data to confirm the overall fire performance of wood assemblies is key to understanding how to appropriately design them, this includes both fire resistance and flame spread data. Flame spread across the surface of wood assemblies is an important property to evaluate since the NBCC limits the amount of exposed combustible interior finishes based on their FSR, when evaluated in accordance with CAN/ULC-S102 [7]. In some situations, according to the NBCC, exposed wood wall and ceiling elements can have a FSR of up to 150 in sprinklered buildings, Table 3.1.13.2 [3], with limitations on surface area coverage. The FSR for vertical service spaces (such as elevator hoistways) and exits is 25. In high-rise buildings, as defined in the NBCC, the Smoke Developed Classification (SDC) may also be limited. The SDC is evaluated during the FSR test procedure.

The NBCC assigns FSR of 150 to typical wood products in Section D-3 of Division B, including lumber with a minimum thickness of 16 mm and various plywoods. FSR data for 19 mm lumber of different species is available in Fire Safety Design in Buildings [8]; the FSR for SPF products ranges from 65-230.

FPInnovations has evaluated flame spread on other mass timber assemblies and found that mass timber products exhibit low FSRs compared to traditional lumber, due to their thickness [9]. Table 1 provides a summary of the FSRs for these mass timber products.

Table 1. FSRs for Mass Timber Products [9, 10]

	Thickness	FSR	SDC
3-ply CLT E1 SPF Stress Grade V2 SPF Stress Grade	 105 mm 99 mm	 35 40	 40 30
3-ply CLT E1 SPF Stress Grade with intumescent coating	105 mm	25	20
Parallel Strand Lumber (PSL)	89 mm	35	25
Laminated Strand Lumber (LSL)	89 mm	75	85

5. PROCEDURE

Flame spread tests were conducted in accordance with CAN/ULC-S102 [7] to establish the FSR of NLT. The standard requires three replicate tests be conducted for each assembly.

The SPF NLT samples were prepared and conditioned at the FPInnovations laboratory in Vancouver; testing was completed by Intertek Testing Services in Coquitlam. Assemblies were tested on June 26th and September 25th, 2018.

Flame spread was evaluated for NLT with lumber boards parallel to the longitudinal direction of the CAN/ULC-S102 testing tunnel. Further testing was conducted to also assess how surface profiles, design details, and the direction of an NLT assembly influences flame spread. The four sections that were evaluated are:

A – Standard NLT parallel to tunnel

B – Standard NLT perpendicular to tunnel

C – Fluted profile, parallel to tunnel

D – Fluted profile, perpendicular to tunnel

The fluted profile was a simple alternating staggered depth cross-section using nominal 2x4s and 2x6s. Typcial NLT and the fluted profile are shown in Figure 1.

Standard NLT Fluted NLT

Figure 1. NLT Profiles

Each of the specimens was constructed in 1830 mm (6') sections; four sections were placed end-to-end in the tunnel to reach a total length of 7315 mm (24'). The NLT was constructed using 3" smooth shank galvanized nails. One row of nails was staggered at 180 mm (7") o.c., placed 20 mm from the bottom and top edge. SPF No. 2 grade lumber was used.

5.1 Designs

5.1.1 Standard NLT – Parallel (A)

The standard NLT (A) assemblies were constructed using nominal 2x6" lumber with the length of the boards running parallel to the tunnel. Each section was 610 mm (24") wide (16 boards across), as shown in Figure 2. Figure 3 shows constructed sections of the constructed A assemblies, which demonstrate how natural imperfections in boards affect the finished surface.

Figure 2. Assembly A configuration

a) b)

Figure 3. Constructed A panels

5.1.2 Standard NLT – Perpendicular (B)

The standard NLT – perpendicular (B) assemblies were constructed using nominal 2x6” lumber with the length of the boards running perpendicular to the tunnel. Each section was 585 mm (23”) wide. Boards were cut to 508 mm (20”) and nailed together with boards added to either side along the length of each section to stiffen the assembly. The assembly configuration is shown in Figure 4 and completed assemblies are shown in Figure 5.

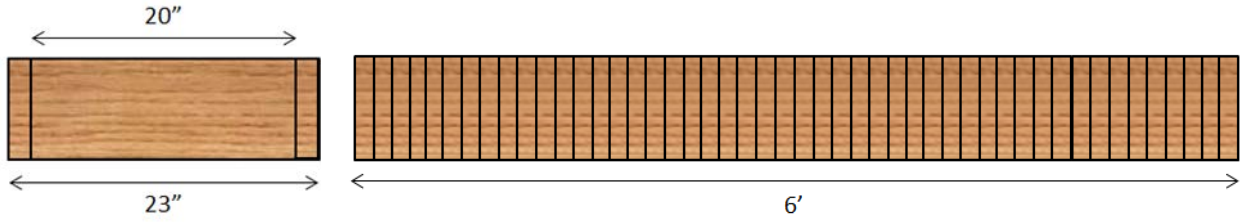


Figure 4. Assembly B configuration

Figure 5. Constructed B panels

5.1.3 Fluted NLT – Parallel (C)

The fluted NLT – parallel (C) assemblies were constructed using alternating nominal 2x4" and 2x6" lumber with the length of the boards running parallel to the tunnel. The two outermost boards were 2x6s to ensure adequate support along the wall of the tunnel. Each section was 570 mm (22.5") wide (15 boards across). The assembly configuration is shown in Figure 6 and constructed panels are shown in Figure 7.

Figure 6. Assembly C configuration

Figure 7. Constructed C panels

5.1.4 Fluted NLT – Perpendicular (D)

The fluted NLT – perpendicular (D) assemblies were constructed using alternating nominal 2x4" and 2x6" lumber with the length of the boards running perpendicular to the tunnel. Each section was 585 mm (23") wide. Boards were cut to 508 mm (20") with boards added to either side to stiffen assembly. The configuration is shown in Figure 8 and constructed panels are shown in Figure 9.

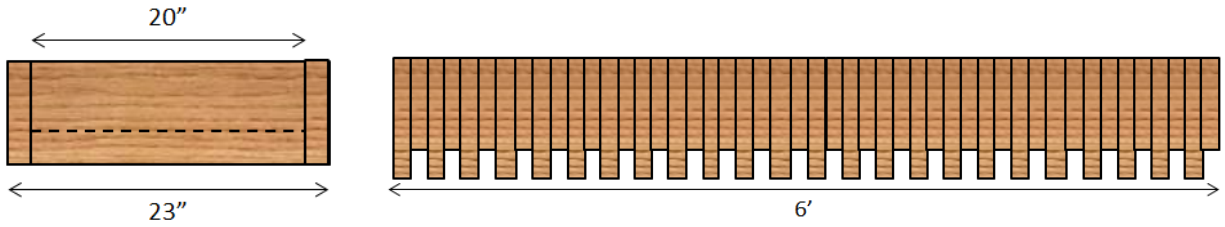


Figure 8. Assembly D configuration

Figure 9. Constructed D panels

5.2 Conditioning

The specimens were conditioned at 23 ± 3°C and 50 ± 5% RH prior to testing, in accordance with CAN/ULC-S102, which would provide a wood equilibrium moisture content of approximately 9%. For hygroscopic materials, such as wood, the standard indicates that a constant mass is deemed to be achieved for the samples when mass change over 72 hours is less than 1%.

For hygroscopic materials the moisture content must be taken immediately prior to the test. Average moisture content readings are given for each of the samples in Table 2. Readings were taken using a Delmhorst RDM-3 pin meter set to SPF.

Table 2. Moisture Content Prior to Testing

Sample	Average MC (%)
A1	10.0
A2	10.4
A3	9.2
B1	9.1
B2	8.9
B3	9.0
C1	9.3
C2	11.5
C3	9.4
D1	9.4
D2	10.8
D3	9.5

6. RESULTS

A summary of the results from the flame spread tests is given in Table 3. The official flame spread reports are included as Appendices to this report.

Table 3. Summary of Flame Spread Results

	Flame Spread Rating	Smoke Developed Classification
NLT Parallel to tunnel (A)	50	40
NLT Perpendicular to tunnel (B)	45	55
NLT Fluted Parallel to tunnel (C)	91	105
NLT Fluted Perpendicular to tunnel (D)	65	125

6.1 A – NLT Parallel

The results for the standard NLT parallel to the tunnel (A) are given in Table 4. There was some variability in the results, for example the A3 flame spread result was higher than the other two replicates. The tests were completed on different days, with the tunnel being calibrated before each series of tests. Pictures before, during and after the test are shown in Figure 10.

Table 4. A Results

Run	Flame Spread	Flame Spread Rating	Smoke Developed	Smoked Developed Classification
A1	40	50	19	40
A2	45		50	
A3	69		53	

a) Unexposed before test

b) Exposed side after test

c) During test

Figure 10. NLT Parallel (A) - Before and After Test

6.2 B – NLT Parallel

The results for the standard NLT perpendicular to the tunnel (B) are given in Table 5. Pictures before, during and after the test are shown in Figure 11.

Table 5. B Results

Run	Flame Spread	Flame Spread Rating	Smoke Developed	Smoked Developed Classification
B1	35	45	72	55
B2	47*		*	
B3	55		40	

*Due to a program error data was not collected. FSR result manually calculated.

a) Unexposed before test

b) Exposed side after test

c) During test

Figure 11. NLT Perpendicular (B) - Before and After Test

6.3 C – NLT Fluted Parallel

The results for the fluted NLT parallel to the tunnel (C) are given in Table 6. Pictures before, during and after the test are shown in Figure 12. The smoke developed measurement was lower in test C1 than the other two replicates.

Table 6. C Results

Run	Flame Spread	Flame Spread Rating	Smoke Developed	Smoked Developed Classification
C1	90	91	67	105
C2	84		153	
C3	99		100	

a) Unexposed before test b) Exposed side after test c) During test

Figure 12. Fluted NLT Parallel (C) - Before and After Test

6.4 D – NLT Fluted Perpendicular

The results for the fluted NLT perpendicular to the tunnel (D) are given in Table 7. There is some variability in the results. The samples were tested on different days; the tunnel was calibrated before series was completed. Pictures before, during and after the test are shown in Figure 13.

Table 7. D Results

Run	Flame Spread	Flame Spread Rating	Smoke Developed	Smoked Developed Classification
D1	53	65	186	125
D2	100		49	
D3	48		147	

The second assembly (D2) tested had a much higher flame spread than the other two replicates, which increased the overall FSR. This sample ignited within a similar timeframe to the others, 28 s. The flame reached the end of the tunnel in 218 s, whereas the others approached the end of the tunnel at the end of the test (600 s). It is not clear why this sample had a higher flame spread. The results for the other two runs were consistent with the values observed for assemblies A and B.

a) Unexposed before test b) Exposed side after test c) During test

Figure 13. Fluted NLT Perpendicular (D) - Before and After Test

7. DISCUSSION

7.1 Effects of Surface Profile

The FSR for typical flat NLT was found to be 50 and 45, whether it was oriented parallel to the tunnel or perpendicular, respectively. The similarity in these numbers demonstrates that the difference in orientation had little impact on the overall FSR. Despite the chamfer of the boards and naturally uneven surface of NLT that results during construction, the face can be considered to be essentially smooth in either direction for the purposes of flame spread evaluation. Figure 14 illustrates the typical surface profile for NLT (assembly A). These numbers are also consistent with other mass timber products with FSRs of 35-40, but slightly higher. As expected, the FSR of NLT is lower than typical flatwise SPF lumber species, assigned a value of 150 in the NBCC.

Figure 14. NLT surface profile (A)

The FSRs for the fluted profiles were higher than the standard NLT panels, reaching 91 and 65 for the parallel and perpendicular orientations respectively. This indicates that varied depth surface profiles have an impact on FSRs. For fluted profiles, there is an increased exposed surface area which can result in more contribution of wood to a fire. Within the flutes, heat can be radiated between opposite surfaces and trapped between the flutes, unable to easily dissipate, thus promoting increased burning. When flutes are used, there is a greater difference between FSRs depending on the orientation of the boards. In this case, the flutes parallel to the tunnel resulted in higher FSRs.

7.2 Charring Between Boards

The depth of charring along the surface was less than 1 mm, as shown in Figure 15, for the second section from the burner location (A assembly).

Figure 15. Depth of charring (A)

Looking between boards following the tests it could be seen that the exposed surface of the wood charred a few millimetres, but further into the gaps between boards the wood was uncharred, shown in Figure 16. This may be a result of a lack of oxygen in the narrow spaces between boards, preventing combustion from occurring up into the gaps. This may have implications on charring rates in evaluating fire resistance of these assemblies.

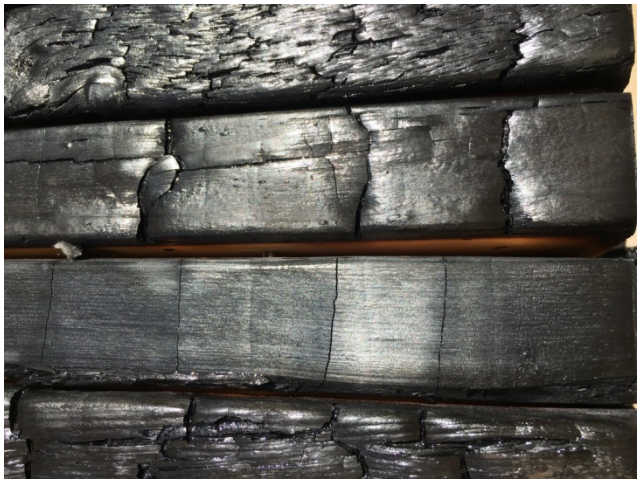
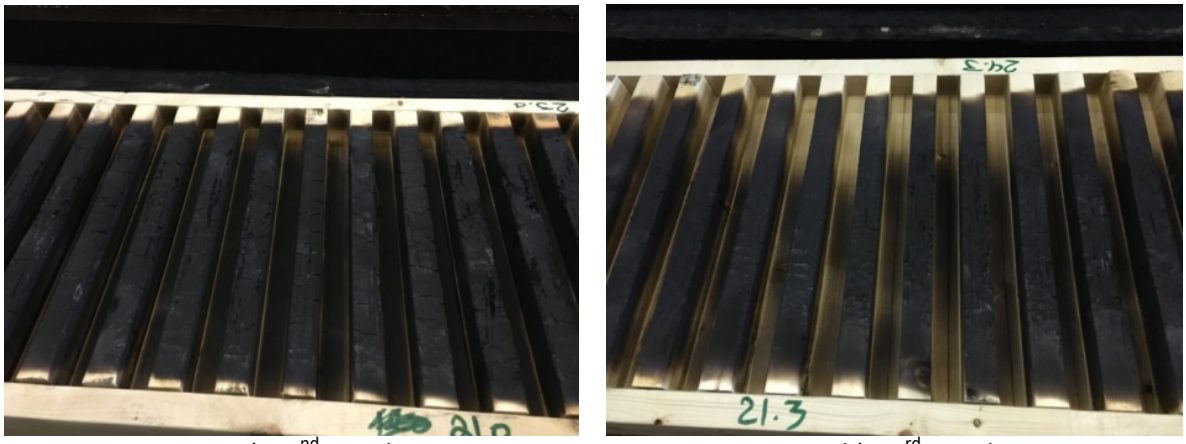


Figure 16. Depth of char between boards in first panel (A assembly)

For the fluted perpendicular profile, there were areas of uncharred wood in the inside corners of the flutes, which was more prominent at the boards near the end of the tunnel. Figure 17 shows the charring between the flutes for the perpendicular orientation at different locations. Near the end of the tunnel, the flame front progressed before all of the wood within the flute was involved in fire.



a) 2nd panel b) 3rd panel

Figure 17. D. Charring between flutes

7.3 Extinguishment

At the end of the flame spread tests a hose is used to extinguish the fire. There were instances of residual burning in some gaps between boards after hose application, such as is shown in Figure 18. This represents a potential challenge for fire fighters to extinguish fires in NLT assemblies. This was also an issue for the fluted perpendicular assemblies, where the flutes shielded the flute cavities, making it difficult to put water on areas that were still burning.

Figure 18. Burning between NLT boards (A assembly)

8. CONCLUSION

Flame spread testing was conducted on NLT profiles to establish FSRs. Four configurations of assemblies were evaluated: standard NLT with boards parallel to the tunnel (A), standard NLT with boards perpendicular to the tunnel (B), a simple staggered depth (fluted) profile with boards parallel to the tunnel (C), and a fluted profile with boards perpendicular to the tunnel (D). The test results are given in Table 8. The two standard NLT assemblies had similar FSRs of 50 and 45, for parallel and perpendicular, respectively. The orientation of the standard NLT did not have a significant impact on the FSR. These values are consistent, but are slightly higher than FSRs other mass timber assemblies.

The fluted profiles received higher FSRs which may be in part due to a greater exposed surface area of wood. The fluted profile parallel to the tunnel had the highest FSR of 91, and the perpendicular orientation received a FSR of 65. For this profile, the orientation had a greater impact on FSR.

Table 8. Flame Spread Results

	Flame Spread Rating	Smoke Developed Classification
NLT Parallel to tunnel (A)	50	40
NLT Perpendicular to tunnel (B)	45	55
NLT Fluted Parallel to tunnel (C)	91	105
NLT Fluted Perpendicular to tunnel (D)	65	125

Examining the assemblies after the test, it could be seen that the surface was charred, however in some larger gaps the charring did not extend up between boards. This may be a result of a lack of oxygen in the narrow spaces between boards, preventing combustion from occurring up into the gaps and may have implications for charring rates in evaluating fire resistance of NLT.

Instances of residual burning after the tests within some gaps were noted. This represents a potential issue for extinguishment as these areas may be difficult to readily detect or target with a hose. The fluted profile also posed challenges to extinguish since the flutes shield the cavities; extinguishing a fire on a fluted surface may be challenging depending on the direction of water application.

9. REFERENCES

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Appendix I:
NLT Parallel to Tunnel (A) Testing Report

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FP INNOVATIONS
TEST REPORT

REPORT ISSUED TO
FP Innovations
580 Booth Street
Ottawa, ON K1A 0E4 CAN
SCOPE OF WORK
Report of R&D testing nominal 2 in. by 6 in. SPF NLT Panels (Parallel) for compliance with the applicable requirements of the following criteria: CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

REPORT NUMBER
103546754COQ-001c

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TEST REPORT FOR FP INNOVATIONS
REPORT NO.: G103546754
REVISION DATE: OCTOBER 19, 2018

CONCLUSION

The samples of nominal 2 in. by 6 in. SPF NLT Panels (Parallel) submitted by FP Innovations, were tested in accordance with CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

The product test results are presented in Section 7 of this report.

Sean Fewer
TECHNICIAN
BUILDING PRODUCTS

Greg Philp
REVIEWER
BUILDING PRODUCTS CANADA

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SECTION 2
OBJECTIVE

Intertek Testing Services NA Ltd. (Intertek) has conducted testing for FP Innovations to evaluate the surface burning characteristics of 2 in. by 6 in. SPF NLT Panels (Parallel). Testing was conducted in accordance with the standard methods of CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

This evaluation began June 26, 2018 and was completed September 25, 2018.

SECTION 3
SAMPLE SELECTION

Samples were submitted to Intertek directly from the client and were not independently selected for testing. The sample panels were received at the Evaluation Center on June 22, and September 20, 2018.

SECTION 4
SAMPLE ASSEMBLY AND DESCRIPTION

Upon receipt of the samples at the Intertek Coquitlam laboratory they were placed in a conditioning room where they remained in an atmosphere of 23 ± 3°C (73.4 ± 5°F) and 50 ± 5% relative humidity.

The product was identified as nominal 2 in. by 6 in. SPF NLT Panels (Parallel). Samples submitted for testing measured nominal 6 in thick by 23 in. wide by 6 ft. long.

For each trial run, Four, Nominal 6 in. thick by 23 in. wide by 6 ft. long sample decks were butted together end to end to form the required 24 ft. sample length and placed on the upper ledge of the flame spread tunnel. A layer of 6 mm reinforced cement board was placed over top of the samples, the tunnel lid was lowered into place, and the samples were then tested in accordance with CAN/ULC S102-18.

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SECTION 5
TESTING AND EVALUATION METHODS

TEST STANDARD

The results of the tests are expressed by indexes, which compare the characteristics of the sample under tests relative to that of select grade red oak flooring and inorganic-cement board.

(A) Flame Spread Rating:

This index relates to the rate of progression of a flame along a sample in the 25 foot tunnel. A natural gas flame is applied to the front of the sample at the start of the test and drawn along the sample by a draft kept constant for the duration of the test. An observer notes the progression of the flame front relative to time.

The test apparatus is calibrated such that the flame front for red oak flooring passes out the end of the tunnel in five minutes, thirty seconds (plus or minus 15 seconds).

(B) Smoke Developed:

A photocell is used to measure the amount of light, which is obscured by the smoke passing down the tunnel duct. When the smoke from a burning sample obscures the light beam, the output from the photocell decreases. This decrease with time is recorded and compared to the results obtained for red oak, which is defined to be 100.

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SECTION 6
RESULTS AND OBSERVATIONS

(A) Flame Spread

The resultant flame spread ratings are as follows:
(Rating rounded to nearest 5)

2 in. by 6 in. SPF NLT Panels (Parallel)	Flame Spread	Flame Spread Rating
Run 1	40	50
Run 2	45	
Run 3	69	

(B) Smoke Developed

The areas beneath the smoke developed curve and the related classifications are as follows:
(Classification rounded to nearest 5)

2 in. by 6 in. SPF NLT Panels (Parallel)	Smoke Developed	Smoked Developed Classification
Run 1	19	40
Run 2	50	
Run 3	53	

(C) Observations

During the test runs, the surface ignited between 23 and 30 seconds. The flame then began to progress along the sample length until it reached the maximum flame spread. This was the case for all three test runs.

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SECTION 7
CONCLUSION

The samples of nominal 2 in. by 6 in. SPF NLT Panels (Parallel), submitted by FP Innovations exhibited the following flame spread characteristics when tested in accordance CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

A series of three test runs of material was conducted to conform to the requirements of the National Building Code of Canada.

Sample Material	Flame Spread Rating	Smoke Developed Classification
2 in. by 6 in. SPF NLT Panels (Parallel)	50	40

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

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SECTION 8

APPENDIX A: TEST DATA (6 PAGES)

CAN/ULC S102-18 DATA SHEETS
Run 1

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 06 26 2018
Project Number: 103546754
Test Number: 1
Operator: Sean Fewer

Specimen ID: NPL1-1- 2x6 SPF NLT parallel to tunnel

TEST RESULTS

FLAMESPREAD INDEX: 40

SMOKE DEVELOPED INDEX: 20

SPECIMEN DATA . . .

Time to Ignition (sec): 23
Time to Max FS (sec): 264
Maximum FS (mm): 2596.0
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): Never Reached
Max Temperature (C): 331
Time to Max Temperature (sec): 591
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 21.5
Smoke Area (%A*min): 32.5
Unrounded FSI: 39.9
Unrounded SDI: 19.4

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

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CAN/ULC S102-18 DATA SHEETS
Run 1

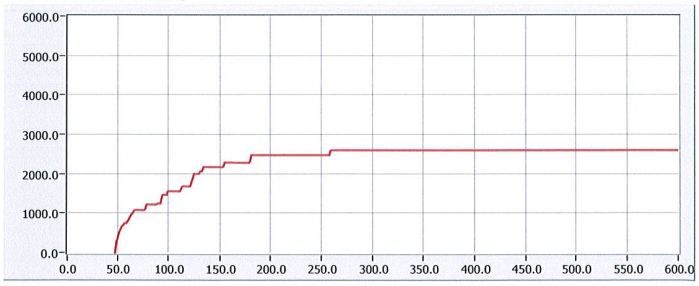
Client: FP Innovations

Specimen ID: NPL1-1- 2x6 SPF NLT parallel to tunnel

Test No.: 1

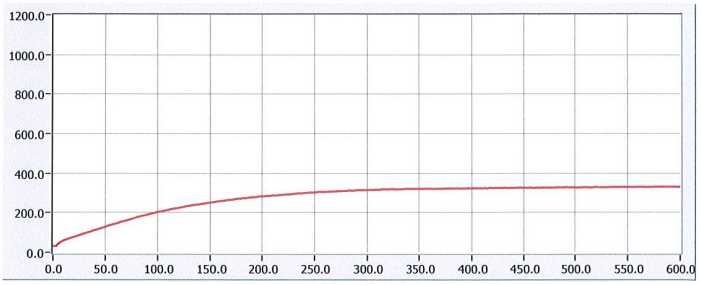
Standard: ULC S102

FLAME SPREAD (MM)



Smoke (%A)

Temperature (°C)



Time (sec)

600

Tested By: SF

Reviewed By: _____

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

Standard: ULC S102

Client: FP Innovations
Date: 06 26 2018
Project Number: 103546754
Test Number: 83
Operator: Sean Fewer

Specimen ID: NPPL3-3 SPF NLT parallel to tunnel

TEST RESULTS

FLAMESPREAD INDEX: 45

SMOKE DEVELOPED INDEX: 50

SPECIMEN DATA . . .

Time to Ignition (sec): 30
Time to Max FS (sec): 313
Maximum FS (mm): 3105.5
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): Never Reached
Max Temperature (C): 401
Time to Max Temperature (sec): 507
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 23.6
Smoke Area (%A*min): 81.6
Unrounded FSI: 43.7
Unrounded SDI: 48.7

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF

Reviewed By:

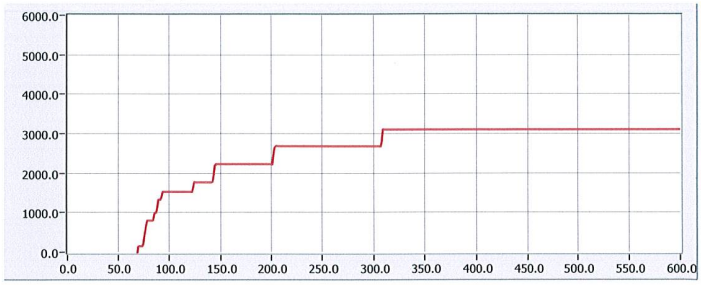
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

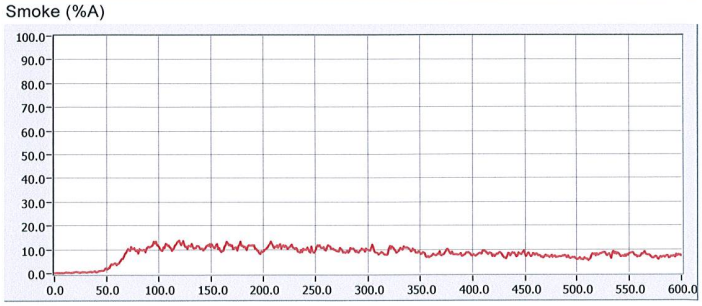
Client: FP Innovations Specimen ID: NPPL3-3 SPF NLT parallel to tunnel

Test No.: 5-3 Standard: ULC S102

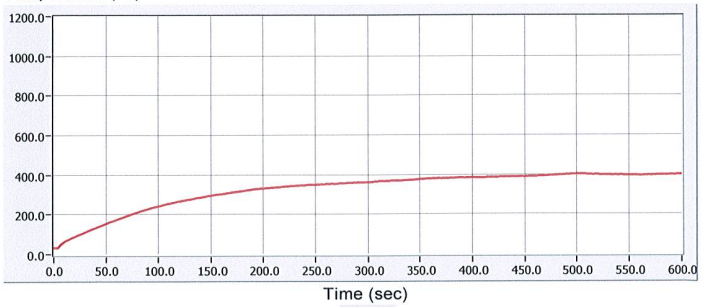
FLAME SPREAD (MM)



Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 3

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 09 25 2018
Project Number: 103546754
Test Number: 1
Operator: Sean Fewer

Specimen ID: NPL2 NLT Parallel

TEST RESULTS

FLAMESPREAD INDEX: 70

SMOKE DEVELOPED INDEX: 55

SPECIMEN DATA . . .

Time to Ignition (sec): 27
Time to Max FS (sec): 454
Maximum FS (mm): 5393.1
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): Never Reached
Max Temperature (C): 425
Time to Max Temperature (sec): 596
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 35.8
Smoke Area (%A*min): 88.4
Unrounded FSI: 69.3
Unrounded SDI: 52.8

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

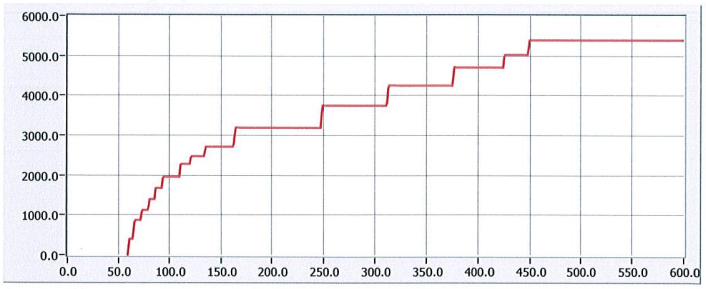
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 3

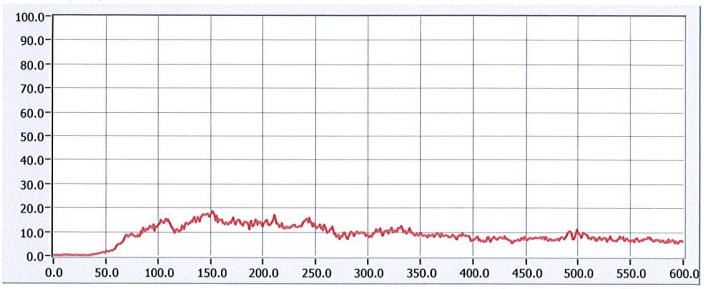
Client: FP Innovations Specimen ID: NPL2 NLT Parallel

Test No.: 1 Standard: ULC S102

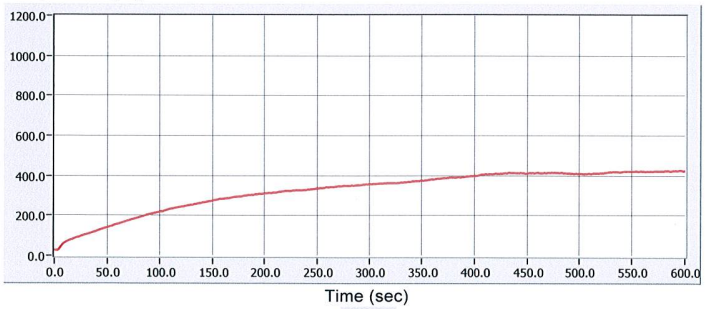
FLAME SPREAD (MM)



Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

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REVISION SUMMARY

DATE	PAGE	SUMMARY
September 26, 2018	All	Original Issue Date
October 19, 2018	6&7	Corrected Data

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Appendix II:
NLT Perpendicular to Tunnel (B) Testing Report

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FP INNOVATIONS
TEST REPORT

REPORT ISSUED TO
FP Innovations
580 Booth Street
Ottawa, ON K1A 0E4 CAN
SCOPE OF WORK
Report of R&D testing nominal 2 in. by 6 in. SPF NLT Panels (Perpendicular) for compliance with the applicable requirements of the following criteria: CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

REPORT NUMBER
103546754COQ-001d

ISSUE DATE
26-September-2018

PAGES
15

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GFT-OP-10b (13-March-2017)
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1500 Brigantine Drive
Coquitlam, BC, V3K 7C1

Telephone: 604-520-3321
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www.intertek.com

TEST REPORT FOR FP INNOVATIONS
REPORT NO.: G103546754
DATE: SEPTEMBER 26, 2018

CONCLUSION

The samples of nominal 2 in. by 6 in. SPF NLT Panels (Perpendicular) submitted by FP Innovations, were tested in accordance with CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

The product test results are presented in Section 7 of this report.

Sean Fewer
TECHNICIAN
BUILDING PRODUCTS

Greg Philp
REVIEWER
BUILDING PRODUCTS CANADA

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SECTION 1
INDEX

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 2
OBJECTIVE

Intertek Testing Services NA Ltd. (Intertek) has conducted testing for FP Innovations to evaluate the surface burning characteristics of 2 in. by 6 in. SPF NLT Panels (Perpendicular). Testing was conducted in accordance with the standard methods of CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

This evaluation began June 26, 2018 and was completed September 25, 2018.

SECTION 3
SAMPLE SELECTION

Samples were submitted to Intertek directly from the client and were not independently selected for testing. The sample panels were received at the Evaluation Center on June 22, and September 20, 2018.

SECTION 4
SAMPLE ASSEMBLY AND DESCRIPTION

Upon receipt of the samples at the Intertek Coquitlam laboratory they were placed in a conditioning room where they remained in an atmosphere of 23 ± 3°C (73.4 ± 5°F) and 50 ± 5% relative humidity.

The product was identified as nominal 2 in. by 6 in. SPF NLT Panels (Perpendicular). Samples submitted for testing measured nominal 6 in thick by 23 in. wide by 6 ft. long.

For each trial run, Four, Nominal 6 in. thick by 23 in. wide by 6 ft. long sample decks were butted together end to end to form the required 24 ft. sample length and placed on the upper ledge of the flame spread tunnel. A layer of 6 mm reinforced cement board was placed over top of the samples, the tunnel lid was lowered into place, and the samples were then tested in accordance with CAN/ULC S102-18.

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SECTION 5
TESTING AND EVALUATION METHODS

TEST STANDARD

The results of the tests are expressed by indexes, which compare the characteristics of the sample under tests relative to that of select grade red oak flooring and inorganic-cement board.

(A) Flame Spread Rating:

This index relates to the rate of progression of a flame along a sample in the 25 foot tunnel. A natural gas flame is applied to the front of the sample at the start of the test and drawn along the sample by a draft kept constant for the duration of the test. An observer notes the progression of the flame front relative to time.

The test apparatus is calibrated such that the flame front for red oak flooring passes out the end of the tunnel in five minutes, thirty seconds (plus or minus 15 seconds).

(B) Smoke Developed:

A photocell is used to measure the amount of light, which is obscured by the smoke passing down the tunnel duct. When the smoke from a burning sample obscures the light beam, the output from the photocell decreases. This decrease with time is recorded and compared to the results obtained for red oak, which is defined to be 100.

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SECTION 6
RESULTS AND OBSERVATIONS

(A) Flame Spread

The resultant flame spread ratings are as follows:
(Rating rounded to nearest 5)

2 in. by 6 in. SPF NLT Panels (Perpendicular)	Flame Spread	Flame Spread Rating
Run 1	35	45
Run 2*	47	
Run 3	55	

*Due to a program error, flame spread data was not collected. Flame Spread Values were manually calculated

(B) Smoke Developed

The areas beneath the smoke developed curve and the related classifications are as follows:
(Classification rounded to nearest 5)

2 in. by 6 in. SPF NLT Panels (Perpendicular)	Smoke Developed	Smoked Developed Classification
Run 1	72	55
Run 2	*	
Run 3	40	

*Due to a program error, smoke value data was not collected. The Average is based on the two tests

(C) Observations

During the test runs, the surface ignited between 26 and 34 seconds. The flame then began to progress along the sample length until it reached the maximum flame spread. This was the case for all three test runs.

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 7
CONCLUSION

The samples of nominal 2 in. by 6 in. SPF NLT Panels (Perpendicular), submitted by FP Innovations exhibited the following flame spread characteristics when tested in accordance CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

A series of three test runs of material was conducted to conform to the requirements of the National Building Code of Canada.

Sample Material	Flame Spread Rating	Smoke Developed Classification
2 in. by 6 in. SPF NLT Panels (Perpendicular)	45	55

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 8

APPENDIX A: TEST DATA (6 PAGES)

CAN/ULC S102-18 DATA SHEETS
Run 1

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 06 26 2018
Project Number: 103546754
Test Number: 2
Operator: Sean Fewer

Specimen ID: NPP1 - SPF NLT perpendicular to tunnel

TEST RESULTS

FLAMESPREAD INDEX: 35
SMOKE DEVELOPED INDEX: 70

SPECIMEN DATA . . .

Time to Ignition (sec): 26
Time to Max FS (sec): 157
Maximum FS (mm): 2189.9
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): Never Reached
Max Temperature (C): 337
Time to Max Temperature (sec): 583
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 18.6
Smoke Area (%A*min): 120.9
Unrounded FSI: 34.5
Unrounded SDI: 72.2

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: _____ Reviewed By: _____

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 1

Client: FP Innovations

Specimen ID: NPP1 - SPF NLT perpendicular to tunnel

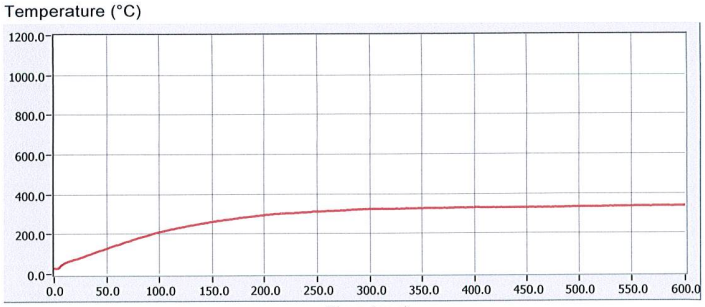
Test No.: 2

Standard: ULC S102

FLAME SPREAD (MM)

Smoke (%A)

Temperature (°C)



Time (sec)

600

Tested By: SF

Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

Data Lost Due To Program Error

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

Data Lost Due To Program Error

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 3

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 09 25 2018
Project Number: 103546754
Test Number: 2
Operator: Sean Fewer

Specimen ID: NPP2 NLT Perpendicular

TEST RESULTS

FLAMESPREAD INDEX: 55

SMOKE DEVELOPED INDEX: 40

SPECIMEN DATA . . .

Time to Ignition (sec): 34
Time to Max FS (sec): 362
Maximum FS (mm): 4063.4
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): Never Reached
Max Temperature (C): 388
Time to Max Temperature (sec): 452
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 30.2
Smoke Area (%A*min): 67.9
Unrounded FSI: 55.9
Unrounded SDI: 40.6

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

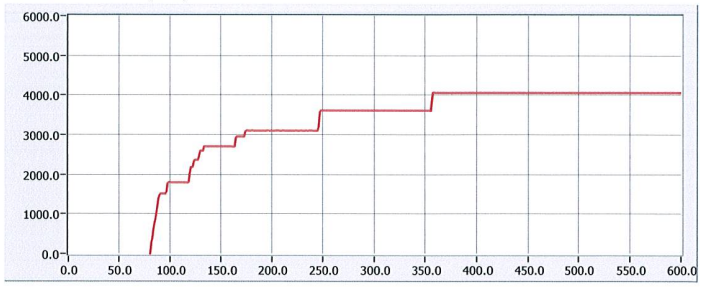
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 3

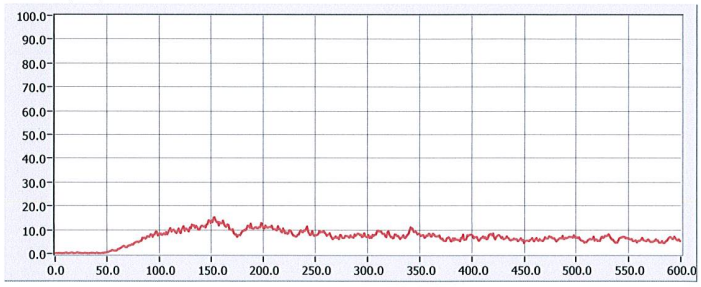
Client: FP Innovations Specimen ID: NPP2 NLT Perpendicular

Test No.: 2 Standard: ULC S102

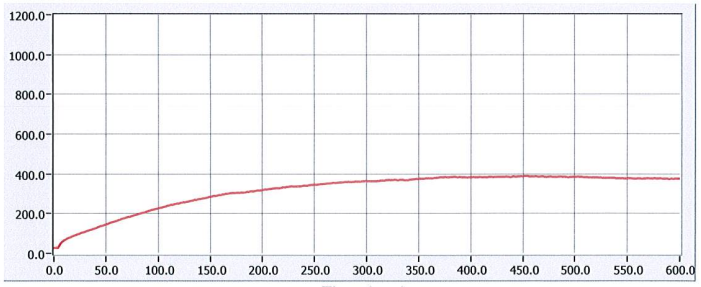
FLAME SPREAD (MM)



Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

REVISION SUMMARY

DATE	PAGE	SUMMARY
September 26, 2018	All	Original Issue Date

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Appendix III:
NLT Fluted Parallel to Tunnel (C) Testing Report

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FP INNOVATIONS
TEST REPORT

REPORT ISSUED TO
FP Innovations
580 Booth Street
Ottawa, ON K1A 0E4 CAN
SCOPE OF WORK
Report of R&D testing nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel) for compliance with the applicable requirements of the following criteria: CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

REPORT NUMBER
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Facsimile: 604-524-9186
www.intertek.com

TEST REPORT FOR FP INNOVATIONS
REPORT NO.: G103546754
REVISION DATE: OCTOBER 19, 2018

CONCLUSION

The samples of 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel) submitted by FP Innovations, were tested in accordance with CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

The product test results are presented in Section 7 of this report.

Sean Fewer
TECHNICIAN
BUILDING PRODUCTS

Greg Philp
REVIEWER
BUILDING PRODUCTS CANADA

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SECTION 1
INDEX

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 2
OBJECTIVE

Intertek Testing Services NA Ltd. (Intertek) has conducted testing for FP Innovations to evaluate the surface burning characteristics of nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel). Testing was conducted in accordance with the standard methods of CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

This evaluation began June 26, 2018 and was completed September 26, 2018.

SECTION 3
SAMPLE SELECTION

Samples were submitted to Intertek directly from the client and were not independently selected for testing. The sample panels were received at the Evaluation Center on June 22, and September 20, 2018.

SECTION 4
SAMPLE ASSEMBLY AND DESCRIPTION

Upon receipt of the samples at the Intertek Coquitlam laboratory they were placed in a conditioning room where they remained in an atmosphere of 23 ± 3°C (73.4 ± 5°F) and 50 ± 5% relative humidity.

The product was identified as nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel). Samples submitted for testing measured nominal 6 in thick by 23 in. wide by 6 ft. long.

For each trial run, Four, Nominal 6 in. thick by 23 in. wide by 6 ft. long sample decks were butted together end to end to form the required 24 ft. sample length and placed on the upper ledge of the flame spread tunnel. A layer of 6 mm reinforced cement board was placed over top of the samples, the tunnel lid was lowered into place, and the samples were then tested in accordance with CAN/ULC S102-18.

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 5
TESTING AND EVALUATION METHODS

TEST STANDARD

The results of the tests are expressed by indexes, which compare the characteristics of the sample under tests relative to that of select grade red oak flooring and inorganic-cement board.

(A) Flame Spread Rating:

This index relates to the rate of progression of a flame along a sample in the 25 foot tunnel. A natural gas flame is applied to the front of the sample at the start of the test and drawn along the sample by a draft kept constant for the duration of the test. An observer notes the progression of the flame front relative to time.

The test apparatus is calibrated such that the flame front for red oak flooring passes out the end of the tunnel in five minutes, thirty seconds (plus or minus 15 seconds).

(B) Smoke Developed:

A photocell is used to measure the amount of light, which is obscured by the smoke passing down the tunnel duct. When the smoke from a burning sample obscures the light beam, the output from the photocell decreases. This decrease with time is recorded and compared to the results obtained for red oak, which is defined to be 100.

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 6
RESULTS AND OBSERVATIONS

(A) Flame Spread

The resultant flame spread ratings are as follows:
(Rating rounded to nearest 5)

2 in. by 6 in. and 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel)	Flame Spread	Flame Spread Rating
Run 1	90	91
Run 2	84	
Run 3	99	

(B) Smoke Developed

The areas beneath the smoke developed curve and the related classifications are as follows:
(Classification rounded to nearest 5)

2 in. by 6 in. and 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel)	Smoke Developed	Smoked Developed Classification
Run 1	67	105
Run 2	153	
Run 3	100	

(C) Observations

During the test runs, the surface ignited between 22 and 29 seconds. The flame then began to progress along the sample length until it reached the maximum flame spread. This was the case for all three test runs.

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 7
CONCLUSION

The samples of nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel) submitted by FP Innovations exhibited the following flame spread characteristics when tested in accordance CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

A series of three test runs of material was conducted to conform to the requirements of the National Building Code of Canada.

Sample Material	Flame Spread Rating	Smoke Developed Classification
2 in. by 6 in. and 2 in. by 4 in. alternating depth SPF NLT Panels (Parallel)	80	120

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

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Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 8

APPENDIX A: TEST DATA (6 PAGES)

CAN/ULC S102-18 DATA SHEETS
Run 1

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 06 26 2018
Project Number: 103546754
Test Number: 5 i 2
Operator: Sean Fewer

Specimen ID: NFPL1 - SPF NLT alternating depth , parallel to tunnel

TEST RESULTS

FLAMESPREAD INDEX: 90

SMOKE DEVELOPED INDEX: 65

SPECIMEN DATA . . .

Time to Ignition (sec): 27
Time to Max FS (sec): 315
Maximum FS (mm): 5775.7
Time to 527C (sec): 385
Time to End of Tunnel (sec): 318
Max Temperature (C): 625
Time to Max Temperature (sec): 593
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 41.3
Smoke Area (%A*min): 112.9
Unrounded FSI: 90.1
Unrounded SDI: 67.4

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

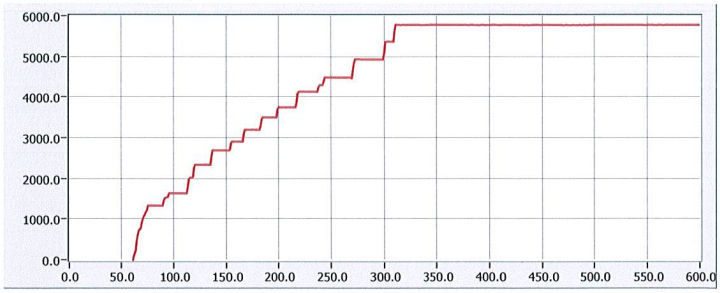
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 1

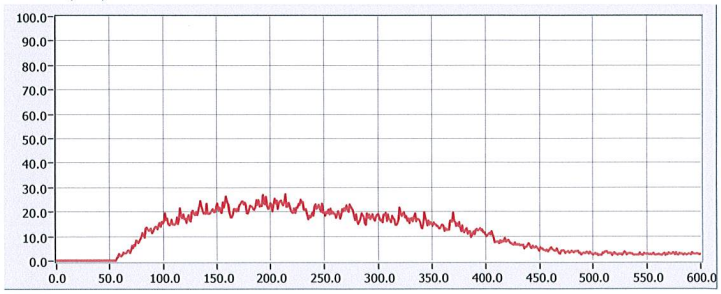
Client: FP Innovations Specimen ID: NFPL1 - SPF NLT alternating depth ,

Test No.: 3) Standard: ULC S102

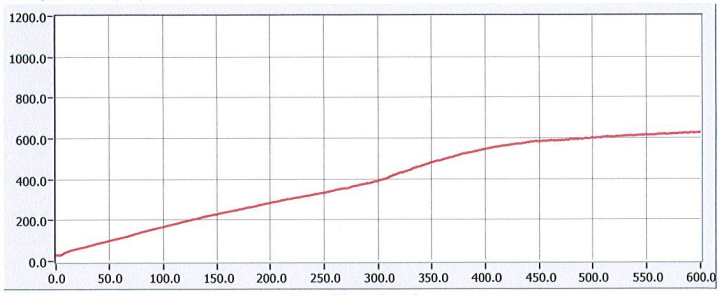
FLAME SPREAD (MM)



Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 06 26 2018
Project Number: 103546754
Test Number: 8 3rd
Operator: Sean Fewer

Specimen ID: NFPL3-3 SPF NLT alternating depth , parallel to tunnel

TEST RESULTS

FLAMESPREAD INDEX: 85

SMOKE DEVELOPED INDEX: 155

SPECIMEN DATA . . .

Time to Ignition (sec): 25
Time to Max FS (sec): 331
Maximum FS (mm): 5783.2
Time to 527C (sec): 369
Time to End of Tunnel (sec): 326
Max Temperature (C): 620
Time to Max Temperature (sec): 598
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 39.9
Smoke Area (%A*min): 255.8
Unrounded FSI: 83.8
Unrounded SDI: 152.7

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By: _____

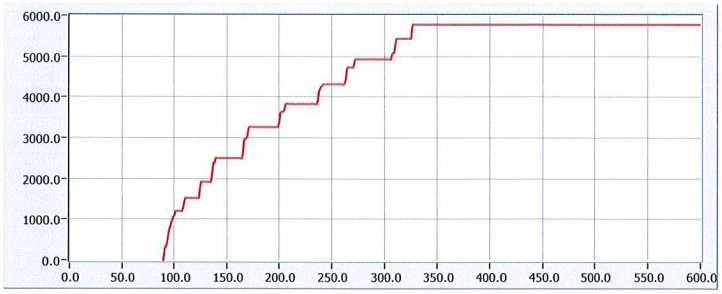
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

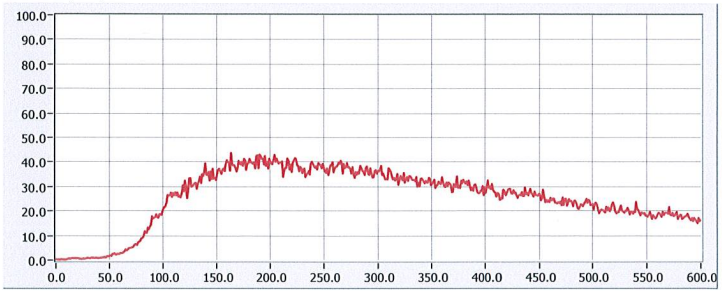
Client: FP Innovations Specimen ID: NFPL3-3 SPF NLT alternating depth ,

Test No.: 6 Standard: ULC S102

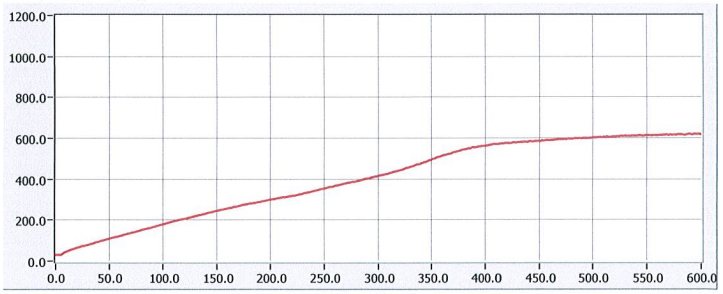
FLAME SPREAD (MM)



Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 3

Standard: ULC S102

Client: FP Innovations
Date: 09 26 2018
Project Number: 103546754
Test Number: 1
Operator: Sean Fewer

Specimen ID: NLT Fluted Parallel NFPL2

TEST RESULTS

FLAMESPREAD INDEX: 100
SMOKE DEVELOPED INDEX: 100

SPECIMEN DATA . . .

Time to Ignition (sec): 29
Time to Max FS (sec): 322
Maximum FS (mm): 6258.7
Time to 527C (sec): 389
Time to End of Tunnel (sec): 328
Max Temperature (C): 629
Time to Max Temperature (sec): 589
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 42.8
Smoke Area (%A*min): 167.0
Unrounded FSI: 98.7
Unrounded SDI: 99.7

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF

Reviewed By:

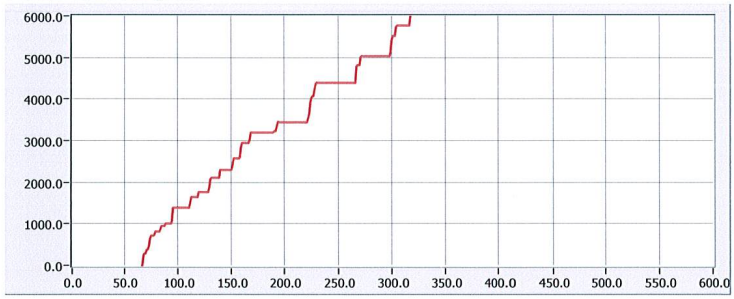
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 3

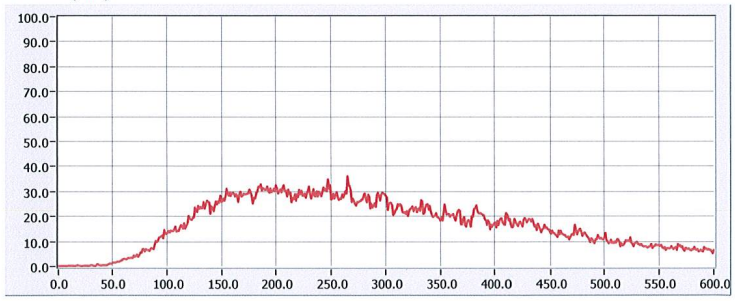
Client: FP Innovations Specimen ID: NLT Fluted Parallel NFPL2

Test No.: 1 Standard: ULC S102

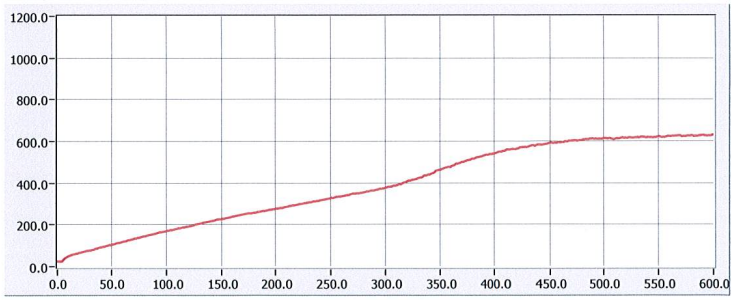
FLAME SPREAD (MM)



Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

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REVISION SUMMARY

DATE	PAGE	SUMMARY
September 26, 2018	All	Original Issue Date
October 19, 2018	6&7	Corrected Data

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Appendix IV:
NLT Fluted Perpendicular to Tunnel (D) Testing Report

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FP INNOVATIONS
TEST REPORT

REPORT ISSUED TO
FP Innovations
580 Booth Street
Ottawa, ON K1A 0E4 CAN
SCOPE OF WORK
Report of R&D testing nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular) for compliance with the applicable requirements of the following criteria: CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

REPORT NUMBER
103546754COQ-001f

ISSUE DATE
26-September-2018

PAGES
15

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TEST REPORT FOR FP INNOVATIONS
REPORT NO.: G103546754
DATE: SEPTEMBER 26, 2018

CONCLUSION

The samples of 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular) submitted by FP Innovations, were tested in accordance with CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

The product test results are presented in Section 7 of this report.

Sean Fewer
TECHNICIAN
BUILDING PRODUCTS

Greg Philp
REVIEWER
BUILDING PRODUCTS CANADA

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SECTION 1
INDEX

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SECTION 2
OBJECTIVE

Intertek Testing Services NA Ltd. (Intertek) has conducted testing for FP Innovations to evaluate the surface burning characteristics of nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular). Testing was conducted in accordance with the standard methods of CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

This evaluation began June 26, 2018 and was completed September 25, 2018.

SECTION 3
SAMPLE SELECTION

Samples were submitted to Intertek directly from the client and were not independently selected for testing. The sample panels were received at the Evaluation Center on June 22, and September 20, 2018.

SECTION 4
SAMPLE ASSEMBLY AND DESCRIPTION

Upon receipt of the samples at the Intertek Coquitlam laboratory they were placed in a conditioning room where they remained in an atmosphere of 23 ± 3°C (73.4 ± 5°F) and 50 ± 5% relative humidity.

The product was identified as nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular). Samples submitted for testing measured nominal 6 in thick by 23 in. wide by 6 ft. long.

For each trial run, Four, Nominal 6 in. thick by 23 in. wide by 6 ft. long sample decks were butted together end to end to form the required 24 ft. sample length and placed on the upper ledge of the flame spread tunnel. A layer of 6 mm reinforced cement board was placed over top of the samples, the tunnel lid was lowered into place, and the samples were then tested in accordance with CAN/ULC S102-18.

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SECTION 5
TESTING AND EVALUATION METHODS

TEST STANDARD

The results of the tests are expressed by indexes, which compare the characteristics of the sample under tests relative to that of select grade red oak flooring and inorganic-cement board.

(A) Flame Spread Rating:

This index relates to the rate of progression of a flame along a sample in the 25 foot tunnel. A natural gas flame is applied to the front of the sample at the start of the test and drawn along the sample by a draft kept constant for the duration of the test. An observer notes the progression of the flame front relative to time.

The test apparatus is calibrated such that the flame front for red oak flooring passes out the end of the tunnel in five minutes, thirty seconds (plus or minus 15 seconds).

(B) Smoke Developed:

A photocell is used to measure the amount of light, which is obscured by the smoke passing down the tunnel duct. When the smoke from a burning sample obscures the light beam, the output from the photocell decreases. This decrease with time is recorded and compared to the results obtained for red oak, which is defined to be 100.

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SECTION 6
RESULTS AND OBSERVATIONS

(A) Flame Spread

The resultant flame spread ratings are as follows:
(Rating rounded to nearest 5)

2 in. by 6 in. and 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular)	Flame Spread	Flame Spread Rating
Run 1	53	65
Run 2	100	
Run 3	48	

(B) Smoke Developed

The areas beneath the smoke developed curve and the related classifications are as follows:
(Classification rounded to nearest 5)

2 in. by 6 in. and 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular)	Smoke Developed	Smoked Developed Classification
Run 1	186	125
Run 2	49	
Run 3	147	

(C) Observations

During the test runs, the surface ignited between 22 and 28 seconds. The flame then began to progress along the sample length until it reached the maximum flame spread. This was the case for all three test runs.

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SECTION 7
CONCLUSION

The samples of nominal 2 in. by 6 in. and nominal 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular) submitted by FP Innovations exhibited the following flame spread characteristics when tested in accordance CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

A series of three test runs of material was conducted to conform to the requirements of the National Building Code of Canada.

Sample Material	Flame Spread Rating	Smoke Developed Classification
2 in. by 6 in. and 2 in. by 4 in. alternating depth SPF NLT Panels (Perpendicular)	65	125

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

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Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

SECTION 8

APPENDIX A: TEST DATA (6 PAGES)

CAN/ULC S102-18 DATA SHEETS
Run 1

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 06 26 2018
Project Number: 103546754
Test Number: 4712
Operator: Sean Fewer

Specimen ID: NFPP1 - SPF NLT alternating depth - perpendicular to tunnel

TEST RESULTS

FLAMESPREAD INDEX: 55

SMOKE DEVELOPED INDEX: 185

SPECIMEN DATA . . .

Time to Ignition (sec): 22
Time to Max FS (sec): 582
Maximum FS (mm): 5782.1
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): 580
Max Temperature (C): 505
Time to Max Temperature (sec): 598
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 28.6
Smoke Area (%A*min): 312.0
Unrounded FSI: 52.9
Unrounded SDI: 186.3

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

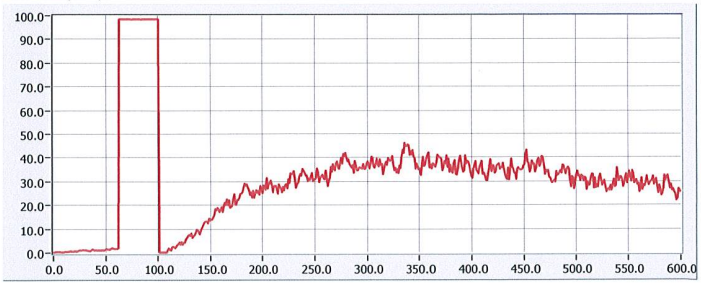
CAN/ULC S102-18 DATA SHEETS
Run 1

Client: FP Innovations Specimen ID: NFPP1 - SPF NLT alternating depth -

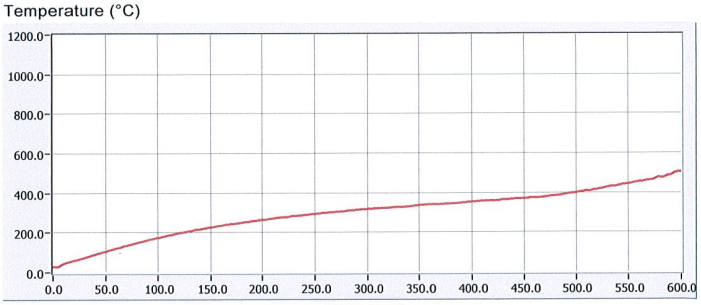
Test No.: A 2 cm Standard: ULC S102

FLAME SPREAD (MM)

Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

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CAN/ULC S102-18 DATA SHEETS
Run 2

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 09 25 2018
Project Number: 103546754
Test Number: 1
Operator: Sean Fewer

Specimen ID: NFPP2 NLT Fluted perpendicular

TEST RESULTS

FLAMESPREAD INDEX: 100
SMOKE DEVELOPED INDEX: 50

SPECIMEN DATA . . .

Time to Ignition (sec): 28
Time to Max FS (sec): 220
Maximum FS (mm): 5788.0
Time to 527C (sec): 289
Time to End of Tunnel (sec): 218
Max Temperature (C): 724
Time to Max Temperature (sec): 600
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 43.1
Smoke Area (%A*min): 82.4
Unrounded FSI: 100.4
Unrounded SDI: 49.2

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

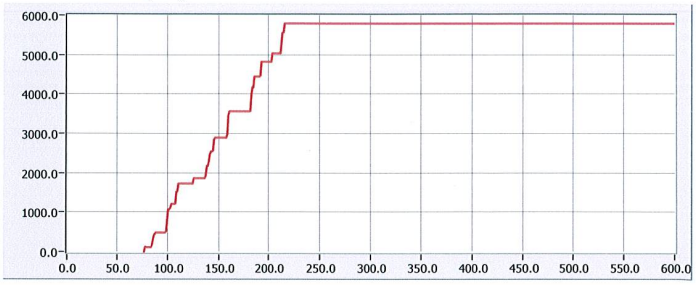
Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

CAN/ULC S102-18 DATA SHEETS
Run 2

Client: FP Innovations Specimen ID: NFPP2 NLT Fluted perpendicular

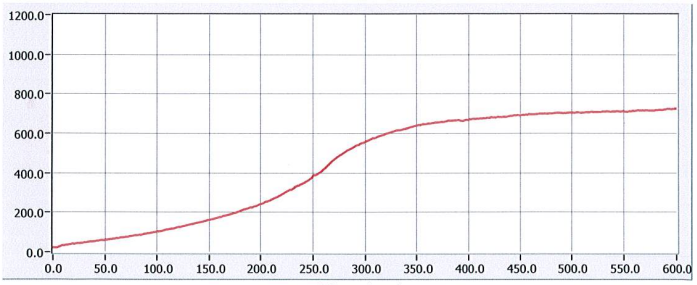
Test No.: 1 Standard: ULC S102

FLAME SPREAD (MM)



Smoke (%A)

Temperature (°C)



Time (sec)

600

Tested By: SF

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CAN/ULC S102-18 DATA SHEETS
Run 3

Standard: ULC S102 Page 1 of 2

Client: FP Innovations
Date: 09 25 2018
Project Number: 103546754
Test Number: 2
Operator: Sean Fewer

Specimen ID: NFPP3 Fluted Perpendicular

TEST RESULTS

FLAMESPREAD INDEX: 50
SMOKE DEVELOPED INDEX: 145

SPECIMEN DATA . . .

Time to Ignition (sec): 26
Time to Max FS (sec): 589
Maximum FS (mm): 5489.0
Time to 527 C (sec): Never Reached
Time to End of Tunnel (sec): Never Reached
Max Temperature (C): 424
Time to Max Temperature (sec): 595
Total Fuel Burned (cubic feet): 45.70

FS*Time Area (M*min): 26.1
Smoke Area (%A*min): 246.4
Unrounded FSI: 48.2
Unrounded SDI: 147.1

CALIBRATION DATA . . .

Time to Ignition of Last Red Oak (Sec): 40.0
Red Oak Smoke Area (%A*min): 167.5

Tested By: SF Reviewed By:

Benchmark and Non-standard Test Report: Report must be reproduced in its entirety

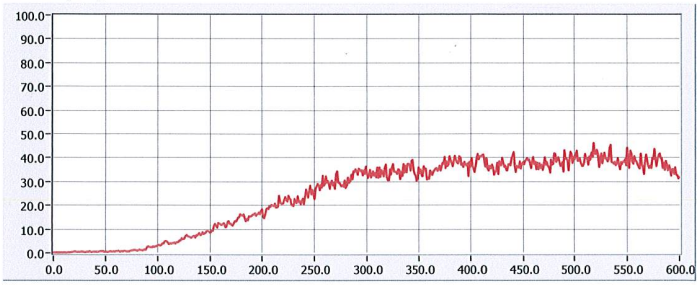
CAN/ULC S102-18 DATA SHEETS
Run 3

Client: FP Innovations Specimen ID: NFPP3 Fluted Perpendicular

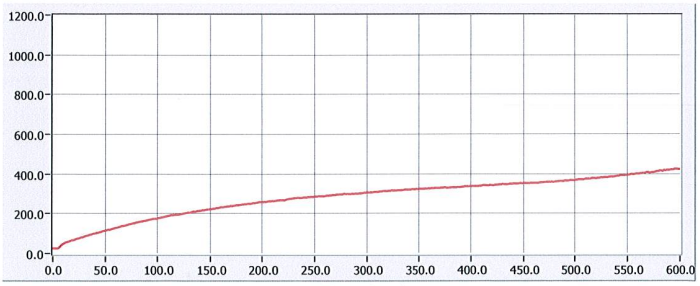
Test No.: 2 Standard: ULC S102

FLAME SPREAD (MM)

Smoke (%A)



Temperature (°C)



Time (sec)

600

Tested By: SF Reviewed By:

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REVISION SUMMARY

DATE	PAGE	SUMMARY
September 26, 2018	All	Original Issue Date

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