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Fire Testing of Exterior Vents

Indicative testing conducted in accordance with the test methodology described in ASTM E2886/E2886M, Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement

Conducted For:

Joto Techno Co., Ltd.
1-14-1 Shodai-tajika
Hirakata-shi, Osaka 573-1132 Japan

Material:

Continuous Foundation Joto-Vent with Architectural Covering

WFCi Report #20034

****The results of this report pertain only to the materials tested****

Test Date: April 29-30, 2020

Report Issued: June 2, 2020

IAS ACCREDITED Testing Laboratory TL-180

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INTRODUCTION

The report summarized the testing of exterior foundation vent system for Joto Techno Co. tested at Western Fire Center, Inc. (WFCi). The purpose of this test was to evaluate the fire test performance characteristics of the exterior vent products in accordance with ASTM E2886/E2886M, *Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement*. Two separate methods are defined in the standard, ember exposure to vents and direct flame impingement in multiple orientations (vertical/horizontal). Direct flame testing was performed only in the vertical orientation for this series, as it would be the only configuration it would be installed.

SUMMARY OF TEST METHOD

Ember Test

Embers are generated from a circular tumbler filled with 10 Class C brand (ASTM E108) positioned over a representative installed exterior vent and combustible target material. The brands are ignited by a 2" gas flame for a 3 min period. After the brand ignition, the tumbler is activated allowing the created embers to fall on top of the vent (upper shelf). Embers that the vent does not collect/stop can pass through and ignite a combustible cotton target (lower shelf) below the vent. Air flow is regulated by a fan downstream of the tumbler, vent, and target material at a velocity of 2 mi/hr. The test is run until all the embers have run out of the tumbler and all combustion ceased. Assembly dimensions and locations are described in Figure 1 as well as the actual installation in Figure 2.

No specific acceptance criterion is given for this standard, but observations are to be made regarding ignition of the target cotton material including smoldering and flaming ignition. To give representative temperature information, 3 thermocouples are installed 1" above the vent at center and quarter points. Three (3) replicates of this test are performed as directed by the standard.

The California Building Code (CBC) Chapter 7A does provide ember requirements for listed vents:

706A.2.1.1 The Ember Intrusion Test shall have no flaming ignition of the cotton material.

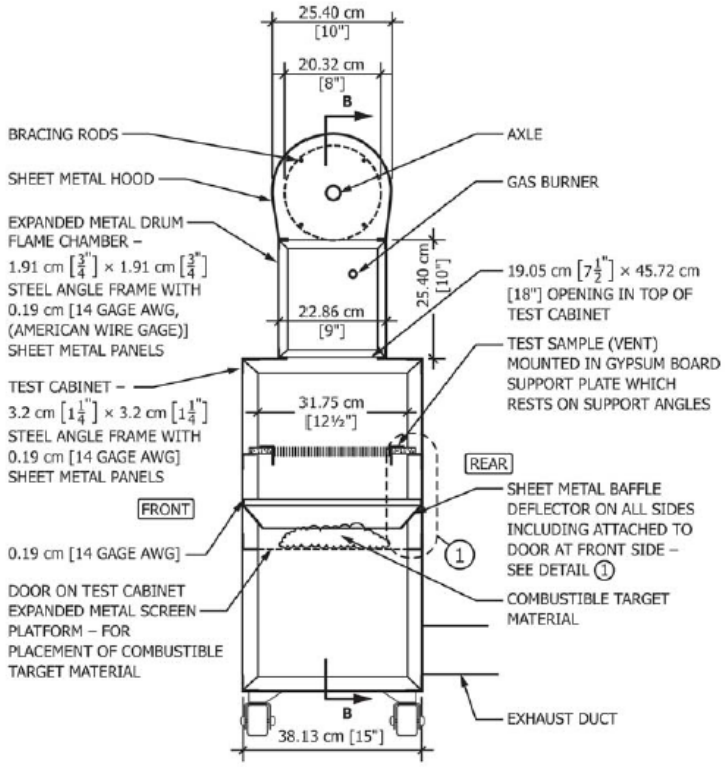

Figure 1. Ember test assembly showing tumbler, vent, and target locations.

Figure 2. Actual installation of vent in ember chamber with upper and lower shelf.

Direct Flame Test

A nominal 4'×8' table (Figure 3) was used for the direct flame exposure. The table had a 20"×20" hole cut on one side and a 23⅝" skirt on each side except the side away from the hole. A 6¾"×6¾" sand burner was positioned 10" below the table hole. A vent sample is installed in either a horizontal or vertical configuration. For the vertical foundation vent system (Figure 3b), a 31½"×31½" box was used with the representative vent installed on the side of the box. A slot was cut into the top of the box towards the installed vent to allow flames to pass over the vertical vent, yet allow for them to escape the box.

Prior to the test, the gas flame was verified to have a heat output of 300 kW. The flat lid or box, depending on vent orientation, was slid over the table hole. The test is designed to run for 10 min. At 30 s, 5 m, and 9 m 30 s into the test, a target cotton pad was placed next to the vent for 30 s to see if the vent allows heat to transfer through the vent.

No specific acceptance criterion is given for this standard, but observations are to be made regarding ignition of the target cotton material including flaming ignition, smoking, and/or darkening of the pad. Thermocouples were placed on the face (TC_S1-2) near the 2×6 wood/plywood interface and on the vent exit (TC_S3-4).

The California Building Code (CBC) Chapter 7A does provide flame intrusion requirements for listed vents:

706A.2.1.2 There shall be no flaming ignition during the Integrity Test portion of the Flame Intrusion Test. The maximum temperature on the unexposed side of the vent shall not exceed 662°C (350°C).

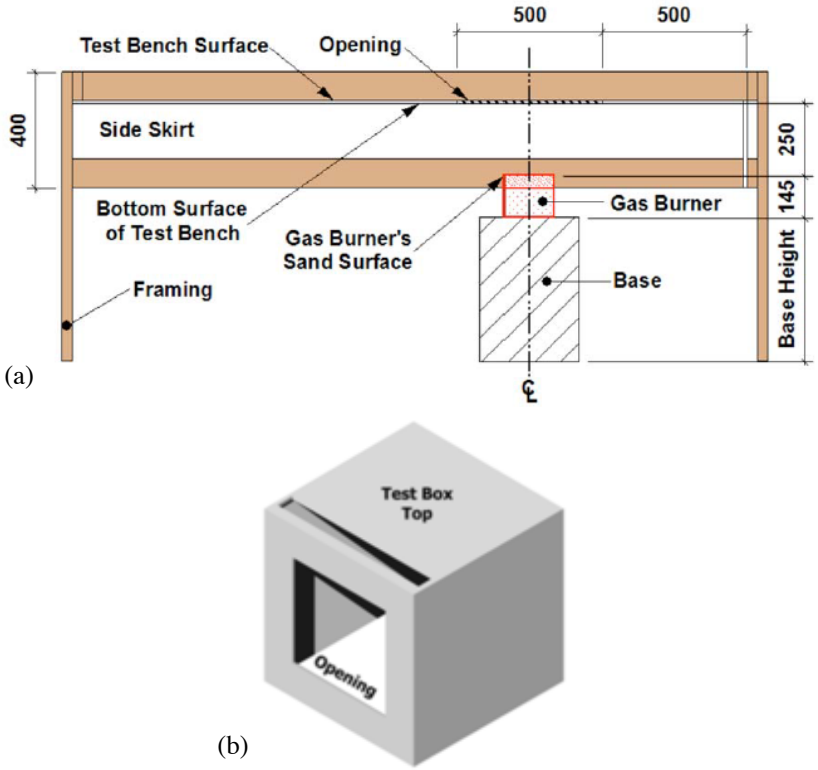

Figure 3. Direct flame apparatus showing (a) overall table and (b) vertical box for vent.

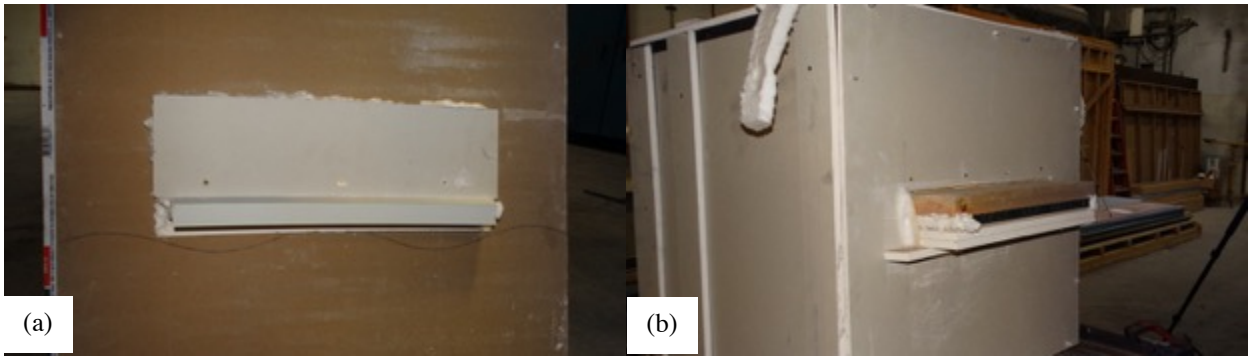

Figure 4. Actual installation of vent in flame chamber showing (a) exposed side and (b) unexposed side.

SAMPLE DESCRIPTION

The two-part vent system consists of a foundation Joto-vent that is placed between a concrete foundation and a nominal 2×6 wood baseplate, and an architectural covering (flashing) that is placed at the bottom of the exterior siding to cover the baseplate/foundation interface (see). Sections (18”) of both the foundation vent and flashing were sent to WFCi and representative sample sections were built for each test. As much as possible, the vent system was installed with appropriate components (e.g., 2×6 baseplate, $^{7}/_{16}$” exterior plywood) to give a representative sample. Due to weight restrictions in moveable box, a section of noncombustible paneling (Hardiboard) was used to replace the concrete foundation. Where needed, additional layers of gypsum and ceramic insulation were used to enclose the sample within the confines of each individual test apparatus, isolating the vent to the fire test (embers or flames).

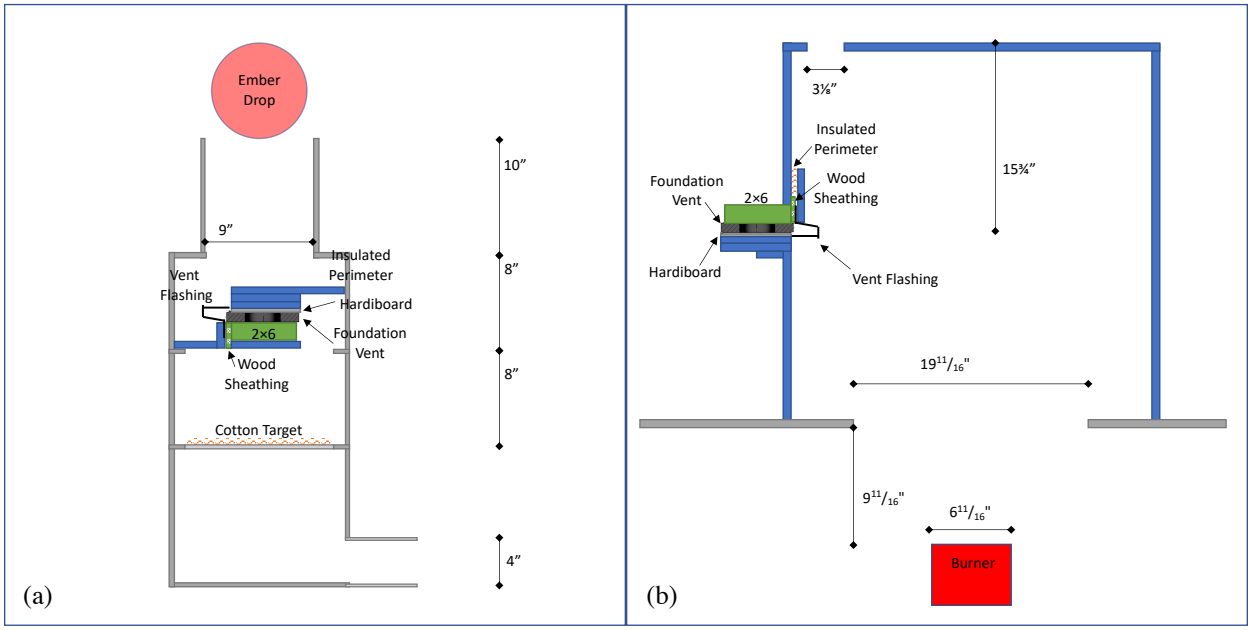

Figure 5. Vent schematics showing (a) ember drop and (b) flame impingement tests.

The Joto-vent and architectural covering were installed as proscribed by the manufacturer with essentially no gap between the bottom of the architectural covering and the foundation. Representative samples are shown in Figure 6. WFCi did not select the sample components and has not verified the manufacturing techniques or accuracy of the products and labeling (see chain of custody in).

Figure 6. Representative samples showing (a) flashing gap for ember test, (b) side cross-section for ember test, (c) flashing gap for flame test, and (d) crawl-space side of vent system.

For the ember tests, the vent was installed up-side-down, so embers fell on top of the flashing material, yet the rest of the opening was sealed with gypsum and/or ceramic insulation. For the direct flame tests, the vent was installed as would be expected on the side of a wall.

TEST RESULTS

Testing was performed on April 29-30, 2020 with the heat source (300 ± 15 kW) for the direct flame exposure tests verified just before the tests began (296.5 kW). Ambient conditions on the test day ranged between 17°C and 18°C and 54% and 60% RH.

Ember Test Results

A typical ember test showed small embers going through flashing and eventually through the continuous foundation vent and landing upon the cotton target, charring the cotton (smoldering ignition), but no flaming ignition was observed. The embers began to run out around 8 min into the test with all signs of combustion out around 9 min. Individual observations are shown below.

Test 1 - Ember

Continuous Foundation Joto-Vent with Architectural Covering

Test Date & Time: April 29, 2020 – 1:20 PM

Table 1. Observations for Test 1.

Test Time (mm:ss)		**Event**
00:00		Burner applied to brands

03:00		Gas off – shield/door being closed
03:10		Tumbler activated
03:35		Small embers through vent
07:30		No significant changes
09:00		All combustion out – terminate test – small charring on cotton – no ignition of cotton

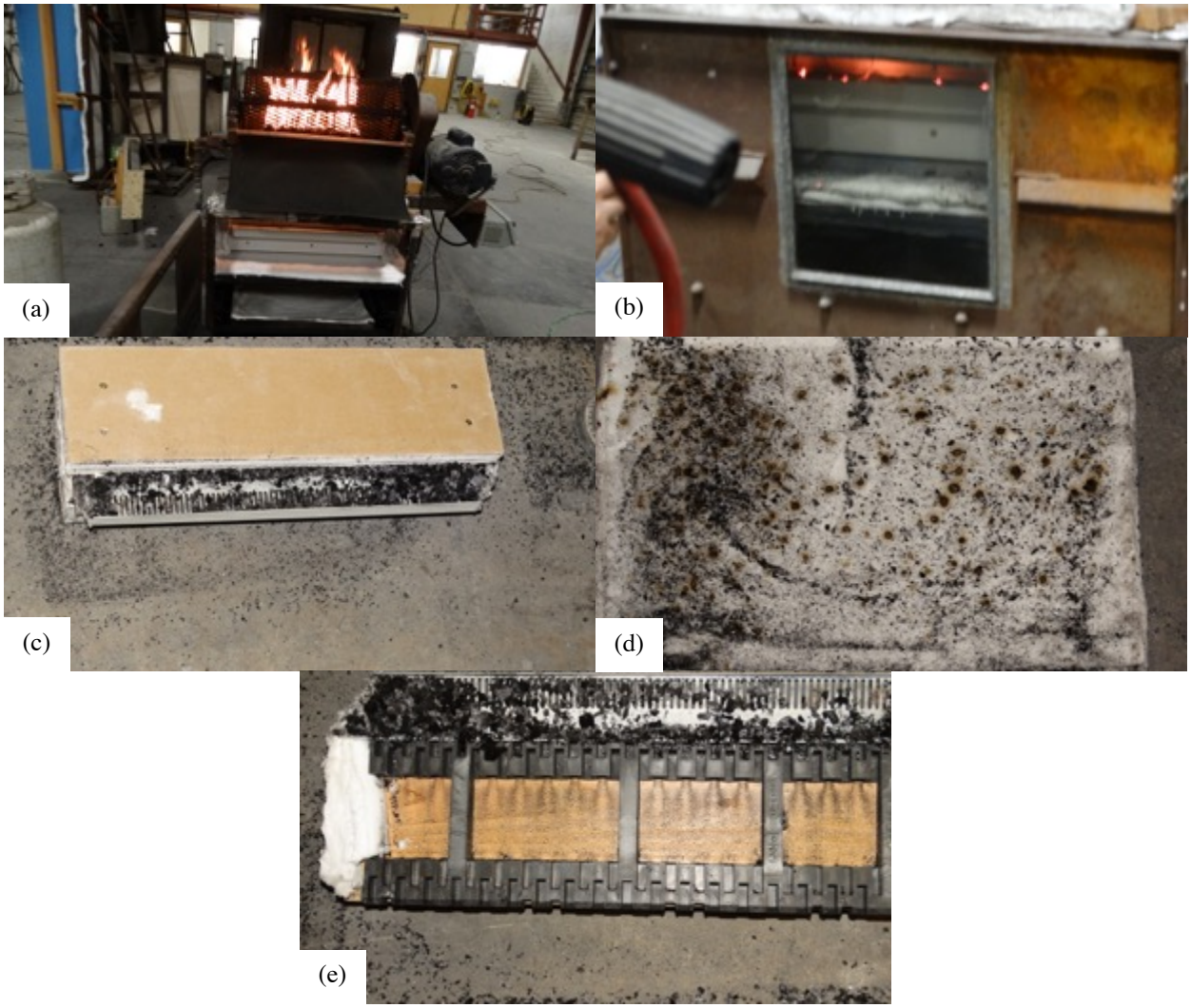

Figure 7. Test 1 showing (a) ignited brands, (b) embers on vent, (c) flashing, (d) cotton target, and (e) removed foundation.

The three thermocouples just above the vent on the upper shelf showed an initial spike to around 90°C when the tumbler was activated which remained for approximately 3 min, then gradually decreased as the embers burned out.

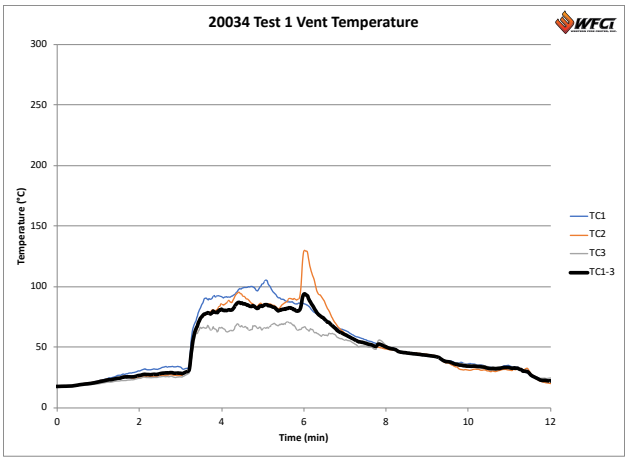

Figure 8. Test 1 temperature just above vent.

Test 2 - Ember

Continuous Foundation Joto-Vent with Architectural Covering

Test Date & Time: April 29, 2020 – 1:50 PM

Table 2. Observations for Test 2.

Test Time (mm:ss)		**Event**
00:00		Burner applied to brands
03:00		Gas off – shield/door being closed
03:09		Tumbler activated
04:00		Small embers through vent
07:00		No significant changes
09:15		All combustion out – terminate test – small charring on cotton – no ignition of cotton

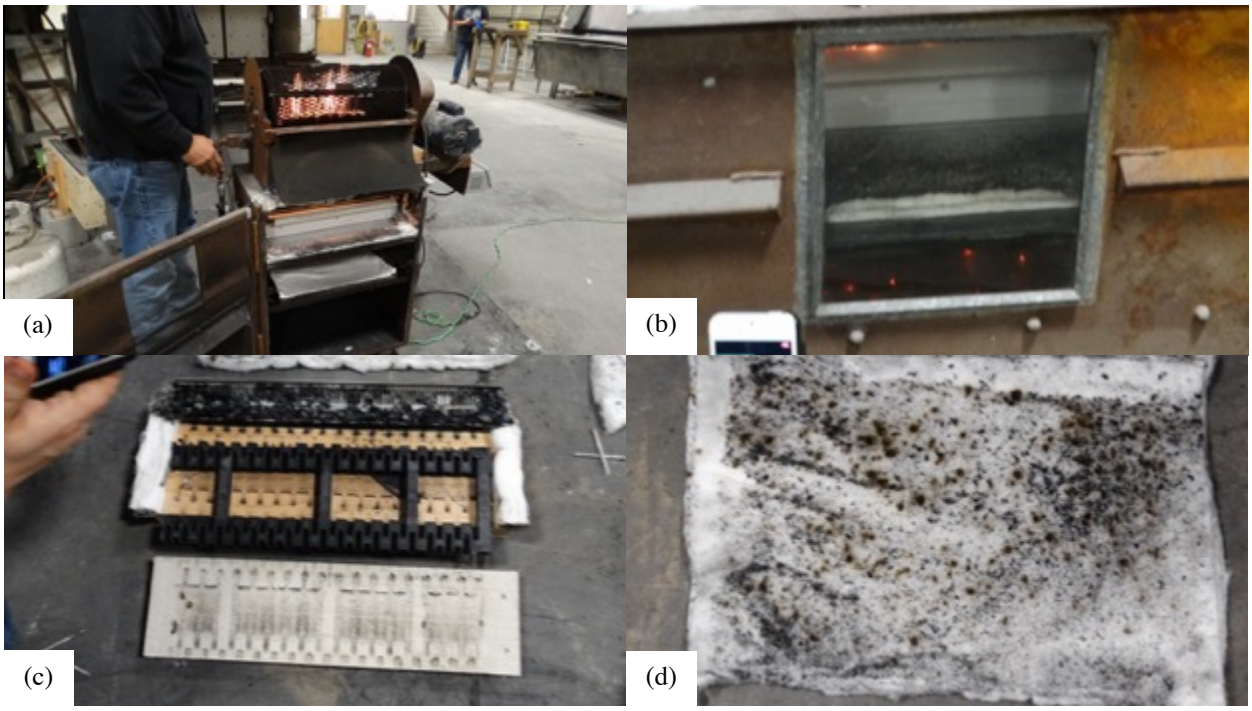

Figure 9. Test 2 showing (a) ignited brands, (b) embers through vent, (c) remaining vent, and (d) cotton.

The three thermocouples (Figure 10) just above the vent on the upper shelf showed an initial spike to around 90°C when the tumbler was activated which remained for approximately 4 min, then gradually decreased as the embers burned out.

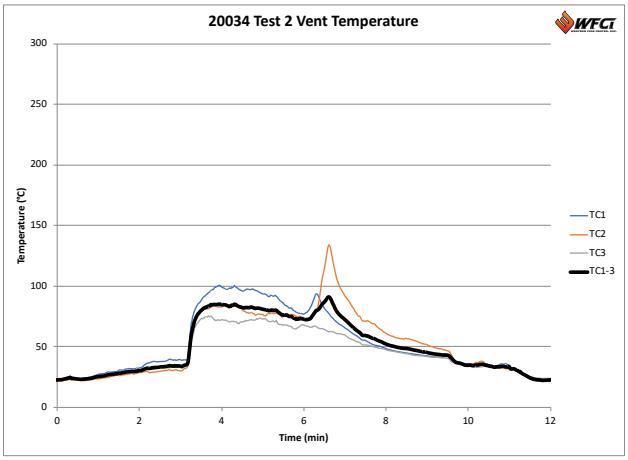

Figure 10. Test 2 temperature just above vent.

Test 3 - Ember

Continuous Foundation Joto-Vent with Architectural Covering

Test Date & Time: April 29, 2020 – 2:10 PM

Table 3. Observations for Test 3.

Test Time (mm:ss)		**Event**
00:00		Burner applied to brands

03:00		Gas off – shield/door being closed
03:09		Tumbler activated
04:30		Small embers through vent
07:00		No significant change
09:00		All combustion out – terminate test – small charring on cotton – no ignition of cotton

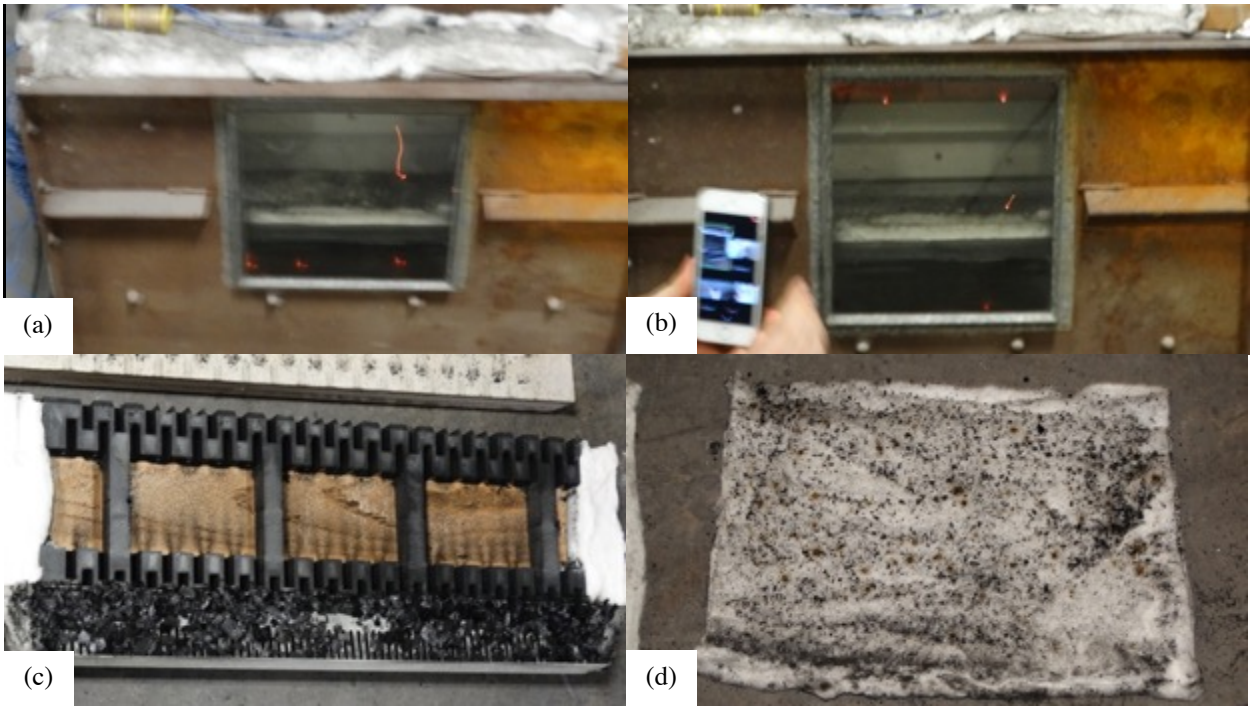

Figure 11. Test 3 showing (a-b) embers through vent, (c) cotton, and (d) vent face.

The three thermocouples (Figure 12) just above the vent on the upper shelf showed an initial spike to around 90°C when the tumbler was activated which remained for approximately 3 min, then gradually decreased as the embers burned out.

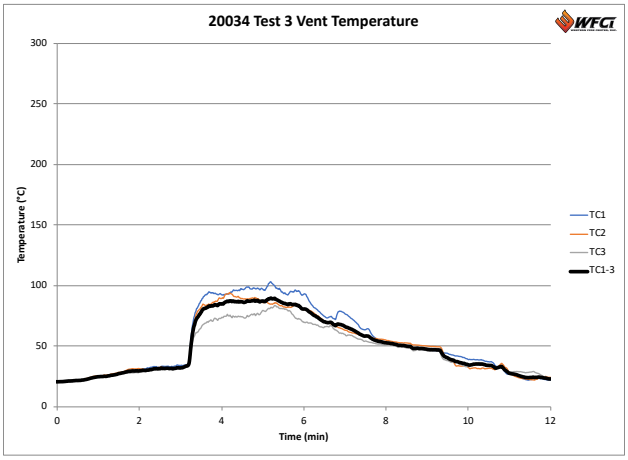

Figure 12. Test 3 temperature just above vent.

Vertical Flame Test Results

The vertical direct flame tests showed that the flames gradually smoked throughout the test, but no flames appeared to pass through the complete vent system. Some flaming/glowing was able to be seen through the foundation vent (from exposed-side burning). Some of the foundation vent had burned/ignited, but flames did not travel through the complete gap between the foundation and the 2×6. No ignition of the multiple cotton targets was observed. Individual observations for the vertical tests are shown below.

Test 4 – Vertical Direct Flame

Continuous Foundation Joto-Vent with Architectural Covering

Test Date & Time: April 30, 2020 – 9:30 AM

Table 4. Observations for Test 4.

Test Time (mm:ss)		**Event**
00:00		Start test – vent/lid moved over burner
00:20		Smoking through end of vent
00:30		Cotton target 1 on vent
01:00		Cotton target 1 off vent – no ignition, slight darkening of cotton
05:00		Cotton target 2 on vent
05:30		Cotton target 2 off vent – no ignition, no discoloration
09:30		Cotton target 3 on vent
10:00		Cotton target 3 off vent – no ignition, no discoloration – terminate test

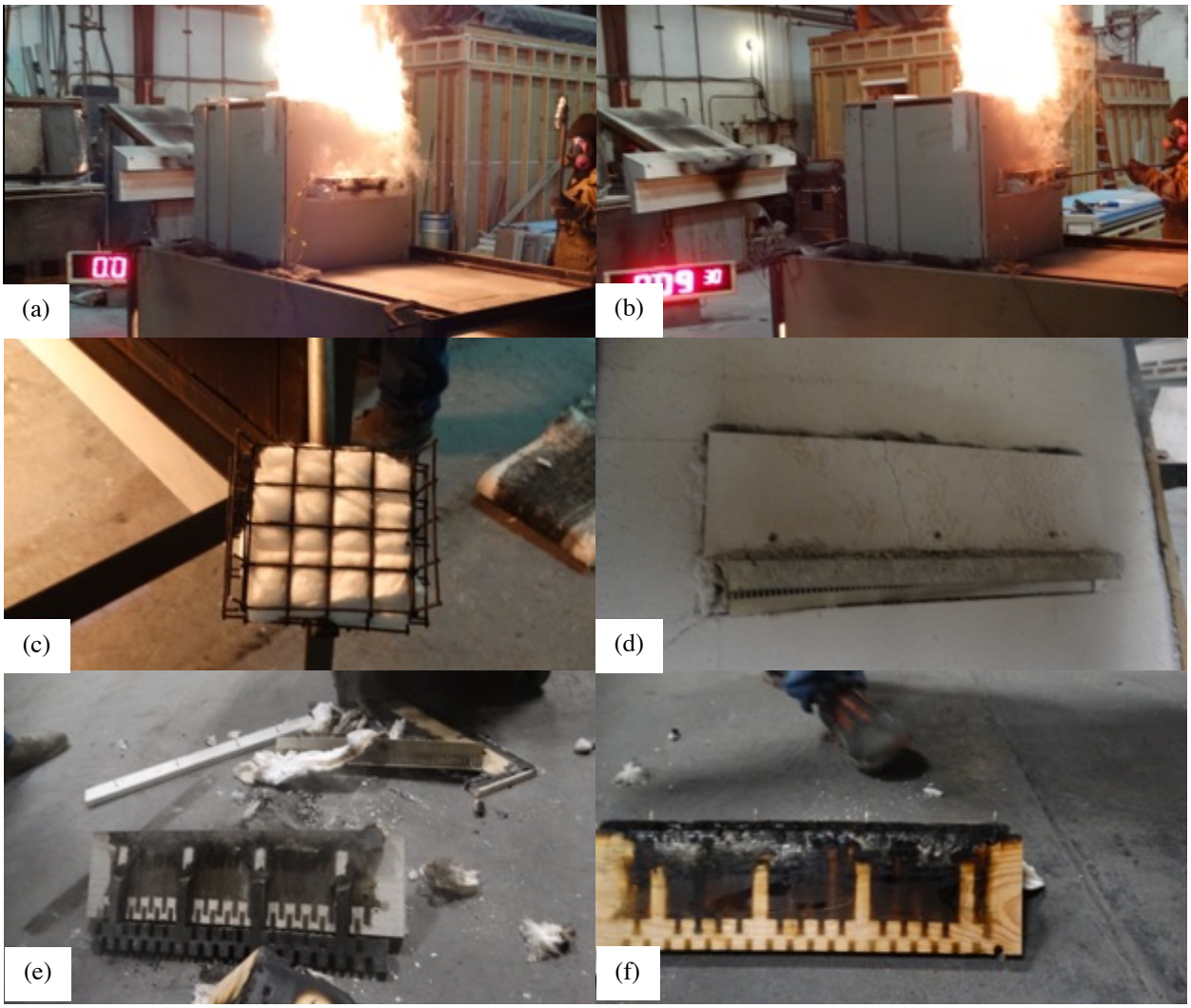

Figure 13. Test 4 showing (a) smoke through vent, (b) cotton 3 test, (c) cotton 3 after, (d) exposed flashing, (e) foundation vent, and (f) 2×6.

The four thermocouples installed on the unexposed vent showed an initial spike of near 250°C by one of the TC_S, which gradually descended for the remainder of the test. No TC_S got above 350°C.

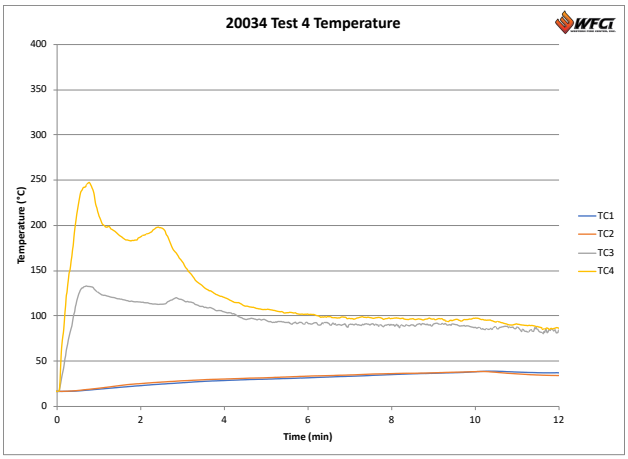

Figure 14. Test 4 temperature on unexposed side of vent.

Test 5 – Vertical Direct Flame

Continuous Foundation Joto-Vent with Architectural Covering

Test Date & Time: April 30, 2020 – 10:30 AM

Table 5. Observations for Test 5.

Test Time (mm:ss)		**Event**
00:00		Start test – vent/lid moved over burner –
00:10		Smoke through vent
00:30		Cotton target 1 on vent
01:00		Cotton target 1 off vent – no ignition, very slight discoloration
05:00		Cotton target 2 on vent
05:30		Cotton target 2 off vent – no ignition, no discoloration
09:30		Cotton target 3 on vent
10:00		Cotton target 3 off vent – no ignition, no discoloration – terminate test

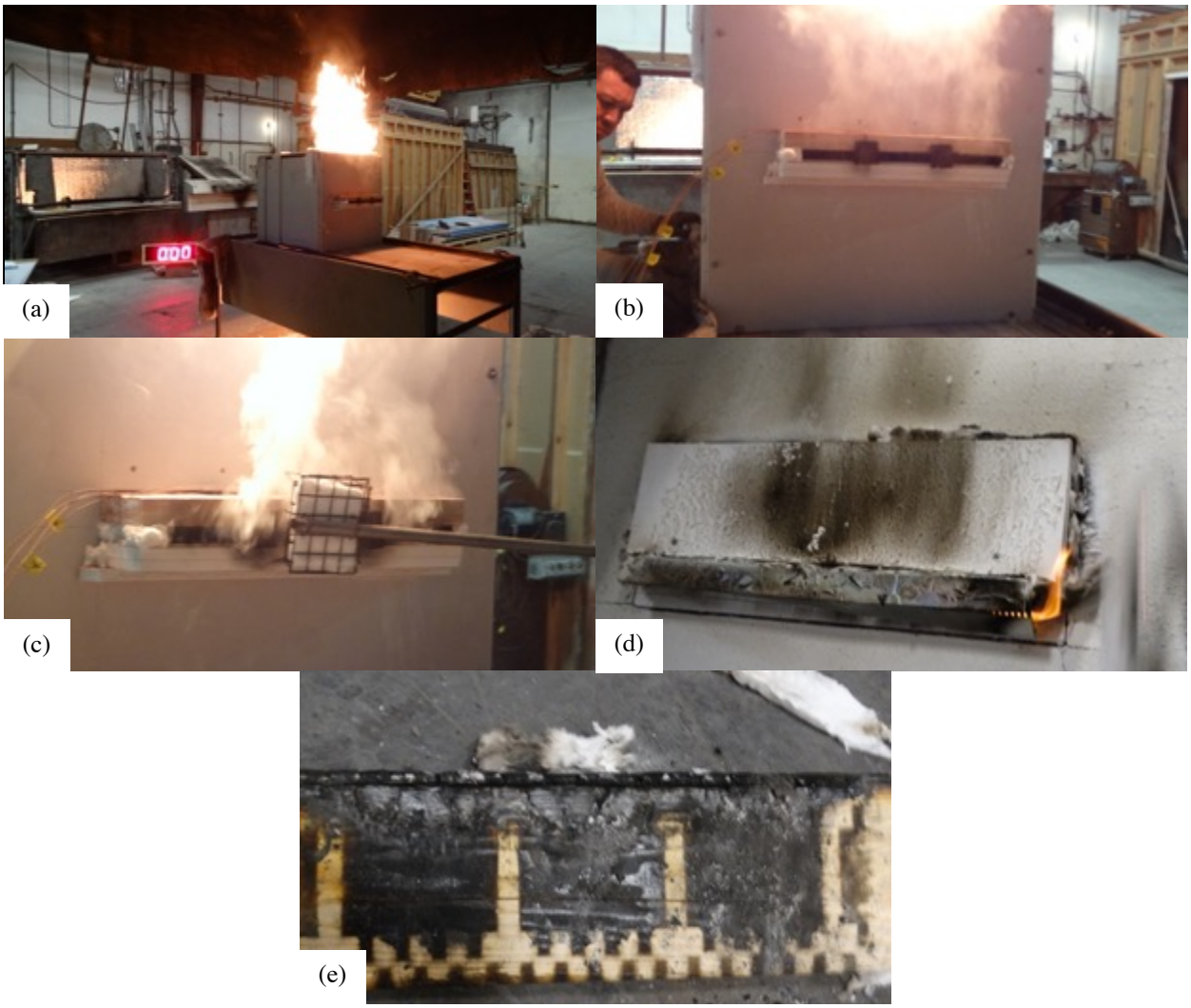

Figure 15. Test 5 showing (a) start of test, (b) unexposed side, (c) cotton 2 test, (d) flashing after test, and (e) 2×6.

The four thermocouples installed on the unexposed vent showed an initial spike of near 250°C by one of the TCs, which oscillated for the remainder of the test. No TCs got above 350°C.

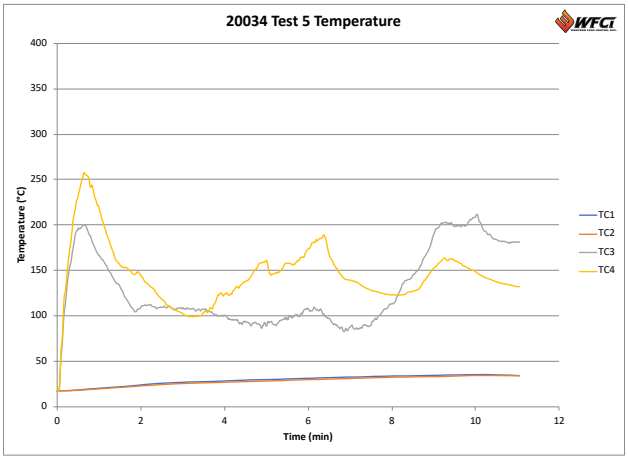

Figure 16. Test 5 temperature on unexposed side of vent.

Test 6 – Vertical Direct Flame

Continuous Foundation Joto-Vent with Architectural Covering

Test Date & Time: April 30, 2020 – 11:15 AM

Table 6. Observations for Test 6.

Test Time (mm:ss)		**Event**
00:00		Start test – vent/lid moved over burner – smoke through vent
00:30		Cotton target 1 on vent
01:00		Cotton target 1 off vent – no ignition, slight discoloration
05:00		Cotton target 2 on vent
05:30		Cotton target 2 off vent – no ignition, no discoloration
07:40		Visible glowing/flaming through foundation vent (exposed side)
09:30		Cotton target 3 on vent
10:00		Cotton target 3 off vent – no ignition, no discoloration – terminate test

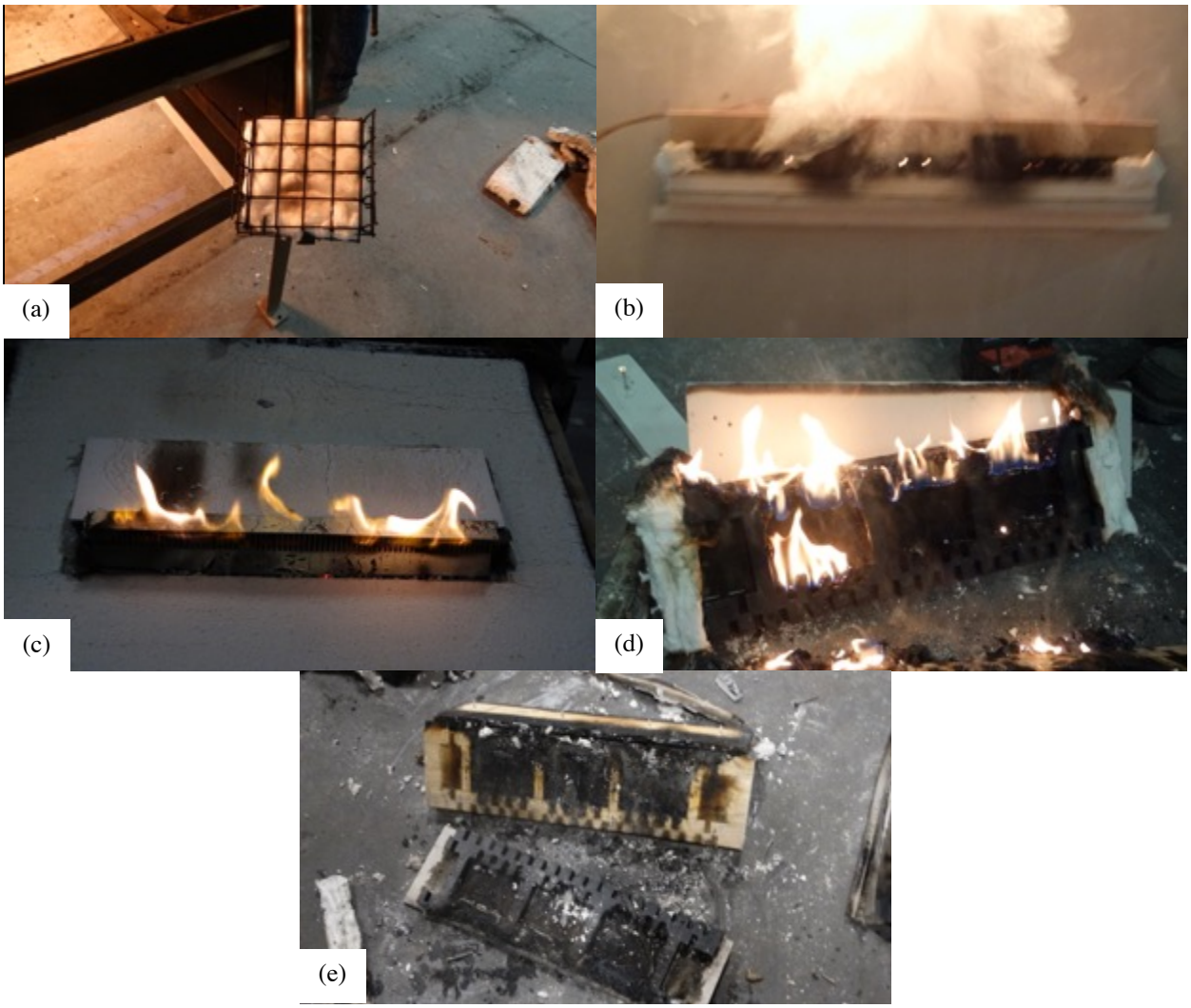

Figure 17. Test 6 showing (a) cotton 1 after, (b) visible glowing, (c) flashing after test, (d) foundation vent, and (e) after test.

The four thermocouples installed on the unexposed vent showed a minimal initial spike of near 120°C by one of the TC_S, which gradually increased by the end of the test to approximately 200°C. No TC_S got above 350°C.

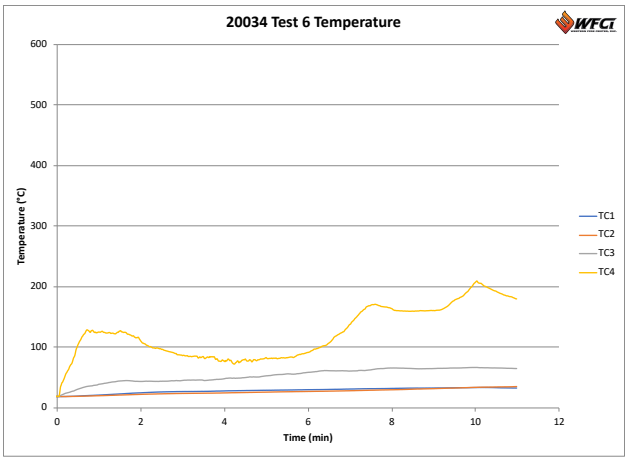

Figure 18. Test 6 temperature on unexposed side of vent.

CONCLUSION

Exterior vents as identified above by Joto-vent were tested according to the two methods within ASTM E2886/E2886M, embers and vertical direct flame. Three replicate tests were performed for the ember and vertically-installed direct flame vent configurations. For the ember tests, the test vents did not allow embers to ignite (flaming) the cotton target, though some did pass through and smoldered the target. For the vertically-installed direct flame tests, according to the approved standard, the vents did not allow ignition of the cotton targets, nor did the tests did have temperatures on the unexposed side face of the vent above 350°C.

SIGNATURES

Testing performed by,

Brent M. Pickett, Ph.D.

Technical Director

Reviewed and approved by,

Mike White

Laboratory Manager

The test specimen identification is as provided by the client and WFCi accepts no responsibilities for any inaccuracies therein. WFCi did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

APPENDIX A: Chain of Custody

Joto-Vent System®
Innovative Building Materials USA, Inc.

Joto-Vent System USA, Inc.
17530 NE Union Hill Rd, Suite 240
Redmond, WA 98052

Western Fire Center, Inc.
Brent M. Pickett, Ph.D.
Technical Director

April 22, 2020

Dr. Brent M. Pickett, Ph.D.,

In accordance with the AC85 3.2 we would like to submit this letter as required. This letter states that we randomly pulled Joto-Vent, and Architectural-covering out of inventory in Seattle, and sent them to our IAS accredited testing lab, Western Fire Center, Inc. in Kelso, WA for the Fire Testing of Exterior Vents described in ASTM E2886/E2886M.

We declare that the samples that we are certifying, and the product tested is representative of the standard manufactured product to be covered in the evaluation report or listing.

Takashige Maebayashi
Director, Engineering & Development
Joto-Vent System USA, Inc.

Mark Cron
Director, Sales & Operations
Interra USA, Inc.

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