



LEADING EDGE CONSTRUCTION MATERIALS TESTING COMPANY LIMITED

Room 22, 13/F Speedy Industrial Building, 114 How Ming Street Kwun Tong, Kowloon, HK
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Test Report No: QTM-2023-42-01
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TEST REPORT

Performance Mock-up Test Report

of

Vuillon Four-Folding Doors

Design Wind Load

Positive Design Wind Pressure = +1.20kPa

Negative Design Wind Pressure = -1.10kPa

Contractor:	Taixing Sainty Industry Co.,Ltd
Date of Testing:	Dec 28, 2023



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1. Introduction

This document describes the method and procedures of the performance test on the **Vuillon Four-Folding Doors** from **Taixing Sainty Industry Co.,Ltd.** The test will be conducted by using the actual sample and simulated conditions in a test chamber against the following specifications in order to ensure the safety and serviceability of the system.

- 1.1 Preloading at 50% of Design Wind Load
- 1.2 Air Infiltration & Exfiltration Test (ASTM E283)
- 1.3 Water Penetration Test under Static Pressure (ASTM E331)
- 1.4 Structural Test at 50% and 100% Design Wind Load (ASTM E330)
- 1.5 Repeat Water Penetration Test under Static Pressure (ASTM E331)



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2. Witnesses on the Test

Test Laboratory

Mr. Alien Zeng
Mr. Zhang Xing Jun
Mr. Wen Xiang Tong
Leading Edge Construction Materials Testing Company Limited

3. Test Information

Testing Yard: Zhaoqing Leading Edge Construction Materials Testing Company Limited

Location of Testing Yard: Asia Aluminum Industrial City, The New & High-Tech Industrial Development Zone, Dawang, Zhaoqing, Guangdong Province, China.

4. Details of the Test Specimen

4.1 General Description

The specimen is constructed with the actual size section to be used in the project. The construction method and fixing of the specimen is the same method used in approval plan. The Dimension & Area of the specimen:

Area for the whole specimen	2.600m(W) * 3.000m(H) = 7.800m²
Operable vents length:	26.8m

4.2 Glass

6mm+9A+8mm Clear Tempered Glass

4.3 Sealant

Weather Sealant: Dowsil TM 791

4.4 Design Wind Pressure

Positive Design Wind Pressure = +1.20kPa

Negative Design Wind Pressure = -1.10kPa

4.5 Equipment

- ◆ The test chamber is equipped with a manometer, air/water flowmeter, water pump, hydraulic jacks and air-blowers.
- ◆ The deformation of specimen shall be detected by displacement transducers.



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5 TEST REQUIREMENTS AND SEQUENCE

5.1 Preloading at 50% of Design Wind Load

Procedure

- Remove any sealing material or construction that is not normally a part of the assembly as installed in or on a building. Fit the specimen into the chamber opening and in such a manner that no joints or openings are obstructed. Seal the outer perimeter of the specimen to the chamber wall and seal at no other points.
- Without disturbing the seal between the specimen and the test chamber, adjust all ventilators, included in the test specimen so that their operation conforms to the specification requirements, and adjust all hardware for maximum tightness without interfering with their operations.
- Preload the specimen to **+0.60kPa** (50% positive design wind load) for 10 seconds.

Requirement

No separation, plastic deformations or deleterious should be observed.

5.2 Air Infiltration & Exfiltration Test (ASTM E283)

Procedure

- Without disturbing the seal between the specimen and the test chamber, adjust all ventilators, included in the test specimen so that their operation conforms to the specification requirements, and adjust all hardware for maximum tightness without interfering with their operations.
- Adjust the air flow through the test chamber to provide the specified test pressure difference across the test specimen. When the test conditions are stabilized, record the air flow through the flow meter and the test pressure difference.
- Eliminate extraneous chamber leakage, or, if this is impractical, measure the amount of such leakage with the specimen sealed, at the air pressure differences to be exerted during the air leakage tests. The metering equipment for the measurement of air leakage may be used for measuring the extraneous leakage, or it may be necessary to provide additional air metering equipment for this purpose.
- Air infiltration & exfiltration rate is to be checked under pressure difference of **±300Pa**.

Requirement

Air infiltration & exfiltration rate should not exceed **1.44m³/(m·hr)** [it means 0.024m³/(m·min)] for operable sash, and the air infiltration & exfiltration limit values were shown in below table:

Air Infiltration & Exfiltration limit of specimen	
for perimeter of operable sashes	$1.44\text{m}^3/(\text{m}\cdot\text{hr}) \times 26.8\text{m} = 38.592\text{m}^3/\text{hr}$

5.3 Water Penetration Test under Static Pressure (ASTM E331)

Procedure

- Without disturbing the seal between the specimen and the test chamber, adjust all ventilators, included in the test specimen so that their operation conforms to the specification requirements, and adjust all hardware for maximum tightness without interfering with their operations.
- Apply the air pressure difference from **+300Pa** on, each step of **100Pa** (each pressure holds for 2 minutes) promptly and maintain the pressure along with the specified rate of 3.4 L/m²·min [0.204m³/(m²·hr)].



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Stop the test if uncontrolled water leakage is observed. It will stop when one of the conditions occur stated below.

- ◆ The water shall be contained and drained to exterior.
- ◆ There shall be no wetting at the interior room surfaces.
- ◆ There shall be no staining or other damage to any part of the completed building or its furnishings.

(c) Observe and record the points of water leakage, if any.

Requirement

Record the max. pressure on which there is no uncontrolled water leakage observed.

The occurrence of condensation during the test is acceptable. Other water leakage is acceptable only if all the following condition is satisfied.

- (a) The water shall be contained and drained to exterior.
- (b) There shall be no wetting at the interior room surfaces.
- (c) There shall be no staining or other damage to any part of the completed building or its furnishings.

5.4 Structural Test at 50% and 100% of the design pressure (ASTM E330)

Procedure

Positive / Negative pressure up to 50% and 100% of the design pressure is applied and held for 10 seconds.

Locations of displacement transducers are shown in **Figure 1**.

Positive

<u>Pressure (kPa)</u>	<u>Duration</u>	<u>Remark</u>
+0.60 (50%)	10 seconds	preload
0.00	1 to 5 min.	set zero
+0.60 (50%)	10 seconds	take readings
+1.20 (100%)	10 seconds	take readings
0.00	1 to 5 min.	take readings for residual deflection

Negative

<u>Pressure (kPa)</u>	<u>Duration</u>	<u>Remark</u>
-0.55 (-50%)	10 seconds	pre load
0.00	1 to 5 min.	set zero
-0.55 (-50%)	10 seconds	take readings
-1.10 (-100%)	10 seconds	take readings
0.00	1 to 5 min.	take readings for residual deflection

Requirement

The performance of the specimen is evaluated against the following criteria.

- (a) The glass should not break.
- (b) The deflection of the mullion and transom should not exceed 1/250 of the span or 20mm, whichever is lesser.
- (c) The glass deflection should not exceed 1/60 of the span.



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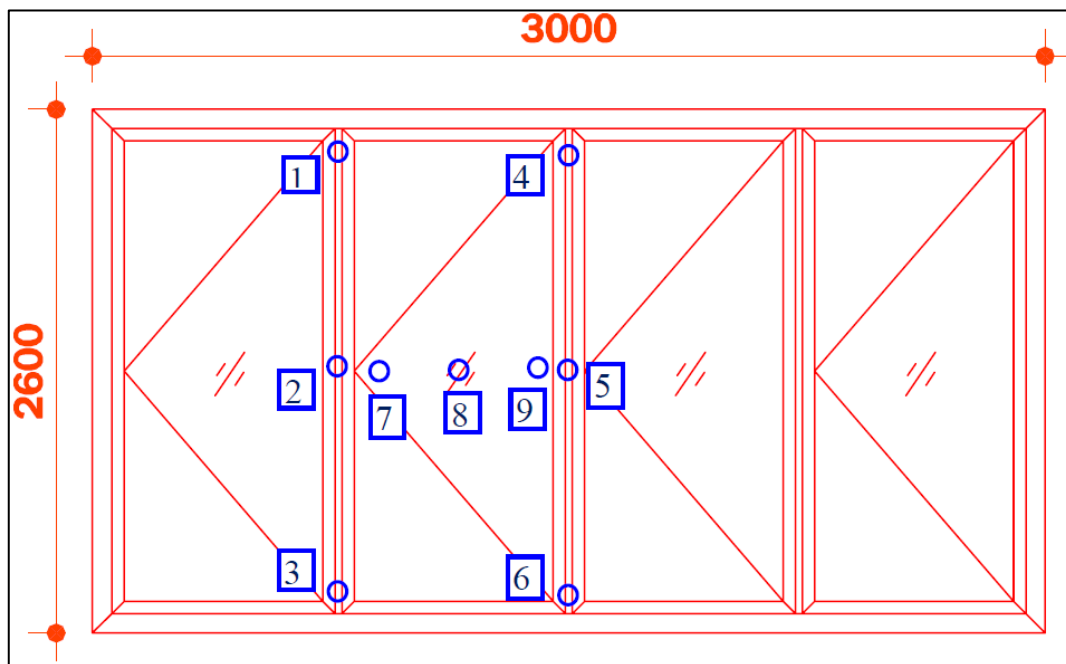


Figure 1: Locations of displacement transducers

5.5 Repeat Water Penetration Test under Static Pressure (ASTM E331)

Procedure

- Without disturbing the seal between the specimen and the test chamber, adjust all ventilators, included in the test specimen so that their operation conforms to the specification requirements, and adjust all hardware for maximum tightness without interfering with their operations.
- A fifteen (15) minute water penetration test will be conducted on the wall system with a water application rate of $0.204\text{m}^3/(\text{m}^2\cdot\text{hr})$ at the pressure has been verified in **Clause 5.3**
- Observe and record the points of water leakage, if any.

Requirement

No uncontrolled water leakage should be observed. The occurrence of condensation during the test is acceptable. Other water leakage is acceptable only if all the following condition is satisfied.

- The water shall be contained and drained to exterior.
- There shall be no wetting at the interior room surfaces.
- There shall be no staining or other damage to any part of the completed building or its furnishings.

6 Test Procedures and Observations

Actual specimen installed in chamber is shown in **Figure 2**



Figure 2 Photograph of Test Specimen
(View from outside of Chamber)

6.1 Preloading at 50% of Design Wind Load

Procedure

The test procedures described in Clause 5.1 were followed.

Observations

No separation, plastic deformations or deleterious was observed.

6.2 Air Infiltration & Exfiltration Test (ASTM E283)

Procedure

The test procedures described in Clause 5.2 were followed.

Observations

The air leakage of the specimen was within allowable values.

(a) Refer to the result shown in **Table 1**.

Pressure Description (Air Infiltration & Exfiltration)	+300Pa	-300Pa
Test Chamber + Test Specimen: (Q_C) + (Q_S)	38.76m ³ /hr	87.14m ³ /hr
Test Chamber: (Q_C)	35.69m ³ /hr	74.89m ³ /hr
Test Specimen: (Q_S)	3.07m ³ /hr	12.25m ³ /hr

Table 1: Measured Air infiltration during test



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(b) Calculate the air flow at standard condition:

$$Q_{st} = Q_{F1} (W/W_s)^{1/2}$$

$$W = 3.485 \times 10^{-3} (B/(T+273))$$

Where: B = 101.900kPa.

T = 15.6°C

W_s = 1.202kg/m³

$$\begin{aligned} W &= 3.485 \times 10^{-3} (B/(T+273)) \\ &= 3.485 \times 10^{-3} (101900 / (15.6+273)) \\ &= 1.230 \text{ (kg/m}^3\text{)} \end{aligned}$$

$$Q_{S-st} (+300Pa) = 3.07 \times (1.230/1.202)^{1/2} = \mathbf{3.11 \text{ (m}^3/\text{hr)}} < Q_s (38.592\text{m}^3/\text{hr})$$

$$Q_{S-st} (-300Pa) = 12.25 \times (1.230/1.202)^{1/2} = \mathbf{12.39(m}^3/\text{hr)}} < Q_s (38.592\text{m}^3/\text{hr})$$

Note: Value of Q_F is shown in clause 5.2.

6.3 Water Penetration Test under Static Pressure (ASTM E331)

Procedure

The test procedures described in Clause 5.3 were followed.

Observation

No water leakage was observed while the pressure was up to +1.0kPa.

6.4 Structural Test at 50% and 100% of the design pressure (ASTM E330)

Procedure

The test procedures described in Clause 5.4 were followed.

Observation

The glass did not break.

The deflection of the mullions and glass panels were within allowable values, as shown in **Table 2**.

Note: The limiting value was span/250 or 20mm for mullions, The glass deflection was 1/60 of the span.

Table 2: Structural Test Data:

Pressure in kPa	Displacement in mm								
	Locations of Transducers								
	Mullion Span=2400mm			Mullion Span=2400mm			Glass Panel Span=540mm		
	1	2	3	4	5	6	7	8	9
Positive Pressure									
At Pressure = 1.2	2.73	11.25	3.43	1.58	10.74	2.73	11.62	11.46	11.09
Relative def.	--	<u>8.17</u>	--	--	<u>8.59</u>	--	--	<u>0.11</u>	--
Permitted Relative def.	<	<u>9.60</u>		<	<u>9.60</u>		<	<u>9.00</u>	



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Pressure in kPa	Displacement in mm								
	Locations of Transducers								
	Mullion Span=2400mm			Mullion Span=2400mm			Glass Panel Span=540mm		
	1	2	3	4	5	6	7	8	9
Negative Pressure									
At Pressure = -1.1	-2.08	-10.46	-2.29	-1.53	-10.45	-2.28	-10.81	-10.87	-10.82
Relative def.	--	<u>8.28</u>	--	--	<u>8.55</u>	--	--	<u>0.05</u>	--
Permitted relative def.	<	<u>9.60</u>		<	<u>9.60</u>		<	<u>9.00</u>	

6.5 Repeat Water Penetration Test under Static Pressure (ASTM E331)

Procedure

The test procedures described in Clause 5.5 were followed.

Observation

No water leakage was observed under +1.0kPa.



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7 Summary of Test Results

Item	Test	Pressure	Results
7.1	Preloading at 50% of Design Wind Load	+0.60kPa	No separation, plastic deformations or deleterious was observed.
7.2	Air Infiltration & Exfiltration Test (ASTM E283)	±300Pa	The rate of air leakage of the specimen was within allowable values.
7.3	Water Penetration Test under Static Pressure (ASTM E331)	+1.0kPa	No water leakage was observed while the pressure was up to +1.0kPa.
7.4	Structural Test at 50% and 100% of the design pressure (ASTM E330)	+1.20kPa/ -1.10kPa	The glass did not break. The deflection of the mullions and glass panels were within allowable values
7.5	Repeat Water Penetration Test under Static Pressure (ASTM E331)	+1.0kPa	No water leakage was observed under +1.0kPa.

I certify that the above test results are the true record for the performance test on the **Vuillon Four-Folding Doors** from **Taixing Sainty Industry Co.,Ltd.**

Leading Edge Construction Materials Testing Company Limited

Authorized Signature
TSANG Hin Hang
Quality Manager

-End of Report-