

IAN BENNIE AND ASSOCIATES

TEST REPORT NO. 2014-023-S1

**TILT & TURN WITH FIXED WINDOW
PROTOTYPE TEST to AS2047-1999**

for

Finesse Window Systems Australia

November 2014



Accreditation No. 2371
Accredited for compliance with ISO/IEC 17025.



TEST REPORT NUMBER 2014-023-S1

Test Client: **Finesse Window Systems Australia**
18 - 20 Killara Rd Campbellfield Victoria 3061

Sample

Identification: A Tilt & Turn with Fixed Window sample measuring 2100 mm in height x 900 mm in width was supplied for testing. The sample is detailed in the Finesse Window Systems Australia drawings given in Appendix C.

Test Method: Structural Deflection, Air Infiltration, Water Penetration Resistance and Ultimate Strength test performance requirements to Clause 2.3 of Australian Standard AS2047-1999, and test procedures to Australian Standard AS4420-1996 as detailed in Appendix A.

Test Location: IBA Test Centre
Dandenong, Melbourne.

Test Date(s): 8 April 2014.

Pre-loading: The sample was operated five (5) times prior to the commencement of testing.

TEST RESULTS

Deflection Test

Deflections recorded:

	Housing (span/150)		Residential (span/180)		Commercial (span/250)	
Pressure (Pa)	+2200	-3000	+2200	-3000	+2200	-3000
Transom						
Deflection	span/369	span/389	span/369	span/389	span/369	span/389
Sash Stile (measurement not required for housing)						
Deflection	span/752	span/1503	span/752	span/1503	span/752	span/1503

All test readings and calculated deflections are given in Table 1 and measurement locations are indicated on Figure 1.

Air Infiltration Test

Air Leakage Recorded (L/s.m ²)	Pressure Applied (Pa)			
	+75	+150	-75	-150
Condition				
Chamber & Sample (A):	0.5	0.9	-0.5	-0.7
Chamber (sample taped) (B):	NR	NR	NR	NR
Sample (A-B):	0.5	0.9	-0.5	-0.7

NR: measurement not required

Water Penetration Test, 200 Pa

No water penetration was observed during the test.

Water Penetration Test, 300 Pa

Water was observed in one location during the test.

- 1/ Water penetrated through the sill glazing bead of the fixed light. This water constitutes failure.

Ultimate Strength Test: +3300 Pa & -3300 Pa

No sign of collapse was observed at either test pressure.

CONCLUSION

The Tilt & Turn with Fixed Window sample achieved the following ratings per AS2047-1999 and Building Importance Level 2 when tested for Structural Deflection, Air Infiltration, Water Penetration Resistance and Ultimate Strength. Referenced Standards, building classifications, housing limitations and Region data are summarised in Appendix B.

NOTES:

1. Ratings have been calculated using the 2002 issue of AS/NZS 1170.2. The client can re-calculate the ratings using the 1989 issues of AS 1170.2 from the test results if required.
2. Ratings have only been calculated for BCA Building Importance Level 2. The client can re-calculate the ratings for other levels of importance from the test results if required.

Housing ratings:

Regions A & B.....N4
 Region C+670 ‡ and -1400 # Pa
 Region D+670 ‡ and -1110 # Pa

Residential and Commercial building ratings:

Region A+670 ‡ and -2230 Pa
 Region B+670 ‡ and -1470 # Pa
 Region C+670 ‡ and -1400 # Pa
 Region D+670 ‡ and -1110 # Pa

‡ - rating is limited by the maximum water test pressure applied without failure.
 # - rating is limited by the maximum ultimate test pressures applied without failure.

Air Infiltration: Airconditioned and Non-airconditioned Buildings
Maximum Water Penetration Resistance Pressure: 200 Pa

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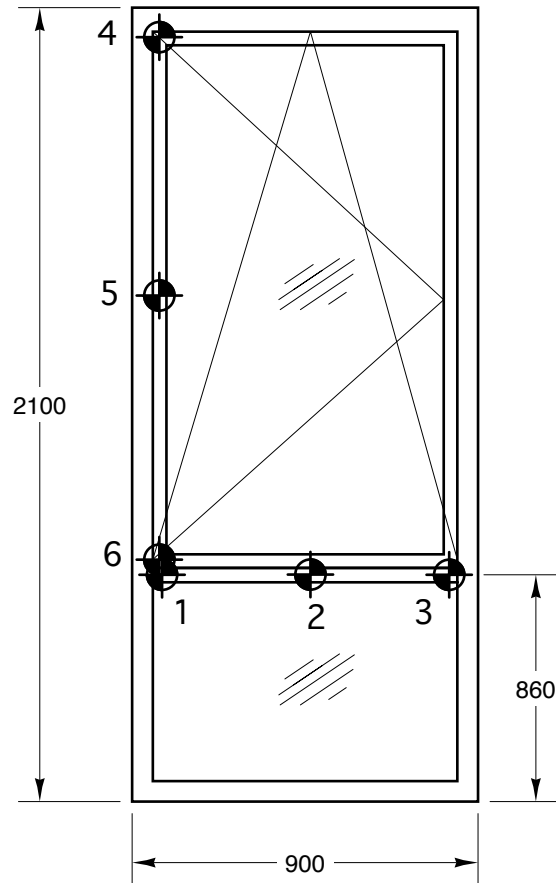


D. Dubout

Derek Dubout 3 November 2014
 Authorised Signatory

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INDOOR VIEW

⊗ - displacement measurement location

1. Transom - left
2. Transom - centre
3. Transom - right
4. Sash stile - top
5. Sash stile - centre
6. Sash stile - botom

Figure 1. Indoor view of the test sample showing the displacement measurement locations.

Table 1
STRUCTURAL PERFORMANCE

DATAFILE 845		TEST NUMBER 1			DATE : 08/04/2014		
MEMBER	PRESSURE (kPa)	DISPLACEMENTS (rounded to 0.1 mm)			BENDING DEFLECTION (rounded to 0.01 mm) DC - $\frac{D1+D2}{2}$ DEF (mm)	SPAN L (mm)	SDR L/DEF
		LEFT OR TOP D1 (mm)	CENTRE DC (mm)	RIGHT OR BOTTOM D2 (mm)			
1,2,3	TRANSOM						
	0.49	0.1	0.6	0.1	0.49	814	1650
	1.00	0.3	1.5	0.4	1.12		729
	1.50	0.5	2.3	0.6	1.69		483
	2.00	0.7	2.9	0.8	2.08		392
	2.20	0.9	3.1	1.0	2.21		369
	-0.74	-0.2	-0.8	-0.2	-0.67		-1220
	-1.50	-0.4	-1.7	-0.5	-1.29		-630
	-2.20	-0.7	-2.4	-0.7	-1.70		-480
-3.01	-1.1	-3.2	-1.1	-2.09	-389		
4,5,6	SASH STILE						
	0.49	0.3	0.5	0.3	0.23	722	3082
	1.00	0.7	1.2	0.8	0.48		1503
	1.50	1.0	1.9	1.4	0.70		1033
	2.00	1.5	2.6	2.0	0.89		810
	2.20	1.7	2.9	2.3	0.96		752
	-0.74	-0.2	-0.4	-0.3	-0.17		-4239
	-1.50	-0.4	-0.9	-0.8	-0.29		-2491
	-2.20	-0.7	-1.4	-1.3	-0.36		-2005
-3.01	-1.0	-1.9	-1.9	-0.48	-1503		

APPENDIX A - Test Procedures for AS2047-1999, Amdt 1 & Amdt 2

1 Preparation for Tests: AS4420.1-1996

Test Description

Prior to commencement of the main tests listed below, any operable windows or doors are to be opened and close five (5) times. The sample is to be subject to positive or negative wind pressures being 50% of the nominated deflection test pressures. This is a pre-requirement for each of the main tests. However, when more than one of the tests is to be conducted the preparations need only be conducted once.

2 Deflection Test : AS4420.2-1996

Test Description

Measurements of movement of critical structural members are taken at a range of test pressures in order to determine if the bending of the members exceed the nominated requirements.

Test Parameters

Test Pressure: is dependent on the type of building nominated by the client-

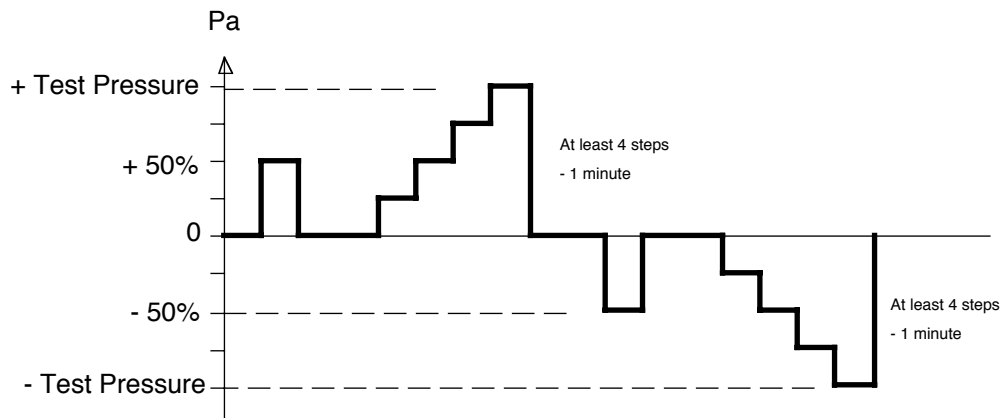
Housing: Based on Window Rating nominated by client as given in the following table:

Window Rating	Test Pressure (Pa)
N1	500
N2	700
N3	1000
N4	1500
N5	2200
N6	3000

Residential or Commercial Buildings:

The pressure shall be the Serviceability Limit State Pressure.

Test pressure steps: as given below



Pass / Fail criteria:

Maximum deflection for structural members is dependent on the type of building-

Housing:	1/150 of span.
Residential buildings:	1/180 of span @ Serviceability Limit.
Commercial buildings:	1/250 of span @ Serviceability Limit.

3 Operating Force Test : AS4420.3-1996

Test Description

The forces required to operate sliding doors and windows are measured to test compliance with the requirements.

Test Parameters

Test measurements: The forces required to initiate and sustain movement of the door/sash in both directions of movement are recorded.

Pass / Fail criteria : Forces shall not exceed the following

Force (Newtons)	Sliding window type		Sliding doors
	Horizontal	Vertical	
To initiate movement	110	200	180
To sustain movement	90	160	110

4 Air Infiltration Test: AS4420.4-1996

Test Description

Air leakage through the entire test sample is measured at the nominated pressures in order to determine if it exceeds the allowable rate.

Test Parameters

Pass / Fail criteria : Maximum air infiltration shall not exceed either of the following

Building type or window type	Pressure direction	Maximum air infiltration, L/s.m ²	
		@75 Pa	@150 Pa
Airconditioned	Positive, negative	1.0	1.6
Non-airconditioned	Positive	5.0	8.0
Louvre window	Positive	20.0	Not applicable
Adjustable louvres, residential and commercial buildings	Positive	20.0	32.0

5 Water Penetration Resistance Test AS4420.5-1996

Test Description

Water is sprayed onto the outdoor face of the test sample with air pressure simultaneously being applied across it to determine if unacceptable water leakage occurs.

Test Parameters

Test pressure : The test pressure is dependent on the type of building-

Housing: Based on Window Rating nominated by client as given in the following table-

Window ratings	Water penetration resistance test pressure (Pa)	
	All windows except adjustable louvres	Adjustable louvre windows
N1	150	150
N2	150	150
N3, C1	150	150
N4, C2	200	200
N5, C3	300	200
N6, C4	450	200

Residential or Commercial Buildings:

The test pressure shall be 30% of Serviceability Limit State Pressure but not less than 150 Pa.

5 Water Penetration Resistance Test AS4420.5-1996 (continued)

Test duration: The test pressure shall be maintained for 15 minutes.

Water application rate : 0.05 litre per second per square metre of sample area.

Pass / Fail criteria :

“Windows for Class 1 buildings shall be subjected to the water penetration resistance test in accordance with AS 4420.5, under the test pressures specified in Table 2.4. During and at the completion of the test there shall have been no penetration of uncontrolled water. Uncontrolled water is defined as-

- (a) water that is not contained in a purpose-built drainage area;
- (b) water that wets or is likely to wet insulation, fixtures and finishes, reveal linings or window furnishings beyond the window frame; or
- (c) water that lies on transoms, rails, sills, etc., that has no designed means of escape to the outside of the product via the drainage system.

Acceptable water penetration is not deemed a failure if-

- (i) minor splashing occurs due to air infiltration, within 1 mm after change of pressure;
- (ii) minor, intermittent leakage on the indoor side of openable sashes, which is contained on sash gaskets, sill tracks and thresholds that are part of a drainage system that allows water to flow to the outside of the product at cessation of the test (constant streams and regular dripping would be regarded as failure); or
- (iii) water running down the indoor face of louvers, which is completely contained within a purpose-built drainage area.

6 Ultimate Strength Test AS4420.6-1996

Test Description

Air pressure greater than the design pressure is applied across the test sample in order to demonstrate that it has a suitable structural safety margin.

Test Parameters

Test Pressure: is dependent on the type of building nominated by the client-

Housing: Based on Window Rating nominated by client as given in the following table-

Window Rating	Test Pressure (Pa)
N1	700
N2	1000
N3	1500
N4	2300
N5	3300
N6	4500

Residential or Commercial Buildings: the pressure shall be the Ultimate Limit State Pressure .

Pass / Fail criteria:

Windows shall not collapse when subjected to the test pressures for a period of ten (10) seconds. Collapse is defined as any one, or any combination, of the following:

- (a) Failure or dislodgment of any glazing.
- (b) Dislodgment of a frame or any part of a frame.
- (c) Removal of a light, either with or without its framing sash, from a frame.
- (d) Loss of support of a frame, such as when it is unstable in its opening in the building structure.
- (e) Failure of any sash, locking device, fastener or supporting stay allowing an opening light to open.

Retesting (if required)

Clause 7 of AS4420.1 states:

“If the test sample requires modification to gaskets, joints seals or drainage details to enable it to pass either the air infiltration test or the water penetration resistance test, then both tests shall be repeated in full. Before retesting, the test sample shall be checked for being operative (see Clause 4.1) and the deflection pressures, both positive and negative, shall be applied for 1 min each to the test sample. Any modifications to the test sample shall be noted in the respective drawing and the amendment coded thereon.”

APPENDIX B – Guide to Interpretation of Results and References

This appendix provides information extracted from the relevant Australian Standards and Codes to aid in understanding the method for determining a Rating of a test sample.

Standards and Codes used

AS 2047:1999 – Windows in buildings, including Amendments 1 and 2.

AS 4420:1996 – Windows-Methods of test, Parts 0 to 5

AS 4055:1992 – Wind loads for housing, including Amendment 1

AS/NZS 1170 - Structural design actions

1170.0:2002 - General principles

1170.0 Supplement 1:2002 - Commentary

1170.2:2002 - Wind Actions

1170.2 Supplement 1:2002 – Commentary

Building Code of Australia, including Amendment 11: July 2002

Building Classifications

Housing

AS2047 Clause 2.3.1.1 General In this Standard, housing is defined as Class 1 buildings and Class 10 buildings, as described in the Building Code of Australia, and is governed by the limitations specified in AS4055, except that windows in Class 10 buildings are not required to pass the air infiltration and water penetration requirements of this Standard.”

AS4055 Clause 6, Limitations

- (a) The distance from ground level to the underside of eaves shall not exceed 6.0 m; from ground level to the highest point of the roof, neglecting chimneys, shall not exceed 8.5 m; and the height of each storey at external walls shall not exceed 2.7 m
- (b) The width (W), including roofed verandahs but excluding eaves, shall not exceed 16.0 m, and the length (L) shall not exceed five times the width.
- (c) The roof pitch shall not exceed 35°.

Residential buildings

AS2047 Clause 2.3.2.1 “...covers residential buildings of Class 2, Class 3 and Class 4 parts of buildings as described in the Building Code of Australia, and Class 1 buildings outside the limitations specified in AS4055.”

Commercial buildings

AS2047 Clause 2.3.3.1 “...covers commercial buildings of Classes 5, 6, 7, 8 and 9 as described in the Building Code of Australia.”

Design Wind Speeds

In a change from the previous issue of AS1170.2, the 2002 issue replaced predefined Basic Regional Wind Speeds for Serviceability, Permissible and Ultimate design with Regional Wind Speeds in terms of average annual recurrence intervals (R) (refer Section 3.1). Determination of the appropriate annual recurrence intervals for Serviceability, Permissible and Ultimate design is now specified in other Standards and Codes as follows:

Serviceability Limit State

Guidance is given in AS/NZS 1170.0 General Principles, which identifies a recurrence interval of 20 years as appropriate for serviceability limit state. (refer to Appendix C of the Standard).

Permissible Stress

Permissible Stress is all but removed from the 2002 issues of the structural design Standards. Clause C3.2 of AS/NZS 1170.2 Supplement states "The permissible stress gust wind speed may be obtained by dividing the wind speed given in the Standard by the square root of 1.5".

Ultimate Limit State

AS1170.0 nominates that the Building Code of Australia (BCA) is used in Australia to determine the recurrence intervals for Ultimate Strength based on a building's Importance Factor. These are indicated in the table below. Refer to the BCA for definitions of importance. For New Zealand, AS/NZS 1170.0 determines the annual recurrence intervals based on Importance Levels and Design Working Life of buildings (refer to Section 3 of the Standard).

Building Importance Levels for Ultimate Strength Wind Loads

This table is defined in the BCA for Australia and AS/NZS1170.2 for New Zealand

Building Importance Level	Recurrence Interval (years)
1 Non-cyclonic	100
1 Cyclonic	200
2	500
3	1000
4	2000

Regional Wind Speeds per AS1170.2

Recurrence Interval (years)	Design State	Regional Wind Speeds				
		Regions				
		A (1 to 7)	W	B	C ¹	D ¹
20	Serviceability, $V_{S,20}$	37	43	38	45	51
100	Ultimate, $V_{U,1NC}$	41	47	48	-	-
200	Ultimate, $V_{U,1C}$	-	-	-	64	80
500	Ultimate, $V_{U,2}$	45	51	57	69	88
1000	Ultimate, $V_{U,3}$	46	53	60	73	93
2000	Ultimate, $V_{U,4}$	48	54	63	77	99

Notes:

1. Values of FC = 1.05 and FD = 1.10 have been applied to the Ultimate Wind Speeds in Regions C & D respectively.
2. For New Zealand, a building Design Working Life of 50 years has been applied.

Calculated Ratio of Design Wind Loads and Window Ratings

Ratio of Ultimate and Serviceability Wind Loads

As a result of the changes in AS1170.2 and other codes as detailed in the previous section in this Appendix, there are now no less than 20 possible ratios of Ultimate and Serviceability Wind Speeds depending on Region and Building Importance.

In order to determine the Rating of a generic window sample tested in accordance with AS2047, it is necessary to apply the ratio of Ultimate and Serviceability **WIND LOADS** for all building types other than Housing in regions A and B.

The following table calculates the Wind Load Ratio p_U / p_S which is equal to $(V_U / V_S)^2$, NOT the ratio of wind speeds. The Wind Load Ratio enables determination of Serviceability Wind Loads from the Ultimate Wind Loads applied during testing.

Wind Load Ratio

Building Importance Level	Ultimate Recurrence Interval (yrs)	Wind Load Ratio (p_U / p_S)				
		Regions				
		A (1 to 7)	W	B	C	D
1 Non-cyclonic	100	1.23	1.19	1.60	-	-
1 Cyclonic	200	-	-	-	2.02	2.46
2	500	1.48	1.41	2.25	2.35	2.98
3	1000	1.55	1.52	2.49	2.63	3.33
4	2000	1.68	1.58	2.75	2.93	3.77

Calculation of Window Rating

In calculating the Window Ratings provided in the conclusion of this report, Ian Bennie and Associates apply the following procedure.

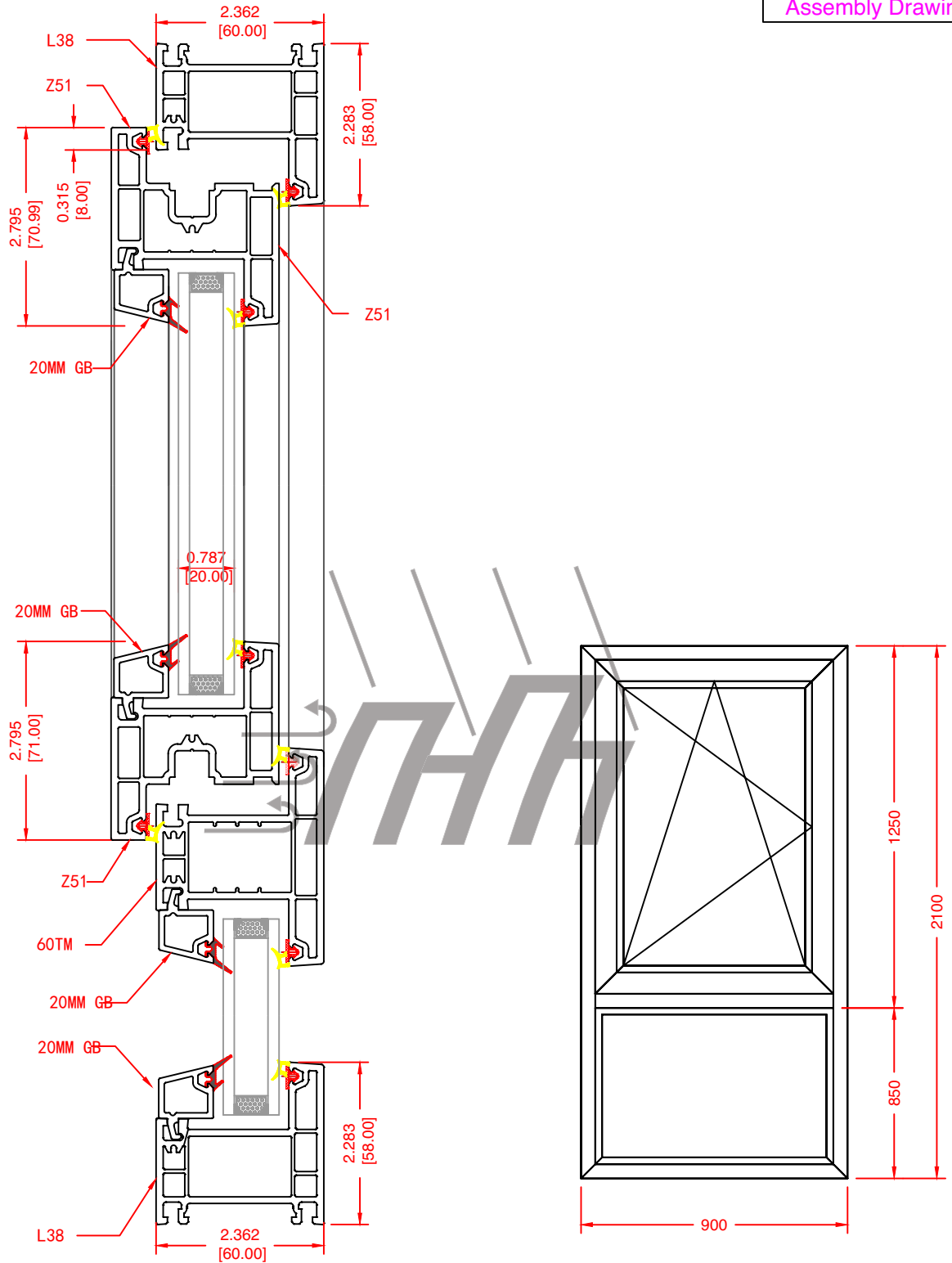
For Housing in regions A & B the results of the Deflection, Water Penetration and Ultimate Tests are checked against the values specified in AS2047 and the lowest rating achieved in the individual tests is reported as the Window Rating.

For Housing in Regions C & D, Residential and Commercial buildings the resultant serviceability wind loads (RSWLs) are first calculated for each of the three wind pressure dependent tests (Deflection, Water Penetration and Ultimate). The lowest positive and negative RSWLs are reported as the Window Rating. RSWLs are calculated for each of the tests as follows:

Deflection Test: The RSWL is the largest positive and negative pressures applied during the test where the deflection of all framing members was less than that required for the different building classifications.

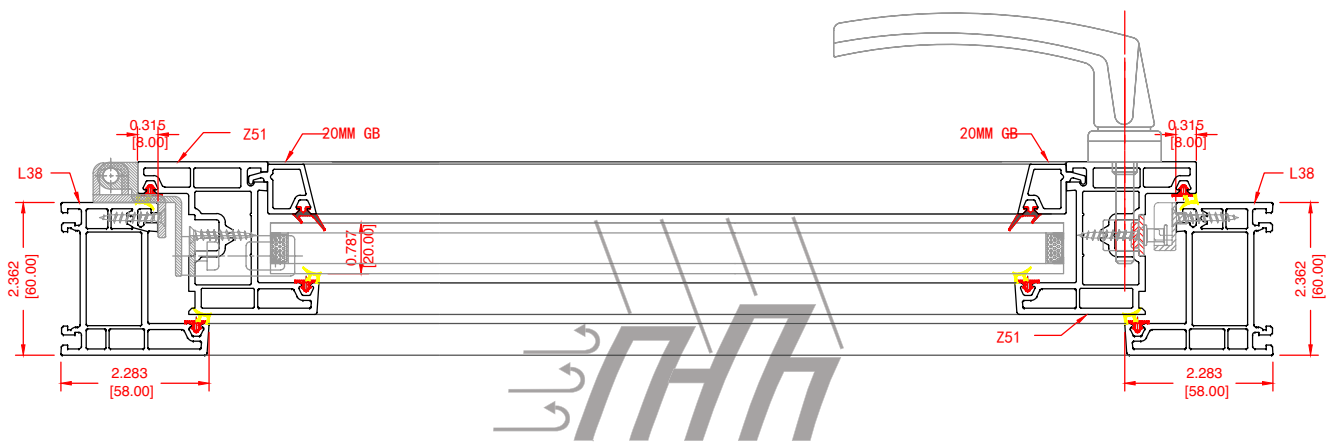
Water Penetration Test: The RSWL is the largest pressure applied during the test without failure divided by 0.3. The pressure value is divided by 0.3 as the Standards requires the water test pressure to be 30% of the Serviceability Pressure.

Ultimate Test: The RSWL is the largest pressure applied during the test without failure divided by the Wind Load Ratios calculated for Importance Level 2 in the table above. An Importance Level of 2 has been used as it is by far the most common type of building. There is no reason why Ratings for other Importance Levels can not be calculated from the test data.



Finesse Window
Systems Australia

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drainage

frames&sash profiles

