Product Performance and Industry Certification

Section Directory

Introduction

In this manual we refer to two types of performance criteria for the selection of windows and doors.

- Product performance
- Glazing performance

Product performance relates to the performance of the entire window or door assembly. Types of this product performance include:

- Structural performance
- Air infiltration
- Water penetration
- Operating force (ease of operation)
- Fire Resistance
- Forced entry resistance
- Acoustic performance
- Thermal performance

Glazing performance pertains to the light transmission and thermal transmission characteristics of the centre glazing only. Glazing performance criteria include:

- U value
- Visible light transmittance
- Solar heat gain coefficient

This section is an in-depth review of window and door performance criteria, limitations and standards.

General Application Guidelines

General Performance Considerations

Dengate Joinery windows and doors are designed and manufactured to established engineering and industry standards which maximize satisfactory performance within the limitations of the specifications, conditions and tests listed.

Published air infiltration performance and design pressure, structural test pressure and water penetration performance numbers are representative of test performance of product samples.

Many products will substantially exceed published specifications; however, performance of installed products may be affected by factors beyond Dengate Joinery's control, such as shipping, handling, installation, construction practices, excessive environmental conditions, normal wear and tear and ongoing care and maintenance.

Although efforts are made to minimize the effects of such factors, it is not possible to guarantee that any particular unit will meet or exceed published specifications.

A. Severe Conditions

Projects that will be subject to severe climatic and atmospheric conditions may require that architects and specifiers address higher product performance requirements and more stringent maintenance schedules.

Severe conditions that should be taken into account when selecting, specifying and designing to accommodate windows and doors may include:

1. **Sand and Salt Exposure**:

   Any windows and doors installed near salt water – regardless of material or manufacturer – are subjected, with other building materials, to more severe weathering than in other typical locations. Along with other building products they should receive the additional protection which is standard and customary practice in such coastal locations at time of installation, and periodic inspection and maintenance as necessary thereafter.

2. **Chemical Exposure:**

   Severe chemical exposure in locations near chemical plants and some types of industrial complexes may adversely affect satisfactory performance of Dengate Joinery products and substantially increase maintenance requirements. Judgments regarding the use of Dengate Joinery products in such areas should be based upon local experience and customer awareness.

3. **Climatic Exposure**:

   Dengate Joinery products are designed to perform in cold climate applications; however condensation can form, mainly on interior glass surfaces, at low temperatures. Condensation conditions will primarily depend upon the amount of room-side humidity to which the products are exposed and generally do not indicate a product defect.

4. **Areas of Severe Wind and Rain:**

   Areas subject to severe wind and rain may produce temporary conditions which exceed product performance standards. No claims are made beyond compliance with the product performance levels published for each product at the time of manufacture. Special design considerations may be required, i.e. Sub sills, built-up curbs. Overhang protection, unit set back from exterior face of wall.

B. Product Performance Limitations

1. **Design Criteria and Performance Requirements:**

   Selection of design criteria and performance requirements is the responsibility of the building owner, architect, contractor, installer and/or consumer responsible for the building system in which Dengate Joinery products are to be installed. The information in this section is presented only as an aid to proper design considerations.

2. **Product Limitations**:

   Dengate Joinery windows and doors must not be installed in conditions beyond published product limitations.

3. **Design Pressure:**

   Window and door design pressures given herein represent the wind load pressure that a single unit is designed to withstand from a structural standpoint. Air infiltration and water resistance performance are as indicated in this section or in the product sections.

4. **Glazing:**

   Dengate Joinery products are glazed to comply with code requirements; wind loading and/or design specifications may require special glazing.

5. **Replacements:**

   Any glass or hardware replacements must be of equal specifications.

6. **Modifications:**

   Product modifications that are not approved by Dengate Joinery will void Warranty.

C. Other Conditions:

1. **Mullion Construction:**

   Mullions should be designed not to exceed 1:150 deflections under design wind pressures. Some conditions may require less deflection.

   In addition, all installations where there is a combination of vertical and horizontal mullions will require reinforcement in either the horizontal or vertical direction. Some conditions may require additional horizontal mullion reinforcement to carry dead loads.

2. **Vertical Stacking**:

   All single units of the same width (maximum 1200mm wide) may be stacked up to 6m high without any intermediate horizontal supports. Greater heights and widths will require horizontal structural supports. The use of slip joints to allow for vertical movement is recommended for anchorage at intermediate floor levels.

3. **Expansion Joints:**

   For continuous horizontal rows of windows, a vertical expansion joint must be provided at least every (6000mm).

4. **Window Walls:**

   Dengate Joinery units are not intended to provide the entire exterior surface or large expanses of a structure. Composites are limited by horizontal and vertical structural mullion design and other installation factors. Installation applications must be designed and considered on a job-by-job basis and require factory shop drawings.

5. **Buildings with Positive Interior Air Pressure:**

   Because of special ventilating requirements or through natural stack action in some buildings, positive interior air pressures may cause between-glass condensation in winter.

6. **Units Set at an Angle:**

   No Dengate Joinery window or door products are to be installed at any angle from vertical.

D. Special Requirements

1. **Safety Glass:**

   Glass installation in areas subject to human impact must be safety-glazed according to the Safety Standard for Architectural Glazing Materials (AS 1288).

2. **Interior Trim:**

   Dengate Joinery products are intended to be installed with interior wood trim or other trim that will cover the frame edge.

Product Performance

Performance is an important criterion in the selection of windows and doors. In this manual, we refer to two types of performance – product performance and glazing performance. Product performance includes the following elements: performance grade (design pressure), performance class, water penetration, air infiltration and forced entry resistance. A definition of each of these terms is below.

Product Performance Terms

Performance Grade (design pressure):
The minimum level of design pressure, (wind load pressure) a product must be tested at to achieve a particular rating. This value is a measure of a product's capacity to withstand the forces of wind loading, in both positive and negative directions, while it is closed and locked.

Performance Class:
Product selection should always be based on the performance requirements of the particular project. For example, many residential buildings are built in locations subject to severe weather that may require higher performance fenestration products than those that meet only the Residential requirements. On the other hand, many hospitals, schools, institutions, etc may successfully use products meeting Residential Light Commercial or Commercial class requirements.

Structural Test Pressure (STP):
A minimum of 1.5 times design pressure. In order for a product to be rated at a given design pressure, it must be able to withstand both positive and negative pressures of at least 1.5 times that design pressure. For example, to receive a design pressure rating of 1000pa, the product must be able to withstand loads of at least 1500pa.

Water Penetration:

The ability of a window or door to withstand water leakage under specified conditions.

Air Infiltration:

The amount of air leaking through windows or doors.

Forced Entry Resistance:

The ability of a window or door in the locked position to resist opening under conditions of stress and load.

Product Performance Considerations

To evaluate whether Dengate Joinery products will meet specific project requirements, follow the steps below:

Step 1: Determine the window rating appropriate to the location of the building.

The minimum rating for each wind classification and guide to the design wind pressure are set out below:

1. **Building classification**: Housing shall be class 1or 10 buildings as defined by the building code of Australia with the geometric limitations specified in AS 4055.

2. **Window ratings:** For any house not requiring specific design, the window rating shall be the same as the window classification of the installation site in accordance with AS4055 and shall be determined by the various tests in accordance with the AS 4420 series

Window Rating For Housing	
Window Rating	Design wind pressure Pa
(See note 1)	(See note 2)
N1 N2 N3, C1 N4, C2 N5, C3 N6, C4	500 700 1000 1500 2200 3000

Notes:
1. Window ratings are the same as wind classifications taken from AS 4055.
2. The net design wind pressures are calculated from the wind speeds V_P for permissible stress method using equations from AS 4055.
3. Windows designed specifically for corners should be capable of withstanding a design pressure of 50% greater than that specified in this table.

Step 2: Verify performance grade of windows and doors.

Use Dengate Joinery CSIRO test results to ensure the product and sizes you have selected meet or exceed the design wind load pressure and performance class requirements determined in step 1.

Step 3: Verify glazing of units.

Once you have verified that the products/sizes selected meet or exceed the design pressure requirements, you must verify that the type of glass used must comply with AS 1288 and must also satisfy the energy certificates submitted to council for DA approval.

Step 4: Determine joining mullion limitations.

A. When joining two or more units together to form a composite, the mullions must be analysed for structural integrity. Use the design pressure to calculate when and what type of mullion reinforcement may be required for each composite.

B. When stacking units, weight limitations of the mullions must be reviewed. I.e. transoms over doors and multiple windows stacked on top of each other.

Forced Entry Resistance

Dengate Joinery has not specifically tested for forced entry resistance as we manufacture our products to suit a wide range of design criteria. Should forced entry resistance be a requirement of a project, Dengate Joinery will work with those necessary to achieve the desired outcomes. Test facilities are readily available should the need arise.

Acoustic Performance

The ability of a window or door to reduce outside noise is an important consideration in product selection. The right combination of timber (a natural sound insulator) and glass will greatly reduce outside noise. Dengate Joinery use Comfort Pac products by Pilkington when noise reduction is a consideration. **Sound reduction (STC: Sound Transmission Class.)**	
5mm ComforTone or EverGreen	29dB
6.38mm ComfortPlus, 6.38mm EverGreen	33dB
6.52mm ComforTone Lamguard	30dB
7.52mm EverGreen Lamguard	35dB
7.02mm ComfortPlus Lamguard	31dB
Comparison – 3mm glass	24dB
6.76mm Laminate	35dB
Note: A difference of 10 Db means the sound is halved.	

Use and Installation Considerations

The following notes are important considerations regarding the use and installation of Dengate Joinery products. Should you have any questions regarding the use and installation of any Dengate Joinery products, contact Dengate Joinery or visit our web site www.dengatejoinery.com.au .

Dengate Joinery reserves the right to change details, specifications, sizes or any other information in this manual without notice.

The material in this manual is not intended to create any warranty of fitness for a particular purpose. Contact Dengate Joinery for specific application recommendations.

Dengate Joinery shall not be liable for errors contained herein or for incidental or consequential damages arising out of the furnishing or use of this material. See Dengate Joinery's warranties for details on warranty coverage and limitations.

Requirements for complying with applicable Building codes

The building owner, architect, contractor, installer and/or consumer are responsible for selecting products which conform to all applicable laws, regulations and building codes.
Dengate Joinery accepts no responsibility whatsoever for failure of building owner, architects, contractor, installer and/or consumer to comply with all applicable laws, safety and building codes. Dengate Joinery is not responsible for windows and doors not installed in compliance with applicable laws, codes or other regulations.

Glazing and safety glass

Dengate Joinery products are glazed to comply with AS 1288 based on information supplied. It is the responsibility of owner, architects, contractor, installer and/or consumer to ensure the supplied

products are installed in the positions shown on the plans and specifications that were supplied to Dengate Joinery for production.

Requirements for Proper Installation

All detail representations in this manual only pertain to the use of Dengate Joinery products and are strictly limited to the published specifications and to the use of Dengate Joinery products. Details shown herein illustrate typical general methods of installing Dengate Joinery products and are to be used as guidelines only.

The performance of any building is dependent upon the design, installation, and workmanship of the entire building system. Dengate Joinery strongly recommends consulting an experienced architect, contractor, or structural engineer prior to installation of Dengate Joinery products.

The individual (building owner, architects, contractor, installer and/or consumer) responsible for the project must take into account local conditions, building codes, inherent component limitations, the affects of aging and weathering on building components, and other design issues relevant to each project.

Over time, all window and door systems may have some water infiltration; it is important that the wall system be designed and constructed to properly manage moisture. Dengate Joinery is not responsible for claims or damages caused by unanticipated water infiltration; deficiencies in building design, construction and maintenance; failure to install Dengate Joinery products in accordance with building regulation standards; or the use of Dengate Joinery products in systems which do not allow for proper management of moisture within the wall systems. The determination of the suitability of all building components, including the use of Dengate Joinery products, as well as the design and installation of flashing and sealing systems are the responsibility of the owner, architects, contractor, installer and/or consumer.

Consult with Dengate Joinery on large and/or complex installations.

Glazing Performance

PERFORMANCE GUIDELINES

A. Glazing Performance

There are three fundamental approaches to improving the energy performance of glazing products (two or more of these approaches may be combined). The first approach is to alter the glazing material itself by changing its chemical composition or physical characteristics. An example of this is tinted glazing. The second approach is to apply a coating to the glazing material surface. Reflective coatings and films were developed to reduce heat gain and glare, and more recently low-emittance coatings have been developed to improve both heating and cooling season performance. The third approach is to assemble various layers of glazing and control the properties of the spaces between the layers. These strategies include the use of two or more panes or films; low-conductance gas fills between the layers, and thermally improved edge spacers.

B. Design Variations - Glazing Area

1 Glazing (mostly heating)

As windows have improved considerably in the last twenty years, very high-performance windows can now equal or exceed the performance of even an insulated wall over a complete winter heating season. Consequently, the strategy of reducing window area to reduce energy use is no longer as significant if highly efficient windows are used.

Total glazing area has a significant impact on heating energy use when poorly insulating, single-glazed windows are used. This difference is diminished with double-glazing and more so with low-E windows.

Depending on the exact factor, SHGC (solar heat gain coefficient), and climate, energy gains in the heating season may be offset by losses in the cooling season. However cooling season energy use can be further reduced by shifting the window area to preferred orientations and employing other cooling load reduction strategies such as shading.

2 Glazing (heating and cooling)

In climates where there is both a significant heating and cooling load, certain high-performance windows can effectively reduce winter heat loss and summer heat gain. Total glazing area has a significant impact on energy use when poorly insulating, single-glazed windows are used. This difference is diminished with double-glazing which has an improved U-factor but provides little help with solar control. Low-E windows represent an even greater improvement but there is a notable difference between high-solar-gain low-E and low-solar-gain low-E. In a climate with both heating and cooling loads, cooling season savings with low-solar gain low-E are likely to outweigh heating season benefits from high-solar-gain low-E (although this depends on the exact U- factor, SHGC and climate) Triple-glazed low-solar-gain low-E provides the best performance by reducing winter losses even further.

In all cases, cooling season energy use can be further reduced by shifting the window area to preferred orientations and employing other cooling load reduction strategies such as shading.

3 Glazing (mostly cooling)

The traditional approach to reduce heat gain is to reduce the total glazing area. This strategy should only be used when less efficient windows are used since new low-solar-gain low-E windows minimize cooling load impacts.

The annual energy use for a house with low-solar-gain low-E glazing still exhibits the same pattern, but the differences are not nearly as great in relative or absolute terms. A high-solar-gain low-E glazing performs worse than the low-solar-gain low-E options and is not optional in such a hot climate.

This analysis indicates that increasing glazing area does increase energy use in this climate, but it will not have nearly as profound an impact when high-performance windows are used. Cooling season energy use can be further reduced by shifting the window area to preferred orientations and employing other cooling load reduction strategies such as shading.

Glazing Performance Terms

Visible Light Transmission-
Percentage of visible light passing directly through the glass. The wave length range for visible light is 380 to 780mm.The higher the percentage the more daylight.

Visible Light Reflection-
Percentage of visible light reflected toward the exterior.

Solar Transmission-
Percentage of normally incident visible light and solar energy passing directly through the glazing. The wave lengths measured for solar energy is 300 to 2500mm.

Solar Reflection-
Percentage of normally incident visible light and solar energy reflected toward the exterior.

UV Transmission-
The percentage of UV light transmitted measured in the light range of 300 - 380mm. The lower the number the better.

U Value-
Measurement unit is watts per m2 per degree Celsius (W/m2degreesC) and is a measure of the rate of heat gain or loss through glazing due to environmental differences between outdoor and indoor air.

Shading Coefficient-
The ratio of solar heat gain through the glass relative to that through 3mm clear glass. The lower the number the better the performance.

SHGC (Solar Heat Gain Coefficient)-
The proportion of total solar radiation that is transferred through the glass at normal incidence, it comprises the direct solar transmission (5) and the part of the solar absorption dissipated inwards by radiation and convection. The lower the number the better the solar performance.

Insulated Glazing Performance Data

For detailed information on insulated glazing performance data click on the Pilkington web site address below and go to **product performance data** then click on

1.Insulated Glazing
2.Insulated Low E
3.Single Glazing

www.pilkington.com.au

Certified Products

Dengate Joinery windows comply with the Window Energy Rating Scheme (WERS). WERS enables windows to be rated and labeled for their annual energy impact on a whole house, in any climate of Australia.

The Window Energy Rating Scheme employs a combination of physical testing and computer simulation to generate energy ratings for fenestration products. WERS applies a suite of interlinked procedures including those used by the U.S. National Fenestration Rating Council (NFRC). As with the NFRC, WERS uses the software tools Window 5, Optics 5 and Therm 5. In addition to the U.S. software, several other 'downstream', purpose-designed tools have been developed for WERS to process data, calculate performance indicators and create final reports. The tools perform different function according to the type of fenestration product being rated.

The WERS scheme operates on three levels to convey information about the energy performance of custom-rated windows and skylights–

- Star ratings for heating and cooling
- Indicative % reduction in heating and cooling needs and interior fading damage
- Thermal, solar and optical performance data

Most of the rating data produced by WERS is at the level of the manufactured product and is therefore valid regardless of the final building type the product is employed in. Only the WERS star ratings are building-specific and relate to the annual energy impact of the rated product on a model house. All other WERS rating data is application-independent and can be adjusted and customised for any building type, usage pattern or climate.

The data derived is available for public access in the Certified Product Directory tables and allows for easy comparison of windows.

The WERS scheme allows manufacturers to assist energy raters, window specifiers and consumers in the selection of the most energy efficient Windows for a home and support those who need to know if the window will enhance or degrade the house in energy and comfort terms. Energy efficient windows offer significant benefits to house owners and occupants. In addition to reducing energy costs and green house gas emissions, a properly selected window plays an important role in improving a homeowner's comfort and well being.

Key to Rating Tables

Column 1:
A window ID number, for example Window 14, used as a shorthand to identify each window in many of the examples given in this chapter.

Column 2:
A glazing description listing the products used to make up the glazed parts of the window, where IG (or IGU) – means insulating glass unit, usually made up of 2 glass panes with a sealed space between them, filled with air, argon or other dry gas. Note that the space is not evacuated.

3/12/3 – represents the order (from outside to inside) and the spacing between glass products, in this example a 3 mm thick glass pane, followed by 12 mm of air space or gas (argon) fill, followed by 3 mm thick glass pane; similar explanations apply to all other combinations listed

“toned” and “supertoned” refer to different grades of body-tinted glass products available in the market. Low-e indicates the presence of glass products with low-emittance (low-emissivity) coatings. A pyrolytic low-e coating is one type of coating technology.

Column 3:
A frame description listing the frame material and type used to make up the window system.

Column 4:
Percentage improvement for cooling compared with the base case Generic Window 1 (3mm clear glass in a standard aluminium frame).

Column 5:
Percentage improvement for heating compared with the base case Generic Window 1 (3mm clear glass in a standard aluminium frame).

Column 6:
Whole-window U-value (Uw) that accounts for the performance of the frame, edge-of-glass and centre-of-glass components. Uw is calculated for the standard sizes given in Table 1.

Column 7:
Whole-window solar heat gain coefficient (SHGCw) that accounts for the performance of the frame and glass components. With SHGC, there is no distinction between centre-of-glass and edge-of-glass. SHGCw is calculated for the standard sizes given in Table 1.

Column 8:
Whole-window visible transmittance (Tvis). Product of glazing Tvis and glazing/frame area ratio.

Column 9:
Air infiltration rate (L/s.m2) at positive (inward) pressure difference of 75 Pa.

2005 WERS Generic Products Directory

NOTES www.wers.net

1. 1. U_w is the whole window *U-value*
2. 2. $SHGC_w$ is the whole window *solar heat gain coefficient*
3. 3. T_{vw} is the whole window *visible (light) transmittance*
4. 4. Percentage improvement figures are compared with using base-case Generic Window 1 (3mm clear in standard aluminium frame)
5. 5. A negative percentage improvement figure indicates performance worse than the base-case window
6. 6. A positive percentage improvement figure indicates performance better than the base-case window
7. 7. Maximum air infiltration is 5.0L/s.m^2 at a positive pressure difference of 75 Pa as measured according to AS 2047
8. 8. Static performance (U_w $SHGC_w$ T_{vw} T_{dw}) calculated using Window 5.2 and Therm 2.1 software (LBNL), 2000-2003
9. 9. Annual energy performance (stars and % improvements) calculated using Nationwide House Energy Rating Software (NatHERS) according to procedures of WERS 2004.

GENERIC DATA			COOLING % impr.	HEATING % impr.	Total Window System Values			
No.	Glazing	FRAME			Uw	SHGCw	Tvw	Air Inf.
1	3mm single clear	Al, standard industry typical	0%	0%	5.84	0.859	0.75	5
2	3mm single clear	Timber or uPVC	15%	15%	4.24	0.736	0.72	5
3	single solar control, pyrolytic low-e	Al, standard industry typical	28%	2%	4.6	0.602	0.49	5
4	single solar control, pyrolytic low-e	Al, thermally improved	34%	10%	3.85	0.555	0.49	5
5	single solar control, pyrolytic low-e	Timber or uPVC	42%	17%	3.07	0.492	0.47	5
6	3/6/3 clear IG, air fill	Al, standard industry typical	11%	17%	4.34	0.777	0.68	5
7	3/6/3 clear IG, air fill	Al, thermally improved	17%	25%	3.59	0.731	0.68	5
8	3/6/3 clear IG, air fill	Timber or uPVC	26%	31%	2.82	0.659	0.65	5
9	3/12/3 clear IG, air fill	Al, standard industry typical	12%	21%	4.07	0.778	0.68	5
10	3/12/3 clear IG, air fill	Al, thermally improved	18%	29%	3.32	0.731	0.68	5
11	3/12/3 clear IG, air fill	Timber or uPVC	27%	35%	2.56	0.659	0.65	5
12	3/12/4 pyrolytic low-e IG, argon fill	Al, standard industry typical	18%	29%	3.31	0.733	0.62	5
13	3/12/4 pyrolytic low-e IG, argon fill	Al, thermally improved	24%	37%	2.56	0.686	0.62	5
14	3/12/4 pyrolytic low-e IG, argon fill	Timber or uPVC	32%	43%	1.84	0.616	0.59	5
15	5mm toned	Al, standard industry typical	16%	-10%	5.8	0.701	0.41	5
16	5mm toned	Timber or uPVC	30%	6%	4.21	0.586	0.39	5
17	5mm supertoned	Al, standard industry typical	20%	-13%	5.8	0.655	0.62	5
18	5mm supertoned	Timber or uPVC	35%	3%	4.21	0.542	0.59	5
19	5/6/5 toned IG with air fill	Al, standard industry typical	29%	5%	4.32	0.596	0.36	5
20	5/6/5 toned IG with air fill	Al, thermally improved	35%	13%	3.56	0.549	0.36	5
21	5/6/5 toned IG with air fill	Timber or uPVC	43%	20%	2.8	0.486	0.34	5
22	5/12/4 supertoned low-e IG with argon fill	Al, standard industry typical	42%	13%	3.31	0.489	0.51	5
23	5/12/4 supertoned low-e IG with argon fill	Al, thermally improved	48%	21%	2.56	0.442	0.51	5
24	5/12/4 supertoned low-e IG with argon fill	Timber or uPVC	55%	28%	1.84	0.384	0.49	5
25	6/10/4 supertoned low-e IG with argon fill	Al, standard industry typical	47%	9%	3.34	0.432	0.46	5
26	6/10/4 supertoned low-e IG with argon fill	Al, thermally improved	54%	17%	2.59	0.386	0.46	5
27	6/10/4 supertoned low-e IG with argon fill	Timber or uPVC	61%	24%	1.87	0.33	0.43	5

Performance Tests on Sample Windows to AS 4420 (as 2047-1999) for Dengate Joinery, Tamworth NSW

CSIRO

Summary of Results:

Test sample windows and a sliding door from Dengate Joinery, Tamworth NSW, were tested on 15 and 16 September, 1999 to establish structural sufficiency, air infiltration, water penetration, operating force and proof loading performance in accordance with AS 2047-1999 Section 2. For housing (Class 1 buildings as described in the Building Code of Australia, and with limitations specified in AS 4055), the tested windows and door met the criteria as follows:

Test	Criteria	Double-Hung	Awning	Casement	Sliding Door
Structural Performance AS 4420.2					
@ +/- 700 pa	Span/150	Pass	N/A	N/A	Pass
@ +/- 1000pa	Span/150	Pass	N/A	N/A	
Air Infiltration AS 4420.4					
@ +/- 75 Pa (a/c)	<1.L/s.m2	Pass	Pass	Pass	
@ +/- 75Pa	<5.0 L/s.m2				Pass
Water Penetration AS 4420.5					
Static @ 150Pa	No leaks	Pass	Pass	Pass	Pass
Static @ 200Pa		Pass	Pass	Pass	Pass
Static @ 250Pa			Pass	Pass	Pass
Operating Force AS 4420.3					
To initiate sash		140N			30N
movement		Pass	N/A	N/A	Pass
To sustain sash		80N			30N
Movement		Pass			Pass
Proof Load AS 4420.6					
@ +/-1500Pa	No collapse		Pass	Pass	
Window Rating		N3 1000/200	N3 1000/250	N3 1000/250	N2 700/250

Summary of test results

1 *TEST SAMPLES:*

The test samples consisted of timber-framed double-hung (2112), awning (1508 sash) and casement (1208 sash) window assemblies, and a two-light sliding door (2118).

2 *TEST REGIME:*

The test regime was that specified in AS 2047-1999, Section2, "Performance". The test criteria were selected as appropriate from those listed in Clause 2.3.1 "Housing":

- Structural performance test (Clause 2.3.1.2) at +/- 700 Pa for the door and at +/- 1000 Pa for the window assemblies

  Structural members : deflection ratio 1:150

- Air infiltration test (Clause 2.3.1.5).

  Less than 1.0 L/s.m2 at +/- 75 Pa (for air-conditioned buildings)
  Less than 5.0 L/s.m2 at + 75 Pa (for non-air-conditioned buildings)

- Water penetration tests (Clause 2.3.1.6) – No leaks at :

  150 Pa static pressure for 15 minutes duration,
  200 Pa static pressure for 15 minutes duration (at manufacturer's request),
  250 Pa static pressure for 15 minutes duration (at manufacturer's request).

- Operating Force Test: (Clause 2.3.1.4)

  Less than 200N to initiate movement and less than 160N to sustain movement for double-hung windows.

  Less than 180N to initiate movement and less than 110N to sustain movement for sliding doors.

- Proof Tests (Clause 2.3.1.7) loading at 1.5 times the serviceability design wind pressures at up to +/- 1 500 Pa.

  No collapse

The tests methodologies are outlined in Australian Standards AS 4420.1 through AS 4420.6-1996.

3.0 *RESULTS:*

1.1 *Structural Performance:*

Displacement of the test sample under structural loading was measured at 6 different positions. The transducers locations, 1,2 and 3, those were on the mullion of the door and; 4,5 and 6 were on the window meeting rails to measure the max deflection/span ratio of the structural member. The samples were tested to a range of pressures up to +/- 1000 Pa. The serviceability deflection limits were satisfied at the pressures shown below.

Member	Span (mm)	Transducer Locations	Rating	Deflection/Span Ratios	
Sliding Door: Middle mullion	2020	1,2 & 3	N2	+ 700 Pa <1 : 150	-700 Pa <1 : 150
Double-hung Window Meeting rails	1040	4,5, & 6	N3	+1000 Pa <1 : 150	-1000Pa <1:150

3.2 *Air Infiltration:*

The test samples were covered with plastic sheet to stop any airflow through them and the airflow through the test rig only measured. The plastic sheeting was then removed in turn from each test sample and the progressive total airflows measured. When each reading was subtracted from the subsequent one, the airflow through each test sample was obtained. Readings were taken at positive and negative pressures of 75 Pa.

Test Sample	Area	Airflow	Air Infiltration	Grading
Double-hung Window	2.5m2	<0.5 L/s	<0.2 L/s.m2	Air conditioned
Awning Window	1.2 m2	<0.5 L/s	<0.4 L/s. m2	Air conditioned
Casement Window	1.0 m2	<0.5 L/s	<0.5 L/s. m2	Air conditioned
Sliding Door	3.9m2	+2.0 L/s	0.5 L/s.m2	Non
		-15.0 L/s	3.9 L/s. m2	Air conditioned

3.3 *Water Penetration:*

Water tests were conducted to the following specification:

- Preliminary water spray for 5 minutes
- 150 Pa static pressure for 15 minutes duration.

No water leaks were observed at the inner faces of the test windows and door samples during the above tests.

The test samples were then subjected to the following higher test pressures.

- 200 Pa static pressure for 15 minutes duration, then
- 250 Pa static pressure for 15 minutes duration.

At 200 Pa, no water leakage through the joinery or sashes was observed at the inner faces of the test samples. Slight dripping of water was noticed through the key cylinder mechanism of the lock-handle assembly of the sliding door. This was sealed before the next pressure was applied.

At 250Pa, no leaks were observed at the inner faces of the awning and casement windows and door samples. After 4 minutes water was observed at the top of the sill stop bead on the double-hung window fitted with spring balances. This water overflowed at approximately 14 minutes.

The water penetration test results are summarised below:

Test Sample	150 Pa	200 Pa	250 Pa
Double-hung window – spring balances	Pass	Pass	
Awning Window	Pass	Pass	Pass
Casement Window	Pass	Pass	Pass
Sliding Door	Pass	Pass	Pass

3.4 *Operating Force Test:*

Both double hung windows and the sliding door assembly were tested for operating force using a dial tensiometer. The test results are summarised below:

Force	Double-hung Window	Sliding Door
To initiate movement	140 N	30 N
To sustain movement	80 N	30 N

3.5 *Proof Test:*

The test samples were loaded with the specified pressures of +/- 1 500 Pa for no less than 10 seconds duration. None of the test samples showed signs of collapse.