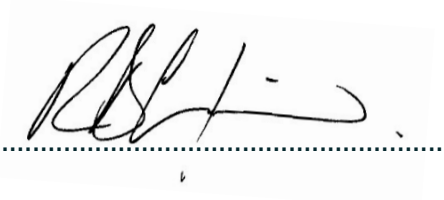
FIELD TESTING PROCEDURES FOR CURTAINWALLS, WINDOWS AND FAÇADE ELEMENTS

These Test Methods are Issued Under the Authority Of:



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WINDOW & GLASS ASSOCIATION NEW ZEALAND

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Revision Schedule

Page No.	Version	Description of Amendment	Date	Authority
All	1.0	Issue of Controlled Document	01.07.2018	R Campion
	2.0	Entire document updated to Version 2.0	12.2019	
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FIELD TESTING PROCEDURES FOR CURTAINWALLS, WINDOWS, AND FAÇADE ELEMENTS

Preface

There are occasions when on-site testing of the weathertightness of a window or façade element installation is required. These tests may be part of building Quality Assurance programmes, verification of remedial work on installation detailing, or diagnostic tests to trace observed water penetration through recently installed fenestration products.

Most products supplied to building sites will either have had prototype testing on near identical component systems carried out by the manufacturer or have been designed based on engineering information and established performance criteria. However as most commercial building sites are not identical, the installation details of fenestration elements will be specific to the particular site. As the testing of facades is an expensive undertaking, such testing is often only carried out where the system or products have no performance history, and it is necessary to demonstrate that the specific criteria of structural performance air infiltration and water penetration at defined wind loads is achieved.

Where established fenestration systems are being used in different arrangements from the original prototype tests, the structural aspects of the design can be verified by engineering calculation, but there may be questions concerning equivalent weatherability performance that need to be considered. If the installation detailing is significantly different to that of the original prototype or there are concerns by the specifiers that require additional verification of the fenestration installation, site testing should be considered.

While field testing represents additional cost to the project, these costs may serve as insurance against significant remedial work, post completion of the building contract, to resolve weathertightness problems. To avoid specifiers and building contractors developing or carrying out site testing procedures that may be non-standard or inappropriate, the Window & Glass Association has developed specific field testing procedures that can be specified for on-site weathertightness verification and quality assurance.

These testing procedures are based on long established testing methods developed by the American Architectural Manufacturers Association (AAMA) for site testing of fenestration elements and their installation.

The test procedures outlined in this document must be carried out by an IANZ accredited laboratory whose scope of accreditation includes the Window & Glass Association Field testing Procedures or, a testing facility or test operator that has demonstrated to the Association they operate under a quality management system consistent with the requirements of NZS ISO/IEC 17025, and that has also demonstrated the knowledge and experience to properly perform and record the results of the Window & Glass Association Field Testing Procedures.

Contents

1. Background

Members of the Window and Glass Association in New Zealand have for many years valued the ready availability of the many technical support documents published by the AAMA. Many of our members have utilised the standardised field testing procedures documented in the AMMA test procedures and/or the ASTM test procedures and accordingly these recognised test procedures form the basis for the Window & Glass Association Field Testing Procedures covered in this document.

For clarity, the relationship between the Window & Glass Association Field Testing Procedures and the AAMA or ASTM test procedures is shown in the following table:

Window & Glass Association Test Procedure	AAMA /ASTM Test Procedure
WGANZ 501	AAMA 501.2-15
WGANZ 502	AAMA 502 -12
WGANZ 503	AAMA 503 -14
WGANZ 1105	ASTM E1105 -15

Historically, field water penetration testing in New Zealand has largely been based on the AAMA 501.2 test procedure with the purchase of the recommended nozzle and making up and using the equipment in accordance with the requirements of the test procedure. More recently there have been moves on a number of building projects to undertake a more detailed evaluation of water tightness performance, using an internal enclosure similar to that covered by AAMA 502-12, AAMA 503-14 or ASTM E1105-15.

An important aspect of the AAMA and ASTM tests is that the field test is conducted at 2/3 of the tested and rated laboratory performance test pressure . Normally, under NZS 4211 and AS/NZS 4284, as well as the Australian window standard AS 2047, the Static Water penetration test is conducted at 30% of the positive Serviceability wind pressure, an empirical relationship developed and substantiated by site service performance for many years. This relationship simulates through a 15 minute test at a constant pressure equal to 30% of the specified positive serviceability wind pressure, a water penetration performance equivalent to the actual pressure from the highly variable wind gust velocity that may on statistically infrequent occasions reach the serviceability wind speed.

AS/NZS 1170.0 Appendix B ‘Use of Data for Design’ has in Section B3 ‘Prototype Testing’ Table B1 which sets out values of Variability Constant K1 to allow for variability of the property being evaluated. When prototype tests are undertaken with only a single sample, such as is usual with window and façade testing to NZS 4211 and AS/NZS 4284, the table indicates that the target value should be increased by the variability factor K1. Experience suggests that the variability of a property such as watertightness would have a variability of at least 10%, which for a single prototype test requires a K1 factor of 1.46. As both NZS 4211 and AS/NZS 4284 define the water penetration test pressure as 30% of the positive serviceability wind pressure for a single prototype test, the implication is that the unfactored requirement would be 1/1.46 or just over 2/3 of the defined NZS 4211 and AS/NZS 4284 specification test pressures.

In addition, as the AAMA note in their test procedure, the field installation conditions also influence the product performance. Products tested in the laboratory are perfectly plumb, level and square in a precision opening. Field test specimens, although installed within acceptable industry tolerances, are rarely perfectly plumb, level and square. Shipping, handling, acts of subsequent trades, aging and other environmental conditions all may have an adverse effect upon the performance of the installed specimen.

A 1/3 reduction of the test pressure for field testing as specified is an appropriate adjustment for the differences between the single prototype laboratory test and the general range of similar products following installation, subject to a field test procedure.

As the requirement for field testing of installed curtainwall and fenestration products has increased the Window & Glass Association has recognised the need to establish a standardised set of Field Testing Procedures that are based on accepted industry practices while recognising tried and tested test methods that have formed the backbone of New Zealand facade or window testing since 1985.

Accordingly, the Window & Glass Association Field Testing Procedures documented on the following pages vary from the AAMA or ASTM Standards as follows:

a) Where the AAMA or ASTM test methods specify a water spray flow rate of 0.057l/s/m^2 (or 3.4l/min/m^2) the Window & Glass Association Field Testing Procedures specify a water spray flow rate of 0.05/s/m^2 (or 3.0l/min/m^2) based on the SIROWET Standard and as specified for testing to NZS 4211 and AS/NZS 4284.

b) The AAMA or ASTM test methods require the specified differential air pressure is to be applied within 15 seconds from commencement of water spray application. To maintain consistency with the NZS 4211 and AS/NZS 4284 test procedures, the Window & Glass Association Field Testing Procedures call for a pre-wetting period of 5 minutes at zero air pressure prior to application of the specified differential air test pressure.

c) The optional Air Infiltration test procedure documented in the AAMA 502-12 and AAMA 503-14 test procedures has been excluded from the Window & Glass Association Field Testing Procedures and is instead provided as a standalone Window & Glass Association test procedure.

d) Where the AAMA 502-12 test procedure specifies water penetration resistance testing for fenestration products installed to residential dwellings and low-rise multi-unit residential buildings to be carried out in accordance with the ASTM E1105-15 Procedure B (cyclic uniform static pressure) unless specified otherwise, the Window & Glass Association WGANZ 502 test procedure specifies the default water penetration resistance test procedure as Procedure A (uniform static pressure).

2. Scope

This document sets out the Window & Glass Association approved test methods for determining the water penetration resistance of a representative sampling of fenestration products including installed Windows, Doors, Curtainwalls, Shopfronts and Sloped Glazing Systems under simulated conditions.

The test methods set out in this document may be applied to all types of facades including low and high-rise, commercial, industrial and residential buildings and may also be used to assess the water penetration resistance of installed cladding systems.

All tests shall be performed by an NZS ISO/IEC 17025 accredited testing laboratory whose scope of accreditation includes the Window & Glass Association Field Testing Procedures or a Window & Glass Association approved test operator.

NOTE: A Window & Glass Association approved test facility or test operator is defined as a test facility or test operator that operates under a quality management system based on the requirements of NZS ISO/IEC 17025 and that has demonstrated the knowledge and ability to properly perform and record the results of the Window & Glass Association Field Testing Procedures.
To be approved as a Window & Glass Association approved test operator or test facility the applicant must be an IANZ Accredited Test Facility and/or IANZ Accredited Signatory whose scope of accreditation includes the Window & Glass Association Field Testing Procedures.
Non IANZ accredited applicants with a minimum of 2 years' experience in water penetration testing may be approved as a Window & Glass Association approved test operator by submitting copy of their quality management system for review by Window & Glass Association and successfully passing assessment by a suitably qualified Window & Glass Association appointed assessor.

3. Referenced Documents

Reference is made in this document to the following:

New Zealand Standards

NZS 4211:2008	Specification for performance of windows
NZS 3604:2011	Timber-framed buildings

Joint Australian / New Zealand Standards

AS/NZS 4284:2008	Testing of building facades

American Architectural Manufacturers Association (AAMA) Standards

AAMA 501.2-15	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
AAMA 502-12	Voluntary Specification for Field Testing of Newly Installed Fenestration Products
AAMA 503-14	Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems
AAMA 511-08	Voluntary Guideline for Forensic Water Penetration Testing of Fenestration Products

ASTM International (ASTM) Standards

ASTM E1105-15	Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
ASTM E2128-12	Standard Guide for Evaluating Water Leakage of Building Walls.

4. Definitions

In this document, unless specified otherwise or inconsistent with the context, terms have the following meaning:

AAMA	American Architectural Manufacturers Association.
Air Barrier	The assembly of materials used in building construction to cut down on the passage of air in and out of the building.
Air Seal	A continuous seal put into the air gap area around the interior side, exterior side or both sides of the fenestration perimeter to restrict infiltration or exfiltration of air past the fenestration product.
Approved Test Operator	A test facility or test operator that has a suitable quality management system and who has demonstrated the knowledge and ability to properly perform and record the results of the Window & Glass Association Field Testing Procedures.
Building Paper	A membrane material typically made of cellulose paper impregnated with asphalt (to inhibit passage of liquid water through the material) and which is commonly used as a concealed water-resistive barrier (WRB), similar to polymer house wraps, in membrane/drainage walls.
Calibration	The comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy.
Cavity Wall	A type of building wall construction consisting of an outer wall secured to an inner wall separated by an air space.
Damp Surface	For the purposes of this document, a ‘damp surface” is ‘damp-to-touch’ and is characterized by a lack of visible water on the surface and no transfer to the skin upon touching.
Design Pressure	A rating that identifies the load, induced by wind that a product is rated to withstand in its end-use application.
Design Wind Load	The wind load pressure a product is required by the specifier to withstand in its end use application.
Extraneous Air Leakage (Qe)	The volume of air flowing per unit of time through the test chamber and test apparatus, exclusive of the air flowing through the test specimen under a test pressure difference and test temperature difference, converted to standard conditions, expressed in m^3/s (ft^3/min).
External wall	The enclosing part of the building that has one surface exposed to the outside and at an angle of more than 60° to the horizontal.
Façade	External skin that transfers wind loads to the framing members or supporting structure (including curtain walls).
Fenestration Product	An assembly designed to be installed in a fenestration opening to permit or control the passage of air, water, light, and/or people, typically comprising of single and dual windows, single and dual side-hinged door systems, sliding doors, stacker sliding doors, over cladding sliding doors, bi-fold doors and opening skylights.

Frame	The outer surrounding members of the window commonly called head and sill and jambs. The frame may or may not incorporate integral linings and facings.
Glass	Infill and glazing material fixed into a light or a sash. Glass shall be in accordance with NZS 4223.
Nozzle	A device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe.
Operable Door	A door that is intended to be opened and closed.
Operable Window	A window that is intended to be opened and closed.
Performance	The capability of a building product, component, construction or assembly to perform the function(s) for which it was designed and constructed.
Pressure Differential	The difference between the absolute air pressure on the external surface of a fenestration product, and the absolute air pressure on the internal surface of the same fenestration product.
Pressure Tap	A hole drilled perpendicularly through the exterior surface of the test specimen or the wall of the pressure chamber to which is attached a plastic tube which leads to the instantaneous pressure measuring device.
Relative Humidity	The percentage of moisture in the air in relation to the amount of moisture the air could hold at that given temperature. At 100 percent relative humidity, moisture condenses, and water droplets are formed.
Sealant	A compound used to fill and seal a joint or opening.
Serviceability limit state (SLS)	State that corresponds to conditions beyond which specified service criteria for a structure or structural element are no longer met. The criteria are based on the intended use and may include limits on deformation, vibratory response, degradation, weathertightness, or other physical aspects.
Skylight	A glazing and framing assembly consisting of sloped and (sometimes) vertical surfaces; the assembly is generally inserted into the roof of a building to admit daylight.
Sliding Door	A door that consists of manually operated door panels, one or more of which slide or roll horizontally within a common frame and can also contain fixed lights/panels.
Sloped Glazing System	A glass and framing assembly that is sloped more than 15° from vertical and which forms essentially the entire roof of the structure; generally, this is a single slope construction.
Specification	A written document often accompanying architectural drawings, giving such details as scope of work, materials to be used, installation method, required performance, and quality of workmanship for work under contract.

Specifier	The person or party responsible for the facade Specification, nominating the use of these test procedures, the test sample, sequence, pressures and performance criteria.
Suitably qualified person	A person with the skills, experience and qualifications to determine compliance with this document and the referenced Standards.
Test Method	A method for testing.
Test Pressure Differential	Difference between the external pressure and the internal pressure across a closed and locked test specimen expressed as Pascals (lbf/ft^2). It is called positive pressure when the external pressure of windows and doors is higher than the internal pressure and is called negative pressure when the external pressure is lower than the internal pressure.
Test Procedure	A definitive and reproducible procedure that produces a test result.
Uncontrolled Water	Any leakage that is not contained and drained away during the water spray operation and for 5 min after the water spray has stopped during which time there is zero air pressure differential on the facade.
Wall	See External wall.
Water Leakage	The penetration of water that would continuously, or repeatedly wet parts of a building or components not designed to be wetted.
Water Penetration	Penetration of water beyond the plane intersecting the innermost projection of the test specimen, not including interior trim and hardware, under the specified conditions of air pressure difference across the specimen.
Water Spray Volume	Amount of water sprayed onto the test specimen.
Window	An operable or non-operable assembly that is installed in an opening with an exterior wall or roof intended to admit light or air to an enclosure and is usually framed and glazed.

5. Equipment Requirements

5.1 General

The following clauses outline the minimum equipment requirements for carrying out field testing in accordance with the Window & Glass Association Field Testing Procedures. Window & Glass Association approved test operators shall maintain test equipment in good condition, at all times, and where applicable shall ensure that equipment requiring calibration is maintained in accordance with the calibration requirements documented in Section 6. Calibration.

5.2 WGANZ 501 Test Equipment Requirements

a) A Spray Wand comprising of an accurate adjustment valve, a calibrated pressure gauge and a Monarch B-25 brass nozzle to provide a solid cone spray at an angle of 80°. The calibrated pressure gauge must be fitted between the spray nozzle and the adjustment valve and should allow for adjustment of the water pressure within a range of 205 to 240kPa (30 to 35psi).

b) A 19mm hose.

c) A water reservoir and booster pump to augment mains water pressure where necessary to achieve the specified pressure at the nozzle inlet of 205 to 240kPa (30 to 35psi).

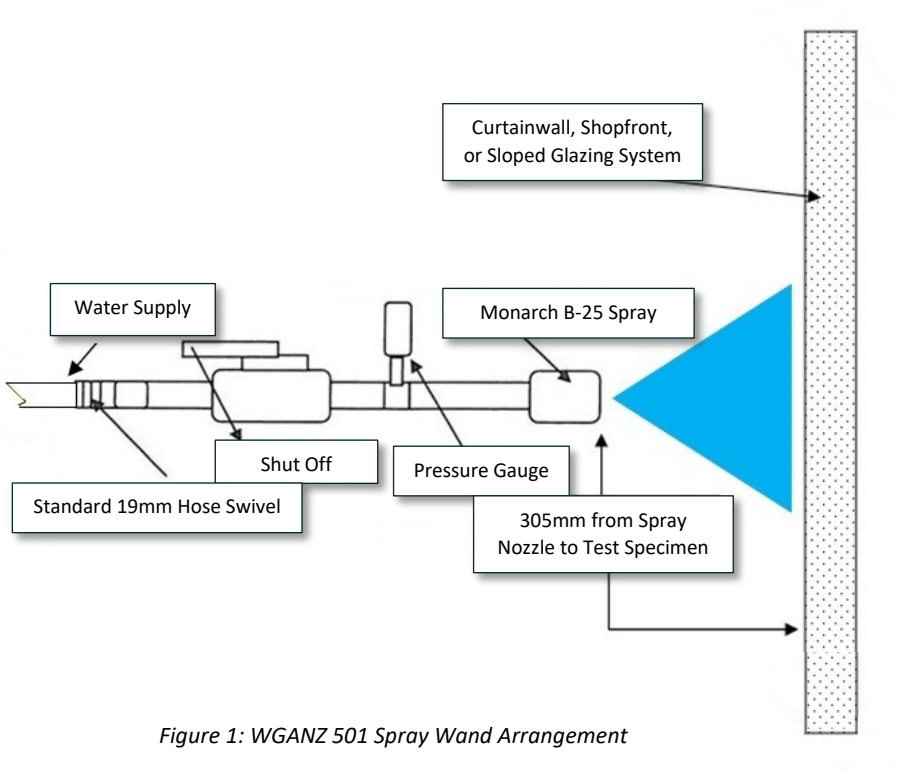

Figure 1: WGANZ 501 Spray Wand Arrangement

5.3 WGANZ 502, WGANZ 503, and WGANZ 1105 Test Equipment Requirements

a) A water spray rack comprising an array of water nozzles set out on a uniform grid. The spray rack shall be located to provide a uniform distance from the nozzles to the test specimen and uniform coverage and wetting of the test area and to wet those areas vulnerable to water penetration. Water flow to the spray nozzles shall be adjustable to provide minimum application of 3.0l/m^2/min. Spray nozzles shall be a solid cone type giving approximately 90° - 100° spray angle with predominantly large droplet size (50% greater than 2mm diameter).

NOTE: A Spraying Systems Co. (USA) 1/4HH-14WSQ nozzle is an example of a square patterns solid cone nozzle that provides a suitable droplet size and coverage of 1.5 - 2.0m^2.

b) A calibrated water flow meter shall be installed between the booster pump and the spray rack or, a calibrated pressure gauge shall be incorporated into the spray rack design (see also 6.4.1).

c) A fan with a variable speed controller capable of moving the volume of air required to achieve a vacuum/pressure that exceeds the specified differential test pressure.

NOTE: Typically, the internal vacuum chamber will be sealed to internal timber framing members surrounding the window opening or façade area under test. When applying a vacuum to the pressure chamber, air may also be drawn from adjacent wall, ceiling and/or sub-floor spaces through defects and construction joints in timber framing, laps in flexible wall underlays etc. To ensure specified test pressures can be achieved and maintained for the required test duration, a commercial fan should be used that has enough capacity to accommodate extraneous air loss.
Residential or commercial vacuum cleaners fitted with or, combined with pressure dump valves or pressure release dampers do not constitute Window & Glass Association approved test equipment.

d) A water reservoir and booster pump to augment mains water pressure where necessary to achieve the required water flow and pressure at the spray rack nozzle inlets.

NOTE: It is recommended that a water reservoir and booster pump is used at all times as town water supply pressures may change during testing due to local demand. Similarly, when testing multi-story buildings or buildings under construction, water pressure typically diminishes at consecutive floor levels and may be interrupted or affected during testing by the demands of other contractors on site.

e) A calibrated differential pressure manometer with an accuracy of ±2%.

f) 19mm hose.

g) A calibrated anemometer with an accuracy of ±5%.

6. Calibration

6.1 General

Calibration is the process of comparing a reading on one piece of equipment or system, with another piece of equipment that has been calibrated and referenced to a known set of parameters to minimise any measurement uncertainty thus ensuring the accuracy of test equipment and subsequent rest results.

The equipment used as a reference should itself be directly traceable to equipment that is calibrated according to NZS ISO/IEC 17025.

6.2 IANZ Accredited Testing Providers

Laboratories and mobile testing laboratories holding a current IANZ, or NATA certificate of accreditation shall maintain field testing equipment in accordance with the calibration requirements of their Quality Manual.

6.3 Field Calibrations

Where calibrations are carried out on site by the testing provider, calibration shall be carried out in accordance with documented in-house calibration methods and/or manufacturer's methods which have been customised for the testing providers equipment and these Window & Glass Association test procedures.

6.4 Calibration Requirements & Frequency

6.4.1 General

The following clauses provide information on the calibration requirements for equipment used in the Window & Glass Association Field Testing Procedures. Test providers may choose to use a water spray rack fitted with a mechanical or digital water flow meter or a water spray rack fitted with a calibrated pressure gauge.

Where a water spray rack with a pressure gauge is used, the test operator must perform a catch-box calibration of the spray rack at not more than six monthly intervals in accordance with the catch-box calibration method described below.

Water flow meters may be calibrated externally (see 6.4.2) or may be calibrated in accordance with the in-house water flow meter calibration method described below, provided that testing shall not be carried out where calibration of the water spray system is more than six months old.

6.4.2 External Calibrations

Calibration of pressure gauges, digital manometers and mechanical manometers must be carried out by an IANZ accredited Metrology and Calibration Laboratory at the intervals specified at 6.4.5 below.

6.4.3 Catch-box Calibration Method

The catch box shall be 610mm square and shall be divided into four areas each 305mm square. It shall be designed to receive only water impinging on the plane of the test specimen face and to exclude all run-off water from above. A cover approximately 760mm square shall be fitted to the face of the catch-box to prevent water from entering it before and after the timed observation interval.

The water impinging on each of the 305mm square quadrants shall be captured separately for 1 minute intervals and weighed. The water pressure shall be adjusted after each 1 minute sampling until a spray that provides at least 1.12l/min (1120grams/min) total for the four areas and not less than 0.22l/min (220grams/min) nor more than 0.56l/min (560grams/min) in any one square is achieved.

When the water spray over a 1 minute period is within the required parameters, record the water pressure on the intake water line to the nozzle grid. When a field test is carried out, adjust the water pressure on the intake line to the pressure recorded when the grid was calibrated.

The water-spray rack shall be calibrated at both upper corners and at the quarter point of the horizontal centre line (of the spray system). If several identical, contiguous, modular spray systems are used, only one module need be calibrated.

The system shall be calibrated with the catch boxes at a distance within ±51mm of the test specimen location from the nozzle. The reference point for location of the spray system from the specimen shall be measured from the exterior glazing surface of the specimen farthest from the spray system nozzles.

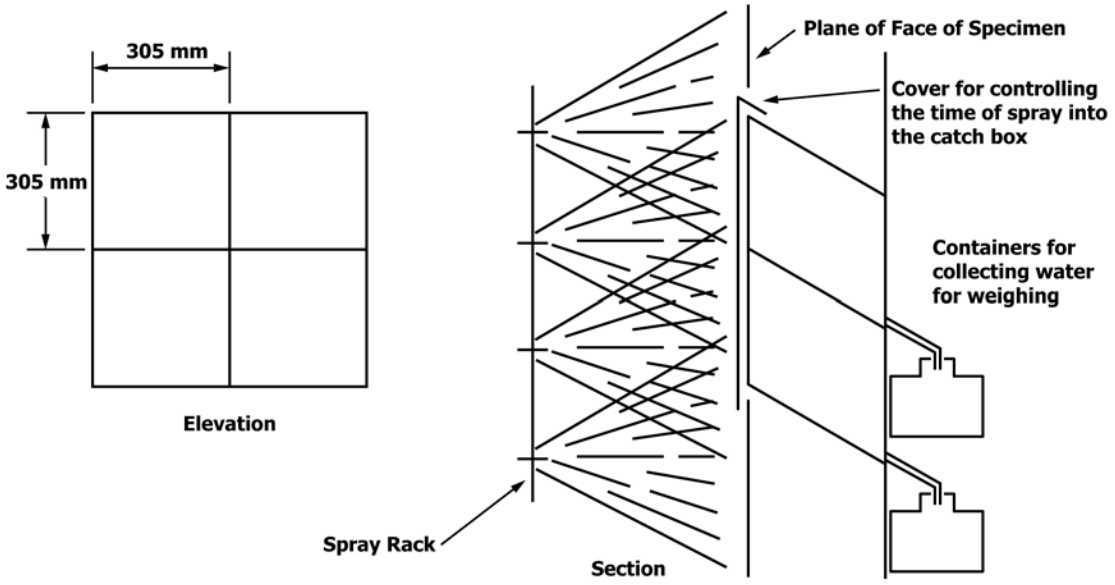

Figure 2: Catch-box design for water spray rack calibration

6.4.4 Water Flow Meter Calibration

Water flow meters may be calibrated in house by the testing provider using the gravimetric flow test process whereby the water passing through the flow meter for a given period of time is caught and weighed.

To use the gravimetric calibration method the operator must know the water coverage area and water flow rate required for each configuration of the spray rack system being used i.e. 4 nozzles, 6 nozzles, 8 nozzles etc.

For each configuration of the spray rack system, calculate the total flow rate required to deliver 3.0l/m^2/min.

e.g. For a spray rack with a water spray coverage area of 2.4m^2 the minimum flow rate required would be:

$$2.4 \times 3.0\text{l/min} = 7.2\text{l/min}$$

Start the water flow and adjust the flow rate until the water flow meter records a flow of 7.2l/m. Divert the water flow into a weighing container of suitable size and catch the water flow for a duration of one minute.

The water flow can be calculated by measuring the volumetric weight of the caught water by the catchment duration.

e.g. $$\frac{\text{Weight}}{\text{Time}} = \text{Flow}$$

Repeat the above process for each configuration of the spray rack system or as required to achieve a minimum of 5 recordings and calculate the average water flow and measurement of uncertainty.

For mechanical or digital water flow meters that have an adjustment or calibration option, adjust the flow meter in accordance with the manufacturer's instructions to apply the calibration corrections and re-test the water flow meter as described above to confirm the new flow rate calibration.

For water flow meters with no adjustment or calibration function apply that calculated correction factors for each water test carried out.

6.4.5 Calibration Frequency

a)	Pressure Gauges	-	Six Monthly
b)	Spray Racks (using pressure gauges)	-	Six Monthly
c)	Water Flow meters	-	Six Monthly
d)	Digital Pressure Manometers	-	Annually
e)	Mechanical Pressure Manometers	-	Annually

6.4.6 Additional Requirements

In addition to calibration requirements noted above, pressure gauges shall be visually inspected at not greater than three monthly intervals and prior to each use. In the event a pressure gauge has been dropped or, where a pressure gauge or any other item of calibrated equipment is found to be damaged or defective, it shall be removed from service and shall be re-calibrated in accordance with Section 6.4 before being returned to service.

7 Sampling

7.1 General

The following clauses provide general guidelines for determining sampling area/numbers for the Window & Glass Association field testing methods covered by this document.

7.1.1

All trades and contractors involved and responsible for the test specimen performance (i.e., manufacturer, installer, glazier, cladding contractor, main contractor etc.) shall be made aware of the test date and invited to witness the testing.

> *NOTE 1: Performing the field test as soon as practical may be beneficial in determining if manufacturing, installation and/or perimeter sealing problems are present before a substantial portion of the project is completed. If the initial testing is performed early in the project installation process, necessary corrections can be made with less financial impact or other deleterious effects on the project. On large projects, tighter construction monitoring may be performed by testing at approximate intervals of 5%, 50% and 90% completion of the installation.*

7.1.2

Typically, the test specimen's size and location shall be selected by the specifier/client and shall be clearly identified within the construction documents. If the specimen location has not been pre-determined in the project documentation, the test specimen's size and location shall be selected by the specifier/client following completion of installation of the test specimen, all adjacent exterior flashings, claddings and internal and external air seals.

7.1.3

If no test specimen(s) and/or location is identified in the construction documents or instructed by the specifier/client and sampling is delegated to the Window & Glass Association approved test operator, sampling shall be based on the sampling procedures outlined in the following paragraphs 7.2 – 7.3.

7.1.4

If the selected test locations are not easily accessible from both the interior and exterior of the building, significant additional cost may arise for scaffolding etc. If identical products are installed at more accessible locations, these locations should be selected for testing.

7.1.5

The specified test specimen(s) shall be inspected prior to testing and shall have no outstanding defects list items, visible damage or irregularities, nor be singled out because of obvious performance problems or, because they have benefited from more stringent QA processes (See Note 2). If problems with a specimen installation are observed, they shall be brought to the responsible contractor's and/or

manufacturer representative's attention and added to the project defects list. If exterior screens are specified, they shall be in place (closed) during testing.

NOTE 2: Be wary of test areas specifically promoted by product installers or manufacturers with prior knowledge of scheduled field testing. Products specifically promoted may have subjected to a more stringent Quality Assurance processes and accordingly may not be representative of a typical installation.

7.2 Curtainwalls, Shopfronts and Sloped Glazing Systems.

7.2.1

All framing and/or units shall be installed on the lower two typical floors of the building for curtain wall testing and on the lowest typical floor for shopfront or sloped glazing system testing. The area shall be fully glazed to provide a completed installation.

7.2.2

Allow a **minimum** test area of 9.3m^2.

7.2.3

Test area(s) should be representative of the project construction and should include where applicable, all seismic frame seals, perimeter seals, frame intersections, mullions, transoms, glazing and spandrel panels.

7.3 Operable Doors and Windows

7.3.1

As soon as practical after installation has commenced, and after a representative number of fenestration products have been completely installed, adjusted, cleaned and perimeter sealed, **a minimum of three** installed fenestration specimens shall be tested for air leakage resistance and/or water penetration resistance.

7.3.2

The fenestration product(s) shall be representative specimens of typical installations specified for the project and shall generally include I representative sample of each of,

a) Cladding type / fenestration product interface,

b) Operable window,

c) Hinged door,

d) Sliding door,

e) Bifold door.

7.3.3

After the specimen(s) locations have been selected, the owner's representative shall direct the responsible contractor and/or manufacturer representative to

remove interior finishes (if necessary) to clean the specimen(s) and check for proper operation. Care shall be taken not to disturb the interior side air seal, if present. Interior or exterior components that are required for product performance shall not be removed as some product installations require an interior air seal to perform as designed.

7.3.4

The designated specimen(s) shall be inspected by the test operator to confirm,

- The specimen is plumb, level, and square.
- The operation of the specimen.
- The designed drainage path of the specimen.
- The pre-test condition of all surfaces to confirm that they were in a condition where a judgment can be made as to whether or not water penetration is a result of this testing.

8 Test Methods

8.1 Selecting the Correct Test Method

When selecting the correct Window & Glass Association test method to use it is important to first understand the objective of the test and the outcomes required e.g. A water penetration test that applies a dynamic pressure is typically unsuitable for replicating a wind driven rain event and the test method for newly installed fenestration products will differ from a test method intended for fenestration products that have been installed for six months or more.

Typically, on-site water penetration testing will follow industry guidelines however prior to commencement of any testing, the Window & Glass Association approved test operator should discuss with the client/specifier the reason for testing and the outputs required to ensure the correct test method is applied.

Discussion should include but not be limited to,

a) The age of the products to be tested,

b) Does the test area include cladding, fenestration products, or both?

c) Is testing required as part of a quality assurance programme or as a diagnostic process to determine the cause or source of known water ingress,

d) Does testing need to replicate a wind driven rain event,

e) Which sampling method is to be used,

f) Time and budget constraints.

8.1.1

Sometimes a specifier may demand a test method which differs from the Window & Glass Association approved test method for the nominated fenestration product(s). Should this occur, testing should not proceed until the specifier has been advised of the correct Window & Glass Association approved test method for the selected fenestration product(s).

If, after advising the specifier of the inconsistency the specifier elects to proceed with an incorrect test method, the test operator shall continue with the test as specified but shall incorporate the following statement in the test report:

"On the instruction of the specifier the test procedure differed from the Window & Glass Association recommended test procedure for the fenestration product(s) under test and as such the test results may be inconsistent with the test results that may have been achieved with the Window & Glass Association recommended test procedure."

8.1.2

The correct Window & Glass Association field testing procedure can be determined using the flow chart shown at Figure 3.

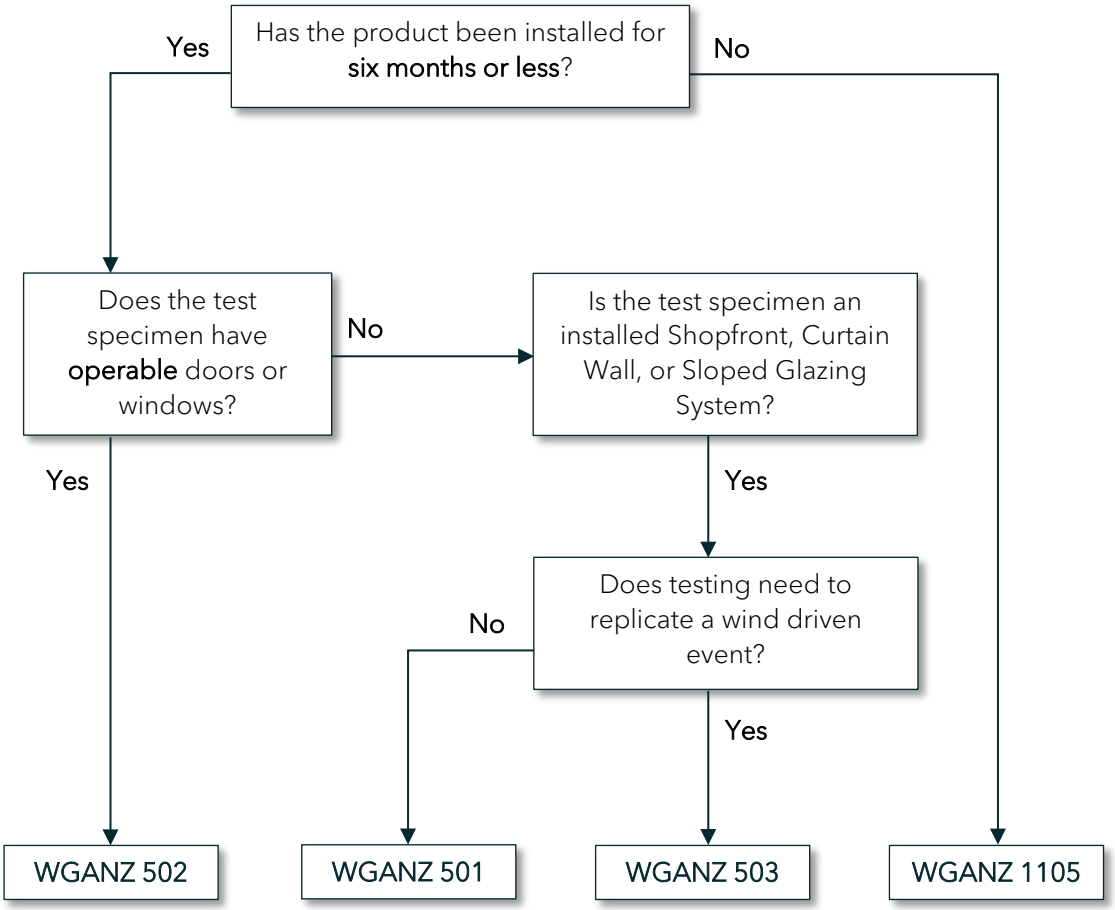

Figure 3: Test Method Flow Chart

8.2 WGANZ 501

8.2.1 General

The WGANZ 501 test method is the Window & Glass Association standard quality assurance and diagnostic water leakage test method for “Field Checking of Installed Shopfronts, Curtain Walls and Sloped Glazing Systems”, using an external water spray delivered at a controlled pressure. The test method requires a competent operator on the building exterior to apply the specified water spray while the test operator monitors the interior of the test area for water ingress.

8.2.2

The purpose of the test procedure is to provide a quality assurance and diagnostic field water check method for installed fenestration elements including shopfronts, curtain walls, and sloped glazing systems. This field test procedure is intended to evaluate those joints, gaskets and sealant details in the glazing which are designed to remain permanently closed and watertight. The procedure is not intended to test the rated or specified water performance representative of a wind driven rain event but instead is intended to be used as a Quality Assurance spot-check during construction of a curtain wall or shopfront system.

8.2.3

This field test method is not appropriate for testing operable components such as operable windows and doors. The WGANZ 502 and WGANZ 1105 field test procedures are the proper test methods for field water penetration resistance testing of operable windows and doors.

8.2.4

This field test method is intended for newly installed fenestration products, i.e. products that have been installed for six months or less. For products that have been installed for more than six months the WGANZ 1105 test procedure is the proper test method.

8.2.5

The WGANZ 501 test procedure is attached as “Appendix B”.

8.3 WGANZ 502

8.3.1 General

The WGANZ 502 test method is the Window & Glass Association standard test method for "Field Testing of Newly Installed Fenestration Products", using an external mounted spray rack delivering a controlled spray of water and an internally mounted vacuum chamber to apply a specified negative differential pressure.

8.3.2

The purpose of this test procedure is to provide a method which can be used to evaluate the installed performance of installed fenestration products for water penetration resistance under controllable, reproducible, and appropriate conditions.

8.3.4

This field test method is intended for newly installed fenestration products i.e., products that have been installed for six months or less, in buildings that are still under construction or that are yet to have a Certificate of Public Use (CPU) or Code Compliance Certificate (CCC) issued. For products that have been installed for more than six months the Window & Glass Association WGANZ 1105 test procedure is the proper test method.

8.3.5

Application of the correct differential pressure to be applied to the internal vacuum chamber requires prior determination of either,

a) the specified positive Serviceability Design Wind pressure for the site for the determination of the default water penetration test pressure in accordance with NZS 4211:2008 or AS/NZS 4284:2008, or

b) the water penetration test pressures specifically documented in the project specifications for the installation being tested.

8.3.6

Default Window & Glass Association water penetration resistance test pressures to be used for the WGANZ 502 test procedure are 20% of the positive Serviceability Design Wind pressure or, for a specified wind zone, the applicable Field Testing Water Penetration Test Pressure from Table 1.

NOTE: Unless stated otherwise and clearly stipulated in the project specifications, in no case shall the specified static water test pressure exceed 2/3 of the tested or rated laboratory performance (see Table 1 for default performance requirements).

Wind Zone	NZS 4211 Water Penetration Test Pressure	Field Testing **Water Penetration Test Pressure**
Low	153 Pa	**102 Pa**
Medium	204 Pa	**136 Pa**
High	291 Pa	**194 Pa**
Very High	375 Pa	**250 Pa**
Extra High	455 Pa	**303 Pa**

Table 1: Default Water Penetration Resistance Test Pressures

8.3.7

The WGANZ 502 test procedure is attached as “Appendix C”.

8.4 WGANZ 503

8.4.1 General

The WGANZ 503 test method is the Window & Glass Association standard test method for “Field Testing of Newly Installed Shopfronts, Curtain Walls and Sloped Glazing Systems”, using an external mounted spray rack delivering a controlled spray of water and an internally mounted vacuum chamber to apply a specified negative differential pressure.

8.4.2

The purpose of this test procedure is to provide a method which can be used to evaluate the performance of installed fenestration products for water penetration resistance under controllable, reproducible, and appropriate conditions.

8.4.3

This field test method is intended for newly installed storefronts, curtain walls and sloped glazing systems and their installation during construction, but no later than six months after issuance of the Certificate of Public Use (CPU). For products that have been installed for more than six months after the issue of a CPU the WGANZ 1105 test procedure is the proper test method. Specifically excluded from this specification are windows, glass doors and skylights.

8.4.4

Application of the correct differential pressure to be applied to the internal vacuum chamber requires prior determination of either:

a) the specified positive Serviceability Design Wind pressure for the project, or

b) the water penetration test pressures specifically documented in the project specifications for the installation being tested.

8.4.5

Test pressures to be used for the WGANZ 503 test procedure are 2/3 of the specified water penetration test pressure for laboratory testing to AS/NZS 4284, but not less than 200Pa.

8.4.6

In In the event that the project does not have a specified water penetration test pressure, the water penetration test pressure to be applied will be 20% of the positive Serviceability Design Wind pressure.

8.4.7

The WGANZ 503 test procedure is attached as “Appendix C”.

8.5 WGANZ 1105

8.5.1 General

The WGANZ 1105 test method is the Window & Glass Association standard test method for “Onsite Water Penetration Testing of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference”. The WGANZ 1105 test method uses an externally mounted spray rack delivering a controlled spray of water and an internally mounted vacuum chamber to apply a specified static or cyclic negative pressure differential.

8.5.2

The purpose of the test procedure is to determine the resistance of installed exterior windows, curtain walls, skylights, and doors to water penetration against specified criteria when water is applied to the outdoor face and exposed edges simultaneously with a static air pressure at the outdoor face higher than the pressure at the indoor face.

8.5.3

This field test method is intended for testing of installed exterior windows, curtain walls, skylights, and doors but may also be used to determine the resistance to water penetration through the joints between the assemblies and the adjacent construction and through claddings.

8.5.4

This field test method may be used for newly installed products i.e., products that have been installed for six months or less but may also be used after the building is completed and in service to determine whether or not reported leakage problems are due to the failure of the installed assemblies to resist water penetration at the specified static air pressure difference.

8.5.5

This field test method allows for water penetration resistance testing to be carried out using a specified static air pressure differential for 15 minutes (procedure A) or testing using a cyclic static air pressure differential (procedure B).

8.5.6

The WGANZ 1105 test procedure is attached as “Appendix D”.

9 Pass / Fail Criteria

9.1 General

For each of the Window & Glass Association Field Testing Procedures described above, assessment for compliance with the specified performance criteria shall typically be based on a visual inspection only of the sample under test. Where the source of water ingress is unable to be determined through visual inspection only however, additional forensic investigation techniques may need to be applied (see also Section 10).

9.2 Fenestration Products

For installed fenestration products, the pass/fail criteria shall be in accordance with NZS 4211 whereby the definition of failure shall be when uncontrolled water penetration takes place, or when controlled water is not drained away.

9.2.1 Uncontrolled water penetration is defined as,

a) Water that is not contained in a purpose-built collection or drainage area,

b) Water that may wet window fixtures and finishes, reveal linings or window furnishings beyond the window frame, or

c) Water that flows in a constant stream on the inside, or regular dripping.

9.2.2 Acceptable water penetration is defined as,

a) Minor splashing which occurs due to air infiltration, within one minute after change of pressure,

b) Minor intermittent leakage on the indoor side of operable sashes, which is contained on gaskets, sill tracks, and thresholds.

9.2.2 A purpose-built collection or drainage area is defined as,

a) A system that allows water to collect or be drained to the outside (at the cessation of testing) from sills, other framing members, or in cavities.

9.3 Building Facades and Curtainwalls

For installed building facades, curtainwalls and window/cladding junctions, the pass/fail criteria shall be in accordance with AS/NZS 4284 whereby the definition of failure shall be when one or more of the following occur,

a) Water appears on any inside surface of the facade and is visible from an occupied space,

b) Uncontrolled water appears on any inside surface of the façade,

c) Water appears that is likely to wet insulation, fixtures, and finishes,

d) Water appears in other locations specified as unacceptable by the Specifier.

10 Forensic Investigation

10.1 General

Damage to buildings caused by uncontrolled water penetration through exterior walls is a serious concern of owners, contractors, architects, and product manufacturers. Often improper or inadequate leak investigations result in investigators misidentifying the source of water penetration through the exterior wall.

In many cases, this error results from observations of water penetration at or near a fenestration product opening that may originate from the surrounding construction. In other cases, the water penetration is a combination of sources which may be inclusive of the fenestration product assemblies. A systematic forensic investigation of the water penetration is required to determine the actual source of the leak.

This section describes the Window & Glass Association approved methods for determining and evaluating causes of water leakage of exterior walls and which are based on the forensic evaluation procedures documented in the ASTM E2128-12 “Standard Guide for Evaluating Water Leakage of Building Walls” and the AAMA 511-08 test procedure. These documents provide valuable information and should be used to supplement the forensic evaluation procedures outlined below.

For this purpose of the evaluation procedures outlined in this section, water penetration is considered leakage, and therefore problematic, if it exceeds the planned resistance or temporary retention and drainage capacity of the wall, is causing or is likely to cause premature deterioration of a building, its structural elements or its contents, or, is adversely affecting the performance of other components. A wall is considered a system including its exterior and interior finishes, fenestration, structural components, and components for maintaining the building interior environment.

10.2 Scope

The Window & Glass Association procedures for forensic investigation can be applied to all areas of the exterior envelope and are intended to provide test operators with a sequence of investigative techniques for suspected or known leaks however they may also be used where Quality Assurance or performance testing results in leaks where the source is unable to be readily determined.

The investigative techniques discussed in this section may be intrusive, disruptive, or destructive. It is the responsibility of the Window & Glass Association approved test operator to advise the client of the potentially destructive nature of some procedures and establish any limitations that may be required as well as responsibilities and for temporary patching and subsequent reinstatement and making good.

The sequential activities described in this section are intended to provide a comprehensive evaluation program, but all activities may not be applicable or necessary for a particular evaluation program. It is the responsibility of the Window & Glass Association approved test operator performing the forensic evaluation to determine the activities and sequence necessary to perform an appropriate leakage evaluation for a specific building.

10.3 Forensic Evaluation Procedures

10.3.1 Preliminary Assessment

A preliminary assessment may indicate that water leakage problems are limited to a specific element or portion of a wall. The preliminary assessment may also indicate that the wall is not the source of a leak even though it is perceived as such by the building occupant.

10.3.2 Information Review

Prior to commencement of any testing the test operator should undertake a review of all relevant information including, but not limited to,

a) Project documentation including,
   - shop drawings
   - installation instructions
   - contracts
   - specifications
   - and warranties

b) Evaluation of design concept, including the fenestration products' designed water management concept (such as drainage system, barrier system, pressure equalized system, etc.) and of critical details, including flashing, sealants, and weep holes.

c) Determination of the service history, including maintenance records, and interviews with building occupants or personnel with a knowledge of any leak history.

10.3.3 Inspection

Inspection not only compliments the information gained from the project documentation but also provides the opportunity to confirm the As-built construction's consistency with the approved design and specifications. The inspection phase is where hypothesis as to the cause or source of the leaks can be formed or, where previously formed hypothesis can be confirmed or rejected.

Areas of inspection should include but not be limited to,

a) Placement, condition, and resilience of sealants and gaskets,

b) Functional aspects of drainage systems, such as end dams, drainage holes, joints, and placement of flashings relative to other components etc,

c) External and internal air seals,

d) Window / cladding interfaces,

e) Interfaces with other building elements such as foundations, soffits, penetrations, etc,

f) Material conditions, including symptoms of deterioration from,

- Wear and tear
- freeze-thaw
- expansion and contraction
- prolonged saturation
- adhesive or sealant failures

g) Other possible mechanisms for water entry into a wall or migration within a wall, such as capillary action, or air movements causing percolation.

10.3.4 Investigative Testing

The purpose of investigative testing is to recreate leaks that are known to occur under controlled and reproducible conditions and to trace the internal path of the leak to determine the source and/or cause. For diagnostic purposes and if the cause of the leaks is to be determined, the test specimen or wall should be tested in its existing condition, prior to any remedial work being carried out.

Perform the test with the perimeter joint and surrounding wall area isolated from the fenestration product to test only the installed product and then conduct a second test which includes the perimeter joint and surrounding wall area.

Testing of isolated areas should commence at the bottom of the test area and progress vertically to the top as selective masking is removed or, as selective testing with a calibrated nozzle advances. Starting at the bottom helps eliminate ambiguity about the origin of a leak that might result from water running vertically down the surface of the test area.

10.3.5 Tracing Leaks

Once testing reproduces an in-service leak, the entry point and the path followed by the water within and through the wall must be traced. A single entry point may lead to several concealed water paths or several entry points may merge together internally. Every contributory source to each water path must be identified if a complete diagnosis and repair is to be developed. Tools that are useful for tracing leaks include,

- Non staining dye,
- Flashlight and mirror,
- Optical Borescope,

- Infrared thermography,
- Paper strips or other absorbent materials that can be used to probe concealed spaces for indications of water,
- Smoke pencil that can be used to expose air paths leading to water percolation,
- Moisture meters.

10.3.6 Sill Dam Test

When testing identifies the source of a leak is due to a defective fenestration product, the optional sill dam test can be used to further investigate the leak path. As this test may subject the fenestration product to greater water intrusion than experienced during a weather event, it is not to be used as the sole criteria to determine whether or not the fenestration product is defective.

Water shall be placed into the fenestration product sills and subframe/receptor systems such that a static water head is maintained for a duration of 15 minutes. All horizontal surfaces within the sill assembly, which rainfall events are expected to wet, shall be covered with water. Plugging weep holes or building an exterior dam to hold water to the required depth shall be permitted for this test.

10.4 Water Sources

10.4.1

Water leakage through exterior wall assemblies can come from several possible sources. Rain on the exterior surface of a wall may lead to some degree of penetration, due to the effects of gravity, surface tension, kinetic energy, or capillary action. Wind-driven rain, which wets an assembly under a pressure differential, can force water through small openings, seams, and cracks in the assemblies or over the top of barriers with insufficient height. Air moving through openings in an assembly can transport water by percolation.

10.4.2

The direction of water movement on the wall surface is determined by the combined effects of gravity, surface tension, and wind velocity. The effects of wind velocity can be greater than the effects of gravity, resulting in regions of the wall where wind-driven rain may flow upwards or sideways.

10.4.3

Surface tension can cause water to cling to and migrate along horizontal surfaces, thereby wetting areas not directly exposed to rain or in the path of water flowing down the face of a building. Drip grooves at the edge of horizontal overhangs are intended to interrupt the effects of surface tension.

10.4.4

Water can penetrate a wall by being transported along a stream of moving air. It will percolate across barriers or through cracks and holes. Control of penetrating water usually also requires considering the control of air movement.

10.4.5

Interfaces between vertical and horizontal surfaces are often subjected to large amounts of water due to sheeting action along the vertical surfaces. Areas where water accumulates in large amounts on the horizontal surfaces are particularly vulnerable to eventual water penetration. The proper design and functioning of interface joinery, sealants, and closures between vertical and horizontal elements are essential to the performance of the system.

10.4.6

Water retained within cavities or absorbed by material components of wall systems can cause significant damage if it freezes. Snow and ice can block drainage systems designed to accommodate water, thereby preventing these systems from functioning properly. The service history and conditions under which leakage occurs are particularly important in evaluating leaks of this type because they might not be recreated during diagnostic testing.

11 Reporting

General

In addition to providing the client with a record of the test carried out, it is important that the test report provides sufficient information to reproduce the test and ensure repeatability of the test outcomes.

11.1 Test reports for all Window & Glass Association test procedures shall, as a minimum, include the following,

a) A title and unique identification in order that all pages of the report are recognized as a portion of a complete report and a clear identification of the end i.e., “Report 1001 - Page 1 of 10”,

b) The name and address of the Window & Glass Association approved testing facility and the name of the test operator,

c) The building name and address where testing was carried out,

d) The date(s) testing was carried out,

e) Details of weather conditions during the test period including,

- Sun / cloud
- Precipitation
- Temperature

f) The name and contact information of the client,

g) The name of the specifier,

h) Identification of the test method used,

i) A description, unambiguous identification and location of the curtainwall area(s), window(s), door(s), or façade elements tested,

j) Details of test pressures and water volumes specified and achieved,

k) A schedule of test equipment used,

l) Calibration expiry dates for calibrated equipment,

m) Reference to the sampling plan and sampling method used by the specifier or Window & Glass Association approved test operator,

n) A statement to the effect that the results relate only to the items tested,

o) A record of the test results including a description of the extent and source of any water penetration on the internal face of the test sample and surrounding enclosure,

p) Details of any additions to, deviations, or exclusions from the method,

q) Identification of the person(s) peer reviewing and authorizing the report,

r) Signature and date of the report.

11.2 The testing facility shall be responsible for all the information provided in the test report, except when information is provided by the client. In addition to the requirements at 11.1, all test reports should include a disclaimer when information is supplied by the client that can affect the validity of results.

11.3 The test operator shall be able to provide certificates of calibration for manometers, water pressure gauges and water flow meter used in the reported tests.

12 Short Form Specifications

12.1 General

To facilitate specifiers calling up the Field Test Procedures, draft Short Form Specifications are attached. As the cost of undertaking these Field tests will need to be covered within any contractual supply from manufacturers or installers, it is important that provision for any Field Test is signalled by specifiers, during contract negotiations, with the necessary details of number, selection, sampling, site access, responsibility, testing agency, etc covered by the specification.

A copy of the Window and Glass Association Short Form Specification for the “Window & Glass Association Procedure for Field Testing of Installed Windows, Doors, Curtainwalls and Shopfronts" is shown at Appendix A.

APPENDIX A

Window & Glass Association Short Form Specification for Field Testing

To simplify the writing of field testing specifications for fenestration products, the Window & Glass Association has prepared the following "Short Form Specification" for use by architects/specifiers. It may be used by merely inserting the following paragraph(s) into the project specifications. Please note that Specifier Notes in italics are not to be inserted into the project specifications.

Short Form Field Testing Specification

1. Newly installed fenestration product(s) shall be field tested in accordance with the Window & Glass Association …… Test Procedure for "Field Testing of Newly Installed Windows and Doors."

or

2. Existing fenestration products that have been installed for a period of six months or more shall be field tested in accordance with the WGANZ 1105 Test Procedure for "Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference".

SPECIFIER NOTE 1: See the Window & Glass Association Procedures for Field Testing of Curtainwalls, Windows and Facade Elements for determination of the applicable test method for existing or newly installed fenestration products during construction and prior to building occupancy or from six months after completion.

3. All tests shall be performed by a Window & Glass Association approved test operator or an NZS ISO/IEC 17025 accredited testing laboratory accredited for such tests.

4. Unless otherwise specified, following installation of the fenestration products and completion of all adjacent exterior flashings and claddings and internal and external air seals, a minimum of 3 fenestration products shall be tested for water penetration resistance in accordance with the specified test procedure.

SPECIFIER NOTE 2: The number of specimens to be selected for testing on a project should be determined after careful consideration of the following factors:

- *What will be the cost impact of the quantity and location of specimens selected for testing?*
- *Selecting a large number of specimens on a small project (fewer than 50 fenestration products) is normally not cost effective, and as few as one specimen may provide the information needed.*

- *On all projects, regardless of size, the specifier should determine how many specimens are required in order to establish a reasonable measure of quality for the entire project ASTM E 122 provides guidance on how to establish the number of test specimens in order to estimate a measure of quality of a production lot with prescribed precision.*

- *The specifier must carefully balance the cost of specimen or specimen preparation, as well as the cost of testing and the restoration of the project surrounding components and finishes to their original condition, before determining the number and location of specimens to be tested. On larger projects, a formal cost-benefit analysis is appropriate.*

  On smaller projects, the specifier should avoid a situation where the cost of testing and building restoration approaches the cost of the fenestration products. If any of the tested fenestration products fail to comply with the project requirements, consideration should be given to the selection and testing of additional products.

- *If water penetration is observed and the source of the leakage cannot be determined, a forensic evaluation using the procedures outlined in Section 10 of the Window & Glass Association Field Testing Procedures shall be performed while maintaining the test pressures and methods defined in applicable test procedure.*

5. Water penetration resistance tests shall be conducted at a static air pressure differential of …….. Pa. The test specimen will be deemed to fail the water penetration resistance test if water is visible in the occupied space or if the test specimen fails to meet the pass/fail criteria of the specified test procedure.

SPECIFIER NOTE 3: When specifying static air pressure differential for on-site water penetration resistance testing, under no circumstance shall the specified test pressure exceed 2/3 of the tested or rated laboratory performance (see WGANZ Field Testing Procedures Section 8 and Table 1 for default performance requirements).

APPENDIX B

WGANZ 501 TEST PROCEDURE

1.0 General

1.1 Prior to using this test procedure, verify the installation date and construction of the fenestration products scheduled for testing. If the items to be tested have been installed for more than six months or contain operable windows or doors this test procedure should not be used. For existing fenestration products installed for greater than six months or fenestration products containing operable windows and doors, refer Section 6 of the Window & Glass Association Field Testing Procedures for verification of the correct test procedure to be applied.

NOTE: In the event the specified test procedure differs from the Window & Glass Association approved test procedure for the nominated fenestration product(s), testing shall be suspended until the specifier has been advised of the correct Window & Glass Association approved test method for the selected fenestration product(s) (See also WGANZ Field Testing Procedures Clause 8.1.1).

2.0 Equipment *(refer also WGANZ Field Testing Procedures Clause 5.2)*

a) Calibrated Spray Wand,

b) Water reservoir and booster pump,

c) 19mm hose,

d) Stopwatch or timer,

e) Torch.

NOTE: It is recommended that a gauge rod be attached to the end of the nozzle to ensure that the specified distance from the joint under test is maintained. Ensure the end of gauge rod is constructed of a material that will not damage the glass or powder coat finishes should it come into contact with them.

3.0 Procedure

3.1 Prior to commencing the test, the designated test area shall be evaluated for obvious defects and starting from the bottom, the framing extrusions and joints shall be divided into 1.5m sections,

NOTE: Using a whiteboard marker, chalk or masking tape to define each 1.5m section will help to ensure consistency of the water spray application area during testing.

3.2 Turn on the water supply valve and booster pump if and adjust water pressure with the control valve until the calibrated pressure gauge records a pressure of 205 to 240kPa (30 to 35psi).

3.3 With the spray wand held perpendicular to both the vertical and horizontal planes and

the spray nozzle positioned 305mm (±25mm) from the test surface, direct the water spray back and forth over each 1.5m section of the test area.

3.4 Working from the lowest horizontal exterior framing, then the adjacent vertical framing members, etc. each 1.5m section shall be tested for 5 minutes. For sections shorter than 1.5m, test at a rate of 300mm per minute or part thereof. During the test, an observer on the indoor side of the wall, using a flashlight if necessary, shall check for any water leakage and shall note where it occurs.

3.5 If no water leakage occurs during the five-minute test, the water spray shall be applied to the next 1.5m section for 5 minutes, and testing continued in this manner until the entire test area is tested.

3.6 For this this water leakage field check, water leakage is defined as any uncontrolled water that appears on any normally exposed interior surfaces, that is not contained or drained back to the exterior, or that can cause damage to adjacent materials or finishes. Water contained within drained flashings, gutters, and sills is not considered water leakage. The collection of up to 15ml of water in a 5 minute test period on top of an interior stop or stool integral with the system shall not be considered water leakage.

3.7 If water leakage occurs and the source of the leakage cannot be identified, the following sequence shall be followed:

3.7.1

After allowing the wall to dry completely and working downward from the top of the area to be checked, all joints, gaskets and framing within this area shall be completely and tightly covered, on the outdoor side, with a water proof adhesive masking tape. If necessary, use small amounts of sealant where the tape wraps around the framing corners and joints to ensure that the masking is complete and waterproof.

3.7.2

Starting at the bottom of the prepared area, the masking tape shall be removed from the lowest horizontal framing section for a distance of not more than 1.5m from one end of the frame including the joint intersection or corner at the end. This exposed section shall be subjected to the nozzle spray as directed in Sections 3.3 and 3.4 above.

3.7.3

If no water leakage occurs during the 5 minute test period, this length of framing shall be considered satisfactory and shall remain uncovered. If leakage has occurred at any point, the framing shall be re-taped at such points to prevent further leakage of these points during the subsequent checking of joints and framing adjacent to or above them.

3.7.4

This process shall then be repeated on all framing, gaskets and joint intersections within the designated area, using increments of exposed framing length not exceeding 1.5mm and always working upward on the area being tested.

NOTE: In some cases, due to unforeseen delays or other causes, more than one working day may be required to completely check the designated area, necessitating that some or all of the masking tape be left in place over night. The tape should not remain on finished metal or glass surfaces any longer than necessary, especially where subjected to strong sunlight, as this may make its removal difficult. It is the responsibility of the party contracting for the test to properly clean any residual adhesive or sealant resulting from the testing.

4.0 Remedial Work and Re-testing

4.1 Wherever water leakage has occurred, the framing shall be made watertight in a manner acceptable to the specifier and/or owner's representative. Where remedial work involves the use of sealants or compounds with specified curing/setting times they shall be allowed to cure/set in accordance with the product manufacturers recommendations before re-testing for leakage.

4.2 After all necessary remedial work has been completed and the required curing time, if any, has elapsed, all remediated framing sections shall again be checked, following the same procedure as before (Section B3). Should leakage still be found, further remedial measures shall be taken, and checking shall be repeated until all framing in the designated area is found to be satisfactory.

4.3 Report all test results and observations in accordance with Section 11.0 of the WGANZ Field Testing Procedures.

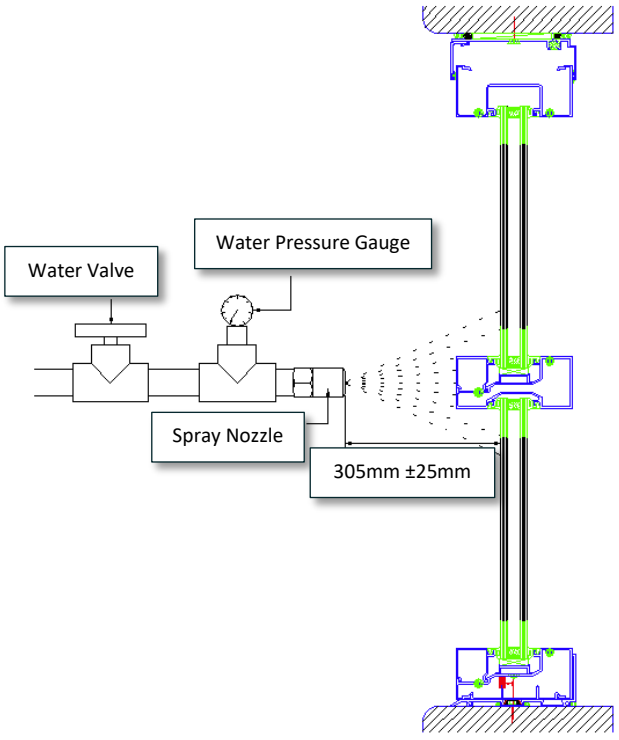

Figure 4: WGANZ 501 Test equipment configuration.

APPENDIX C

WGANZ 502 / WGANZ 503 TEST PROCEDURE

1.0 General

1.1 Prior to using this test procedure, verify the installation date and construction of the fenestration products scheduled for testing. If the items to be tested have been installed for more than six months or construction has been completed and the building has been occupied this test procedure should not be used. For existing fenestration products installed for longer than six months or the building has been occupied, the correct test procedure is the WGANZ 1105 Test Procedure (see also Section 8 of the WGANZ Field Testing Procedures).

> *NOTE: In the event the specified test procedure differs from the Window & Glass Association approved test procedure for the nominated fenestration product(s), testing shall be suspended until the specifier has been advised of the correct Window & Glass Association approved test method for the selected fenestration product(s) (See also 8.1.1).*

1.2 Prior to using this test procedure, operators must read and understand the additional information for the WGANZ 502 and/or WGANZ 503 tests method as documented at Sections 8.3 and 8.4 of the Window & Glass Association Field Testing Procedures.

1.3 This test procedure allows for water penetration resistance testing under a uniform static pressure differential (Procedure A) or, water penetration resistance testing using a cyclic static pressure differential (Procedure B).

1.4 For WGANZ 502 testing, and where the project specifications or the specifier/client makes no stipulation as to whether WGANZ 502 testing is to be carried out using Procedure A or B, testing shall be carried out using Procedure A only, applying a uniform static pressure differential for a period of 15 minutes. Procedure B shall apply only when included in the project specifications or as instructed by the specifier/client.

1.5 For WGANZ 503 testing only Procedure A shall be used.

1.6 If the test specimen incorporates operable doors or windows these should be checked for proper installation by opening, closing, and locking the unit 5 times prior to sealing off the face of the internal pressure chamber.

2.0 Equipment *(refer also WGANZ Field Testing Procedures Clause 5.3)*

a) Water spray rack fitted with a calibrated water pressure gauge,

> *NOTE: Where a calibrated water flow meter is used the calibrated water pressure gauge may be omitted.*

b) Calibrated water flow meter,

c) Water reservoir and booster pump,

d) Variable speed fan,

e) Calibrated differential pressure manometer,

f) 19mm hose,

g) Stopwatch or timer.

3.0 Installation

3.1 Where the test area incorporates the window/cladding interface and the interior plasterboard linings and timber trim have been installed, remove the timber trim and cut back the plasterboard linings to expose the air space and/or installed air-seal between the window or window revel and adjacent framing to the window opening.

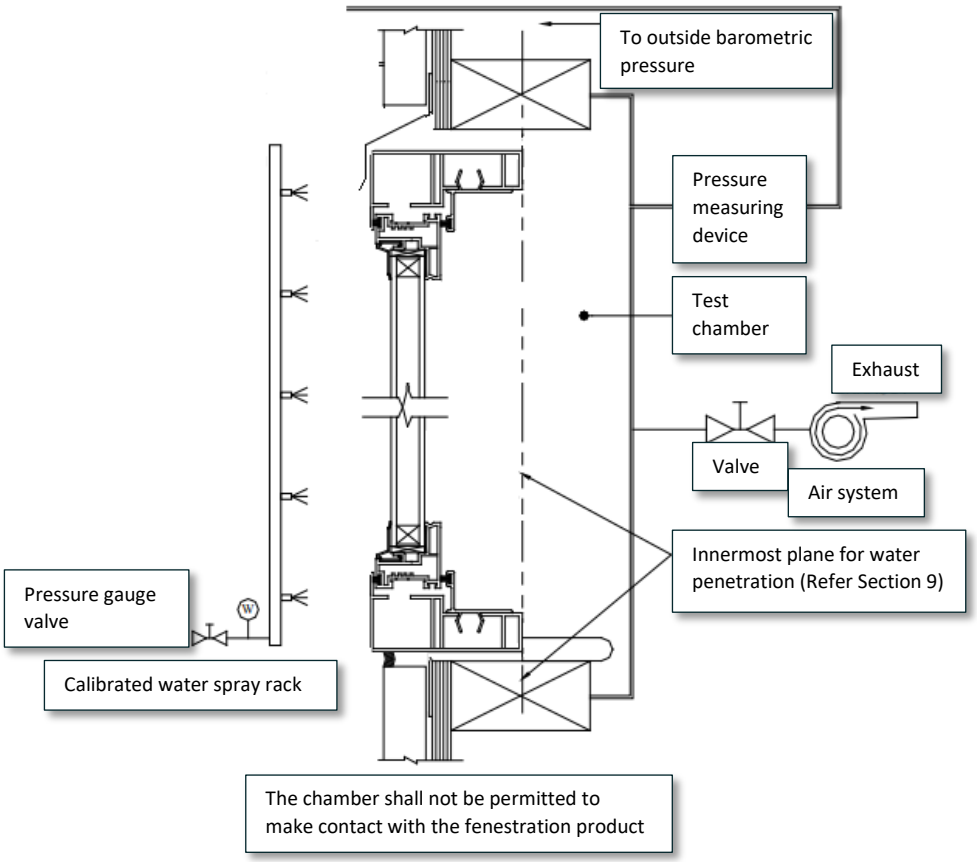

Figure 5: Typical Vacuum Chamber and Spray Rack Arrangement

3.2 Construct a temporary timber framed enclosure on the internal face of the window or door under test, with the perimeter framing having a sealed joint onto the perimeter support framing of the installation under test. The temporary framing must be supported only from the outer edges of the window frame or perimeter and must be sufficiently rigid to prevent any contact with the door or window under test when the negative pressure (suction) is applied to the internally positioned enclosure.

3.3 Seal all joints between the timber framing and the perimeter of the window with duct tape, flexible flashing tape or removable foam tape seal. Where internal finishes have been completed care must be exercised to use only sealing methods that can be subsequently removed without damage to internal linings and paintwork. It should be noted that as the internal enclosure will be under negative pressure, the resulting suction will draw the temporary enclosure onto the existing window perimeter without the need for substantial structural attachment.

3.4 Fasten 6gauge transparent vinyl or transparent acrylic sheeting onto the internal face of the enclosure framing using 3M flashing tape, foam sealant tape other suitable tape applied to the perimeter edges of the enclosure to minimise air leakage.

NOTE: Spacing of intermediate framing members must be sufficient to prevent contact between transparent vinyl or acrylic sheeting and window/door unit when under test at the specified test pressure(s).

3.5 Create an opening through the transparent vinyl or acrylic sheeting to provide connection of the flexible hose from the fan providing the negative pressure (suction).

3.6 Insert a hose tail through the vinyl or acrylic sheet and connect to the positive signal side of the calibrated differential pressure manometer with appropriately sized flexible tubing.

3.7 Open any adjacent windows or doors to allow pressure equalization between the building interior and exterior.

NOTE: Where pressure equalisation cannot be achieved between the building interior and exterior, a second length of flexible tubing must be run from the building exterior and connected to the negative or reference side of the calibrated differential pressure manometer to ensure the specified pressure differential is achieved.

3.8 Position the external water spray rack at the distance calculated for the selected water spray nozzle pattern.

3.9 Connect the inlet side of the calibrated water flow meter to the outlet side of the booster pump and then connect the water spray rack to the outlet side of the water flow meter and the water reservoir to the inlet side of the booster pump with 19mm hoses.

3.10 If the area to be tested exceeds the coverage area of the spray rack, mask off the additional area to prevent unintentional wetting.

4.0 Procedure A

4.1 Turn on the water supply valve (and booster pump if required) and adjust water flow until the water pressure gauge shows the same water pressure at which the spray rack was calibrated or adjust the water flow rate with the water flow meter adjusting valve to the required water flow volume for the coverage area of the spray rack grid, to achieve a minimum water application rate of 3.0l/m^2/min.

4.2 Continue the application of water onto the exterior surface of the window or door under test for a period of 5 minutes at 0.0Pa pressure differential.

4.3 After the 5 minute pre-wetting phase at 0.0Pa, apply the specified or calculated negative differential air pressure for a period of 15 minutes.

NOTE: Weather conditions can affect the static air pressure difference measurements. If wind gusting causes pressure fluctuation to exceed ±10 % from the specified test pressure, the test should not be conducted.

4.4 Reduce the applied differential air pressure to 0.0Pa and turn off the water sprays.

4.5 Record any water appearing on the internal face of the test specimen, stating the source and extent of the penetration observed during the period under pressure and for the following 5 minutes.

Water penetration attributable to the surrounding condition shall be defined as the presence of uncontrolled water that did not originate from the fenestration product or the joint between the fenestration product specimen and the wall/roof. Water penetration attributable to the fenestration product specimen shall be defined as the penetration of uncontrolled water beyond a plane parallel to the innermost edges of the product and that indisputably originates from the fenestration product. Water penetration attributable to the perimeter joint shall be defined as uncontrolled water that indisputably originates at the joint.

4.6 Water leakage shall be as defined at 9.2 above or, any water that is not contained in an area with provisions to drain to the exterior or the collection of more than 14ml (14gm) of water in the 15 minute test period on top of an interior horizontal framing member surface. Any water present shall not extend beyond a plane parallel to the glazing (the vertical plane) intersecting the innermost projection of the test specimen, not including interior trim and hardware, under the specified conditions of air pressure difference across the specimen.

4.7 If the area to be tested is greater than the coverage area of the water spray rack, remove and area of the masked off section equivalent to the coverage area of the water spray rack and reposition the water spray rack. Repeat 4.1 – 4.5 above.

4.8 During, or immediately prior to the test, record the temperature and weather conditions.

5.0 Procedure B *(WGANZ 502 Test Procedure only)*

5.1 Turn on the water supply valve (and booster pump if required) and adjust water flow until the water pressure gauge shows the same water pressure at which the spray rack was calibrated or adjust the water flow rate with the water flow meter adjusting valve to the required water flow volume for the coverage area of the spray rack grid, to achieve a minimum water application rate of 3.0l/m^2/min.

5.2 Continue the application of water onto the exterior surface of the window or door under test for a period of 5 minutes at 0.0Pa pressure differential.

5.3 After the 5 minute pre-wetting phase at 0.0Pa, apply the specified static air pressure difference across the test specimen promptly and maintain this pressure, along with the specified rate of water spray, for the period of time stipulated by the specification or the specifier. Unless otherwise specified, the duration of the pressure cycle shall be 5 minutes.

5.4 While maintaining the water spray, reduce the air pressure difference to 0.0Pa for a period of not less than 1 minute.

5.5 Repeat the preceding two steps for the specified number of cycles. In no case, however, shall the total time of pressure application be less than 15 minutes.

> *NOTE: Weather conditions can affect the static air pressure difference measurements. If wind gusting causes pressure fluctuation to exceed ±10 % from the specified test pressure, the test should not be conducted.*

5.6 Reduce the applied differential air pressure to 0.0Pa and turn off the water sprays.

5.7 Record any water appearing on the internal face of the test specimen, stating the source and extent of the penetration observed during the period under pressure and for the following 5 minutes.

> *NOTE: Water penetration attributable to the surrounding condition shall be defined as the presence of uncontrolled water that did not originate from the fenestration product or the joint between the fenestration product specimen and the wall/roof. Water penetration attributable to the fenestration product specimen shall be defined as the penetration of uncontrolled water beyond a plane parallel to the innermost edges of the product and that indisputably originates from the fenestration product. Water penetration attributable to the perimeter joint shall be defined as uncontrolled water that indisputably originates at the joint.*

5.8 If the area to be tested is greater than the coverage area of the water spray rack, remove and area of the masked off section equivalent to the coverage area of the water spray rack and reposition the water spray rack. Repeat 5.1 – 5.6 above.

5.9 During, or immediately prior to the test, record the temperature and weather conditions.

6.0 Forensic Evaluation

6.1 Where water ingress is observed and the source of the water ingress cannot be determined, commence a forensic evaluation using the procedures outlined in Section 10 of the WGANZ Field Testing Procedures while maintaining the test pressures and methods described in the WGANZ 502 test procedure.

7.0 Reporting

7.1 Report all test results and observations in accordance with Section 11 of the WGANZ Field Testing Procedures.

APPENDIX D

WGANZ 1105 TEST PROCEDURE

1.0 General

1.1 Prior to using this test procedure, verify the installation date and construction of the fenestration products scheduled for testing. If the items to be tested have been installed for less than six months and the building is still under construction, this test procedure should not be used. For existing fenestration products not yet in service and installed for less than six months the correct test procedure is the WGANZ 502 or the WGANZ 503 test procedure (see also Section 8 of the Window & Glass Association Field Testing Procedures).

> *NOTE: In the event the specified test procedure differs from the Window & Glass Association approved test procedure for the nominated fenestration product(s), testing shall be suspended until the specifier has been advised of the correct Window & Glass Association approved test method for the selected fenestration product(s) (See also 8.1.1).*

1.2 Prior to using this test procedure, operators must read and understand the additional information for the WGANZ 1105 test method as documented at Section 8.5 of the Window & Glass Association Field Testing Procedures.

1.3 The WGANZ 1105 Test Procedure allows for water penetration resistance testing under a uniform static pressure differential (Procedure A) or, water penetration resistance testing using a cyclic static pressure differential (Procedure B).

1.4 Where the project specifications or the specifier/client have no stipulation as to whether Procedure A or Procedure B (or both) are to be used, the test operator shall carry out water penetration resistance testing under a uniform static pressure differential only in accordance with Procedure A below.

1.5 If the test specimen incorporates operable doors or windows these should be checked for proper installation by opening, closing, and locking the unit 5 times prior to sealing off the face of the internal pressure chamber.

2.0 Equipment *(refer also WGANZ Field Testing Procedures Clause 5.3)*

a) Water spray rack fitted with a calibrated water pressure gauge,

> *NOTE: Where a calibrated water flow meter is used the calibrated water pressure gauge may be omitted.*

b) Calibrated water flow meter,

c) Water reservoir and booster pump,

d) Variable speed fan,

e) Calibrated differential pressure manometer,

f) 19mm hose,

g) Stopwatch or timer.

3.0 Installation

3.1 Where the test area incorporates the window/cladding interface and the interior plasterboard linings and timber trim have been installed, remove the timber trim and cut back the plasterboard linings to expose the air space and/or installed air-seal between the window or window revel and adjacent framing to the window opening.

3.2 Construct a temporary timber framed enclosure on the internal face of the window or door under test, with the perimeter framing having a sealed joint onto the perimeter support framing of the installation under test. The temporary framing must be supported only from the outer edges of the window frame or perimeter and must be sufficiently rigid to prevent any contact with the door or window under test when the negative pressure (suction) is applied to the internally positioned enclosure.

3.3 Seal all joints between the timber framing and the perimeter of the window with duct tape, flexible flashing tape or removable foam tape seal. Where internal finishes have been completed care must be exercised to use only sealing methods that can be subsequently removed without damage to internal linings and paintwork. It should be noted that as the internal enclosure will be under negative pressure, the resulting suction will draw the temporary enclosure onto the existing window perimeter without the need for substantial structural attachment.

3.4 Fasten 6gauge transparent vinyl or transparent acrylic sheeting onto the internal face of the enclosure framing using 3M flashing tape, foam sealant tape other suitable tape applied to the perimeter edges of the enclosure to minimise air leakage.

NOTE: Spacing of intermediate framing members must be sufficient to prevent contact between transparent vinyl or acrylic sheeting and window/door unit when under test at the specified test pressure(s).

3.5 Create an opening through the transparent vinyl or acrylic sheeting to provide connection of the flexible hose from the fan providing the negative pressure (suction).

3.6 Insert a hose tail through the vinyl or acrylic sheet and connect to the positive signal side of the calibrated differential pressure manometer with appropriately sized flexible tubing.

3.7 Open any adjacent windows or doors to allow pressure equalization between the building interior and exterior.

NOTE: Where pressure equalisation cannot be achieved between the building interior and exterior, a second length of flexible tubing must be run from the building exterior and connected to the negative or reference side of the calibrated differential pressure manometer to ensure the specified pressure differential is achieved.

3.8 Position the external water spray rack at the distance calculated for the selected water spray nozzle pattern.

3.9 Connect the inlet side of the calibrated water flow meter to the outlet side of the booster pump and then connect the water spray rack to the outlet side of the water flow meter and the water reservoir to the inlet side of the booster pump with 19mm hoses.

3.10 If the area to be tested exceeds the coverage area of the spray rack, mask off the additional area to prevent unintentional wetting.

4.0 Procedure A

4.1 Turn on the water supply valve (and booster pump if required) and adjust water flow until the water pressure gauge shows the same water pressure at which the spray rack was calibrated or adjust the water flow rate with the water flow meter adjusting valve to the required water flow volume for the coverage area of the spray rack grid, to achieve a minimum water application rate of 3.0l/m^2/min.

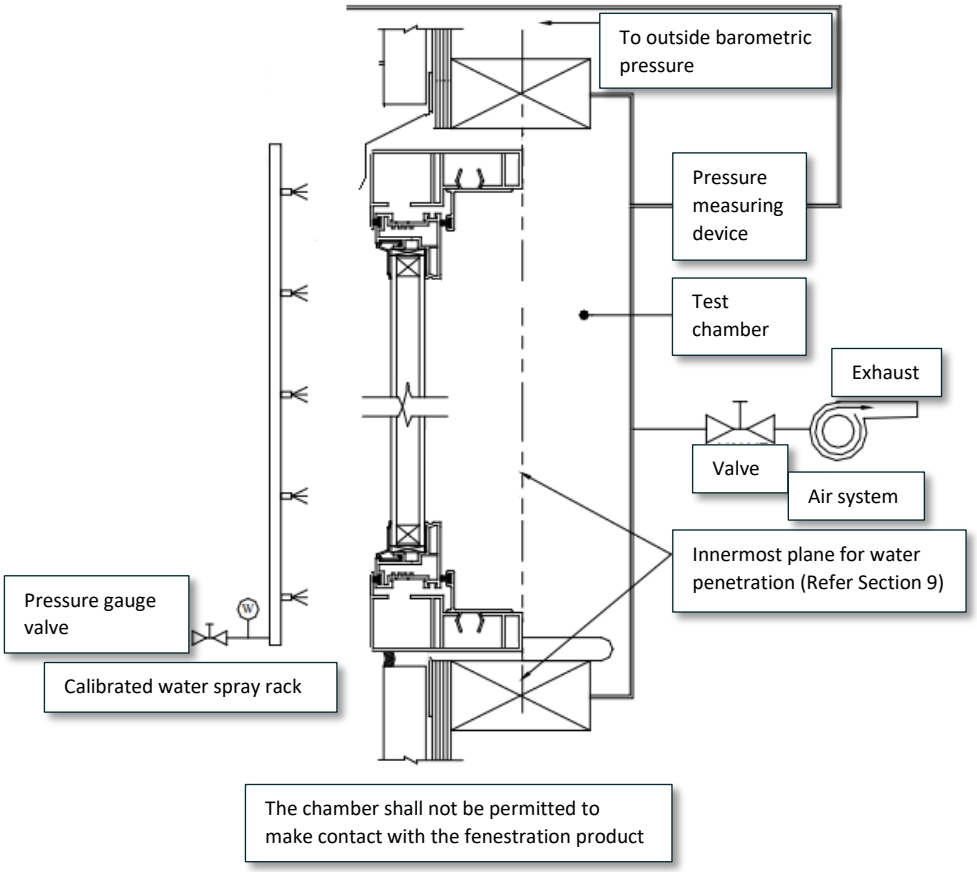

Figure 6: Typical Vacuum Chamber and Spray Rack Arrangement

4.2 Continue the application of water onto the exterior surface of the window or door under test for a period of 5 minutes at 0.0Pa air pressure differential.

4.3 After the 5 minute pre-wetting phase at 0.0Pa, apply the specified or calculated negative differential air pressure for a period of 15 minutes.

NOTE: Weather conditions can affect the static air pressure difference measurements. If wind gusting causes pressure fluctuation to exceed ±10 % from the specified test pressure, the test should not be conducted.

4.4 Reduce the applied differential air pressure to 0.0Pa and turn off the water sprays.

4.5 Record any water appearing on the internal face of the test specimen, stating the source and extent of the penetration observed during the period under pressure and for the following 5 minutes.

> *NOTE: Water penetration attributable to the surrounding condition shall be defined as the presence of uncontrolled water that did not originate from the fenestration product or the joint between the fenestration product specimen and the wall/roof. Water penetration attributable to the fenestration product specimen shall be defined as the penetration of uncontrolled water beyond a plane parallel to the innermost edges of the product and that indisputably originates from the fenestration product. Water penetration attributable to the perimeter joint shall be defined as uncontrolled water that indisputably originates at the joint.*

4.6 If the area to be tested is greater than the coverage area of the water spray rack, remove and area of the masked off section equivalent to the coverage area of the water spray rack and reposition the water spray rack. Repeat D4.1 – D4.5 above.

4.7 Measure and record the barometric pressure and temperature of the air near the exposed surface of the test specimen, and of the air near the air intake or exhaust of the air system. Measure and record the speed and direction of the air movement (wind) at or near the exposed surface of the test specimen. These measurements must be taken immediately prior to or during the test.

5.0 Procedure B

5.1 Turn on the water supply valve (and booster pump if required) and adjust water flow until the water pressure gauge shows the same water pressure at which the spray rack was calibrated or adjust the water flow rate with the water flow meter adjusting valve to the required water flow volume for the coverage area of the spray rack grid, to achieve a minimum water application rate of 3.0l/m^2/min.

5.2 Continue the application of water onto the exterior surface of the window or door under test for a period of 5 minutes at 0.0Pa pressure differential.

5.3 After the 5 minute pre-wetting phase at 0.0Pa, apply the specified static air pressure difference across the test specimen promptly and maintain this pressure, along with the specified rate of water spray, for the period of time stipulated by the specification or the specifier. Unless otherwise specified, the duration of the pressure cycle shall be 5 minutes.

5.4 While maintaining the water spray, reduce the air pressure difference to 0.0Pa for a period of not less than 1 minute.

5.5 Repeat the preceding two steps for the specified number of cycles. In no case, however, shall the total time of pressure application be less than 15 minutes.

NOTE: Weather conditions can affect the static air pressure difference measurements. If wind gusting causes pressure fluctuation to exceed ±10 % from the specified test pressure, the test should not be conducted.

5.6 Reduce the applied differential air pressure to zero and turn off the water sprays.

5.7 Observe and record any water appearing on the internal face of the test specimen, stating the source and extent of the penetration, during the time at pressure and for the following 5 minutes.

NOTE: Water penetration attributable to the surrounding condition shall be defined as the presence of uncontrolled water that did not originate from the fenestration product or the joint between the fenestration product specimen and the wall/roof. Water penetration attributable to the fenestration product specimen shall be defined as the penetration of uncontrolled water beyond a plane parallel to the innermost edges of the product and that indisputably originates from the fenestration product. Water penetration attributable to the perimeter joint shall be defined as uncontrolled water that indisputably originates at the joint.

5.8 If the area to be tested is greater than the coverage area of the water spray rack, remove and area of the masked off section equivalent to the coverage area of the water spray rack and reposition the water spray rack. Repeat 5.1 – 5.6 above.

5.9 Measure and record the barometric pressure and temperature of the air near the exposed surface of the test specimen, and of the air near the air intake or exhaust of the air system. Measure and record the speed and direction of the air movement (wind) at or near the exposed surface of the test specimen. These measurements must be taken immediately prior to or during the test.

6.0 Forensic Evaluation

6.1 Where water ingress is observed and the source of the water ingress cannot be determined, commence a forensic evaluation using the procedures outlined in Section 10 of the Window & Glass Association Filed Testing Procedures while maintaining the test pressures and methods described in the WGANZ 1105 test procedure.

7.0 Reporting

7.1 Report all test results and observations in accordance with Section 11 of the Window & Glass Association Field Testing Procedures.