

CWCT test standards are primarily intended for the testing of Building Envelopes in the United Kingdom whilst ASTM and AAMA Standards are produced for use in the USA and are also used in many other countries worldwide.

CWCT Standard for Systemised Building Envelopes – Dec 2005 were updated to include the requirements of European EN Curtain Walling Standards and now all test requirements are at least equal to the European Standards and several surpass those requirements. For example, for water penetration tests, EN Standards require that water is sprayed at a flow rate of 2ltrs/m²/hr, whilst the CWCT Standards mirror the higher rate of 3.4ltrs/m²/hr of the ASTM, AAMA standards

CWCT tests are generally more onerous, although the American Standards include requirements for Seismic tests which are not required in the UK

CWCT	ASTM - AAMA
Air Permeability	
<p>Test pressure requirements are based on Design Wind loads with a minimum requirement of 300 Pa and testing is conducted in stages up to the peak test pressure – 50 Pa and then 50 Pa stages up to 300 Pa, followed by 150 Pa steps up to peak test pressure – it states that 300 Pa is the minimum test pressure and that a higher test pressure may be specified when a more airtight building is required.</p> <p>The maximum allowable air leakage rate is 1.5 m³/hr/m² at peak test pressure and there are also requirements for intermediate pressures using a formula in the standard. At the lowest maximum test pressure of 300 Pa, using the formula there is a maximum allowable leakage rate of 0.45 m³/hr/m² at 50 Pa which is well below the allowable rate of ASTM/AAMA testing</p> <p>CWCT uses classifications as per EN standards, however it does not feel that the lower classifications are suitable for use in the UK and in the case of Air Permeability testing, the lowest specified classification is A3 at 300 Pa with A4 – 450 Pa and A5 – 600 Pa being the higher classes</p> <p>There is no requirement for test results to be adjusted to standard conditions in either CWCT end EN Standards</p> <p>There is a mandatory requirement for Exfiltration testing which should be conducted at 50 Pa and 100 Pa – however there is no performance requirements but the standard makes reference to the current Building Regulations requirement of 10 m³/hr/m² at 50 Pa and states that the specifier may wish to require lower leakage rates for the main building elements in order to allow for greater leakage in other parts of the envelope</p> <p>There is also a requirement that Air leakage should not increase during the repeat test, which follows Wind Resistance testing, by more than 0.3 m³/hr/m² at the peak test pressure</p>	<p>Test pressure requirements are left for the Architect – Project Consultant to determine and the test is only conducted at that pressure – ASTM states that the minimum test pressure should be 75 Pa – AAMA recommends a minimum air pressure difference for walls should be 75 Pa and a maximum allowable rate of air leakage of 1.08 m³/hr/m² at that pressure. It then goes on to say that a maximum pressure difference of 300 Pa and a maximum allowable rate of air leakage of 1.08 m³/hr/m² at that pressure is recommended for buildings in which greater control of air quality and/or humidity is required. In all cases, the pressure is only held until it stabilises and then the airflow reading is recorded</p> <p>ASTM test methods also require that test results have to be adjusted to Standard Conditions, that is Pressure – 101.3 kPa, Temperature – 20.8°C and Air Density – 1.202 kg/m³. This ensures that whatever the conditions during testing, all test sample results are based on a single set of ‘Standard conditions’, and are therefore comparable.</p> <p>There are no mandatory requirement for Exfiltration testing – Leakage from inside to the outside of the building envelope</p> <p>There is no mandatory requirement for a repeat air leakage test following Wind Resistance testing</p>
Static Water Penetration	
<p>Test pressure requirements are based on Design Wind loads with a minimum requirement of 300 Pa Testing begins at 0 Pa for 15 minutes and then in stages of 50 Pa up to 200 Pa, then 300 Pa, followed by 150 Pa steps up to peak test pressure – each pressure stage being held for 5 minutes, therefore a test to 600 Pa would continue for a total of 50 minutes</p> <p>CWCT uses classifications as per EN standards, however it does not feel that the lower classifications are suitable for use in the UK and in the case of Air Permeability testing, the lowest specified classification is R5 at 300 Pa with R6 – 450 Pa and R7 – 600 Pa being the higher classes</p>	<p>Test pressure requirements are left for the Architect – Project Consultant to determine and testing is only conducted at that pressure</p> <p>The ASTM standard states that a default pressure of 137 Pa should be used, however AAMA 501-05 recommends an air pressure difference equal to 20% of the positive design wind pressure with a minimum of 300 Pa, and a maximum of 720 Pa – whichever pressure is used, the test continues for 15 minutes at that pressure</p> <p>Water flow rate is 3.4ltrs/m²/hr</p>

<p>A water flow rate of 3.4ltrs/m²/hr is required, although the lower rate of 2ltrs/m²/hr as per EN standards can be used but the spray frame must be set up as to spray above the top of the test specimen, instead of level with the top – this ensures a greater flow of water across the sample as CWCT feel that the lower flow rate of EN standards in their unmodified method are not sufficient for UK conditions</p> <p>CWCT performance requirements state that ‘There shall be no leakage onto the internal face of the building envelope system at any time during the test – At the completion of the test there shall be no standing water in locations intended to remain dry</p> <p>It also advises that: - To avoid difficulty in interpreting the results it is good practice to agree which materials and zones within the building envelope may be allowed to get wet</p>	<p>The ASTM standard defines Water penetration as: <i>Penetration of water 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. For products with non-planer glazing surfaces (domes, vaults, pyramids etc.) the plane defining water penetration is the plane defined by the innermost edges of the unit frame</i></p> <p>AAMA 501-05 states that there shall be no water leakage, as defined in AAMA 501.1 paragraph 5.5 which states: <i>Any water leakage occurring during the period of testing shall be noted and reported, stating both the location and the quantity of leakage. 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 15 ml (1/2 oz) of water in a 15-minute test period on top of an interior stop or stool integral with the system shall not be considered water leakage.</i></p> <p>The definition of interior stop or stool is as follows:</p> <p>Stop - A moulding used to hold, position or separate window parts.</p> <p>Stool - An interior trim piece on a window which extends the sill and acts as a narrow shelf.</p>
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Wind Resistance	
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<p>For Serviceability testing, CWCT test methods are the same as EN Standards – testing is required at both Positive and Negative pressures - Preparation pulses are 50% of design wind load or 500 Pa whichever is greater, and these pulses should be held for at least 3 secs.</p> <p>After the preparation pulse has been conducted, all deflection sensors are zeroed – Measurements are required to be recorded for the deflection of Framing members, transoms, mullions etc – there is also a requirement for measuring the displacement of framing members at their point of support to the building structure</p> <p>Positive test pressure pulses are applied in 4 stages, for a minimum period of 15 secs +/- 5 secs at each stage and the pressure stages are at 25%, 50%, 75% and 100% of design wind load – deflection measurements are recorded at each pressure stage.</p> <p>Upon returning to 0 Pa deflection measurements are recorded again as there are requirements for the system to return within defined limits.</p> <p>The test is then repeated at negative pressure – preparation pulses are applied after which, sensors are zeroed, however any sensors used to measure the displacement of framing members at their point of support to the building structure should not be zeroed as there is a requirement for the total movement which occurs between the peak positive and negative pressures</p> <p>Allowable CWCT deflection details are as follows</p>	<p>ASTM E 330-02 specifies 2 types of test, Procedure A and Procedure B and either can be used, but the choice will be left with the specifier and will be decided well before any testing takes place</p> <p>Procedure A is used when there is no load-deflection curve required and after opening and closing 5 times etc a pre-load of 50% of the Positive Test Load is applied and held for 10 seconds. The pressure is then released and after a period of not less than 1 minute or greater than 5 minutes the deflection sensors are zeroed. The Positive Test Load is then applied and sustained for not less than 10 seconds and the deflections are then recorded. The test pressure is then reduced to zero and after a period of not less than 1 minute or greater than 5 minutes, any permanent deformation shall be recorded. This procedure shall then be fully repeated at Negative pressure</p> <p>The test will then be repeated exactly as described above but at a Proof Load, this is the test load multiplied by a factor of safety, for example x 1.5, however the actual factor is not quoted in the standard but it would be provided by the specifier well in advance of any testing</p> <p>If glass breakage occurs at any test load, carefully examine the test specimen to determine the cause of the breakage. If the breakage was caused by the deformation or failure of the supporting frame of the glass, by loosening or failure of any fasteners, or by damage to the glass caused by interaction between the glass and its supporting elements, record the findings and discontinue the test. If the breakage was not caused by the above named structural problems, replace the glass using the original fasteners and continue the test at the load where glass breakage occurred. If new structural elements or fasteners are used instead of the original ones,</p>
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FRAMING MEMBERS GENERALLY	
LENGTH	ALLOWABLE DEFLECTION
Less than or equal to 3000 mm	Equal to or less than H/200
Greater than 3000 or less than 7500 mm	Equal to or less than H/300 + 5mm
Equal to or greater than 7500 mm	Equal to or less than H/250
DESCRIPTION	ALLOWABLE DEFLECTION
FRAMING MEMBERS WITH SINGLE GLAZING	L/125 of their length measured along pane edge
FRAMING MEMBERS WITH DOUBLE GLAZING	L/175 of their length measured along pane edge, or 15 mm, whichever the lesser
RAINSCREEN PANELS	Aluminium, Glass or Steel = L/90 measured between points of attachment
	Stone or similar brittle matl. = L/360 or 3mm whichever the lesser, measured between points of attachment

Residual deformation of Framing Members

After loading to the peak test pressure and unloading, residual deformation to framing members shall nowhere be more than 5% of the maximum measured deformation or 1 mm, whichever the greater, with 1 hour being allowed for recovery – this applies to both positive and negative tests

Displacement of Supports

The displacement of framing members at their point of support shall be less than 2mm taken as the difference between the positions under peak positive and negative loads

The air infiltration of the sample shall not exceed that measured before the application of the design wind load by more than 0.3 m³/hr/m² at the peak test pressure

For Wind Resistance – Safety testing – this is a mandatory test in the CWCT standard although an optional test in EN Standards

The sample is subject to one pulse of 150% of the design wind load, having first being subject to Preparation pulse - 50% of design wind load or 500 Pa whichever is greater, and these pulses should be held for at least 3 secs and the sensors are then zeroed exactly as per the serviceability test – the test pressure is held for a minimum period of 15 secs +/- 5 secs

When the pressure is removed the whole sequence is the repeated at Negative pressure

PERFORMANCE REQUIREMENTS - AT 1.5 X DESIGN WIND LOAD (SAFETY)

Integrity of building envelope system

At both positive and negative applications of the peak test pressure, there shall be no permanent damage to framing members, panels or anchors. Framing members shall not be buckled. Panels, glazing beads and decorative capping pieces shall remain securely held and gaskets shall not be displaced.

repeat the entire test. There is a note in the standard which should be remembered to the effect that 'The probability of glass breakage is directly related to the duration of the load on the glass' so any overloading or over timing of the test loads must be avoided

Procedure B is used when there is a load-deflection curve required and after opening and closing 5 times etc a pre-load of 50% of the Positive **Test Load** is applied and held for 10 seconds, unless otherwise specified. The pressure is then released and after a period of not less than 1 minute or greater than 5 minutes the deflection sensors are zeroed. The Positive **Test Load** is then applied in the number of increments specified up to the specified maximum test load. The specifier shall determine the number of increments to be used in the test, not to be less than 4 approximately equal increments, (25%, 50%, 75% and 100%), to the maximum test load. At each increment, unless otherwise specified, apply and maintain the full test load for 10 seconds, unless otherwise specified and record pertinent deflection readings. The test pressure is then reduced to zero and after a period of not less than 1 minute or greater than 5 minutes, any permanent deformation shall be recorded. There is no requirement for this procedure to be repeated at Negative pressure

ASTM E 330-02 does not specify any allowable deflections, but **AAMA 510-05** states the Deflection shall not exceed L/175 of the clear span at a uniform load equal to the specified design wind pressure – it also recommends that maximum deflections normal to the plane of the wall shall be limited to L/175 for spans up to 4115 mm. For spans greater than 4115 mm but less than 12.2m, deflections at design loads shall be limited to L/240 +1/4", (6.4mm)

AAMA also requires that a Safety test is conducted following the repeat water tightness test and shall be at 150% of Positive and Negative design pressures. It requires that at that load, no glass breakage or permanent damage to panels, fasteners or anchors shall occur and permanent deformation to wall framing members shall not exceed 0.2% of their clear spans

Residual deformation

After loading to the positive and negative peak test pressure, residual deformation of framing members shall not exceed $L/500$ of the span, measured between points of attachment, 1 hour after the loading has been removed

Displacement of Supports

Displacement of framing members at their point of support which shall be less than 3mm taken as the difference between the positions under peak positive and negative loads

Opening Lights

Opening lights shall remain closed