Technical Note No. 10
SITE TESTING FOR WATERTIGHTNESS

Site testing is frequently used to test the watertightness of windows and cladding as installed, and is specified in Test Methods for Curtain Walling (CWCT, 1996). This technical note adds further clarification on site testing procedures and equipment and the selection of test method. It should be read in conjunction with Test Methods for Curtain Walling.

Introduction

Although many cladding components and systems can be tested for watertightness in the laboratory or on a large-scale mock-up, these tests neglect a critical issue with watertightness - the impact of site workmanship.

The fabricator and installer of a cladding system are relied upon to ensure that the joined surfaces of components are cut straight, gaskets properly fitted, and sealants properly installed. However, the installer is often left to resolve intersections between joints, overcome inaccuracies in the as-built structure and ensure proper sealing to adjacent cladding systems.

For this reason it is often appropriate to test a small part of the installed cladding system, to ensure that fabrication and installation have not in any way reduced the performance of the system, and to check the performance of interfaces with adjacent systems that did not form part of the laboratory test. However, site testing itself can also be poorly applied, and this technical note aims to identify some of the key issues of which the site test specialist and specifier should be aware.

The frame of reference

An important requirement before carrying out site testing is to have a frame of reference - the assessor must know whether certain parts of a component or system are capable of passing the specified test when properly fabricated and installed. This is simple to define when a component or large-scale specimen has been successfully tested in the laboratory. The site testing procedure can then be applied at the laboratory to determine if the test is suitable.

This approach will also generate a second piece of important information - which components or parts of the system will not pass the test. It is known, for example, that the hose test generates a strong jet of water with a penetrating power far in excess of normal driven rain; this test will usually fail joints which are intended to be opened (for example around doors and opening lights of windows), unless a modification to the test procedure is made. It is often possible, on a test mock-up, to modify the parameters for a site hose test to determine the condition under which an opening joint will pass the test with the agreement of all parties.

Specifying and witnessing site tests

Non-specialist specifiers should seek advice from a UKAS accredited test laboratory or cladding consultant on how to specify and witness site tests.

Site tests

Watertightness can be assessed on site using three distinct approaches - the hose, the spray bar and the cabinet.

Hose testing

This test is defined in Test Methods for Curtain Walling (CWCT, 1996) and the AAMA standard 501-94. The CWCT hose test varies from the AAMA test only in that joints within 120mm of each other can be tested in one pass, providing there are no projections/obstructions that shield the joint.

Hose testing uses a compressor to drive a flow
of water through a nozzle, forming a strong jet of water droplets. The nozzle is defined, as is the pressure of water entering the nozzle and the flow rate of water through the nozzle. The water jet is always aimed perpendicular to the plane of the cladding system, and at a fixed distance from it.

Hose testing is primarily intended for the testing of permanently sealed joints. The high pressure water spray should not dislodge gaskets or wet-applied sealants unless they have been poorly installed or not been allowed to cure. Water will be forced through small gaps in these types of seal, and will find its way through unsealed joints between framing components.

Hose testing may not be not suitable, in its unmodified form, for use on open joints (even if baffled, the flow of water from the nozzle may overwhelm many open joints) or joints which are intended to open. Weatherseals around doors and opening lights of windows are made of softer rubber compounds, in part, to ensure that the door or window can be operated comfortably - these softer seals are intended to prevent penetration of run-off water but are easily pushed aside by the jet from a hose.

If the hose test is used on open or opening joints the normal procedure is to reduce the pressure of water entering the nozzle appropriate for the joint under test, and to maintain the distance from the nozzle to the joint. This will ensure a meaningful test and is preferable to holding the nozzle further away from the joint as it does not require any change of action on the part of the operator. However, the spray bar test is usually more applicable to this type of joint.

Where it is not possible to obtain this frame of reference at the time of laboratory testing, the following procedure can be followed.

All parties should agree on a good quality window in terms of both fabrication and installation, and this is used to determine the frame of reference.

Where this benchmarking process results in a very low nozzle pressure, say below 150kPa, or one party considers the results to be questionable, or the component selected for benchmarking to be unacceptable, it is recommended that a cabinet test be carried out to determine if the selected component/area can achieve the specified performance. If the results are successful, the hose test can be carried out on that area to determine the frame of reference for further testing.

When testing joints at an internal corner the hose should be positioned 0.3m from both walls (rather than 0.3m from the joint) to take account of the water re-directed off the walls and towards the joint.

The hose test is also suitable for use on sloped claddings, providing the jet is aimed perpendicular to the joint. If a volume flow of water is required simply to observe its flow and drainage from the cladding/roofing the spray bar test is more suitable.

**Apparatus for hose testing and method of test**

A typical set of apparatus for hose testing is shown in Figure 1. Note that no connections (e.g. quick-clip connections) should be placed between the pressure gauge and the nozzle as these can dramatically reduce the water pressure. The recommended nozzle is the Monarch Type B-25, #6.030 nozzle.

![Figure 1](image)

**Figure 1** Typical apparatus for hose testing

Note that the nominal water pressure is 220±20kPa, which gives a water flow of 22±2 litres/minute through the standard nozzle, with a cone angle of 30°. The standard distance from
nozzle to joint is 0.3m, and the joint is tested in 1.5m steps.

Wetting of the test area begins at the lowest horizontal joint, rising progressively upwards via the intersecting vertical joints to the next horizontal joint. If water leakage occurs but is not easily located, an additional procedure is recommended: all joints to be tested are sealed with masking tape and progressively exposed and tested by working the hose back and forth across the stretch of joint for a period of five minutes. Once the source(s) of leakage have been found and rectified the area is re-tested.

One parameter which is not defined in the test procedure is the rate at which the hose should be played along the joint - a 30 second period for the specified 1.5 metre test length is comfortably achieved, such that there are ten passes during the five minute test.

A specimen that has been successfully tested in the laboratory can be used to calibrate the site hose test: a window of acceptable workmanship is tested with the hosepipe and the flowrate is gradually increased until water leakage occurs. A slightly reduced flowrate is then used on site to distinguish between windows of acceptable workmanship and those of unacceptable workmanship. However, the results are only comparative and do not absolutely guarantee weathertightness.

Spray bar testing

Spray bar testing is not yet standardised, although a draft European standard is in preparation. A spray bar is a long pipe fitted with holes or nozzles at regular intervals, to provide a spray of water over the face of a cladding system. A single line of nozzles should be used, and water allowed to run down the face of the cladding system.

This test is suitable for open-jointed systems (e.g. rainscreen cladding and unsealed patent glazing) and opening joints, as water is not forced into the joint. Moreover, the test is useful for assessing water flow around penetrations through systems - a penetration may redirect the run-off flow onto a joint, or perhaps onto a drainage opening.

Apparatus for spray bar testing

The basic apparatus for spray bar testing is shown in Figure 2. From the draft European standard prEN 13051, the nozzles should each give a water flow of 2 litres/minute with a 3 bar water pressure per nozzle, and have a spray angle of 120°. The nozzles are spaced 400mm apart and mounted 250mm from the face of the cladding system.

![Figure 2 Apparatus for spray bar testing](image)

The area of cladding to be tested should be agreed. Essentially the spray bar test is a test for runoff. Therefore, the position of the grid of spray bar nozzles in relation to open and protected joints (e.g. under projections) should be properly considered. The nozzles can be directed at a joint, but it is preferable that they are directed at a point above the joint, so that the run-off flow runs down over the joint or area under test.

It should not be necessary to alter the water pressure or flow rate for the spray bar (5 litres/minute/metre length of spray bar), although the position of the spray bar on the cladding system is open to some adjustment. As stated above, the spray bar should generally be located above the area of cladding to be tested, and at the ridge, with water running down one slope, when testing roofs.
Cabinet testing

Cabinet testing is based on the procedure outlined in standards such as BS 5368: Part 2. The basic apparatus comprises a cabinet which can be sealed to the cladding system, a means for pressurising or de-pressurising the cabinet and a spray system (usually a spray bar or grid of nozzles).

The basis of cabinet testing is to create a positive pressure difference on the cladding system, whilst spraying water onto the external face. This technique is suited to the testing of doors or windows after installation. However, there are several problems associated with this test:

- The first problem is where to fit the cabinet. If the cabinet is mounted on the external face it is necessary to pressurise the cabinet, which will tend to push the cabinet off the cladding system. External fitting is also costly when many storeys above ground level because of the reliance on access equipment. If mounted on the internal face the cabinet must be de-pressurised, which will help to hold it in place, but this will limit access to the surface of the cladding system to look for signs of leakage.

- The next problem is how to prevent lateral air movement through the wall - pressurising or de-pressurising a section of wall may draw air in from the sides, rather than directly through the part of the wall under investigation.

- Finally, the finished surface of a wall may not permit easy attachment or sealing of the test cabinet - many cabinets are built in-situ and are specific to one part of the cladding system.

These limitations make cabinet testing costly, and it may be easier to remove a window or door for testing in a conventional test rig. The interface between a window and a wall is more suited to hose or spray bar testing.

Apparatus for cabinet testing

The operation of the cabinet is generally based on a Standard such as BS 5368: Part 2, which defines parameters such as water flow rate and nozzle position and spacing.

A cabinet may be constructed of plywood inside or outside of the wall as for a laboratory test.

A simplified method of cabinet testing is to seal the test area internally with polythene and to de-pressurise the enclosure with an industrial vacuum cleaner, measured with a gauge.

If this simplified method is used the polythene sheet must not come into contact with any of the sample area on the inside of the wall to ensure that air is drawn through the joints. However, the results are not comparable with the cabinet test unless the full net pressure across the wall is developed and the true deflections of the wall or component occur.

Figure 3  Simplified test cabinet

Whilst cabinet tests are perceived to require rigid test cabinets similar to those used in laboratories it is possible to construct a cabinet from polythene sheet and a frame of scaffold tubes or similar. If this approach is used the frame should be braced against the building structure and transmit no loads to the wall which
Site testing for watertightness

should carry only the pressure difference generated by the cabinet.

General issues for site watertightness testing

The following are general issues which apply to all of the methods described above:

Surface cleaning

Before testing, the test area should always be washed with a mild detergent and rinsed with clean water. This prevents dirt from being forced into the system and clogging normal drainage paths, and the detergent also helps to break surface tension (water can otherwise be prevented from entering a small opening by surface tension effects).

Internal finishes

Site testing should always be carried out before internal finishes are applied - internal finishes prevent observation of the internal surface of the cladding, and would have to be removed anyway if remedial work is necessary.

Test location

It is very easy with hose and spray bar testing for the observer on the inside of the building to be looking at a section of cladding remote from that where the hose or spray bar is actually applied. Good co-ordination is required, and radio communication between assessor and observer is essential.

Summary of site testing procedure

The following steps are required if the site test is to provide genuine results:

- Determine which site testing techniques are to be used and, if they allow fine tuning, what form/modification to the standard sequence is to be used;
- ‘Site’ test a laboratory mock-up of the sample which has already passed all other specified tests;
- Armed with a knowledge of the expected site performance of the component or system agree which parts of the installed system are to be tested;
- Agree a suitable procedure for remedial action should problems be found;
- Consider how water runoff will be managed to prevent flooding or damage to elements not designed to be wetted;
- Proceed with site testing.

Summary of tests suitable for various components/systems

- Permanent (fixed) joints - hose test, spray bar test, cabinet test
- Opening joints - spray bar test, cabinet test
- Open joints - spray bar test, cabinet test

References

AAMA Standard 501-94 Methods of test for exterior walls, Architectural Aluminium Manufacturers Association, USA.

BS 5368 Methods of testing windows, Part 2, 1980, Watertightness test under static pressure, British Standards Institution.

CWCT, 1996, Test methods for curtain walling, Centre for Window and Cladding Technology, University of Bath.

PrEN 13051 Curtain walling - Watertightness - Field test Without Air Pressure Using A Water Spray Bar, European Committee for Standardisation.

Note

A video demonstrating laboratory and site hosepipe testing is available from CWCT.

© CWCT 2000

CWCT
The Studio, Entry Hill, Bath, BA2 5LY

T: +44 (0) 1225 330945
cwct@cwct.co.uk www.cwct.co.uk