Windows with Enhanced Resistance to Intrusion

CENTRE FOR
WINDOW AND
CLADDING
TECHNOLOGY

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The Centre for Window & Cladding Technology is an industry sponsored research and education organisation based at the University of Bath. It provides training and education for those involved in the design, fabrication and installation of cladding, curtain walling and windows. The Centre undertakes research funded by industry and by Government and gives technical advice to its members. Membership of the Centre is open to all who have an interest in the building envelope.

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FOREWORD

The document is written in two parts. The first three sections comprise a standard for the performance and testing of glazing frames. The clauses of the standard are mandatory and they define categories of resistance to intrusion. The remaining five sections are a guide to good practice. The clauses are recommendations for design, glazing, selection, fabrication and installation. An appendix details a method of testing that may be applied to simple domestic windows of typical dimensions and construction.

The tests presented in the standard are intended to load windows in ways representative of the more common forms of manual attack. As such they allow reproducible and repeatable tests as a means of comparing the resistance of windows to intrusion.

The forces applied during the tests are based on measured forces that may be exerted by various tools. The maximum forces measured have been scaled to allow for the difficulty of levering flexible resilient materials. Manipulation and glass removal is based on the three minute period that a burglar might devote to attacking a window. Manual tests of shorter duration than two minutes have been found to be not reproducible with different testers.

The degree of force used and the length of time that an attack is sustained on a window are highly variable. The tests described in this standard do not aim to replicate the most determined attempts of intruders. The levels of attack considered are those appropriate to attempted entry by an opportunistic intruder. Compliance with this standard does not ensure any absolute standard of security.

The performance set by this standard is similar to the lowest class recognised by CEN for security windows. Higher levels of security performance may be assessed by the CEN standards. However such levels of performance are not usually appropriate to windows in residential buildings.

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1 INTRODUCTION

1.1 Scope

This Standard describes how windows and window systems shall be assessed for their ability to prevent unauthorised entry to buildings by opportunistic intruders.

1.2 Methods of entry

Common methods of entry to buildings through windows include:

1 Unrestricted entry through an open window.

2 Manipulation techniques using hand pressure and smaller tools.

3 Removal of glazing.

4 Levering using screwdrivers, nailbars and garden and other implements to disengage locking mechanisms, bolts or hinges.

5 Glass breakage.

Methods of entry not considered include:

a Drilling to gain access to a locking mechanism.

b Sawing to sever fixings.

c Use of flame to destroy or cut through part of an assembly.

These methods of entry are time consuming and are not common practice by intruders.

d This Standard does not consider the performance of windows subjected to vehicle impacts, 'ram raiding'.

1.3 Exclusions

This Standard does not apply to:

1 Entrance doors.

2 Patio doors.

3 French windows.

4 Windows forming part of a large glazing screen, curtain walling or conservatory.

5 Windows containing infill panels other than glazing materials.

6 Retro fitting of improved hardware to existing frames.

7 Windows installed in higher risk buildings.

Parts of this Standard may apply but the following further aspects must be considered:

a For doors and French windows larger forces may be relevant. Lock performance must also be considered.

b For windows not installed in rigid surrounds greater flexibility of the frame may lead to a reduction in performance.

c Infill panels other than glazing materials may be subject to greater forces and higher impact loads than can be applied to glass.

Higher risk buildings include:

a Those with valuable contents where heavier tools may be used or an attack may be more sustained.

b Isolated properties and unoccupied properties where an attack may be more sustained.

For higher risk buildings the methods of test given in CEN documents ENV 33.036 - 9 may be more relevant.

1.4 Performance

1.4.1 General

This standard sets performance criteria for the intrusion resistance of windows. A method of testing frames and hardware is given and a single category of performance is defined. The testing of glass performance is not addressed in the standard.

No methods of test for glass are widely recognised other than tests for anti-bandit glass. Anti-bandit performance is above and beyond the scope of this standard.

Guidance on the assessment of glass performance is given in Section 5 as part of the guide to good practice.

1.4.2 Applied forces

The forces applied during the test are:

Principal force	3000N
Secondary force	1000N

These forces correspond to manual attack with screwdrivers, nail bars and other large tools. They are based on measured forces applied by various tools.

3000N is the force used in the lowest category within CEN.

The principal force is the force acting directly to open the window and acts in the direction of opening. The secondary force is the other component of force arising from the levering action of a tool.

1.5 Testing

1.5.1 General

It is fundamental to this Standard that the performance of frame, glazing details and hardware are considered as a whole. A window shall be tested as a complete system.

1.5.2 Criteria for further assessment

1.5.2.1 Any change to the frame profile, internal reinforcement or packing of the glass will necessitate the retesting of the window.

Performance of the window is dependent on the torsional and flexural stiffness of the frame. This can only be assessed by testing.

1.5.2.2 Any change to the locking mechanisms, handles, keeps, striker plates or associated fasteners, (other than cosmetic changes to handles), will necessitate the re-testing of the window.

Performance of locking mechanisms is highly dependent on the torsional and flexural stiffness of the frame and on the method of attachment. Locking mechanisms cannot be tested separately from frames.

1.5.2.3 Any change to the hinges or associated fasteners will necessitate the re-testing of the window.

Performance of hinges is highly dependent on the torsional and flexural stiffness of the frame and on the method of attachment. Hinges and fasteners cannot be tested separately from frames.

1.5.2.4 Substitution of any of the following components will necessitate a further assessment of the window:

1 Glazing beads.

2 Glazing clips.

3 Security glazing tapes.

Changes to the method of securing the glazing will change the performance of the window. This will necessitate further manipulation tests and glass removal tests. A test authority may decide that further loading tests are not required.

1.6 Validity of test results for different window configurations

1.6.1 Changes to the dimension of the window will not necessitate further testing provided that:

a The number and disposition of locking points remains the same.

b The distance between locking points is not increased.

c The overall dimensions of any element are not increased.

1.6.2 Changes to the configuration of the window will not necessitate further testing provided that:

a The unsecured openings are identified and are not potential significant openings.

Unsecured openings are defined in Clause 2.3.

b All other openings and fixed lights comply with the requirements of Clause 1.6.1.

c The stiffness of the fixed frame is not reduced by the omission of frame members or the replacement of fixed lights by opening lights.

The performance of a window will be reduced if for instance:

a An opening light is tested in a rigid frame but then used in a multi-light window.

b A top hung vent is tested above a fixed light but used as a top hung vent above a top hung vent.

c Two fixed lights with an intermediate framing member are replaced by a single fixed light.

Detailed assessment of the window structure is required. It is recommended that the advice of the test laboratory is sought as part of the original testing and assessment programme.

2 FRAME PERFORMANCE CRITERIA

2.1 Scope

The performance criteria set out in this section are applicable to the entire window. The frame comprises all fixed frame members and the frames of all opening lights and dummy vents.

Frame and hardware are tested as a complete system. The term frame includes frame and hardware.

2.2 Significant openings

2.2.1 Requirements

The window shall not permit an opening that allows access by the intruder.

2.2.2 Definition

An opening is a significant opening if it either:

1 Allows the intruder to enter through the opening.

2 Gives access to an opening device that can be operated to create a significant opening.

2.2.3 Testing

2.2.3.1 Test method

Refer to Clause 3.4.

2.2.4 Performance criteria under test

The opening is a significant opening if either:

1 A body block, as defined in Clause 3.4.1, can be passed through the opening.

2 A handle capable of opening a vent to create a significant opening is positioned such that the shortest distance between the handle and the opening is less than 700 mm.

2.3 Secured and unsecured lights

2.3.1 General

All lights shall be designated as unsecured or secured.

Opening lights that have a night vent position shall be designated as either:

a Unsecured.
b Secured only when fully closed.
c Secured in the night vent position.

2.3.2 Requirements

2.3.2.1 Unsecured lights shall prevent entry by manipulation, as defined in Clauses 2.4, when they are in the fully open position.

2.3.2.2 All other lights shall be secured to comply with the clauses of this section.

2.4 Entry by manipulation

2.4.1 Requirements

All lights, when secured shall prevent entry by manipulation.

Manipulation may include the pushing or banging of the window elements to dislodge components. Aids to manipulation may be used. For example, bent wire and light tools (see Clause 3.5.1).

2.4.2 Testing

2.4.2.1 Test method

Refer to Clause 3.5.

2.4.2.2 Test time

No limit shall be placed on the overall duration of this test. No one technique shall be attempted for more than three minutes.

2.4.3 Performance criteria under test:

After testing there shall be no significant opening as defined in Clauses 2.2.

2.5 Glass removal

2.5.1 Requirements

All secured lights shall be glazed in a manner that prevents removal of the glass from the frame, without glass breakage, to create a significant opening.

The intruder works from the attack side of the window but may take advantage of access through unsecured lights.

2.5.2 Testing

2.5.2.1 Test method

Refer to Clause 3.6.

2.5.2.2 Test time and force

The window shall be subjected to the manual test for a period of three minutes.

The test force applied in the mechanical test should be 2000N.

2.5.3 Performance criteria under test

2.5.3.1 Removal of glass as an integral unit or pane shall not be possible.

2.6 Levering of opening lights

2.6.1 Requirements

All opening lights, when secured, shall prevent entry when subjected to the forces equivalent to those which can be applied by the use of screwdrivers, nailbars, garden and other implements.

2.6.2 Locking points

Locking points are all those points around the frame of an opening light where devices are fitted to hold the opening light secure.

Locking devices include all devices that contribute to the security of the window including hinges.

The locking points shall, acting singly or in combination, prevent the creation of a significant opening.

Failure of an individual locking point does not necessarily constitute failure.

For sliding sashes it shall be assumed that locking points exist at each corner of the sash and at the mid-point of each side in addition to the positions of the locking devices.

2.6.3 Testing

2.6.3.1 Test method

For inward or outward opening lights, refer to Clause 3.7.

For sliding sashes refer to Clause 3.8.

2.6.3.2 Test force

The principal test force shall be 3000N.
The secondary test force shall be 1000N.

2.6.4 Performance criteria under test

2.6.4.1 At the end of the test there shall be no significant opening as defined in Clauses 2.2.

2.6.4.2 At the end of the test there shall be no means of entry by manipulation as defined in Clauses 2.4.

2.7 Levering of fixed lights

2.7.1 Requirements

Fixed lights constructed as dummy vents which are subsequently installed into the fixed frame shall offer the same level of security as opening lights.

Depending on the construction and mode of fixing of a dummy vent it shall be tested as either:

1 *An inward or outward opening light.*

2 *A sliding sash.*

2.7.2 Testing

2.7.2.1 The manufacturer shall identify the points of mechanical attachment of the dummy vent to the fixed frame.

2.7.2.2 If there are discrete points of attachment they shall be regarded as locking points. The dummy vent shall then be tested as an opening light as defined in Clause 2.6.3.

2.7.2.3 If discrete points of attachment cannot be identified it shall be assumed that locking points exist at each corner of the dummy vent and at the mid-point of each side. The dummy vent shall then be tested as an opening light as defined in Clause 2.6.3.

2.7.3 Performance criteria under test

2.7.3.1 At the end of the test there shall be no significant opening as defined in Clauses 2.2.

2.7.3.2 At the end of the test there shall be no means of entry by manipulation as defined in Clauses 2.4.

2.8 Entry by impact

2.8.1 Requirements

Where a window may be subjected to the impact forces that can be applied by body charging or kicking, it shall remain secure under that impact.

The risk of body charging or kicking is dependent on location and also on the type of glazing or infill material. Materials other than glass are more susceptible to this form of attack.

2.8.2 Testing

2.8.2.1 Only internally beaded lights, pivoting lights and inward opening lights need be tested.

2.8.2.2 Test method - refer to Clause 3.9.

2.8.2.3 The drop height shall be 800 mm.

2.8.3 Performance criteria under test:

2.8.3.1 At the end of the test there shall be no significant opening as defined in Clauses 2.2.

2.8.3.2 At the end of the test there shall be no means of entry by manipulation as defined in Clauses 2.4.

3 TESTING

3.1 Scope

This section describes the method of testing window frames and hardware to assess their security performance. All those involved in the design of windows to be tested and those involved in testing have to make their own assessment of security performance.

Testing for security cannot be fully prescriptive. Testers have to exercise judgement as to how the tests are to be run and the methods of working to be employed.

The tests described in this section do not test the security of the glass.

3.2 Testing authority

3.2.1 General

Testing shall be conducted by an independent testing laboratory: the Testing Authority.

Testing shall be conducted by a laboratory experienced in the testing of windows for security.

Less experienced laboratories may test under the guidance of an experienced laboratory which shall then be the Testing Authority.

Judgement and experience are required to carry out the manipulation test and glass removal test.

Knowledge of window usage is required to determine the appropriate sizes and layouts of specimens.

3.2.2 Calibration

All measurement devices used in tests shall be calibrated and traceable to National Standards.

3.3 Performance testing of specimens

3.3.1 Specimen size and features

3.3.1.1 The specimens shall be production windows fabricated in strict accordance with the manufacturers drawings, specification and fabrication instructions (but see Clause 3.3.1.2).

The manufacturer shall supply full supporting documentation to the Testing Authority prior to commencement of the testing.

Hybrid specimens are permitted. They shall be clearly identified as such in the test report. Examples of hybrid specimens are:

a A symmetrical window containing identical opening lights each fitted with different hardware.

b A window in which glazing details differ from light to light.

3.3.1.2 Windows to be tested shall be glazed with toughened glass or laminated glass irrespective of the glazing material that is normally used.

These tests are hazardous to the testers unless safety glazing is used.

These tests are tests of the frame and hardware. The results are not influenced by the type of glazing.

3.3.1.3 Specimens shall be of a suitable size to ensure that the results will apply to most window sizes that will be constructed.

The Testing Authority shall consider the range of use of the product to be tested and shall state the size of specimens to be tested.

3.3.1.4 Specimens shall be of a suitable configuration to ensure that the results will apply to most window configurations that will be constructed

The testing authority shall consider the range of use of the product to be tested. The testing authority shall only test windows of a configuration it considers appropriate to the product under test.

3.3.2 Laboratory conditions

3.3.2.1 The environmental conditions in the laboratory shall be maintained in the following range:

Temperature	15°-25° C.
Humidity	Less than 70% rh

3.3.2.2 Windows shall be stored under laboratory conditions prior to test.

This is particularly important for timber windows (moisture) and PVC-U windows (temperature).

3.3.3 Attachment and support frame

3.3.3.1 The test specimens shall be mounted in a rigid test frame to prevent energy absorption and to ensure the most favourable working conditions for the tester.

The recommended method of attachment is shown in figure 3.1.

3.3.3.2 The test specimen shall be mounted vertically at a height above the floor relevant to its final installation in a building.

Specimens must be mounted vertically to allow manipulation tests at all stages of the testing.

The Testing Authority shall only test windows mounted at a height above the floor that it considers appropriate to the product under test.

3.3.3.3 There shall be adequate access to both sides of the specimen to allow for observation and to allow manipulation tests at all stages of the testing.

3.3.4 Testing procedure

The test specimens shall be subjected to significant opening, manipulation, glass removal, levering and, where applicable, soft impact tests.

Prior to testing the Testing Authority shall identify the range of tests to be performed.

The manufacturer and Testing Authority shall agree the number of windows to be supplied for testing. The same window may be used to conduct more than one test but its performance is likely to be adversely affected. It is recommended that separate windows be used to conduct the glass removal, levering and soft impact tests.

Prior to every test all opening lights shall be opened and closed five times. Lights shall then be secured in either the fully closed or night vent position.

The forces applied shall be those given in Section 2 of this Standard.

At every stage of testing the Testing Authority shall consider whether entry may be gained by a manipulation test. Manipulation tests shall be performed at all appropriate entry times.

The manipulation test and glass removal test are variable tests. Full details of the test sequence and methods of manipulation shall be recorded.

It is recommended that all tests are recorded on video tape in case of future dispute. Recordings shall be kept in secure storage by the Testing Authority only for consultation between the Testing Authority and the manufacturer.

At the end of the testing programme all specimens tested shall be dismantled and the Testing Authority shall confirm that they were fabricated according to the drawings, specification and fabrication instructions.

3.4 Significant opening test

3.4.1 Body block

A body block of the shape and dimensions shown in figure 3.2 shall be used to conduct this test.

3.4.2 Procedure

3.4.2.1 This test shall be run as required by the test programme and at other stages of test when there is reason to believe that a significant opening exists.

3.4.2.2 The tester shall attempt to pass the body block through the opening without the use of force.

3.4.2.3 On every occasion that the test is run it shall be recorded in the test report. The information recorded shall include the opening tested and the result of the test.

The test should be recorded even if the body block cannot be passed through the window.

3.5 Manipulation test

3.5.1 Tool set

A tool set comprising the following items shall be available to the tester:

Different tools may be used to the same end and the tester may suggest additional ones. The tester will use appropriate forms of personal protection (gloves, safety goggles etc).

Small screwdrivers with different blade types
max total length 150mm
max blade width 7mm

Wood chisels
20-30mm width
5-7.5mm width

Sharp craft knife

Joiners bolster
50-70mm width

2 x paint scrapers
75mm width

Adjustable gripping pliers or equivalent

Set of hexagonal socket wrenches

Set of Allen keys

Piece of stiff wire
approx 750mm long

Small working platform
approx 700mm high

3.5.2 Procedure

3.5.2.1 Working from the attack side of the window and standing on the floor or small working platform the tester shall attempt to gain entry by hand manipulation alone or with the use of the toolset.

The glazing bead performance is not considered as part of this test.

The times allowed for this test shall be limited to the values given in Clauses 2.4.

3.5.2.2 If entry is gained or if a significant opening test is to be performed immediately following the manipulation test then the full details of the manipulation test shall be included in the test report. The information recorded shall include:

The result of the test shall be either a pass, a fail or a requirement for a significant opening test.

a Opening attacked.

b Tools and technique used.

c Components that failed.

d Result of the test.

3.6 Glass removal test

3.6.1 Scope

This test comprises two parts:

a Manual glass removal test

b Mechanical glass removal test

The manual test represents the burglar's attempts to remove glazing beads and other components using small tools.

The mechanical test represents attempts to dislodge internally beaded glazing by levering or pressing on the glazing. The force is less then that for the mechanical levering test (Clause 3.7) as the glass will not sustain such high forces in practice without breakage.

The mechanical glass removal test is only performed on internally glazed windows or for glazing materials other than glass.

3.6.2 Manual glass removal test

3.6.2.1 Tool set

A tool set comprising the following tools shall be available to the tester:

Different tools may be used to the same end and the tester may suggest additional ones. The tester will use appropriate forms of personal protection (gloves, safety goggles etc).

Small screwdrivers with different blade types
max total length 150mm
max blade width 7mm

Wood chisels
20-30mm width
5-7.5mm width

Sharp craft knife

Joiners bolster
50-70mm width

2 x paint scrapers
75mm width

Adjustable gripping pliers or equivalent

Set of hexagonal socket wrenches

Set of Allen keys

Piece of stiff wire
approx 750mm long

Small working platform
approx 700mm high

3.6.2.2 Procedure

The tester shall study the window and drawings showing the frame and glazing bead cross sections.

The tester shall select the opening to be tested.

The glass removal test may be conducted on separate specimens prepared for the purpose. They should be mounted vertically at an appropriate height for test. The mounting of the specimens should not impart any additional stiffness to the frame.

Working from the attack side of the window and standing on the floor or working platform the tester shall attempt to remove the glazing without breaking the glazing. The tester may work by hand manipulation alone or with the use of the toolset.

If glass breakage occurs the test may be re-run at the request of the Testing Authority.

The manufacturer and Testing Authority shall then agree to either:

a Re-glaze the opening and re-test

b Replace an entire opening light or carrier frame and re-test;

c Test a different opening.

The Testing Authority may ignore minor cracks that occur during the test.

The time allowed for this test shall be limited to the value given in Section 2.5. The time elapsed shall be recorded if the test is stopped within the time allowed.

The result of the test shall be either a pass or a fail.

If the glass can be removed then the following information shall be recorded:

a Opening attacked

b Tools and technique used

c Components that failed

d Time elapsed

e Result of the test.

3.6.3 Mechanical glass removal test

3.6.3.1 Test apparatus

This test is conducted using the same test apparatus as for the levering tests (Clauses 3.7 and 3.8).

Normal forces shall be applied through a bearing pad of dimensions 150mm x 150mm.

3.6.3.2 Procedure

The Testing Authority shall decide which lights are to be tested.

At each corner of the glazing in turn, the test force shall be applied, normal to the glazing.

The force shall be applied gradually increasing from zero to full value in a period of 30 ± 5 seconds. The force shall then be maintained for 30 seconds.

If any movement of the glazing beads is observed, the tester may apply the force at other points on the glazing in an attempt to remove the glazing.

If the glass can be removed the following information shall be recorded:

a opening attacked
b sequence of loading

3.7 Levering test for inward and outward opening lights

3.7.1 Scope

This test is intended to apply the forces that can be applied by a lever or pair of levers inserted between framing members of inward and outward opening lights.

This test applies to inward opening casement windows, outward opening casement windows, tilt and turn windows, horizontal and vertical pivot windows.

3.7.2 Testing principle

The Testing Authority shall assess the flexibility of the window frame by manual levering.

The Testing Authority shall then decide the combination of forces to be applied at each locking point.

The forces to be considered shall be:

a A normal force, applied normal to the plane of the window and adjacent to the locking point

There may be a single normal force applied to the movable frame or two opposed forces. The opposing force acts on the fixed frame and is created by a fixed prop.

b A first inplane force, applied in the plane of the window and adjacent to the locking point

The purpose of the first inplane force is to part framing members and assist in disengagement of the locking device. There may be a single force or two opposed forces depending on the configuration of the frame.

c A second inplane force, applied in the plane of the window and normal to the first inplane force. This force may be applied remote from the locking point.

The purpose of the second inplane force is to cause slippage between framing members and assist in disengagement of the locking device. These may be a single force or two opposed forces depending on the configuration of the frame.

Some typical loading arrangements are shown in figure 3.3.

3.7.3 Test apparatus

The test apparatus shall comprise a support frame as described in Clause 3.3.3.

Normal forces shall be applied through a bearing pad of area 2000 mm^2.

Where necessary two pads, each of area 1000mm^2 may be used.

Figure 3.4 shows suitable bearing pads.

Where bearing pads cannot be used, for instance on narrow framing members, an alternative method of attachment shall be agreed between the manufacturer and Testing Authority.

Inplane forces shall be applied through tension straps as shown in figure 3.5, or metal brackets as shown in figure 3.6.

Where tension straps or brackets cannot be used, for instance the testing of carrier frames for fixed lights, an alternative method of attachment shall be agreed between the manufacturer and Testing Authority.

All forces shall be applied by hydraulic actuators or other means such that a gradually increasing load is applied.

All loads shall be measured to an accuracy of two per cent.

Provision shall be made for measuring differential displacements normal to the plane of the window and in the plane of the window.

Displacements do not form part of the pass/fail criteria for this test. However they are an important record of the window performance under test and of the manner in which the tests were conducted.

Displacements shall be measured to an accuracy of 0.1 mm.

3.7.4 Component failure

Component failure shall be recorded if in the opinion of the tester either:

a The component has sustained damage that will impair its performance

b The frame local to the component has sustained damage that will impair the component performance.

Common causes of component failure are:

1 Partial or complete disengagement

2 Fracture of the component, screws or rivets

3 Buckling of hinges

4 Deformation of profile walls.

Locking points may carry the load singly or in combination. Failure of a single component may not constitute product failure.

3.8 Levering test for sliding sashes

3.8.1 Scope

This test is intended to apply the forces that may be applied by a lever or pair of levers inserted between framing members of sliding sash windows.

This test applies to vertical and horizontal sliding sashes.

3.8.2 Testing principle

The Testing Authority shall assess the flexibility of the window frame by manual levering.

The Testing Authority shall then decide the combination of forces to be applied at each locking point.

The forces to be considered shall be:

a A normal force, applied normal to the plane of the window and adjacent to the locking point;

The purpose of the normal force is to part framing members and assist in disengagement of the locking device. There may be a single force or two opposed forces depending on the configuration of the frame. The opposing force is created by a fixed prop.

b A first inplane force, applied in the plane of the window and in the direction of opening of the sash. This force may be applied remote from the locking point.

The purpose of the first inplane force is to open the sash.

c A second inplane force, applied in the plane of the window and normal to the first inplane force. This force may be applied remote from the locking point.

The purpose of the second inplane force is to cause slippage between framing members and assist in disengagement of the locking device. These may be a single force or two opposed forces depending on the configuration of the frame.

Some typical loading arrangements are shown in figure 3.7.

3.8.3 Test apparatus

See Clause 3.7.3.

3.8.4 Component failure

See Clause 3.7.4.

3.8.5 Window failure

See Clause 3.7.5.

3.7.5 Window failure

Window failure shall be recorded if a subsequent manipulation test or significant opening test shows failure has occurred.

3.7.6 Procedure

The Testing Authority shall decide the sequence in which the locking points are to be tested.

At each locking point in turn the inplane forces shall be applied. The inplane forces shall be maintained while the normal force is applied.

The test shall also be conducted at the corner of lights if the distance to the nearest locking point is greater than 150mm.

The inplane forces shall be the secondary force given in Clause 2.6.3.2. The normal force shall be the primary force given in Clause 2.6.3.2.

All forces shall be applied gradually increasing from zero to their full value in a period of 30 ± 5 seconds. The normal force shall then be maintained for 30 seconds.

If during the application of the normal force a relative displacement of 150mm is achieved, then the normal force shall be removed. A normal force of 1000N shall then be applied until no further movement occurs.

At displacements greater than 150mm, burglary tools become ineffective levers.

The force of 1000N represents a person pulling on a partially open vent.

For each locking point the normal forces and normal differential displacements shall be measured.

If a component failure occurs all locking points previously tested shall be re-tested.

It is necessary to re-test to ascertain what contribution the failed component made to earlier results.

If at any stage of the test the Testing Authority considers entry may be gained by a manipulation test a manipulation test shall be conducted.

If at any stage of the test the Testing Authority considers that a significant opening has been created a significant opening test shall be conducted.

Each time a locking point is tested the peak and final normal force and final differential displacement shall be recorded. The position, direction and magnitude of any second inplane force shall also be recorded.

The sequence of tests shall be recorded showing all leverage tests at locking points, all manipulation tests and all significant opening tests.

3.8.6 Procedure

The Testing Authority shall decide the sequence in which the locking points are to be tested.

At each locking point in turn the normal and second inplane forces shall be applied. These forces shall be maintained while the first inplane force is applied.

The first inplane force shall be the principal force given in Clause 2.6.3.2. The normal force and second inplane force shall be the secondary force given in Clause 2.6.3.2.

All forces shall be applied gradually increasing from zero to their full value in 30 ± 5 seconds. The first inplane force shall be maintained for 30 seconds.

For each locking point the first inplane force and corresponding inplane differential displacements shall be measured.

If a component failure occurs all locking points previously tested shall be re-tested.

It is necessary to re-test to ascertain what contribution the failed component made to earlier results.

If at any stage of the test the Testing Authority considers entry may be gained by a manipulation test a manipulation test shall be conducted.

If at any stage of the test the Testing Authority considers that a significant opening has been created a significant opening test shall be conducted.

Each time a locking point is tested the peak first inplane force and final differential displacement shall be recorded. The position, direction and magnitude of all the inplane forces shall also be recorded.

The sequence of tests shall be recorded showing all leverage tests at locking points, all manipulation tests and all significant opening tests.

3.9 Soft impact test

3.9.1 Scope

This test is intended to apply the forces that can be generated by forms of human impact.

This test was devised for doorsets (see ISO 8270) and its relevance to windows is still a matter of debate. However, it has been retained in CEN (see draft ENV 38.038E) and it is important to confirm that lights which are either inward opening or internally beaded are not vulnerable to some form of kick or charge.

3.9.2 Testing principle

The Testing Authority shall nominate the location and number of impact points on the attack side.

Given the flexibility of UK fenestration intelligent choice of appropriate action is more important than rigorous prescription for this particular field.

The forces to be considered shall be:

for internally beaded systems:

a a series of blows applied around the glazing perimeter

The purpose of this attack is to dislodge the beads from the frame.

b a blow in the centre of the glazing infill.

The purpose of this attack is to dislodge the glazing directly.

for inward opening lights:

a blows at the corners of the vent

The purpose of this attack is to damage or disengage hardware.

3.9.3 Test apparatus

The test apparatus shall consist of a sample support frame as described in Clause 3.3.3 together with an impact device.

The form of the test requires the impactor to be adjusted to the correct height for impact against the specimen then withdrawn away from the sample to an agreed vertical drop height. On release the impactor swings in an arc until making contact with the sample.

The impact device shall be as described in CEN ENV 33.038E, an impactor consisting of a leather sphero-conical bag filled with dry sand to a total mass of 30 kg, being approximately 350 mm in diameter, suspended upon a suitable rope or cable and with a release mechanism and appropriate height regulating apparatus.

The impact point is that point at which a line drawn around the diameter of the spherical section of the impactor first makes contact with the sample.

The drop height shall be measured to an accuracy of ± 10 mm.

3.9.4 Procedure

Suitable proposed impact points shall be marked up on the glazing infill area.

For internally beaded lights these shall be:

a at the centre point of the glazing

b near each corner, at a point 200 mm in a perpendicular line from both the horizontal and vertical beads

c near the mid-points of beads over 800 mm in length, at a point 200 mm in a perpendicular line from the bead.

For inward opening, externally beaded, lights these shall be near each bottom corner, at a point 200 mm in a perpendicular line from both the horizontal and vertical beads.

The impactor shall be positioned such that it hangs in a vertical position just lightly touching the proposed impact point, the marks on sample and impactor coinciding to an accuracy of ±10mm. It shall then be raised back from the sample to a measured drop height of 800±10mm and released

One impact shall be made at each selected point. Following each impact, the sample specimen shall be inspected for appropriate damage or displacement and this shall be recorded.

This test has been known to reveal unexpected weaknesses, such as imperfect welds in PVC-U frames.

If at any stage of the test the Testing Authority considers that entry may be gained by a manipulation test, then such a test shall be conducted.

If at any stage of the test the Testing Authority considers that a significant opening has been created, then a significant opening test shall be conducted.

The sequence of tests shall be recorded with a note of the intent of the test.

3.10 Test report

The report shall contain the following information:

3.10.1 General

- Names and addresses of the person requesting the test, the fabricator, the system supplier (where appropriate), the Testing Authority, laboratory conducting the tests and official observers witnessing the tests.
- The date and place of testing
- Signatures of persons responsible for supervising the test.

3.10.2 Specimens

- Identification of all the specimens
- Detailed drawings of the specimen showing configuration, horizontal and vertical sections. All profile cross sections, bead cross sections and reinforcement details are to be shown. All glazing packers, other packing pieces and centring blocks are to be shown.
- Type, quantity and location of all window operating hardware and hinges. For each device the following information shall be given:
  Manufacturer, type and model number.

3.10.3 Testing

- Diagram of the window showing all loading and measurement points
- Sequence of tests carried out

And for each test:

- Element of window tested
- Position of opening lights (closed or partially open)
- Summary of records of measurements taken
- The result of the test.

3.10.4 Verification of conformity of specimen

- A statement certifying that the specimen tested was as shown in the drawings, or identifying any deviations or modifications
- A statement describing damage to each of the specimens at the end of the test.

3.10.5 Conclusion

- The overall outcome of the test series including classification.

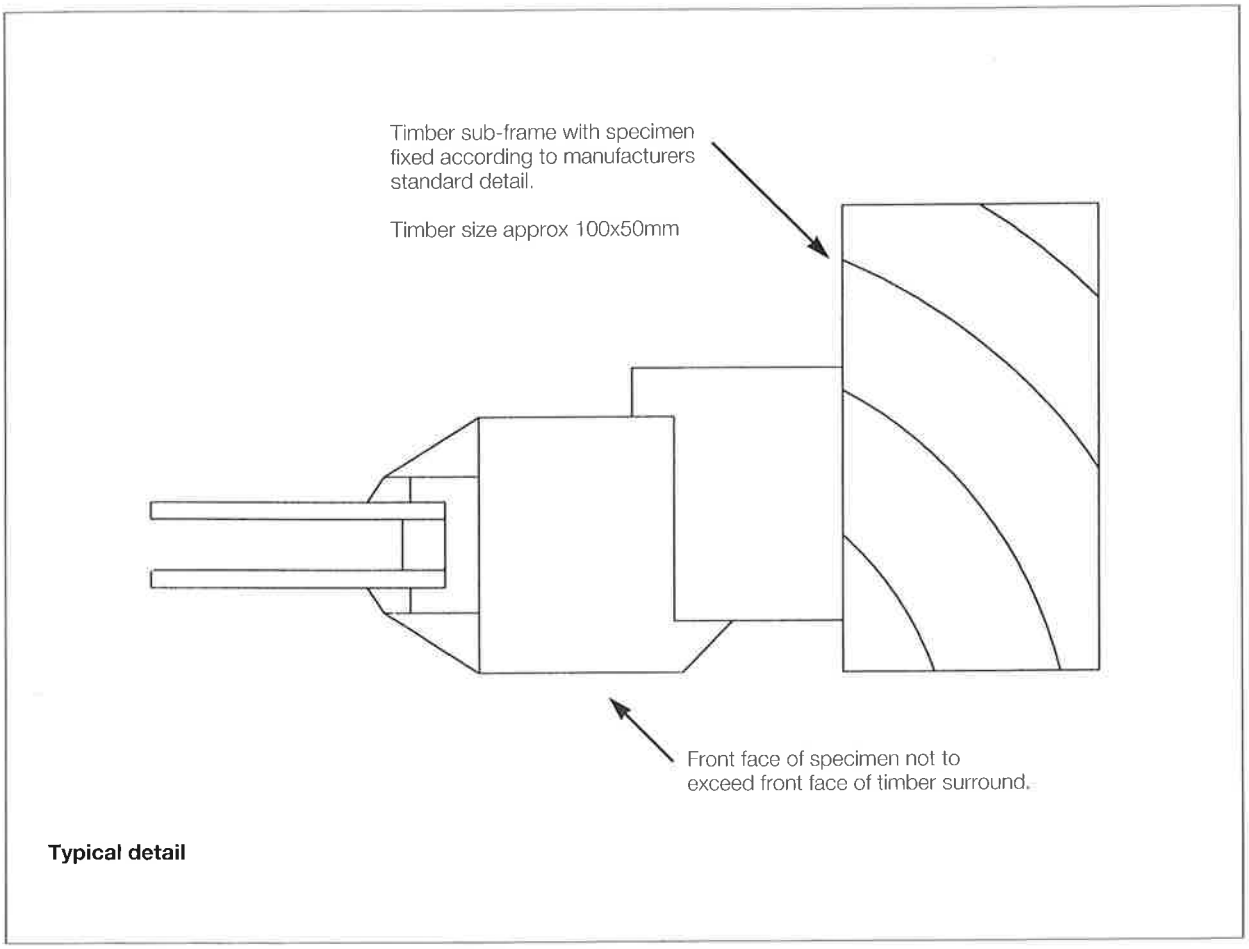

Figure 3.1 *Specimen Preparation and attachment to sub-frame*

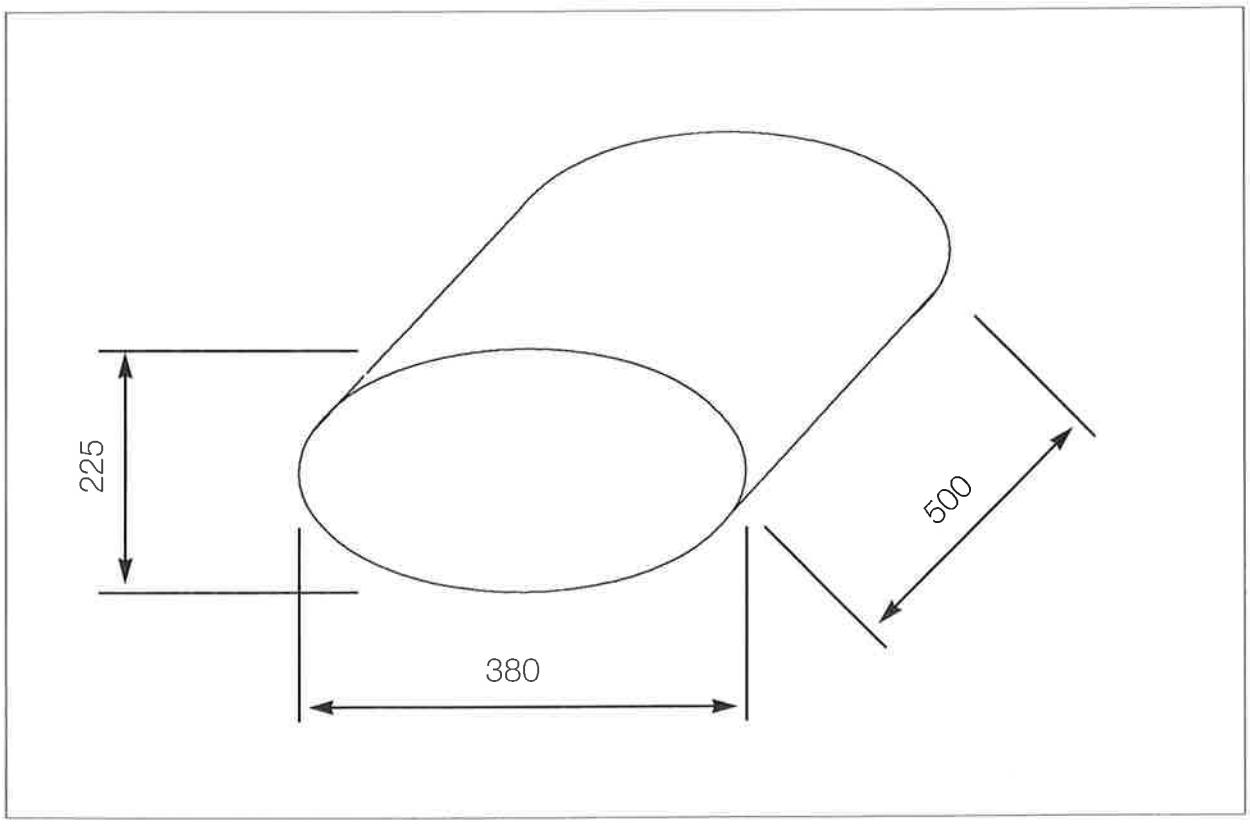

Figure 3.2 *Body Block Dimensions*

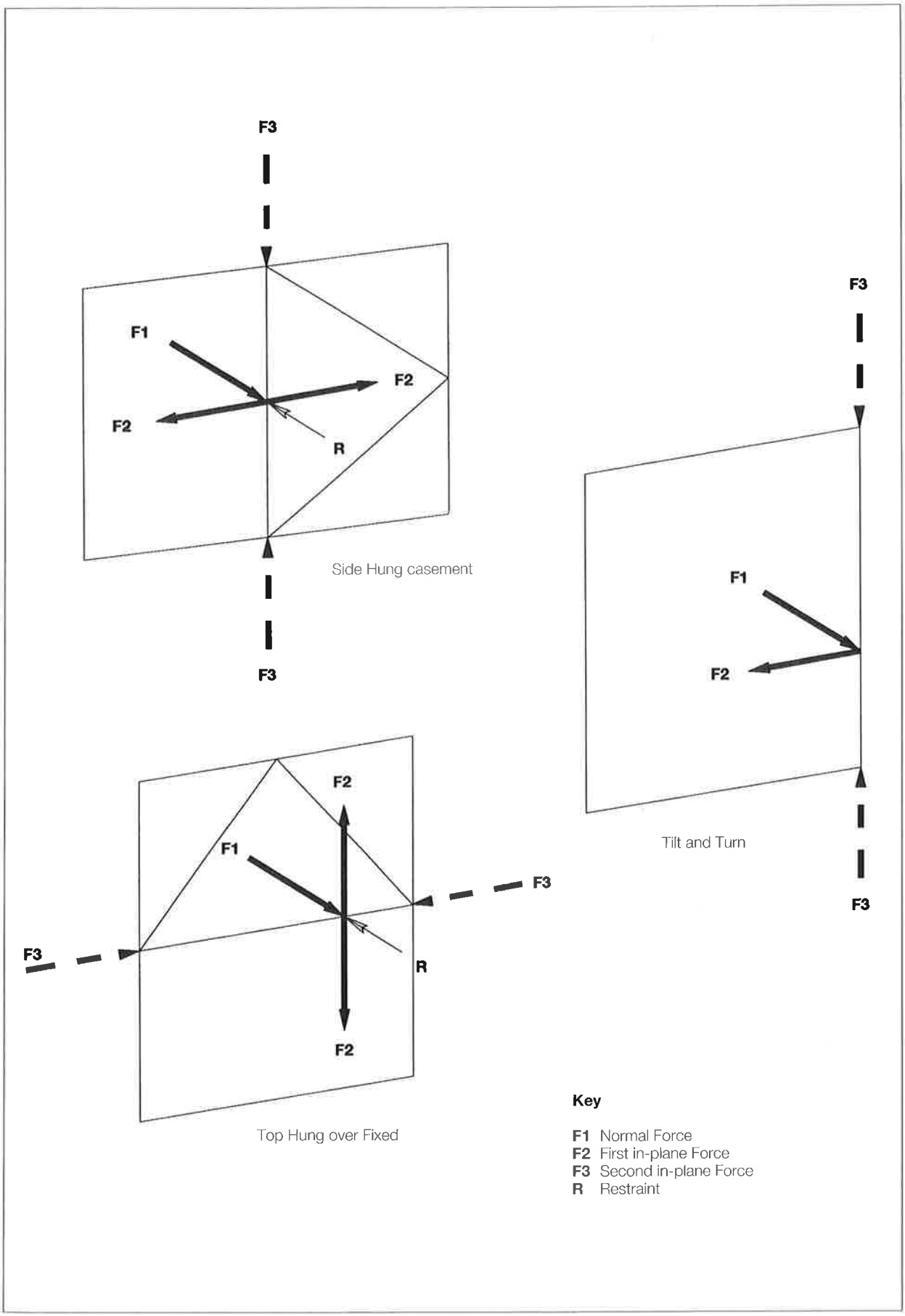

Figure 3.3 *Levering Test, Inward and outward opening windows. Typical loading arrangements.*

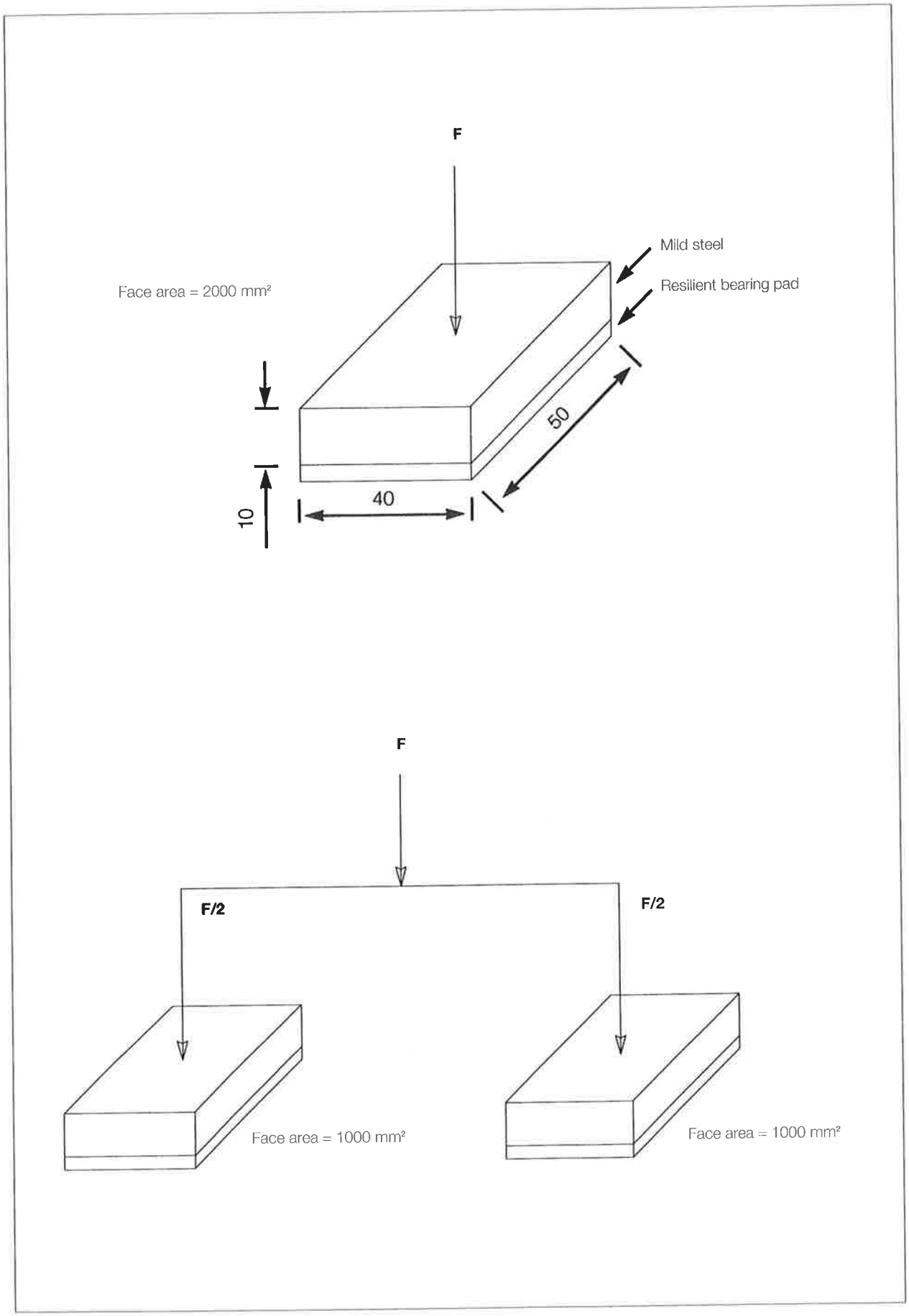

Figure 3.4 *Test apparatus bearing pads*

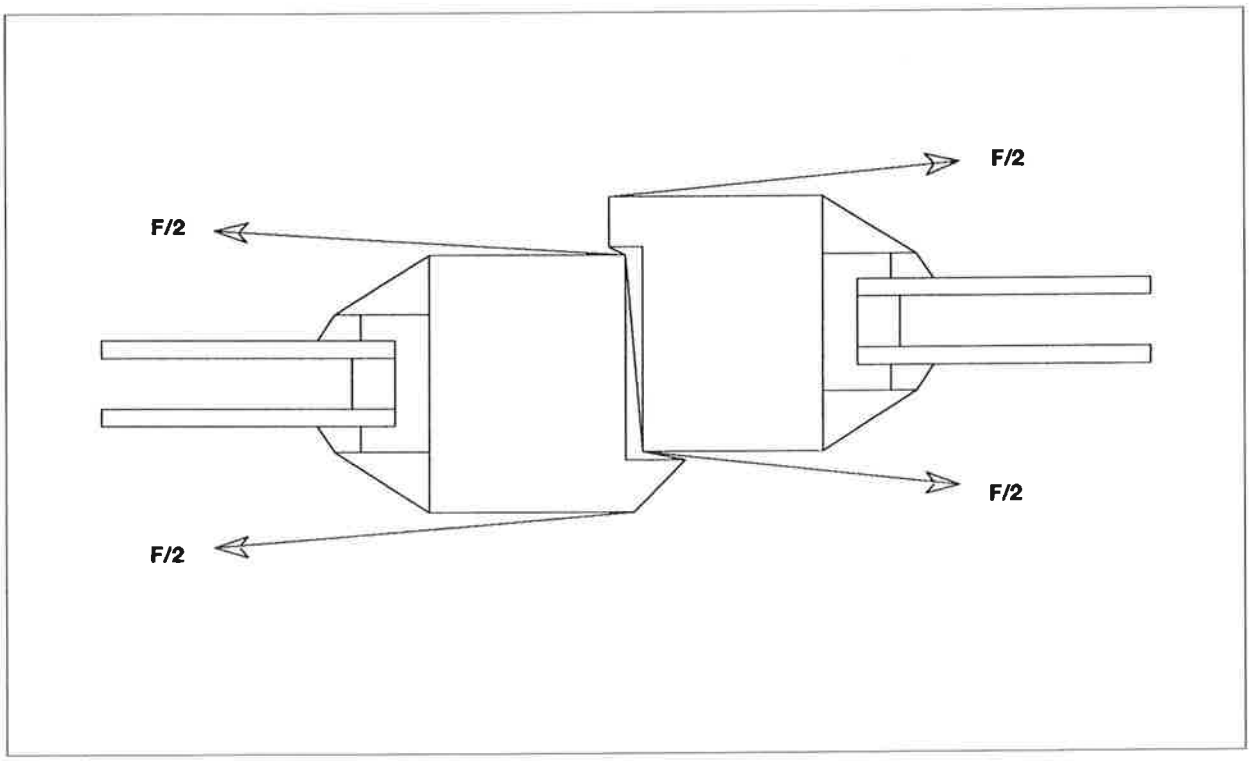

Figure 3.5

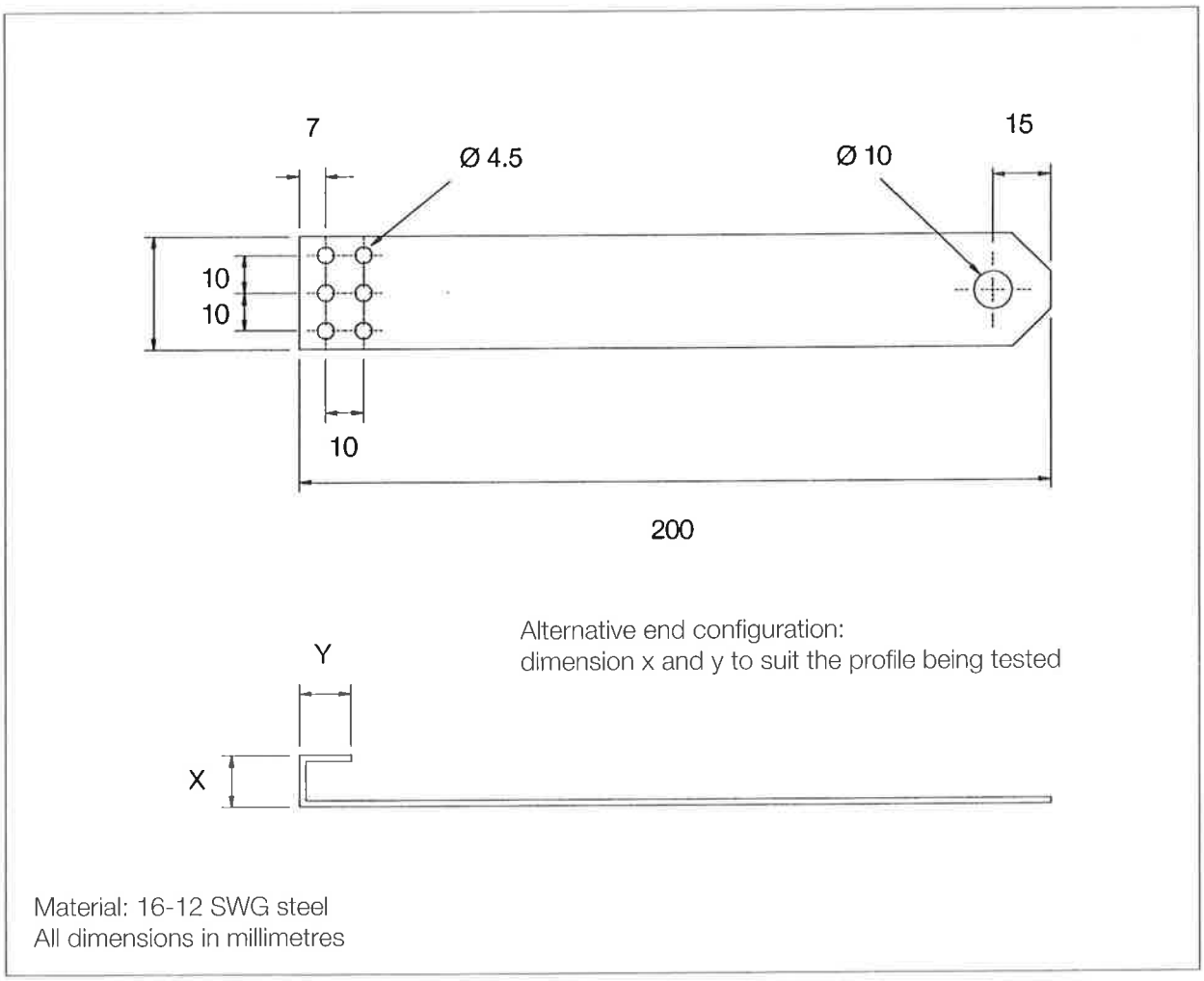

Figure 3.6

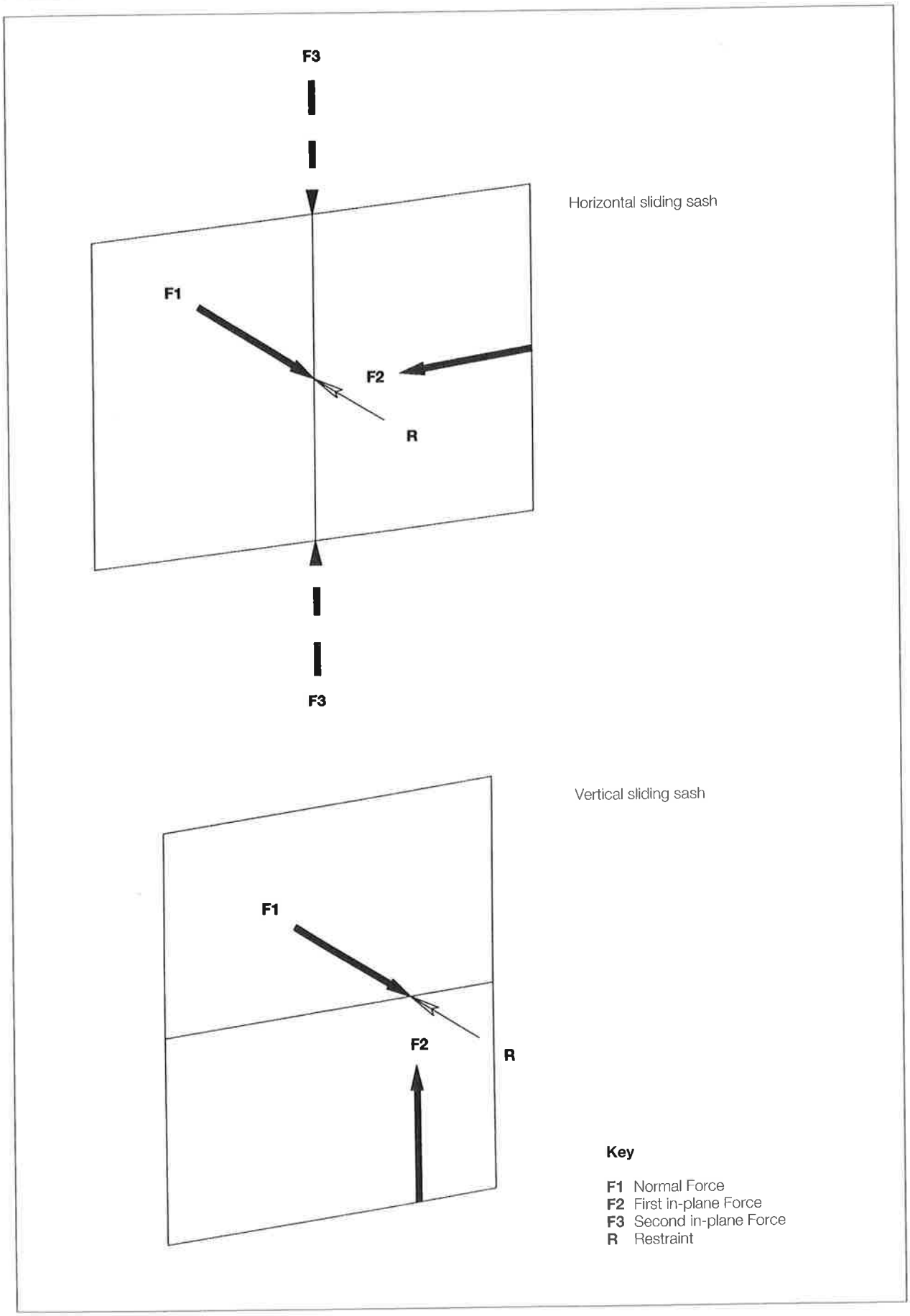

Figure 3.7 *Levering Test, Sliding sashes.*

4 DESIGN

4.1 Introduction

Enhanced resistance to intrusion is only one aspect of window performance. When designing windows to have enhanced resistance to intrusion full account should still be taken of all other performance requirements. This should include both technical and aesthetic considerations.

4.2 Fixings

4.2.1 General

Fixings are not considered in the performance criteria of Section 2. The performance of fixings is highly dependent on the nature of the opening into which the window is to be installed. It also depends on the material of the surround. Fixings should however be considered as part of the window design.

4.2.1.1 The performance of window fixings depends on the building material into which they are fastened. The window design should allow for sufficient fixings when fixing to the weakest building materials that may be encountered.

4.2.1.2 The window design should allow for variable fixing positions so that screws and bolts can be positioned away from mortar joints and other weak spots at the time of installation. Where pre-drilled fixing holes are provided alternative holes should be provided.

4.2.1.3 Fixings should prevent removal of the window from the opening by intruders. Where fixing screws and bolts are all accessible from the attack side or concealed only by sealants and fillers they should be additionally protected. One form of protection is the use of rolling collars on the screws or bolts to prevent sawing through.

4.3 Ventilation

Many windows are provided with a night vent closing position. Lights held in this position invariably offer less resistance to an intruder. The window designer should decide whether to make a window that is secured when in the night vent position or secured only when in the closed position.

In the absence of a secured night vent position some other source of ventilation may be required. Consideration should be given to the provision of ventilators mounted within the glazed area, within the frame or adjacent to the window.

4.4 Egress in case of fire

Windows that are secured against intruders may also be secured against people trying to escape from fire. This is particularly the case when key-lockable handles are used in combination with more secure types of glazing. Key-lockable handles offer little security benefit when used in combination with laminated glass and other high performance glazing materials. However, a window tested with a lockable handle should be fitted with one. A button-lockable handle could be used.

Where locking handles are required, consideration should be given to the use of push button lockable handles and similar hardware.

There is no single answer to these design conflicts but specifiers and surveyors should be aware of these issues.

5 GLAZING PERFORMANCE

5.1 Scope

The performance criteria set out in this section are applicable to the glazing used in every opening or fixed light of the window.

5.2 Selection of glazing material

Different glazing materials offer differing levels of resistance to intrusion, when selecting glazing for a particular installation the material performance described in Clause 5.3 should be considered.

The materials described in Clause 5.3 are ranked according to their level of resistance to intrusion. Materials shown lower down the listing offer the greatest resistance to intrusion.

Glazing materials should be selected or offered on the basis of the ranking shown in Clause 5.3.

5.3 Glazing

5.3.1 General

For all glazing, resistance to intrusion improves with increasing thickness of materials.
For laminated glass, resistance to intrusion generally improves as the interlayer thickness increases.

When comparing glazing systems comprising toughened or annealed glass of thicknesses 4 mm and 6 mm the ranking shown below shall remain unchanged

When considering glazing systems containing glass of thickness 10 mm or greater further consideration must be given to the ranking given below.

5.3.2 Toughened single glass

Toughened glass is formed by a heat treatment process which compresses the surface layers. As a result it is up to five times stronger than ordinary annealed glass when subject to blunt impact but may be fractured by sharp penetration of the surface layer. When broken it provides no residual barrier to bodily entry.

5.3.3 Annealed single glass

Annealed glass offers less resistance to blunt impact but offers greater resistance to sharp penetration. When broken it generally remains in the window frame in large pieces. This acts as a deterrent to the intruder.

5.3.4 Sealed units comprising only leaves of toughened glass

See Clause 5.3.2

Sealed units create an air cushion between the glazing which helps to resist breakage by blunt impact.

With a sealed unit two leaves of glass have to be broken.

5.3.5 Wired glass

The effect of the wire on fracture is to hold together the broken pieces of glass, at least until the wire can be sheared.

5.3.6 Sealed units comprising at least one leaf of annealed glass

See Clause 5.3.3.

Sealed units create an air cushion between the glazing which helps to prevent breakage by blunt impact.

With a sealed unit two leaves of glass have to be broken.

5.3.7 Laminated glass

Laminated glass for domestic use is formed from two leaves of annealed or toughened glass bonded together with a plastic interlayer. The interlayer holds together the broken pieces of glass to delay entry by the intruder.

Laminated glass may be used as a single glazing leaf or as one leaf of a sealed unit.

5.3.8 Polycarbonate

Polycarbonate offers good impact resistance and is more difficult to break than glass.

Polycarbonate is flexible. The level of resistance to intrusion is highly dependent on the frame design and glazing rebate depth.

6 FRAME AND GLASS SELECTION

6.1 General

For any window the selection of an appropriate frame and appropriate glazing should take account of all performance requirements. This should include both technical and aesthetic considerations.

When selecting a frame and glazing to provide enhanced resistance to intrusion an assessment of risk should be made for each window.

6.2 Risk assessment

When evaluating the risk of forced entry through a window the following factors should be taken into account.

General factors affecting the risk of forced entry to a building:

- Location.
- Contents.
- Use.
- Hours of occupation.
- Remoteness.
- Ease of access.
- Other security measures.

Particular factors affecting the risk of forced entry through a window:

- Accessibility.
- Visibility.

6.3 Assessment of method of entry

Crime figures show that forced entry is more often gained by forcing the frames and locks of windows than by breaking glass.

The breaking of glass is a deterrent to intruders as it is dangerous and it creates an obvious noise.

There is a greater risk of entry by glass breakage at unoccupied premises and properties remote from other properties, particularly at night, when the noise of breaking glass may not be heard.

6.4 Frame selection

6.4.1 Materials

All of the materials commonly used for window frames can be used to fabricate windows with enhanced resistance to intrusion. Frames should be selected according to the performance criteria in Section 2 (see also Clause 1.3).

6.4.2 Class of resistance

The client has to assess risk and select a suitable class of resistance for each window. Each window of a building has a different vulnerability to intrusion as a result of its visibility and accessibility.

The client may decide to install frames with greater resistance to intrusion only at ground floor level. However consideration should then be given to other windows that are easily accessible from flat roofs, balconies, porches and canopies.

The client may decide to install frames with greater resistance to intrusion only at the rear of a building.

6.5 Glazing selection

The client may decide that the risk of entry by glass breakage is low and use enhanced frames without enhanced glazing.

Each window of a building has a different vulnerability to intrusion as a result of its visibility and accessibility.

The client may decide to use enhanced glazing only at ground floor level. However consideration should then be given to other windows that are easily accessible from flat roofs, balconies, porches and canopies.

The client may decide to use enhanced glazing only at the rear of a building.

Glazing should be selected according to the performance described in Section 5.

7 FABRICATION

7.1 General

7.1.1 Windows should be fabricated in accordance with fabrication instructions, component and assembly drawings and general arrangement drawings.

7.1.2 Fabrication manuals should be provided. The information given should include, but not be limited to, the following:

- Details of all components to be used.
- Instructions for the cutting and assembly of all framing members.
- Tolerances for cutting dimensions and tolerances for complete frames, including squareness.
- Instructions for the cutting and fixing of reinforcement if it may be required.
- Instructions for the fitting of components.
- Dimensions for the positioning of components including tolerances.
- Details and position of all spacing, packing and centring blocks.
- Method of glazing including position of all packing and setting blocks.
- Instructions for adjusting locking devices to ensure fabrication in accordance with toleranced drawings.
- Drawings showing depth of engagement of all locking mechanisms.
- Details of window configurations that will comply with this Standard, (Clause 1.6).

7.1.3 The fabricator should employ competent workers. The fabricator should maintain records to demonstrate his employees' experience and all related training.

7.1.4 All windows should be inspected for compliance with the fabrication manual prior to installation.

7.1.5 All windows complying with this Standard should be labelled as one of the following:

- Secure in the night vent position
- Secure when fully closed

7.1.6 All quality inspectors should be trained in the security aspects of the product. The fabricator should maintain records to demonstrate such training.

7.2 Materials and components

7.2.1 All components should have supporting documentation showing compliance with the fabrication manual. This should include all profiles, reinforcement, hinges, locks, handles, screws, glazing beads, gaskets and weatherstrips.

7.2.2 No substitution of components should be allowed without further assessment by the Testing Authority (Clauses 1.5.1 and 1.5.2).

8 INSTALLATION

8.1 General

8.1.1 Windows should be installed in accordance with installation instructions and, where appropriate, installation drawings.

8.1.2 Installation manuals should be provided. The information given should include, but not be limited to, the following:

- Details of all fixings and components to be used
- Details of all sealants and fillers to be used
- The number and position of all fixings to be used for each window size and style
- Bracket, packing and spacing details
- Maximum spacings between fixings
- Tolerance for squareness of the frame
- Instructions for glazing including positions of all packing and setting blocks
- Instructions for adjusting locking devices to ensure correct engagement
- Drawings showing depth of engagement of all locking mechanisms

8.1.3 The installer should employ competent workers. The installer should maintain records to demonstrate his employees' experience and all related training.

8.1.4 All windows should be inspected for compliance with the installation manual following installation.

8.1.5 All inspectors should be trained in the security aspects of the product. The installer should maintain records to demonstrate such training.

8.1.6 The operation of the window should be demonstrated to the client and the client should be advised of any limitations to performance in use. For instance, the insecurity of the night vent position.

8.2 Fixings and materials

8.2.1 All fixings and materials should have supporting documentation showing compliance with the installation manual.

8.2.2 No substitution of fixings or materials should be allowed without assessment by the window designer.

APPENDIX

Testing of multi-light plane windows constructed from standardised systems for use in dwellings.

A.1 Introduction

This appendix considers a simplified approach to the testing and specification of windows of typical size, configuration and construction for use in dwellings. It may form the basis of a performance certification scheme.

A.2 Simplified testing

A.2.1 Levering tests

For many of these windows the levering tests, Clause 3.7, may be simplified by omitting one of the two inplane forces.

The forces applied shall then be:

	Case	Parallel to Plane	Perpendicular to Plane
1	Projection stay	Along edge towards the other stay	On nearest corner
2	Butt hinge	At right angles to edge	Centred over hinge
3	At each corner of a tilt and turn vent or a dummy vent or opening corner of a casement vent	Test 1 Along edge horizontally to adjacent corner	On that corner
		Test 2 Along edge vertically to adjacent corner	On that corner
4	Mushroom bolt sliding parallel to edge of frame into keeps	Along edge in direction to disengage bolt	Centred over bolt
5	Bolts, cams, roller cams without mushroom restraint sliding parallel to edge of frame into keeps	Test 1 Along edge in direction to disengage bolt	Centred over bolt, cam, roller cam
		Test 2 At right angle to edge and towards opposite edge	Centred over bolt, cam, roller cam
6	Dog bolts or other hardware specifically to provide security where there is not normally contact until the vent is forced and with contact length not greater than 150mm and/or contact area not greater than 500 mm^2	At right angles to edge and towards opposite edge	Centred over bolt

7	On dummy vents, all hardware and fasteners used where the greatest dimension of the hardware or fastener does not exceed 150mm	At right angles to edge and towards opposite edge	Centred over bolt hardware or fastener
8	Cockspur handle (with or without retaining hook)	Test 1 At right angles to edge with line of action centred on handle	Centred over handle pivot using a saddle bracket
		Test 2 Along edge towards direction of disengagement	Centred over handle pivot using a saddle bracket adjacent to the locking part

A.2.2 Soft impact test

This test may be omitted.

A.2.3 Manual burglary test

When using the simplified method of testing described in this appendix, the Testing Authority shall conduct a manual burglary test at the end of the sequence of testing.

A.2.3.1 Tool set

2 x screwdrivers
- overall length 250 ± 20mm
- blade width 10mm

2 x nail bars
- overall length 300 ± 25mm

Small working platform
- approx height 700mm

A.2.3.2 Procedure

Working from the attack side of the window and standing on the floor or small working platform, the tester shall attempt to gain entry by force using tools selected from the tool set in any combination. The time allowed for this test shall be 3 minutes.

A.2.3.3 Result

Failure of this manual burglary test will require the window to be tested in full compliance with Clauses 3.7 and 3.8 of this standard.

A.3 Configuration and dimensions

Windows in dwellings vary greatly in configuration and size. In order to avoid the problem of identifying unsecured openings and potential significant openings (Clause 1.6.2), two courses of action are possible. Either key-lockable handles are fitted to all opening vents, or the openings achievable during test are limited so as to prevent access to opening devices, (see Clause 4.4 for further commentary on key-lockable handles).

In the absence of a full assessment of the window configurations in accordance with Clause 1.6 either:

a all opening devices shall be key-lockable

or

b at no time during any of the tests shall it be possible to insert a 25mm diameter rod through any opening created in the window.

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