CPNI
Centre for the Protection of National Infrastructure

DOMESTIC WINDOW SECURITY

A GUIDE TO THE ASSESSMENT OF SECURITY AFFORDED BY DOMESTIC WINDOWS

June 2013

This guide has been written by BRE Global in partnership with the Centre for the Protection of National Infrastructure (CPNI). It is intended to help security managers and practitioners working for the UK Government and critical national infrastructure to assess the security resistance afforded by domestic windows.

This guide aims to highlight the key factors when assessing the resistance of domestic windows to forced entry and provides guidance on how to enhance the security of windows. Furthermore, although not generally assessed for domestic windows, the guide aims to familiarise the reader with important features which could affect windows' resistance to undetected compromise.

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Design overview

Domestic windows in the UK are generally manufactured from the following materials:

- PVC-u
- timber
- composite materials, e.g. GRP
- aluminium[1]
- steel[†]

In most cases modern domestic windows are designed in accordance with the following relevant British Standards associated with the material the window is manufactured from:

BS 7412:2007[1] *Specification for windows and doorsets made from unplasticized polyvinyl chloride (PVC-U) extruded hollow profiles*

BS 644:2012[2] *Timber windows and doorsets – Fully finished factory-assembled windows and doorsets of various types- Specification*

BS 8529:2010[3] *Composite doorsets – Domestic external doorsets – Specification*

BS 4873:2009[4] *Aluminium alloy windows and doorsets – Specification*

BS 6510:2010[5] *Steel-framed windows and glazed doors – Specification*

These standards specify a range of performance criteria covering all aspects of the window design including:

- weathertightness
- glazing
- finishes
- jointing methods/material performance
- security

Further information on these standards can be obtained from the BSI (British Standards Institution).

Until late 2012 the security of domestic windows was mainly assessed in accordance with **BS 7950 1997**: *Specification for enhanced security performance of windows for domestic applications*.[6]

This has since been incorporated into **PAS 24:2012:** *Enhanced security performance requirements for doorsets and windows in the UK. External doorsets and windows intended to offer a level of security suitable for dwellings and other buildings exposed to comparable risk* which covers the assessment of domestic doorsets and windows. This Standard assesses the security of domestic windows using a series of manual and mechanical tests aimed at removing the glazing and overcoming the locking mechanisms and hardware.

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[1] These materials are not commonly used in domestic applications. They are more commonly used in commercial applications.

[†] Although this standard is for doorsets it is often referenced for windows as no composite window standard currently exists.

These tests use basic tools and assume minimal noise is made by domestic burglars. While damage to the window is permitted, breaking the glazing is not permitted in PAS 24:2012[7].

The security performance of domestic windows can also be assessed in accordance with:

LPS 1175 Issue 7: *Requirements and testing procedures for the LPCB approval and listing of intruder resistant building components, strongpoints, security enclosures and free-standing barriers.*[8]

BS EN 1627, 2011: *Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Requirements and classification*.[9]

However, it is not always possible to establish the standards to which windows have been tested, or the manufacturing process through which they have been constructed, especially when they have been in position for some time. This guide therefore aims to help the reader determine a window's likely resistance to forced entry based on a visual examination.

Features which affect the security afforded by windows

A number of key features should be taken into account when determining a window's likely resistance to forced entry, undetected or otherwise. These are:

- opening mode
- materials used to manufacture the window and how they are assembled
- locking mechanism
- hinges
- glazing method and type of glazing used
- installation method

The following sections highlight the key factors associated with each feature which should be considered when determining the security afforded by a window.

Opening mode

The mode of opening should not affect the window's fundamental security performance potential, providing the window has been constructed correctly and is fitted with appropriate locking hardware and ironmongery. However, the following should be taken into account if it is not possible to ascertain the quality of construction and hardware fitted to a window due to the absence of product documentation.

- Are any elements of the hardware exposed? (E.g. exposed hinges can increase the risk of entry being gained because they can be directly manipulated.)

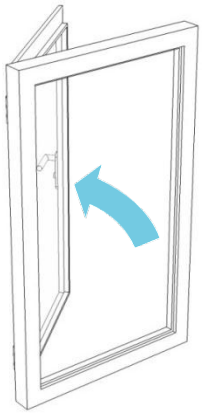
- Does the opening sash sit tight against/within the frame when closed? (See Figure 2.) Are gaps between the sash and the frame sufficient to access and exploit hardware? A check should be made on sliding windows to ensure that there is no excessive movement of the sash such that:

  ○ the sash can be levered out of the frame within which it slides; ○ the sash can be levered to create access to manipulate the hardware on the protected side.

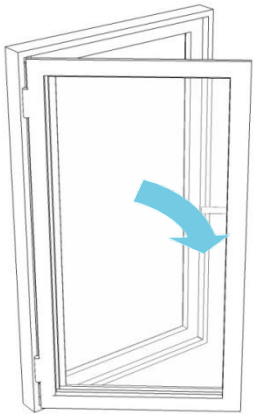
- Does the window incorporate joints which would allow the internal hardware to be manipulated? (E.g. joints between adjoining sashes on vertical or horizontal sliding windows.)

The window types shown in Figure 1 are commonly used on residential properties.

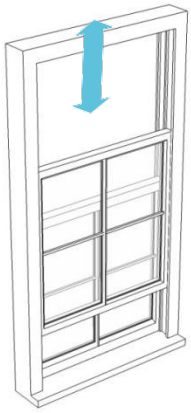
Figure 1: Window opening modes (viewed from outside the property)



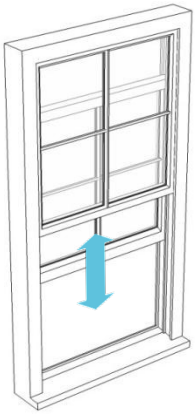
Inward opening[‡§]



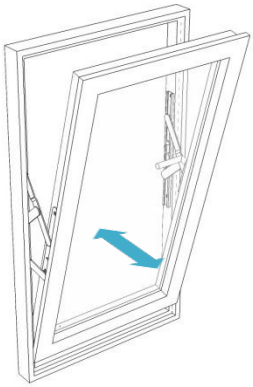
Outward opening[§]



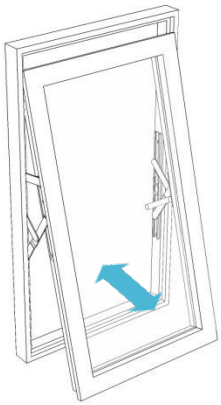
Sash (downward opening)



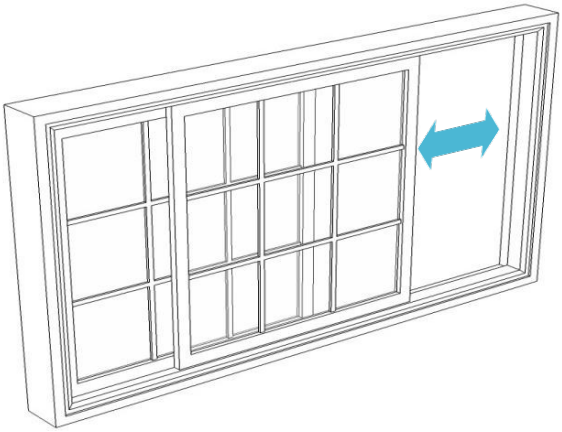
Sash (upward opening)



Bottom hung§



Top hung§

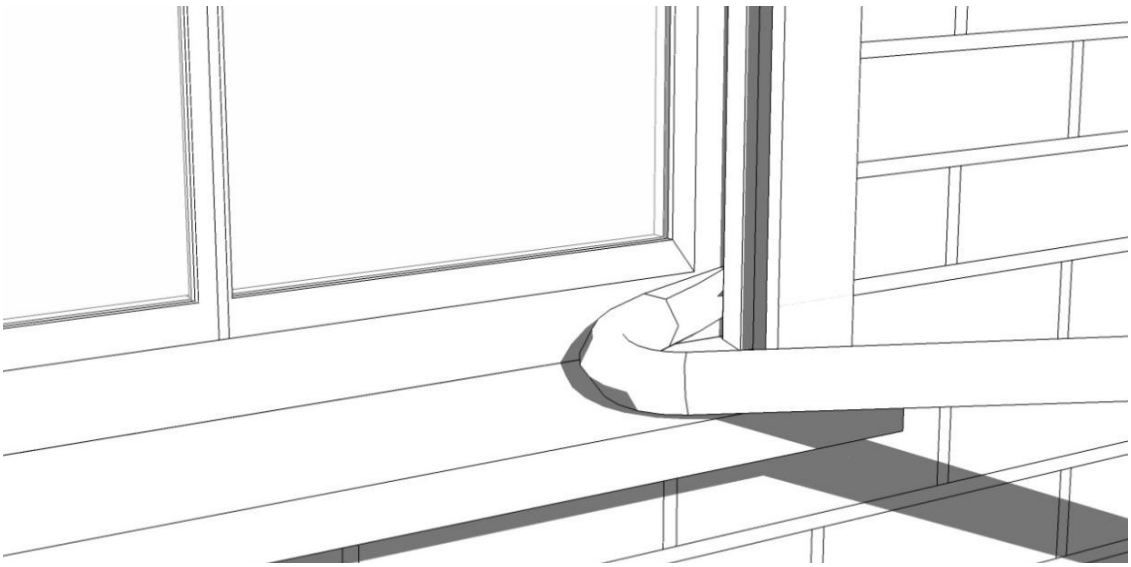


Sideways sliding

‡ Inward opening windows are more commonly used on upper floor windows of multi-storey residential buildings. This is to enable residents to clean their windows.

§ Some windows have multiple opening modes, i.e. they operate as both outward/inward opening and top/bottom hung. These are known as 'tilt and turn' windows.

Figure 2: A view of the meeting point of the sliding sash leaf and frame, where if gaps are present, tools may be used to exploit the hardware.



Materials

The material used to assemble the window and the quality of that material can have a significant effect on the window's security. It should be noted that all materials used to construct domestic windows are vulnerable to attack. In most cases, attempts to gain entry through the window will leave some form of damage. However, although the type of material used to form the window may affect the force required, or the method adopted to gain entry, the benefit of one material compared to another is difficult to quantify. This is mainly because many factors influence the security afforded by a window – not just the material from which it is made.

Timber

Timber windows are prone to degradation through rotting and weathering, therefore the type, quality, condition and maintenance of the timber is of key importance. If there is visual evidence of damage or deterioration, steps can be taken to investigate the quality of the timber, e.g. trying to remove a small section of the timber and confirming whether it splinters easily.

Any degradation of the window may lower its security performance because it will be easier to gain access through or around the material to either force the window open or manipulate the hardware.

When assessing timber windows the following points should be considered:

- Does the material look weathered and are there visible signs of degradation?
- Is there any movement or splitting in the joints of the frame and opening sash(s)?
- Is the glazing fully supported by the timber beading or other retention system, such as putty?

In terms of general security, timber windows of a suitable quality can offer good levels of security for domestic purposes. The quality of the timber will affect its resistance to attacks aimed at levering open the sash, splitting the frames to remove the glazing or to remove the whole window. Any attacks on the timber are likely to result in visible damage. However, if not significant that damage may be repairable. This may have an effect if the main concern is undetected compromise. However, painting the windows can make it more difficult for intruders to conceal damage.

PVC-u

Although PVC-u does degrade, the visual signs of this are not as apparent as with timber windows. If the quality of the PVC-u is not appropriate, or the material has deteriorated, it can become brittle.

The following points should be considered when assessing PVC-u windows:

- Does the PVC-u look discoloured or deformed?
- Are there any splits/cracks in the corner joints of the frame or sashes?
- Are any sections of the PVC-u damaged?
- Is there any evidence of the beading becoming detached?

As with timber windows, PVC-u windows can offer good levels of security for domestic purposes. Furthermore, any attacks aimed at gaining entry through the window are likely to result in visual damage. Depending on the amount of damage and where the damage occurs, it may be possible to repair the window more easily and more quickly than a timber window, especially if the damage only relates to the beading around the glazing.

Composite materials

Composite materials have, in recent years, become more popular in the domestic market. These materials come in many forms and it may not be obvious during an assessment of the windows what combination of materials has been used. Nonetheless, as with timber and PVC-u windows, the following checks should be made:

- Are there any visible signs of degradation to the material?
- Are there any cracks in the joints or members forming the window? Is the glazing unit fully supported by the window frame?

For domestic purposes, composite windows can offer a level of attack resistance equivalent to that provided by timber and PVC-u products. However, unlike timber and PVC-u, depending on the actual composite material used, it may not be very easy to repair the window if attacked. This may have significant effect if the main concern is undetected compromise.

Steel and aluminium

Steel and aluminium windows are not commonly used for domestic purposes. Nonetheless, the same principles should be adopted as those detailed above for other materials. Steel and aluminium windows may offer slightly greater resistance to attack by nature of the material. However, this will depend on the design of the window and thickness of the material used. As with PVC-u windows, damage created during some attacks may be repaired easily if the correct steel/aluminium components can be sourced.

Locking mechanisms and hinges

Locking mechanisms

It is not practical to cover all configurations of locking mechanisms fitted to domestic windows. Designs are continually evolving to meet the ever-changing demands of users and the need to make windows more secure. Nonetheless, it is possible to identify the key factors when assessing the security resistance afforded by domestic windows.

Non-lockable hardware

Modern domestic windows are unlikely to incorporate non-lockable hardware. However, older style pivot windows and sliding sash windows (see Figure 3), may have non-lockable hardware.

Non-lockable hardware is considered to be far less resistant to attack than lockable hardware. Nonlockable hardware (e.g. Figure 3), may be vulnerable to manipulation through gaps in the window frame or between the opening sash and window frame. Intruders may also be able to operate such hardware by drilling or gouging small holes through the frame or sash.

It is recommended that non-lockable hardware is **not** relied upon to secure domestic windows where any reasonable level of security is required. Consideration should be given to replacing the locking mechanism completely if possible or incorporating supplementary locking mechanisms (see page 15, *Enhancing the security of windows*).

It should be noted that the ease and effectiveness with which non-lockable hardware can be replaced with lockable versions will depend on the design and condition of the window. In many cases it may be more effective to replace the whole window.

Lockable hardware

Where some level of security is required, it is recommended that lockable hardware is used, as shown in Figure 3. In many cases on domestic windows this comes in the form of a lockable cockspur handle, although other devices are available.

Generally, unless there are significant gaps between the opening sash and the window frame, damage would be caused to the window during any attempt to overcome the lockable hardware. The extent of the damage would depend on the design of the window and the material from which it is made.

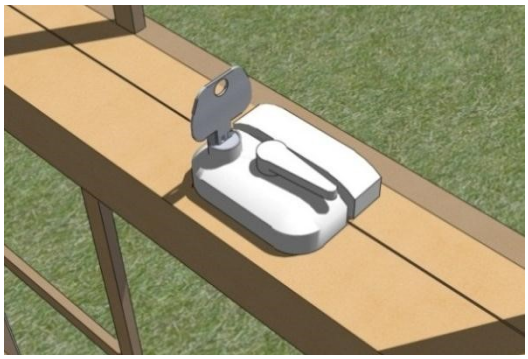
Locking Points

Many modern domestic windows incorporate ***espagnolette*** locking devices (see Figure 4). These incorporate multiple locking points around the perimeter of the opening sash. They are generally operated via a single lockable handle. On the basis that the operating handle cannot be overcome without first creating damage to the window, such locking mechanisms offer greater resistance to attack than devices only incorporating single locking points.

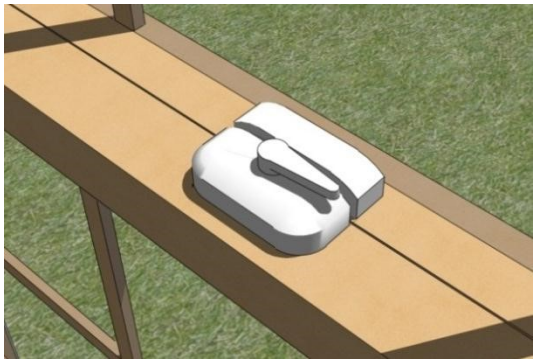
It is recommended that where possible, windows incorporate multiple locking points. Consideration should be given to replacing the locking mechanism completely (if possible) or incorporating supplementary locking mechanisms (see page 15), in order to enhance security.

The ease and effectiveness with which locking hardware can be replaced will depend on the window's design and condition. In most cases it may be more effective to replace the whole window.

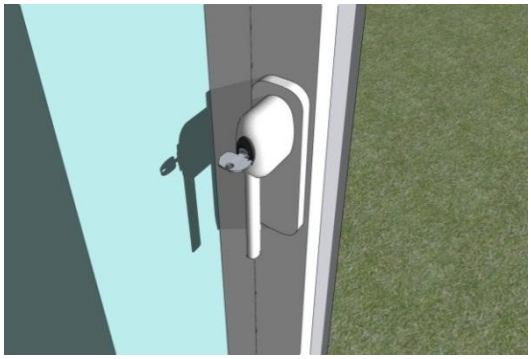
Figure 3: Lockable and non-lockable hardware



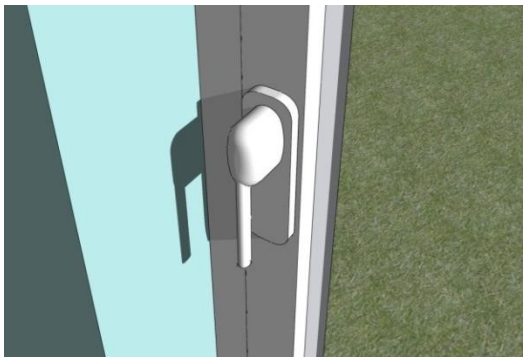
Sliding sash (lockable)



Sliding sash (non-lockable)

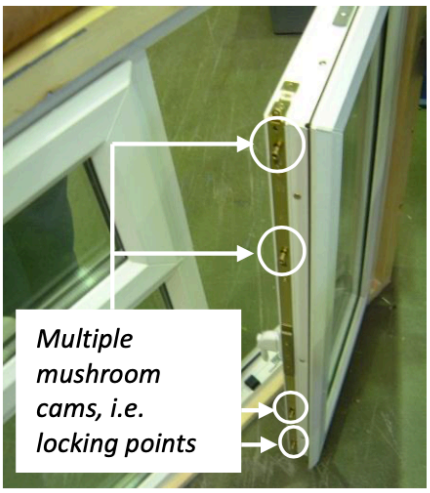


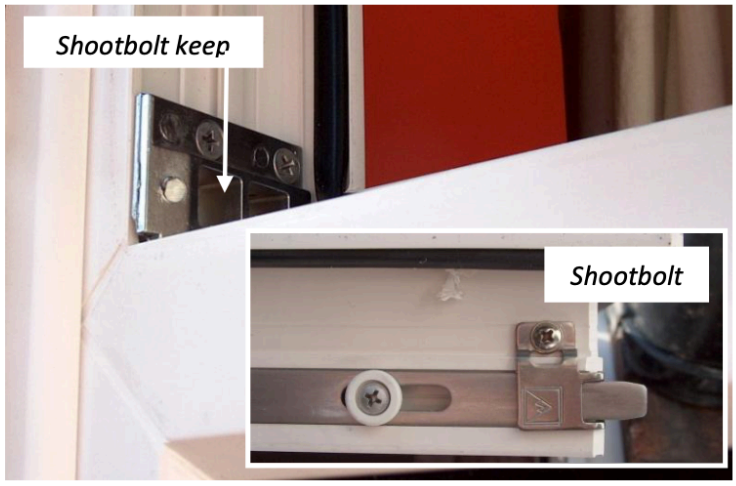
Hinged sash (lockable)



Hinged sash (non-lockable)

Figure 4: Espagnolette locking system features

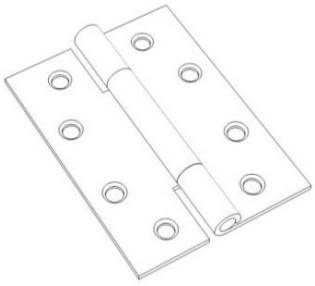




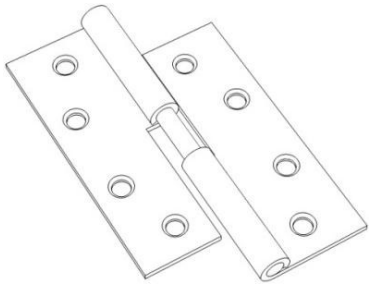
Hinges

The type and style of hinges on domestic windows varies depending on the window's opening mode and, to some extent, on the materials used to construct the window. Hinge types typically used on domestic windows can include those shown in Figure 5.

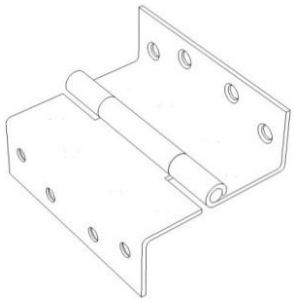
Figure 5: Hinge types



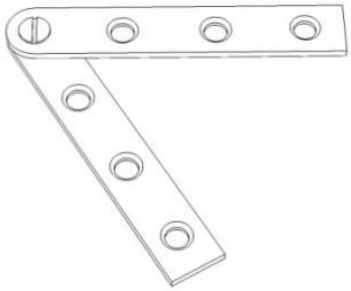
Butt hinges



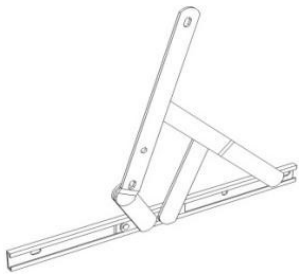
Lift-off hinges



Cranked hinges



Pivot hinges



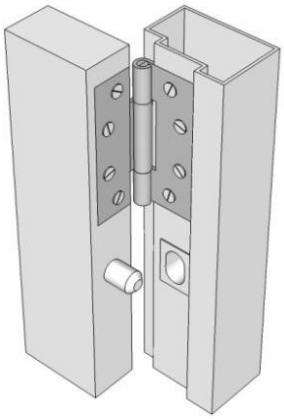
Variable geometry hinges

In general terms, exposed hinges on the attack face of a window are more likely to be susceptible to attack. This is because it may be possible to remove the hinge pins and/or gain greater access to overcome the hinge fixings.

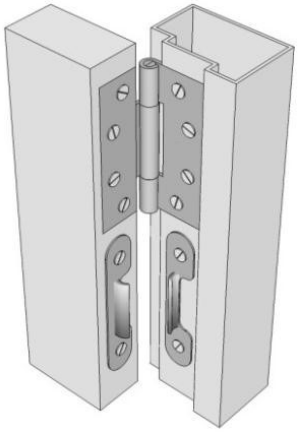
Modern domestic windows often incorporate hinge claws. These are located within the hinge jamb, adjacent to the hinges. If loads are applied to the window to force apart the opening light and the frame, the claws engage and thereby enhancing the window's resistance to being levered open (see Figure 6).

As an alternative to hinge claws, dogbolts can be used along the hinge edge to provide greater resistance to levering attack.

Figure 6: Hinge protection hardware



Dog bolt



Hinge claw

Glazing method and type of glazing

Glazing methods

Domestic windows are either externally or internally glazed.

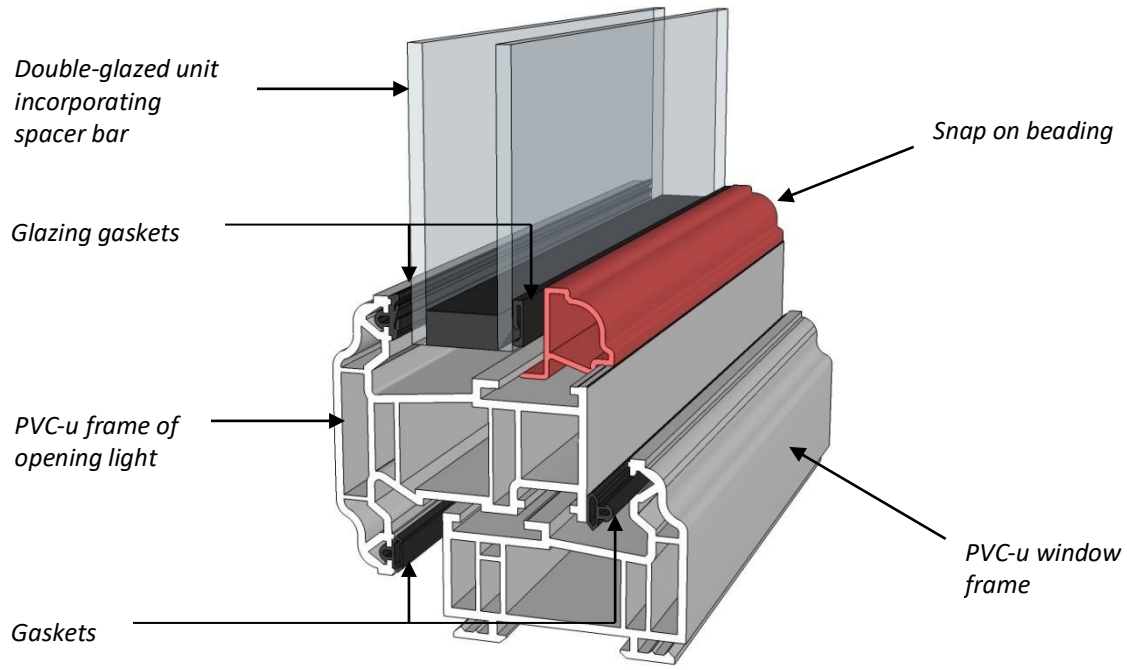
Having installed the glazing unit into the window frame, beads are fixed around the perimeter of the aperture to secure the glazing in place. Figure 7 shows a typical beading detail of an internally-glazed PVC-u window.

The type and style of beading varies. The beading on PVC-u, aluminium and steel windows is generally clipped into place and secured by the profile of the bead and the frame profile into which it fits. A neoprene, or similar material, gasket would be fixed between the bead and the glazing unit to provide a weather seal. These types of beading are designed to be removed with relative ease and without causing any damage. Furthermore, the type and size of the beading is unlikely to affect the ease with which it can be removed. This could be critical if undetected compromise is of concern.

The beads on timber windows are generally pinned into place or, in some cases, glued. The gap between the bead and the glazing is usually filled with some form of gasket or sealant. Although timber beads can be removed, this may not be as easy as the ‘clip-in’ type used on other materials. It may also result in damage to the bead itself. Therefore, in the case of externally beaded windows, it does not take significant effort to remove the glazing unless additional measures are taken to secure the beading. Such measures can include:

- using screws to secure the beading, especially in the case of the ‘clip-in’ beading;
- securing the glazing in place using glazing clips or tape.

Figure 7: PVC-u window section – beading detail



In older types of domestic window the glazing may be secured by putty, which deteriorates over time and can fall out. Furthermore, putty needs time to dry, which introduces a period of vulnerability as the putty and glass can be more easily removed when the putty is still soft on newly installed or repaired windows. It is therefore advisable to avoid the use of putty for retaining glass.

Types of glazing

Domestic windows are generally fitted with double-glazed units. The overall thickness can vary, as can the type of glass. Older windows may only have single-glazed units consisting of a single thickness of glass. The glass used in modern domestic windows would typically be:

- toughened glass
- float/annealed**
- laminated

The main difference between the glass types is the way in which it fails when broken and the ease with which it can be broken.

Toughened glass, when broken, will shatter into small fragments that either fall out of the window or can easily be pushed out.

Float/annealed glass will break into large, sharp pieces.

** The use of float/annealed glass is restricted by the Building Regulations for England and Wales. Float/annealed glass may be installed within windows in older properties which pre-date the restrictions incorporated in building regulations.

Laminated glass is used where a higher security level is required. There are many forms of laminated glass, but those used in domestic windows are usually formed from two layers of glass with a PVB interlayer. When impacted the glass will generally break but will not necessarily fall out. However, such glazing can still be very susceptible to forced entry.

In order to significantly increase the window's resistance to attacks aimed at creating apertures through the glazing, consideration should be given to installing laminate glazing incorporating polycarbonate interlayers.

Further guidance on security glazing is published in *Security Glazing: Is it all it's cracked up to be?*[10]

Installation method

Domestic windows are normally fitted within a structural opening and fixed to the substrate using a number of screwed fixings around the perimeter. The heads of the fixings are usually not visible from the external face of the window. The gap between the window frame and the substrate is then filled with sealant.

Unless access can be gained to the heads of the fixings to unscrew them, the only other way to gain entry would be to shear all the fixings and then lever the window out of the frame.

Enhancing the security of windows

The extent to which windows can/should be enhanced to improve their security resistance will depend on the risk/threat to the building/location where the windows are installed. It will also depend on whether the risk is from attacks where damage is acceptable, or whether undetected compromise is the main concern.

General improvements

It is not always possible to significantly improve the security of the window itself. This may be due to the condition of the window, the material from which it is made or its configuration. In some cases it may be more economical to change the window or add proprietary products such as:

- window bar sets
- collapsible or fixed grilles
- security screens

Proprietary products should be specified to an appropriate performance standard for security, commensurate with the anticipated threat. Windows can be specified to the following performance standards:

- LPS 1175[††]
- EN 1627[††]
- PAS 24[††]
- PBAS

When making improvements, consider:

- changing the locking system to a multi-point version incorporating a lockable handle. Alternatively add additional locking devices to the window;
- changing the glazing to a laminate glass incorporating polycarbonate;
- installing devices to secure the glazing unit in place so that if the beading is removed additional force is required to remove the glazing and therefore leave signs of attack;
- ensuring that the window is internally beaded. Install additional fixings to secure the beading. These fixings should have anti-tamper heads to further increase their removal time;
- providing cover plates around the perimeter of the window to cover the joint between the substrate and the frame;
- installing hinge claws or additional dogbolts into the hinged edges of openable windows.

†† A current list of security products approved to this standard by LPCB can be found in the BRE Red Book: www.redbooklive.com

References

1. **BS 7412:2007** *Specification for windows and doorsets made from unplasticized polyvinyl chloride (PVC-U) extruded hollow profiles*. British Standards Institution.

2. **BS 644:2012** *Timber windows and doorsets – Fully finished factory-assembled windows and doorsets of various types- Specification*. British Standards Institution.

3. **BS 8529:2010** *Composite doorsets – Domestic external doorsets – Specification*. British Standards Institution.

4. **BS 4873:2009** *Aluminium alloy windows and doorsets – Specification*. British Standards Institution.

5. **BS 6510:2010** *Steel-framed windows and glazed doors – Specification*. British Standards Institution.

6. **BS 7950: 1997** *Incorporating Amendments Nos. 1, 2 and 3 Specification for enhanced security performance of windows for domestic applications.*

7. **PAS 24:2012** *Enhanced security performance requirements for doorsets and windows in the UK. External doorsets and windows intended to offer a level of security suitable for dwellings and other buildings exposed to comparable risk*. British Standards Institution.

8. **LPS 1175:** Issue 7 *Requirements and testing procedures for the LPCB approval and listing of intruder resistant building components, strongpoints, security enclosures and free-standing barriers.* BRE Global Limited.

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