



Design in  
Mental Health  
Network  
LIGHT | SPACE | HOPE

**DRAFT FOR CONSULTATION JUNE 2019**

**DESIGN GUIDE FOR PRODUCTS INSTALLED AND  
USED WITHIN BUILDINGS AND FACILITIES USED  
FOR THE CARE OF MENTAL HEALTH – TEST  
METHODS AND PERFORMANCE CATEGORIZATION  
CRITERIA**

**bre**

## **ACKNOWLEDGMENTS**

BRE and the DIMHN would like to thank the following people and organisations who helped in the preparation of this first draft of this Design Guide:

Internal Working Group:

- Philip Ross - DIMHN/Safehinge Primera
- Tony Crumpton - DIMHN/Anti-Ligature Shop
- Jeff Bartle - DIMHN
- John Pendergast - Technical Publishing Resources
- Chris Hall – BRE
- Richard Hardy – BRE
- David Gall - BRE

Workshops:

- Aaztec
- Alex Caruso Architects
- Altro Technical Services
- Alessandro Caruso Architecture & Interiors
- Andy Johnston Associates
- Anti-ligature-shop
- Assa Abloy
- P21+/P22 framework
- Bradford District Care Trust
- Britplas
- Blu Building Consultants
- Couch Perry Wilkes
- Dorset Health Care NHS Trust
- Ecophon Saint-Gobain
- FBS Contracts
- Greater Manchester Mental Health
- Guardian Staff Safety Systems
- Health Facilities Scotland (incl NHS Greater Glasgow and Clyde, Lothian, Grampian, Ayrshire and Arran and Highland)
- Humber NHS Foundation Trust
- IBI Group
- Interserve Construction
- Integrated Door Sets (IDSL)
- Jenssen Architecture
- Kingsway Group
- Knightsbridge Furniture
- McSweeney Architecture
- Mersey Care NHS Trust
- NHS Improvement
- North Staffordshire Combined Healthcare NHS Trust

- Oxford Health NHS FT
- Oxleas NHS Foundation Trust
- Pennine Care NHS
- P+HS Architects
- Pineapple Contracts
- Polar NE
- South Essex Partnership NHS Trust
- Stafford Bridge Doors
- St Andrew's Healthcare
- Surelock McGill
- Sussex Partnership NHS Trust
- Teal Life Care
- Technical Publishing Resources
- Thomas Dudley
- Tough Furniture Ltd
- UCLAN
- Wallgate
- Water Management Group
- West London Mental Health Trust
- Work Space
- Yewdale

## **CONTENTS**

|   |    |
|---|----|
| Foreword  | 5  |
| Preamble  | 5  |
| 1. Scope  | 8  |
| 2 Terms and Definitions   | 8  |
| 3 General Test Procedure  | 11 |
| 4 Part 1: Assessment of The Sensitivity of Products To Be Used As Ligature<br>Anchor Points       | 14 |
| 5 Part 2: Assessment of Robustness  | 40 |
| 6 Part 3: Assessment of Additional Requirements for Doorsets, Hardware and<br>Windows Performance | 64 |
| Appendix 1  | 85 |
| Appendix 2  | 86 |
| Appendix 3  | 87 |
| Appendix 4  | 88 |
| Appendix 5  | 90 |

# **FOREWORD**

## **Preamble**

Three-quarters of people who kill themselves while in a mental health in-patient setting do so by hanging or strangulation. And although the actual number of in-patient hangings is decreasing, it is evident that continued efforts need to be made to restrict any opportunity for hanging – particularly as focus on certain types of ligatures and ligature points change over time.

It is essential that innovation is encouraged and that new and existing products used in mental health environments are assessed for ligature and self-harm risks using an independent and repeatable format. In that respect, this Design Guide aims to:

- ensure patient safety is not compromised by inappropriate selection of products for current and future use;
- communicate product-testing requirements to manufacturers to enable them to supply a product that is appropriate for the environment in which it is to be used;
- help procurement teams to better evaluate manufacturers' trade literature.

## **Introduction**

This Design Guide provides testing methodologies for materials, fixtures and hardware that have been specifically designed for use within mental healthcare facilities to reduce the risk of harm to inpatients. It brings the many disparate requirements for such products into one document to enable suitably qualified experts to choose the most appropriate products for the patients under their care, considering the specific care pathway's needs.

The document's main objectives are:

- to discourage the proliferation of unique product-testing methods by NHS trusts and authorities so that designers, contractors, manufacturers, operators and estates/maintenance staff can benefit from one national test methodology;
- to set the minimum acceptable standards that can be used with confidence knowing that the products will be within stringent NHS cost limits as well as meeting the special requirements imposed on mental health facilities;
- to provide a standard that can be easily used or referred to in contract documentation for contractors, specifiers, procurement teams and manufacturers;
- to improve efficiency and reduce design costs;
- to harness specialist knowledge;
- to enable periodical updating as standards and clinical requirements change;
- to form the basic test methodology for quality assurance systems and a certification scheme.

It has been written in such a way as to support an approvals/certification process. It does not however set pass / fail criteria, but defines test procedures and requirements that should result in demonstrating a range of performance characteristics that will enable an informed

choice for those procuring the products. It will also enable product manufacturers to demonstrate the performance of their products based on standardised rules and requirements.

This Design Guide has where appropriate specified test methods and test equipment that already exist in industry documents. However the parameters specified in those documents do not always cover the full range of scenarios that the products under test may face, or the parameters have not been defined in sufficient detail to ensure the repeatability and reproducibility of results that must underpin any approvals process that can be relied upon. In these circumstances this Design Guide has added additional requirements to cover the parameters at issue. Where there is no current appropriate standard methodology to evaluate a products performance, this Design Guide provided details on how this can be demonstrated.

It is recognised that the performance of many products can be affected by their installation, maintenance and interaction with other products and the environment that they are placed in. Whilst the product manufacturers must produce installation and maintenance guidance, the managers controlling facilities must still exercise due diligence on products and how they are used and installed to maintain the performance that the product demonstrated under test conditions. Therefore good product design must go hand in hand with good management. Regular inspections and risk assessments are necessary to help ensure buildings and rooms are safe for those patients intent on self-harm or escape and who have large amounts of time and ingenuity to plan and execute those plans.

The above points are covered in detail in the Department of Health, 'Health Technical Memorandum (HTM)' series that contains a suite of nine core subjects. HTM 00: 'Policies and principles of healthcare engineering 2014 edition' aims to ensure that everyone concerned with the managing, design, procurement and use of healthcare facilities understands the requirements (including regulatory) of the specialist, critical building and engineering technology involved. The core guidance addresses the general principles, key policies and factors common to all engineering services within a healthcare organisation. Key issues include:

- compliance with policy and relevant legislation;
- professional support and operational policy;
- design and installation;
- maintenance;
- training requirements.

This Guidance Document should be read in conjunction with the HTM standards and also the Department of Health standards series called Health Building Notes (HBN), in particular: Health Building Note 03-01: 'Adult acute mental health units'

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/147864/HBN\\_03-01\\_Final.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/147864/HBN_03-01_Final.pdf)

It is anticipated that this document will be the first of many to cover all aspects of the buildings used in the care of Mental Health and the products used within them. It is also anticipated that this document will continually evolve as new evidence from real events come to light and new research indicates better ways of doing things (for example, from incidents recorded on the National Reporting and Learning System (NRLS) (the world's largest and most comprehensive patient safety incident reporting system which receives over two million reports each year) or from safety bulletins issued through Estates and Facilities Alerts (EFA's) and through the Home Nations NHS bulletins).

This document primarily covers the performance of:

- products for their ability to reduce the risk of ligature;
- products for their ability to withstand sustained attack and abuse.
- some specific characteristics of doors, windows and their furniture and hardware such as anti-barricade for doors and cleanability of mesh for windows

Other characteristics such as fire performance, acoustics, aesthetics, and other desirable design performance requirements are touched on in this document.

The working groups that helped inform the development of this Design Guide divided into three work streams and these are recognised in this Design Guide as three distinct parts.

- Part One: Assessment of sensitivity of products to be used as ligature anchor points.
- Part Two: Assessment of Robustness.
- Part Three: Assessment of Doorsets, hardware and windows performance assessment requirements.

The working groups during their deliberations covered a vast range of issues and gave significant feedback on issues that should be considered in future work and guidance documents. Their feedback is captured in Appendices 3 and 5.

## **IMPORTANT**

This Design Guide does not cover legislation such as acts and regulations, and the requirements specified herein do not take the place of users' and manufacturers' statutory duties.

## 1.0. SCOPE

This Design Guide specifies test methods and performance criteria relevant to products installed and used within buildings and facilities used for the care of mental health.

This Design Guide does not specify pass/fail criteria, instead it sets out threshold points against which manufacturers can claim compliance, or/and if they wish an achieved result. Specifiers can use the outputs of testing to this Design Guide to make informed choices of products that meet the needs of their specific requirements.

This Design Guide is applicable to the following products used within, primarily high risk, areas such as bedrooms, bathrooms, toilets and other spaces and areas that are infrequently observed:

- doorsets and windows and their associated hardware
- furniture
- sanitary fittings
- fixtures and fittings
- safety devices

This Design Guide only specifies test methods for the following parameters

- sensitivity of products to be used as ligature anchor points
- robustness of products from a strength, operational durability, and failure mode assessments
- Certain additional parameters specific to doorsets, hardware and windows, including noise; cleanability; light attenuation; airflow and ventilation; daylight transmission; and safety devices

This Design Guide is applicable to new products as manufactured. They must be installed on/in a suitable substrate representative of how it will be mounted in service, according to the manufacturer's installation instructions.

## 2.0. TERMS AND DEFINITIONS

For the purpose of this guide the following definitions apply:

**Associated mounting device:** A plate, escutcheon or similar fixture by means of which the reduced ligature device is mounted and/or attached to a surface using fixings that are either inaccessible or require special tools to release them. Associated mounting devices will normally be subject to the same safety tests as the fixed hardware devices.

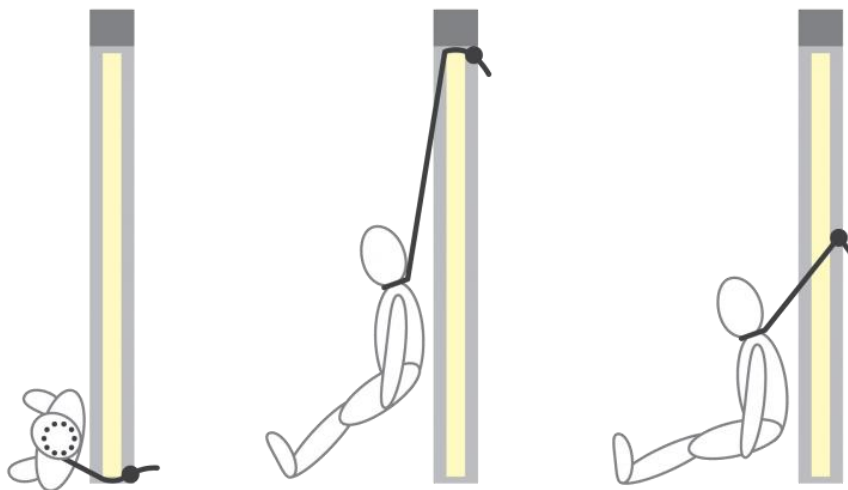
**Fixed hardware device:** A product which performs a specific function that is fixed/attached to a surface which has fixings that are either inaccessible or require special tools to release them. It may be possible to attach potential ligature materials, but the measure of ligature performance will be the load at which it releases at.



**Ligature:** A ligature can be defined as anything a person can use to hang or strangle themselves with. It can be made from anything that can be used to form a noose that can be used to inflict harm by restricting normal breathing or blood flow, leading to asphyxiation and not necessarily obviously able to support body weight.

Examples include chains, linen, clothing (including belts, laces, bras, ties, tights stitching) plastic bags, bag straps, pull cords, medical and non-medical tubing, cables or wires, audio and video tapes, toilet rolls, paper towel rolls, self-adhesive leaflet backing paper, wallpaper borders etc.

**Ligature Anchor Point:** A ligature point is anything that could be used to attach (i.e. immobilise at one end) a cord, rope or other material for the purpose of strangulation. The ligature point is used to secure a ligature where the whole, or significant part of the bodies' weight can be suspended.



Ligature points can be both high and low. The loading pattern will differ depending on the anchor point height and direction of body lean/fall.

**Load release hardware device:** A product which is attached to a surface by a method which allows the products to be released from the surface when the load reaches a threshold value, below which the product performs a specific core function.

**Reduced ligature device sometimes referred to as “Anti-ligature”:** An “anti-ligature” or reduced ligature fitting is any fitting that is designed in such a way as to minimise the risk of it being used as a ligature attachment point or limit the consequences from attachment (e.g. load release devices), that could cause death however this does not mean it is not a risk, it is reduced risk.

**Snagging point:** [add definition]

**Test wire:** A normally flexible device used to assess the reduced ligature characteristics of a device



## 3.0. GENERAL TESTING PROCEDURE

### 3.1 Sample submission

Manufacturers must submit to the test laboratory:

- a full set of drawings;
- instructions and specifications on how the product is to be used, installed and maintained; and
- inspection regimes.

The manufacturer must also state the range of heights that the product can be installed and any other dimensional criteria such as proximity to other products or fixed structures. The documentation must describe the full scope and operational range of the product and highlight any operational limitations or exemptions. Manufacturers must submit to the test laboratory 3 samples of the product to be tested. Where applicable the samples must be mounted in/on a sub-structure that meets the specification stated in their installation drawings and instructions and in its intended orientation. The overall size of surrounding sub-structure is to be agreed with the laboratory. Alternatively a manufacturer may install their product into a suitable structure at the test laboratory (note that it is the responsibility of the manufacturer to ensure the product is installed correctly). If the laboratory deems that the range of suitable sub-structures specified in the manufacturer's installation instructions and drawings could affect the performance of the products, the laboratory may request more samples to test for a variety or worst-case scenarios.

### 3.2 Core function

The test laboratory must test the product to ensure that it can fulfil its core function described by the manufacturer. It must test the full range of functions claimed by the manufacturer to ensure an accurate description of the product's uses and capabilities.

The range, capability, and function verified must be reported by the laboratory.

### 3.3 Tools potentially available to patients

The following list, although not exhaustive, represents a common range of materials and tools that patients either have in their rooms, or have commonly been found to have in their possession that have been used in attempts to produce; a ligature, weapon or damage/ manipulate a product to prevent its normal operation and/or cause it to fail.

|   | <u>Items of Clothing</u>      | Ligature Susceptibility Level |
|---|-------------------------------|-------------------------------|
|   |                               |                               |
| 1 | Shoe lace small round section | 2                             |
| 2 | Shoe lace flat section        | 2                             |

|    |   |   |
|----|---|---|
| 3  | Boot lace flat section  | 2 |
| 4  | Boot lace large round section   | 2 |
| 5  | Shirt Cotton torn strip   | 2 |
| 6  | Shirt Synthetic torn strip  | 2 |
| 7  | Underwire from Bra  | 3 |
| 8  | Tights  | 1 |
| 9  | Boot  | 2 |
| 10 | Shoe  | 2 |
| 11 | Belts   | 1 |
| 12 | Elastic underwear   | 2 |
|    | <i>Note: Patients are likely to have access to multiples of these items</i> |   |
|    | <u>Personal Effects</u>   |   |
|    |   |   |
| 13 | Rings   | 2 |
| 14 | Wrist watch   | 2 |
| 15 | Hair extension  | 2 |
| 16 | Other jewellery   | 2 |
| 17 | Toothbrush  | 2 |
| 18 | Hair Comb   | 2 |
| 19 | Spectacles  | 2 |
| 20 | Hairclip  | 2 |
|    |   |   |
|    | <u>Commonly used materials</u>  |   |
|    |   |   |
| 21 | Pens  | 2 |
| 22 | Pencils   | 2 |
| 23 | CDs   | 3 |
| 24 | Headphones and associated cords   | 1 |
| 25 | Computer mouse and cord   | 2 |
| 26 | Credit card   | 2 |
| 27 | Paper and cardboard   | 2 |
| 28 | Plastic fork  | 2 |
| 29 | Plastic knife   | 2 |
| 30 | Spork   | 2 |
| 31 | Plastic Plate   | 2 |
| 32 | Plastic Cup   | 2 |
|    |   |   |
|    | <u>Room materials</u>   |   |
|    |   |   |
| 33 | Mattress  | 1 |
| 34 | Blanket   | 1 |
| 35 | Sheets  | 1 |
| 36 | Towels  | 1 |
|    |   |   |

|    |                                  |   |
|----|----------------------------------|---|
|    |                                  |   |
|    | <u>Items smuggled into rooms</u> |   |
| 37 | Screws                           | 3 |
| 38 | Nails                            | 3 |
| 39 | Poly food container              | 3 |
| 40 | Keys                             | 3 |
| 41 | Paper clip                       | 3 |
| 42 | Dental floss                     | 3 |
| 43 | Tyvek Suit                       | 3 |

The test laboratory will have a reference set of these items at their disposal. When testing products for reduced ligature performance the Test Engineer must use at least one item from each group.

### **3.4 Failures**

After testing against any of the tests specified in this Design Guide the specimen under test should continue to function normally, as described in the manufacturer's instructions. Application of the tests should not result in the specimen suffering damage or deformation, including loosening of fixings or joints, which would render it unfit for its purpose, nor should any of its composite parts become dislodged or shattered in a dangerous manner that would enable it to be used for self-harm, or as weapons. If any product does fail, (breaks, cracks, pieces become detached) under the tests specified in this Design Guide, the mode of failure and description of the failure must be recorded, photographed and reported.

## **4.0. PART 1: ASSESSMENT OF THE SENSITIVITY OF PRODUCTS TO BE USED AS LIGATURE ANCHOR POINTS**

### **4.1. Introduction**

Patient-accessible rooms should be designed to make the act of suicide or self-harm as difficult as practicable. Suicide from a ligature anchor point is generally a solitary act which takes place in areas in which the patient is alone. High risk areas include bedrooms bathrooms and toilets. Corridors are often considered lower risk however these areas are often observed intermittently. It only takes a short period of time unobserved to create an opportunity to hurt oneself – a study by the University of Manchester showed that 91% of suicides occur under intermittent observations (typically every 15 minutes).

The design of buildings, including fixtures and fittings should promote a therapeutic milieu, enable clear lines of site and encompass design features which reduce the opportunity of patients to hurt themselves or others and enable staff to gain access when required (e.g. anti-barricade doors).

The following interior detailing should be avoided:

- projections;
- level surfaces that could form hook points;
- horizontal rails or similar;
- Door handles, taps, coat hooks and the like should all be reduced ligature in patient periodically observed areas.

Self-strangulation is the main method of suicide for mental health patients. Hanging may involve suspending the body from a high ligature anchor point, with or without the feet touching the ground, but many deaths also occur through asphyxiation without suspension of the body or using a ligature anchor point below head height (see Vladislav and Khokhlov's research paper in Appendix B). It is almost impossible to eliminate all potential ligatures, since articles of clothing as well as material from everyday items such as bedding can be used. The environmental suicide risk assessment and management procedures must be viewed as part of a comprehensive suicide prevention strategy which includes clinical risk management which is outside the scope of this document. However all products used in patient rooms must be designed as far as possible to prevent them from being used as potential anchor points for ligatures, used as ligature themselves, or used for other forms of self-harm.

The testing defined in the following section is conducted on products installed according to manufacturers' instructions. Incorrect installation can have fatal results (see [Estates & Facilities Alert 2010/003](#)). It is vital that manufacturers' installation instructions are clear and unambiguous and that trained people are used to install all products.

#### **4.1.1. Indicative loads to cause harm**

There is considerable debate on what is the threshold load for a ligature to cause a death. Some US research suggests that it could be as low as 5.5 lbs (2.5 kg) although some think

11 lbs (5 kg) to be more realistic. Some of the research found is in Appendix 2. For this Design Guide, 4 levels of ligature are used these being 3/6/10/20kg.

#### 4.1.2 Types of ligature

Table 1 below shows some of the vast numbers of ways a ligature can be formed.

|                             |  |
|-----------------------------|--|
| <b>Clothing accessories</b> | <ul style="list-style-type: none"> <li>• Belts</li> <li>• Braces</li> <li>• Laces</li> <li>• Stockings</li> <li>• Tights</li> <li>• Brassieres</li> <li>• Plastic bags: <ul style="list-style-type: none"> <li>○ Carrier bags</li> <li>○ General waste bags</li> <li>○ Clinical waste bags</li> </ul> </li> </ul>                                  |
| <b>Cords</b>                | <ul style="list-style-type: none"> <li>• Lighting pull cords</li> <li>• Curtain pull cords</li> <li>• Cord from curtain header tape</li> <li>• Draw cord on bags</li> <li>• Venetian blind pull cords or chains</li> </ul>   |
| <b>Clothing</b>             | <ul style="list-style-type: none"> <li>• Shirts</li> <li>• Blouses</li> <li>• T-shirts</li> <li>• Ties</li> <li>• Trousers</li> <li>• Underwear</li> </ul> <p>(all of the above clothing items can also be torn up into strips)</p> <ul style="list-style-type: none"> <li>• Chains</li> <li>• Ropes</li> <li>• Hoses</li> <li>• String</li> </ul> |
| <b>Curtains</b>             | <ul style="list-style-type: none"> <li>• Shower curtains</li> <li>• Window curtains</li> <li>• Cubicle curtains</li> <li>• Bedding (also when torn into strips)</li> </ul>   |
| <b>Miscellaneous</b>        | <ul style="list-style-type: none"> <li>• Electrical leads</li> <li>• Flex</li> <li>• Telephone flex</li> <li>• Mobile phone charger leads</li> <li>• Headphone leads</li> <li>• Rubber strips – from fire doors, double glazing, and dust strips on cubicle curtain tracking.</li> </ul> <p>This list is not exhaustive</p>                        |
| <b>Doors</b>                | <ul style="list-style-type: none"> <li>• Trapping a ligature between door and frame, particularly at the top; or from the top edge of an open door (this has been used with wardrobe doors)</li> <li>• Door self-closing mechanism</li> </ul>  |
| <b>Door hinges</b>          | <p>Either from the hinges themselves from the part of the hinge that is sticking out from the door; or by trapping a ligature in the door above the hinge; or tying a ligature around the hinge.</p>   |
| <b>Handles</b>              | <ul style="list-style-type: none"> <li>• Bedroom door handles</li> <li>• En-suite door handles</li> <li>• Wardrobe door handles</li> <li>• Chest of drawers and cabinets in service-users' rooms</li> <li>• Door handles in toilets, shower rooms and bathrooms</li> </ul>   |

|                           |  |
|---------------------------|--|
| <b>Ceiling fittings</b>   | <ul style="list-style-type: none"> <li>• Suspended ceiling</li> <li>• Lights</li> <li>• Air vents and diffusers</li> <li>• Smoke detectors</li> <li>• Extractor grills</li> </ul>  |
| <b>Curtain tracks</b>     | <ul style="list-style-type: none"> <li>• Shower curtains</li> <li>• Bed cubicle tracking</li> <li>• Window curtains</li> </ul>   |
| <b>Windows</b>            | <ul style="list-style-type: none"> <li>• Trapping a ligature between window and frames</li> <li>• Window handles</li> <li>• Window restrictors</li> <li>• Window locks</li> </ul>  |
| <b>Pipes</b>              | <ul style="list-style-type: none"> <li>• Radiator pipes</li> <li>• Hot and cold water pipes</li> <li>• Tumble dryer ducting</li> </ul>   |
| <b>Wall fittings</b>      | <ul style="list-style-type: none"> <li>• Fire alarm bells</li> <li>• Soap dispensers</li> <li>• Paper towel dispensers</li> <li>• Shelves</li> <li>• Fire alarm call points</li> <li>• Coat hooks</li> <li>• Pictures and paintings</li> <li>• Mirrors</li> <li>• Cabinets</li> <li>• Fire doors electric or magnetic</li> </ul> |
| <b>Miscellaneous</b>      | <ul style="list-style-type: none"> <li>• Hold back/hold open devices</li> <li>• Alarm panels</li> <li>• Key cabinets</li> <li>• Wall mounted TVs</li> <li>• Wall lights</li> <li>• Patients alarm/call points</li> <li>• Disability rails/grab bars</li> <li>• Stair rails</li> </ul>  |
| <b>Beds</b>               | <ul style="list-style-type: none"> <li>• Bedhead/headboard</li> <li>• Beds upended or propped up on their end/against the wall</li> <li>• Profiling beds from frame or actuating mechanism</li> </ul>  |
| <b>Cupboards</b>          | <ul style="list-style-type: none"> <li>• Shelving</li> <li>• Coat hooks</li> <li>• Wire coat hangers</li> <li>• Clothes racks</li> <li>• Cupboard doors and handles</li> </ul>   |
| <b>Building structure</b> | <ul style="list-style-type: none"> <li>• False ceilings</li> <li>• Loft hatch</li> <li>• Maintenance access hatch / panel</li> </ul>   |
| <b>Outside Space</b>      | <ul style="list-style-type: none"> <li>• Trees</li> <li>• Fencing</li> <li>• Gazebos</li> <li>• Covered walkways</li> <li>• Guttering</li> <li>• Rainwater down pipes</li> </ul>   |

### 4.1.3. Forms of ligature with load

1. Hooking over or under, or to the side on products (multi-directional) – ligature cord attached to product, pulled in variety of directions (undamaged)
2. Products with insecure fixing or insufficiently robust substrate (to fix to), damaged and exposing ligature point (connecting cord to fixings or created hole)



3. Digging around products into wall structure to expose ligature points
4. Ligature point through window mesh or shower drains (ligature through small holes) or window trickle vents
5. Ligature points at joints or holes (thin slot) on LST/radiators cover or fixed furniture or hinge knuckle
  - a. Using an external item in hole or slots (i.e. toothbrush or staff ID card) to form/create a ligature point by wedging in a gap
  - b. Wedging knots (bed sheets) in recesses or slots
  - c. Solid item inserted in slot and rotated (i.e. pen inserted and rotated)

## **4.2. Assessment**

### **4.2.1. Requirement**

Ligature resistance (looping): The product must resist the ability of a flexible device to be used as a ligature by means of either looping around or tying off to any part or device on or attached to the product.

Ligature resistance (wedging): The product must resist the ability of a flexible device to be used as a ligature by means of being knotted, jammed, or otherwise wedged into any opening, crevice, hole, or operating clearance associated with the product.

Secondary criteria: configuration: If installed in a particular configuration, the product would create ligature opportunities that would not otherwise exist. Example 1; an item of furniture could be wedged between two fixed points thereby creating a ligature point, even though all the individual products may not present a ligature opportunity on their own. Example 2; a solid surface bathroom counter with an integral undermount bowl is safe when installed according to the following two conditions:

1. the counter must either be fully recessed into a niche or carefully detailed so that one end of the counter is bordered by a wall with the other end carefully detailed to eliminate the possibility of looping.
2. the sink trap under the counter must be fully enclosed behind a continuous ligature-resistant enclosure. If either of these two conditions is not met, the counter or the under counter pipes will provide a ligature point.

### **4.2.2 Product categories**

There are various methods to reduce the risk of ligature on fixtures and fittings, and so the products are divided into five categories

- Fixed products (A product intended to be permanently attached that does not have parts operable by patients (for example, handrails or light fittings.))
- Movable fixed products (A product that is part of the built fabric, but operable by a patient. Ligature risk assessments are different as the product can be moved to various positions to create a ligature point. An example of this product could be a door or a window.)
- Load release products (A product that has two states, normal use (core function) and release function where the product will react to an abnormal load and fall away or collapse to prevent a ligature, for example, shower curtain rail.)

- Abnormal load or ligature detection systems (There are a number of systems that now detect a ligature being attempted. These considerations with these products are different as they do not eliminate the risk of a ligature, but alert when it occurs. The focus of the assessment is the reliability of these systems.)
- Loose furniture (Items found within a room or mental health environment that are not fixed in position. This might be a chair or a coffee table.)

### 4.2.3 Assessment procedure

Assessment of products will be carried out and categorised into 3 levels of risk

1. Susceptibility of being used as a ligature anchor point from a patient acting on impulse or with little or no planning.
2. Susceptibility of being used as a ligature anchor point by a patient with some planning and manipulation.
3. Susceptibility of being used as a ligature anchor point by a patient with a great deal of planning and determined attack.

## 4.3. Test procedures

### 4.3.1. Fixed products

#### 4.3.1.1. Introduction

Fixed products are intended to be permanently attached and does not have parts operable by patients.

#### 4.3.1.2. Test methods

##### 4.3.1.2.1. Level 1. Susceptibility of being used as a ligature anchor point from a patient acting on impulse or with little or no planning

###### 4.3.1.2.1.1 Stage 1 Test Wire

|  | Grade 1* | Grade 2* | Grade 3* | Grade 4* |
|--|----------|----------|----------|----------|
| Test wire diameter   | 4mm      | 2mm      | 1mm      | 0.5mm    |
| Note: *These are the four grades of test wire to test for ligature susceptibility (looping) as defined in Technical Specification DHF TS 001:2013 – ‘Enhanced Requirements & Test Methods for Anti-Ligature Hardware’. |          |          |          |          |

The wire must be prepared such that it can lasso the product or form a ligature with a slip knot. At the free end, a loop must be formed to attach a suitable digital force gauge with

peak-hold function. The test engineer must sweep the product in all directions with each wire in turn to see if the wire can be made to snag on any part of the product including the interface with the sub-structure or other products. The test engineer may push the wire into any crevices or other potential snagging points. When a snagging point is found a force must be applied to the test wire through the force gauge until the wire releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded including the angle at which the ligature was formed, the wire diameter used and the force to release. The test must be repeated using all four different wire diameters although in most instances if a product passes the test with the smallest diameter wire it will usually pass with the thicker wires

#### **4.3.1.2.1.2 Stage 2 Sheet material**

Susceptibility to the use of a sheet material. An untampered bedding sheet and/or towel, (whichever is most onerous), must be used to wrap around the product to try and produce a ligature point. At the free end of the sheet a loop must be formed to attach a suitable digital force gauge with peak-hold function. The test engineer must sweep the product in all directions to see if the sheet can be made to snag on any part of the product including the interface with the sub-structure or other products. The test engineer may push the sheet into any crevices or other potential snagging points. When a snagging point is found a force must be applied to the sheet through the force gauge until the sheet releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded including the angle at which the ligature was formed, wrapping technique used for the sheet to grip and the force to release.

#### **4.3.1.2.2 Level 2. Susceptibility of being used as a ligature anchor point by a patient with some planning and manipulation**

##### **4.3.1.2.2.1 Test A - Product undamaged**

The test engineer must attempt to secure a ligature point on the product under test using any one, or combination of the test wires, test sheeting and items from the list in clause 3.3. in such a way that a ligature anchor point can be achieved. The ligature point could be created through looping or wedging. When a ligature point is achieved a force must be applied to the ligature point created through the force gauge until it releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded, including the angle at which the ligature was formed, the materials and tools used to create the ligature point, and the force to release

#### **4.3.1.2.2.2 Test B – Product damaged or manipulated**

The test engineer must attempt to damage, disassemble or manipulate the product or its mounting sub-structure, using any one, or combination of, the test wires, test sheeting and tools from the list in clause 3.3. in such a way that a ligature anchor point can be achieved. The ligature point could be created through looping or wedging. The engineer has 20 minutes to conduct their attack. The attack must be of a stealthy nature that could not be heard by staff outside the patients' room or excused for being only a small number of audible impacts.

Indicative examples: A broken CD, or a key may be used as a tool on the product or the sub-structure to scratch/abrade, cut, or bore a hole. A tool could be used as a lever (with or without body weight) to bend or overstress a product to produce a gap big enough to produce a ligature point. The use of tools as impactors, or body parts such feet used to kick are likely to be heard outside the room and therefore not included in this test method. Pushing and pulling using human force is acceptable.

When a ligature point is achieved a force must be applied to the ligature point created through the force gauge until it releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded, including the angle at which the ligature was formed, the products used to create the ligature point, and the force to release.

#### **4.3.1.2.3 Level 3. Susceptibility of being used as a ligature anchor point by a patient with a great deal of planning and determined attack.**

##### **4.3.1.2.3.1 Test A**

The test described in clause 4.3.1.2.2.2 must be repeated but the engineer will have 40 minutes to conduct their attack. They will also be allowed to use a power tool, such as an electric drill, to hold one of the tools listed in clause 3.3 to speed up, or increase, the number of repetitive actions. This test tries to replicate a determined long duration attack on a product that may covertly span many days or weeks. It also recognises that patients with mental health illness can produce forces and tolerate pain far in excess of accepted norms. In conducting these tests the engineer has no limitation of noise made during the attacks.

Indicative examples; a hairclip or paperclip may be used as a crude drill. An engineer may put the hairclip or paperclip into the drill chuck and attempt to drill a hole. A broken CD may be used as a crude saw. The engineer may use an electric reciprocating saw to hold the broken CD.

##### **4.3.1.2.3.1 Test B**

The determination of susceptibility of being used as a ligature point by a patient must also be tested where applicable after the product has completed any robustness or aging tests.

### 4.3.1.3 Results

All snagging points/ligature points must be recorded, including the angle at which the ligature was formed, the products used to create the ligature point, and the force to release. The results must be presented as shown below:

|   |     |     |     |       |       |
|---|-----|-----|-----|-------|-------|
| <b>Product Description (including range, capability, and function):</b>       |     |     |     |       |       |
| <b>Height Range of use</b>  |     |     |     |       |       |
| <b><u>Ligature detection</u></b>  |     |     |     |       |       |
| <b>Level 1 Susceptibility – impulse, no planning</b>                          |     |     |     |       |       |
| Test wire / material used to form a ligature                                  | 4mm | 2mm | 1mm | 0.5mm | sheet |
| Load and angle at which the ligature was formed                               |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| <b>Level 2 Susceptibility – some planning</b>                                 |     |     |     |       |       |
| Test A: - Describe what tool or material that was used to form a ligature     |     |     |     |       |       |
| Load and angle at which the ligature was formed                               |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| Test B: – Describe how product was damaged or manipulated and time to achieve |     |     |     |       |       |
| Load and angle at which the ligature was formed                               |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| <b>Level 3 Susceptibility – A great deal of planning</b>                      |     |     |     |       |       |
| Test A: - Describe how product was damaged or manipulated and time to achieve |     |     |     |       |       |
| Load and angle at which the ligature was formed                               |     |     |     |       |       |
|   |     |     |     |       |       |
| Test B: Describe the  |     |     |     |       |       |

|  |  |
|--|--|
| failure mechanism that allowed a ligature point to be achieved |  |
| Load and angle at which the ligature was formed                |  |
|  |  |
|  |  |

### 4.3.2 Movable fixed products

#### 4.3.2.1 Introduction

A movable fixed product is a product that is part of the built fabric, but operable by a patient. Ligature risk assessments are different as the product can be moved to various positions to create a ligature point such as wedging. An example of this product could be a door or a sliding window.

When the product is submitted for testing it must be fully operational, mounted in its intended surround or frame, which in turn is mounted into a suitable sub-structure, and include all seals, hinges, and hardware with tolerance gaps that can be achieved in real world constructions settings. If the product can be supplied in a number of different configurations with a range of different hardware, a risk assessment must be carried out with the Test Laboratory Engineers to identify the worst-case scenarios. It is likely therefore that several products may be needed to be tested to cover the full range of possible options.

When conducting the testing, the Test Engineer must also assess the ligature risk of not only the product, for example the door, but also its fire and draft seals, hinges, vision panels, locks, hardware, trickle vents and any other features that it may have.

##### 4.3.2.1.1 Forms of ligature with load

1. Trapping (by clamping) or wedging between two movable components i.e. between door and frame
2. Sliding panels on windows, wedging in gap, then window moving it further to enhance anchor
3. Enlarged gaps manipulated with for example a shoe
4. Gaps in hinges
5. Connection point between two moving parts
6. Binding of door on frame or stop (stressing door by over-opening/extending) to create temporary gap (must be tested within manufacturers scope of operation guidance)
7. Handles working loose over time – creates ligature point
8. Lock latch bolt
9. Conical turns (handles or showers adjustments) – gaps between the turn and the frame.

## 4.3.2.2 Test Methods

### 4.3.2.2.1 Level 1. Susceptibility of being used as a ligature anchor point from a patient acting on impulse or with little or no planning

#### 4.3.2.2.1.1 Stage 1 Test Wire

|                    | Grade 1* | Grade 2* | Grade 3* | Grade 4* |
|--------------------|----------|----------|----------|----------|
| Test wire diameter | 4mm      | 2mm      | 1mm      | 0.5mm    |

Note: \*These are the four grades of test wire to test for ligature susceptibility (looping) as defined in Technical Specification DHF TS 001:2013 – ‘Enhanced Requirements & Test Methods for Anti-Ligature Hardware’.

The wire must be prepared such that it can ‘lasso’ the product or form a ligature with a slip knot. At the free end a loop must be formed to attach a suitable digital force gauge with peak-hold function. The test engineer must sweep the product in all directions with each wire in turn to see if the wire can be made to snag on any part of the product including the interface with the sub-structure or other products. The test engineer may push the wire into any crevices or other potential snagging points. The above test method must be applied through the entire range that the product can be moved through, based on its specified designed normal movement range. Whilst moving the product through its range of movement the test engineer must look for wedging, trapping and clamping opportunities of the test wire due to closing of gaps. When a snagging/clamping point is found, a force must be applied to the test wire through the force gauge until the wire releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenarios. All snagging points must be recorded including the angle at which the ligature was formed, the position of the product in its movement range, the wire diameter used, and the force to release. The test must be repeated using all 4 different wire diameters.

#### 4.3.2.2.1.2 Stage 2 Sheet material

Susceptibility to the use of a sheet material. A bedding sheet and/or towel (whichever is most onerous), must be used to wrap around the product to try and produce a ligature point. At the free end of the sheet a loop must be formed to attach a suitable peak holding electronic force gauge. The test engineer must sweep the product in all directions to see if the sheet can be made to snag on any part of the product including the interface with the sub-structure or other products. The test engineer may push the sheet into any crevices or other potential snagging points. The above test method must be applied through the entire range that the product can be moved through, based on its specified designed normal movement range. Whilst moving the product through its range of movement the test engineer must look for wedging, trapping and clamping opportunities of the test sheet due to closing of gaps. When a snagging point is found a force must be applied to the sheet through the force gauge until the sheet releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt

can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded including the angle at which the ligature was formed, the position of the product in its movement range, wrapping technique used for the sheet to grip and the force to release.

#### **4.3.2.2.2 Level 2. Susceptibility of being used as a ligature anchor point by a patient with some planning and manipulation**

##### **4.3.2.2.2.1 Test A - Product undamaged**

The test engineer must attempt to secure a ligature point on the product under test using any one, or combination of the test wires, test sheeting and tools from the list in clause 3.3. in such a way that a ligature anchor point can be achieved. The ligature point could be created through looping or wedging. The product must be moved through its full range of designed normal movement whilst trying to detect potential ligature points and wedging, trapping and clamping opportunities. When a ligature point is achieved a force must be applied to the ligature point created through the force gauge until it releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded, including the angle at which the ligature was formed, the position of the product in its movement range, the tools and materials used to create the ligature point, and the force to release

##### **4.3.2.2.2.2 Test B – Product damaged or manipulated**

The test engineer must attempt to damage, disassemble or manipulate the product or its mounting sub-structure, using any one or combination of the test wires, test sheeting and tools from the list in clause 3.3. in such a way that a ligature anchor point can be achieved. The ligature point could be created through looping or wedging. With products that can move, the engineer must simulate forced over movements, or strained movements, on items such as over opening of a door and other pivots using stealthy attack methods to attempt to produce ligature points. Patients can demonstrate great ingenuity in looking to damage products therefore in simulating over strained movements the Test Engineer can use any commonly used items such as shoes to act as wedges. The engineer has 20 minutes to conduct their attack. The attack must be of a stealthy nature that could not be heard by staff outside the patients' room

Indicative examples: A broken CD, or a key may be used as a tool on the product or the sub-structure to scratch/abrade, cut, or bore a hole. A tool could be used as a lever (with or without body weight) to bend or overstress a product to produce a gap big enough to produce a ligature point. A belt could be wedged between a door and frame gap. The use of tools as impactors, or body parts such feet used to kick are likely to be heard outside the room and therefore not included in this test method. Pushing and pulling using human force is acceptable.

When a ligature point is achieved a force must be applied to the ligature point created through the force gauge until it releases from the product. The force must be applied gently and slowly at a rate of approximately 1 Newton per second. More than one attempt can be



made if the test engineer considers that the force achieved was affected by the way the load was applied. The aim of the test is to find the worst-case scenario. All snagging points must be recorded, including the angle at which the ligature was formed, position and orientation of the movable product, the products used to create the ligature point, and the force to release.

**4.3.2.2.3 Level 3. Susceptibility of being used as a ligature anchor point by a patient with a great deal of planning and determined attack.**

**4.3.2.2.3.1 Test A**

The test described in clause 4.3.2.2.2 must be repeated but the engineer will have 40 minutes to conduct their attack. They will also be allowed to use a power tool, such as an electric drill, to hold one of the tools listed in clause 3.3. to speed up, or increase, the number of repetitive actions. This test tries to replicate a determined long duration attack on a product that may covertly span many days or weeks. It also recognises that patients with mental health illness can produce forces and tolerate pain far in excess of accepted norms. In conducting these tests the engineer has no limitation of noise made during the attacks.

Indicative examples; a hairclip or paperclip may be used as a crude drill. An engineer may put the hairclip or paperclip into the drill chuck and attempt to drill a hole. A broken CD may be used as a crude saw. The engineer may use an electric reciprocating saw to hold the broken CD.

**4.3.2.2.3.2 Test B**

The determination of susceptibility of being used as a ligature point by a patient must also be tested after the product has completed any robustness or aging tests where applicable.

**4.3.2.3 Results**

All snagging points/ligature points must be recorded, including the angle at which the ligature was formed, the products used to create the ligature point, and the force to release. The results must be presented as shown below:

|  |     |     |     |       |       |
|--|-----|-----|-----|-------|-------|
| <b>Product Description (including range, capability, and function):-</b> |     |     |     |       |       |
| <b>Height Range of use</b>   |     |     |     |       |       |
| <b><u>Ligature detection</u></b>   |     |     |     |       |       |
| <b>Susceptibility 1 – impulse, no planning</b>                           |     |     |     |       |       |
| Test wire / material used to form a ligature                             | 4mm | 2mm | 1mm | 0.5mm | sheet |
| Load and angle at which the ligature                                     |     |     |     |       |       |
|  |     |     |     |       |       |

|   |  |  |  |  |  |
|---|--|--|--|--|--|
| was formed  |  |  |  |  |  |
| <b>Susceptibility 2 – some planning</b>   |  |  |  |  |  |
| Test A: - Describe what tool or material was used to form a ligature                |  |  |  |  |  |
| Load and angle at which the ligature was formed                                     |  |  |  |  |  |
|   |  |  |  |  |  |
|   |  |  |  |  |  |
| Test B: – Describe how product was damaged or manipulated and time to achieve       |  |  |  |  |  |
| Load and angle at which the ligature was formed                                     |  |  |  |  |  |
|   |  |  |  |  |  |
|   |  |  |  |  |  |
| <b>Susceptibility 3 – A great deal of planning</b>                                  |  |  |  |  |  |
| Test A: - Describe how product was damaged or manipulated and time to achieve       |  |  |  |  |  |
| Load and angle at which the ligature was formed                                     |  |  |  |  |  |
|   |  |  |  |  |  |
|   |  |  |  |  |  |
| Test B: Describe the failure mechanism that allowed a ligature point to be achieved |  |  |  |  |  |
| Load and angle at which the ligature was formed                                     |  |  |  |  |  |
|   |  |  |  |  |  |
|   |  |  |  |  |  |

### 4.3.3 Load release products

#### 4.3.3.1 Introduction

This is a product that has two states, normal use (core function) and release function where the product will react to an abnormal load and fall away or collapse to prevent a ligature.

##### 4.3.3.1.1 Points for consideration:

1. Important to acknowledge that all load release items have a fixed product base/anchor that needs to be assessed differently

2. The weight of load release items could give an opportunity for accidental harm (i.e. towel holder falling on foot)
3. Ligature connecting to load release item – will it release at sufficient load?
4. Load release item used to create an additional ligature risk/tool once detached
5. ‘Bunching’ load release points to give distorted load release weight value
6. Manipulating load release connection – i.e. trapping bed sheet in connecting interface to distort load characteristics
7. Multiple attempts – testing load release after extended periods of use
8. Preloaded/empty item – i.e. towel rail or paper towel dispenser tested empty or not
9. Non-vertical load release characteristics
10. Wedging load release track in smaller space (guidance point?)

Load release devices are often used for curtain tracks. The following points are for guidance: Fill all joints between sections of curtain track with tamper resistant sealant to reduce opportunities for ligature.

End caps can create opportunity for a wedge ligature.

A looping point can be created in curtain tracks when an object, such as a penny, is inserted into the track.

The product could be a fixed product or a fixed movable product as defined in the previous two sections and will therefore be subject to the tests defined for these products.

The manufacturer of the product must submit to the Test Laboratory detailed specifications of how the product works and its designed purpose, its designed release load at all designed angles, and any limitations of operation.

#### **4.3.3.1.2 Important note**

It is vital that adequate risk assessments are conducted on load release products when they are installed to check for the proximity of other products that might inhibit the operation of the load release or if there is potential for several load release products in close proximity (bunching) to each other to be used as a single ligature point. Consideration should also be given in risk assessments of balancing the risk of ligature and the risk of using the load release product as a weapon.

#### **4.3.3.2 Test Method**

##### **4.3.3.2.1. Normal Operation**

The Test Engineer must test the product in its designed configuration to verify the manufacturer’s claims, particularly the release load claimed. All verified operations must be recorded and reported. The Test Engineer must also assess the possibility of the released part being suitable as a weapon or tool for self-harm.

##### **4.3.3.2.2. Level 1. Susceptibility of being used as a ligature anchor point from a patient acting on impulse or with little or no planning**

The tests defined in sections **4.3.1.2.1** and **4.3.2.2.1** must be applied to the product as appropriate whether it is a fixed or movable product. These tests must be used to detect any

potential ligature points that are not covered by the intended design release mechanism of the product.

**4.3.3.2.3. Level 2. Susceptibility of being used as a ligature anchor point by a patient with some planning and manipulation**

The Test Engineer using the tools in clause 3.3 must manipulate or attack the load release product in a stealthy manner for a maximum of 20 minutes in an attempt to either prevent it from releasing entirely or to increase the release load above the claimed designed release load. If the Test Engineer is successful the results must be recorded and reported stating how the failure was achieved.

The product must also be tested to the same requirements in sections 4.3.1.2.2 and 4.3.2.2.2 test A and B as fixed, or fixed movable products, whichever is applicable.

**4.3.3.2.4. Level 3. Susceptibility of being used as a ligature anchor point by a patient with a great deal of planning and determined attack.**

The Test Engineer using the tools in clause 3.3 must manipulate or attack the load release product for maximum of 40 minutes in an attempt to either prevent it from releasing entirely or to increase the release load above the claimed designed release load. If the Test Engineer is successful the results must be recorded and reported stating how the failure was achieved.

The product must also be tested to the same requirements in sections 4.3.1.2.3 and 4.3.2.2.3 as fixed, or fixed-movable products, whichever is applicable

**4.3.3.3. Results**

All snagging points/ligature points must be recorded, including the angle at which the ligature was formed, the products used to create the ligature point, and the force to release. The results should be presented as shown below:

The products claimed and verified load release characteristics must be stated in the test report.

|   |  |
|---|--|
| <b>Product Description (including range, capability, and function): -</b> |  |
| <b>Height Range of use</b>  |  |
| <b>Designed release load and mode of operation</b>                        |  |
| <b>Measured release load and mode of operation</b>                        |  |

| <b><u>Ligature detection</u></b>  |     |     |     |       |       |
|---|-----|-----|-----|-------|-------|
| <b>Susceptibility 1 – impulse, no planning</b>                                      |     |     |     |       |       |
| Test wire / material used to form a ligature  | 4mm | 2mm | 1mm | 0.5mm | sheet |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| <b>Susceptibility 2 – some planning</b>   |     |     |     |       |       |
| Test A: - Describe what tool or material was used to form a ligature                |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| Test B: – Describe how product was damaged or manipulated and time to achieve       |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| <b>Susceptibility 3 – A great deal of planning</b>                                  |     |     |     |       |       |
| Test A: - Describe how product was damaged or manipulated and time to achieve       |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| Test B: Describe the failure mechanism that allowed a ligature point to be achieved |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |

#### **4.3.4 Abnormal load or ligature detection systems**

##### **4.3.4.1 Introduction**

There are a number of electro-mechanical systems that now detect a ligature being attempted on a fixed or moveable-fixed product. The considerations with these products are different as they do not eliminate the risk of a ligature, but trigger staff alerts when it occurs. The focus of the product assessment is the reliability and coverage of these systems.

Detectors that are sold as accessories to be added to, for example doors, must be submitted to the test laboratory with full operating and installation instructions. The instructions must clearly show the types of fasteners to be used, along with any applicable torque settings. If the product can be fitted to a number of different manufacturer's products, the instructions must be clear on range, sizes and specifications. The type of door it can be fitted to and how, must be clearly documented and any limitations with the scope depending on the different types of door, frame and hinging detail. The detector must not undermine any of the functions or design parameters of product to which it is being attached such as door closers, smoke and fire sealing, or the anti-barricade release.

Detectors that are sold as integral with another product must be tested with the whole product. This may mean the product/s may undergo multiple different tests depending on the feature under test.

The following must be addressed in the manufacturer's operation instructions and must be submitted to the Test Laboratory.

- System testing procedures and/or active fault detection systems that include;
  - Visual identification that the door alarm is still operational
  - Maintenance regimes and vulnerable items such as dirt in product gaps, preventing operation of alarm
  - Frequency and process for checking operation of the alarm system
  - Active fault detection systems fail-safe mechanism
- Resistance to liquid (water or urination)
- EMC (Electromagnetic Compatibility) and wireless compatibility with other wireless systems within hospitals, use CE marked testing of product radio frequencies and restrictions
- Robustness and ongoing maintenance, life-cycle considerations
  - Alarm system
    - Robustness against attack
    - Impact of wear and tear (number of operations)
  - Infrastructure (cabling, etc – ease of maintenance if concealed)

##### **4.3.4.2 Test Method**

###### **4.3.4.2.1 Normal Operation**

The Test Engineer must test the product in its designed configuration to verify the manufacturers claims, particularly the load or ligature detection method and scope claimed. The Test Engineer must evaluate if there are any gaps or blind spots in the detection system.

## Examples

*On a door top load detector the Test Engineer must check that the detection force is within design parameters across the whole width of the door or whatever the defined scope is. Check to see if there are dead spots at either end of the device. Check detection accuracy with point loads and uniformly loaded points applied vertically and at all achievable angles, depending on the claims of the product.*

*If the detector is of the full door type where systems monitor increases or decreases in the mass of the door, the Test Engineer must check that the detection force is within design parameters across the whole width of the door. Check to see if there are dead spots at any of the door extremities. Check detection accuracy with point loads and uniformly loaded points applied vertically and at all achievable angles.*

*If the detector is of the 'Presence detection systems' type. The Test Engineer must introduce a range of typical ligature materials ranging from the test wires defined in clause 4.3.1.2.1.1 to sheet materials to evaluate the accuracy of detection.*

*The detector must also be tested for its sensitivity to the speed of load application such as slow application or sudden or shock load application.*

If the detector relies on a power source for its operation the test Engineer must test the product in its powered and unpowered states. Any alarm system that detects a power failure must be checked for operation and adequate warning systems.

The responsiveness of the detector must be assessed by the Test Engineer. The test report must indicate the time taken from a load being applied to the alarm sounding which should be compared with response times claimed by the manufacturer. Alarms triggering more than 1 second greater than that claimed should be regarded as failing.

If the product's detection system is adjustable, the adjustment must not be accessible to patients. The product must be tested at the extreme ends of its adjustment and at a typical adjustment setting. All tests listed below that simulate abuse, must also assess the susceptibility of the product's adjustment system being altered into a dangerous configuration.

If a product's alarm system is designed to be integrated into a more comprehensive alarm system, full details must be provided to the Test Laboratory. A worst-case test regime must be agreed with the Test Laboratory to fully evaluate the potential for either the product's or system alarms being compromised in the event of an attack or malfunction.

All verified detection parameters must be recorded and reported.

### **4.3.4.2.2. Level 1. Susceptibility of being used as a ligature anchor point from a patient acting on impulse or with little or no planning**

The installed detector must be subjected to the tests defined in sections 4.3.1.2.1 and 4.3.2.2.1 to see if potential ligature points have been introduced outside of the detectors intended range. They must be applied to the product as appropriate whether it is a fixed or

movable product. These tests must be used to detect any potential ligature points that are not covered by the intended design and detection system of the product.

**4.3.4.2.3. Level 2. Susceptibility of being used as a ligature anchor point by a patient with some planning and manipulation**

The Test Engineer using the tools in clause 3.3 must manipulate or attack the load or ligature detection system in a stealthy manner for a maximum of 20 minutes in an attempt to either prevent it from detecting a load or ligature entirely, or to alter the detection characteristics sufficiently to enable a ligature to be formed or for increased loads to be applied without detection. If the Test Engineer is successful the results must be recorded and reported stating how the failure was achieved.

The product must also be tested to the same requirements in sections 4.3.1.2.2 and 4.3.2.2.2 tests A and B as fixed, or fixed movable products, whichever is applicable.

**4.3.4.2.4. Level 3. Susceptibility of being used as a ligature anchor point by a patient with a great deal of planning and determined attack.**

The Test Engineer using the tools in clause 3.3 must manipulate or attack the load or ligature detection system for a maximum of 40 minutes in an attempt to either prevent it from detecting a load or ligature entirely, or to alter the detection characteristics sufficiently to enable a ligature to be formed or for increased loads to be applied without detection. If the Test Engineer is successful the results must be recorded and reported stating how the failure was achieved.

The product must also be tested to the same requirements in sections 4.3.1.2.3 and 4.3.2.2.3 tests A and B as fixed, or fixed movable products, whichever is applicable.

**4.3.4.3 Results**

All snagging points/ligature points must be recorded, including the angle at which the ligature was formed, the products used to create the ligature point, and the force to release. The results should be presented as shown below:

The products claimed and verified load or ligature detection characteristics must be stated in the test report.

|   |  |
|---|--|
| <b>Product Description (including range, capability, and function): -</b> |  |
| <b>Height Range of use</b>  |  |
| <b>Designed detection load and zone of</b>                                |  |



|   |     |     |     |       |       |
|---|-----|-----|-----|-------|-------|
| <b>detection</b>  |     |     |     |       |       |
| <b>Measured detection load and zone of detection and response time</b>              |     |     |     |       |       |
| <b>Power failure indication</b>   |     |     |     |       |       |
| <b>Compatibility with other systems</b>   |     |     |     |       |       |
| <b><u>Ligature detection</u></b>  |     |     |     |       |       |
| <b>Susceptibility 1 – impulse, no planning</b>                                      |     |     |     |       |       |
| Test wire / material used to form a ligature  | 4mm | 2mm | 1mm | 0.5mm | sheet |
|   |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| <b>Susceptibility 2 – some planning</b>   |     |     |     |       |       |
| Test A: - Describe what tool or material was used to form a ligature                |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| Test B: – Describe how product was damaged or manipulated and time to achieve       |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| <b>Susceptibility 3 – A great deal of planning</b>                                  |     |     |     |       |       |
| Test A: - Describe how product was damaged or manipulated and time to achieve       |     |     |     |       |       |
| Load and angle at which the ligature was formed                                     |     |     |     |       |       |
|   |     |     |     |       |       |
|   |     |     |     |       |       |
| Test B: Describe the failure mechanism that allowed a ligature point to be achieved |     |     |     |       |       |

|   |  |
|---|--|
| Load and angle at which the ligature was formed |  |
|   |  |
|   |  |
|   |  |

### 4.3.5. Loose Furniture

#### 4.3.5.1 Introduction

Built in furniture must be assessed as a fixed product or fixed moveable product or both if they have fixed and moveable elements. Loose furniture is categorised as items found within a room or mental health environment that are not fixed in position. This might be a chair or a coffee table.

The design and specification of all furniture and fittings to be used in patient-accessible areas should be robust; reduced ligature; prevent opportunities for concealment of contraband, weapons or small items; and meet infection control requirements. The furniture should also be designed to reduce the potential of the furniture being able to be stacked to access 'out of reach' ligature points. Furniture that is very light and easily picked up should be designed to reduce the potential of it being used as a weapon. Furniture that is very heavy to prevent it being lifted or easily moved, should be designed to reduce the potential for it to be used as an anchor point for self-harm through means of a crocodile roll or as a means of barricading or as a tool to damage other products. Where furniture is weighted the means of weighting must be inaccessible to patients to avoid it being used as a weapon.

It is essential to conduct a risk assessment for all rooms and areas where loose furniture is to be used. The following are some of the considerations to be made:

1. Interaction with the room, can you trap an item of furniture between two fixed items (similar to fixed movable item) – for example between a bed and wall or over the top of the door
2. Using furniture to access 'out of reach' ligature points
3. Manipulation of furniture (cutting wedge into form) to create ligature, placed on bed for height
4. Low level anchor points for crocodile roll, wrapping around a chair

#### 4.3.5.2 Test requirements:

The furniture must undergo a thorough examination by the Test Engineer to assess:

- does the product perform its core function
- whether the product could be stacked or interlocked with other products
- whether the product could be used as a weapon,
- whether the weighting method can be accessed, could it be used as a weapon, create a ligature anchor point, or used in any other means of self-harm
- whether the product has any places to conceal contraband or weapons
- product mass

The furniture could be heavy, or light. If a ligature anchor point can be achieved on the product during level 1 testing, and the product moves before the maximum permitted load for classification is met, the load at which the product moves must be recorded by the Test

Engineer. For level 2 and 3 testing the Test Engineer using the tools defined in clause 3.3 must try to stop the product moving and record the maximum load achieved at the ligature anchor point. If it is likely that the product could be wedged against other items in a typical room this should also be replicated in the test methodology for level 3 testing.

#### **4.3.5.2.1 Level 1. Susceptibility of being used as a ligature anchor point from a patient acting on impulse or with little or no planning**

The furniture must be subjected to the tests defined in sections 4.3.1.2.1 and 4.3.2.2.1 as fixed or fixed movable products, whichever is applicable, to assess if potential ligature points are present on the furniture.

#### **4.3.5.2.2 Level 2. Susceptibility of being used as a ligature anchor point by a patient with some planning and manipulation**

The furniture must be tested to the same requirements in sections 4.3.1.2.2 and 4.3.2.2.2 tests A and B as fixed, or fixed movable products, whichever is applicable.

Test A: The test engineer must attempt to secure a ligature point on the product under test using any one, or combination of the test wires, test sheeting and items from the list in clause 3.3. in such a way that a ligature anchor point can be achieved.

Test B: The Test Engineer using the tools in clause 3.3 must manipulate or attack the furniture in a stealthy manner for a maximum of 20 minutes in an attempt to form a ligature anchor point and/or to alter the products design features such as its ability to be stacked, used as a weapon, enable access to the weighting method, generate places to conceal contraband or weapons.

If the Test Engineer is successful in any of the tests the results must be recorded and reported stating how the failure was achieved.

#### **4.3.5.2.3 Level 3. Susceptibility of being used as a ligature anchor point by a patient with a great deal of planning and determined attack.**

The product must also be tested to the same requirements in sections 4.3.1.2.3 and 4.3.2.2.3 tests A and B as fixed, or fixed movable products, whichever is applicable.

The Test Engineer using the tools in clause 3.3 must manipulate or attack the furniture for a maximum of 40 minutes in an attempt to form a ligature anchor point and/or alter the design characteristics of the furniture sufficiently to be stacked, used as a weapon, enable access to the weighting method, or generate places to conceal contraband or weapons.

If the Test Engineer is successful the results must be recorded and reported stating how the failure was achieved.

### 4.3.5.3 Results

All ligature anchor points/snagging points must be recorded, including the angle at which the ligature was formed, the products used to create the ligature point, and the force to release. The results should be presented as shown below:

|  |     |     |     |       |       |
|--|-----|-----|-----|-------|-------|
| <b>Product Description (including range, capability, and function): -</b>      |     |     |     |       |       |
| <b>Height Range of use</b>   |     |     |     |       |       |
| <b>Stack ability</b>   |     |     |     |       |       |
| <b>Weaponisation</b>   |     |     |     |       |       |
| <b>Concealment</b>   |     |     |     |       |       |
| <b>Access to Weight</b>  |     |     |     |       |       |
| <b>Mass of Furniture</b>   |     |     |     |       |       |
| <b><u>Ligature detection</u></b>   |     |     |     |       |       |
| <b>Susceptibility 1 – impulse, no planning</b>                                 |     |     |     |       |       |
| Test wire / material used to form a ligature                                   | 4mm | 2mm | 1mm | 0.5mm | sheet |
| Load and angle at which the ligature was formed. Did furniture move?           |     |     |     |       |       |
|  |     |     |     |       |       |
|  |     |     |     |       |       |
| <b>Susceptibility 2 – some planning</b>  |     |     |     |       |       |
| Test A: - Describe what tool or material was used to form a ligature           |     |     |     |       |       |
| Load and angle at which the ligature was formed. Did furniture move?           |     |     |     |       |       |
|  |     |     |     |       |       |
|  |     |     |     |       |       |
| Test B: – Describe how product was damaged or manipulated and time to achieve  |     |     |     |       |       |
| Load and angle at which the ligature was formed. Did furniture move?           |     |     |     |       |       |
|  |     |     |     |       |       |
|  |     |     |     |       |       |
| <b>Susceptibility 3 – A great deal of planning</b>                             |     |     |     |       |       |
| Test A: - Describe how product was damaged or manipulated and time to achieve. |     |     |     |       |       |

|   |  |
|---|--|
| Load and angle at which the ligature was formed. Did furniture move?                |  |
|   |  |
|   |  |
|   |  |
| Test B: Describe the failure mechanism that allowed a ligature point to be achieved |  |
| Load and angle at which the ligature was formed. Did furniture move?                |  |
|   |  |
|   |  |
|   |  |

#### 4.4. Ligature Categorization Table

For each of the tests described in section 4.3. the results of the assessments and tests must be reported on the forms detailed for each type of product. The results will indicate both the maximum force a potential ligature anchor point can sustain, and also the angle(s) and direction the load was applied. The result sheet will also indicate the height range over which the product might be used. Those doing risk assessments within the facility that the products are to be used in should take all three of these parameters into consideration when deciding if a product is suitable for the environment into which it is being installed.

*For example if a ligature anchor point can be created on a product only in an upward direction, and that product is designed to be used at height the risk of the product being used as a ligature point is very low. However if the product is designed to be used at low level the risk of it being used as a ligature point will be higher.*

However to make it easier for the industry to identify different performance levels of a product the following table has been developed to indicate 5 different category groups. Whilst this table cannot fully take the place of a standalone risk assessment, the categorizations used should be a helpful guide that will cover most scenarios

| Performance  | Rating | Description   |
|--|--------|---|
| No ligature anchor point was created, or the release load was less than 3kgs at all three levels of susceptibility testing.    | LIG 5  | A very determined patient who pre-plans, manipulates products using tools with time no object until they achieve their aims, and engages significant ingenuity to succeed. May have smuggled in extra materials and tools. Unlikely to stop planning until an attempt is made or is discovered. Ligature anchor points could be created from any angle. |
| No ligature anchor point was created, or the release load was less than 6kgs after testing to Susceptibility levels 1 and 2.   | LIG 4  | A determined patient who pre-plans, manipulates products using tools in the times between observations, and engages some ingenuity, mixing different tools and materials to achieve their aims.<br>Ligature anchor points used from any angle below the horizontal and angles up to $\pm 30^\circ$ above the horizontal.                                |
| No ligature anchor point was created, or the release load was less than 10kgs after testing to Susceptibility levels 1 and 2.  | LIG 3  | A patient who pre-plans and manipulates products using readily available tools and materials in the times between observations to engineer a ligature anchor point. Ligature anchor points used from any angle below the horizontal   |
| No ligature anchor point was created, or the release load was less than 10kgs after testing to Susceptibility levels 1 and 2A. | LIG 2  | A patient who is largely acting on impulse but makes some considerations on method and materials. Ligature anchor points used downwards through a $\pm 60^\circ$ from the vertical.   |
| No ligature anchor point was created, or the release load was less than 20kgs after testing to Susceptibility level 1 only.    | LIG 1  | A patient who acts on impulse and spur of the moment using whatever materials are at hand. Ligature anchor points used downwards through a $\pm 30^\circ$ from the vertical.  |

## 5.0. PART 2: ASSESSMENT OF ROBUSTNESS

### 5.1. Introduction

Part 2 of this Design Guide, deals with the robustness and security testing of products used in facilities for the care of patients with mental ill health.

A significant proportion of damage caused to products used in mental health care units are done so by human force such as caused by running at a product with the full body weight, a kick from a stationary position, a drop kick, punching or jumping on products. The strength of attack can be affected by clothing (e.g. shoes, no shoes) and medication. The 'superhuman' strength that can be exerted when pain receptors are reduced must be considered and factored into the test regimes. The length of time of attacks can depend on Service Provider's intervention policy, and these forms of damage are typically audible allowing staff to observe and, if/when safe, intervene. We also hope that more thorough testing can allow Service Providers to better inform their intervention policies based on recorded time to failure.

Some typical methods used to damage products:

- Running at door with force, repeatedly. Distance and therefore potential speed increases with the type of room/area (bedroom, seclusion rooms and long corridors)
- Kicking sanitary ware to break off of fixings
- Lying down to repeatedly kick doors and or fixtures (floors are often anti-slip)
- Jumping on window sills to remove and use as weapon. Jumping on top of sanitary ware to damage or remove from wall fixings
- Punching (and kicking with run and jump) observation panel to cause the beading to fail in the door
- Wedging a wet towel in door and ramming shut to break hinging point
- Over-opening of doors when not restricted (assuming this is within the scope of the manufacturers guidelines)
- Slamming doors/windows opening or closed

Less frequent are attacks with significant planning. Damage can be caused without any audible or visible signs or alerting staff carrying out observations. Those intent on this type of attack may use background noise levels (e.g. bin lorry arriving) and/or intentional use of noise to distract such as playing music loudly.

Typical examples:

- Use of heat friction on rubber using an ID card or credit card
- Picking at screw fixings with finger nails or using hardened skin to try and remove screw fixings
- Using thread/zip on clothes to erode curtain track fixings (or other fixed items) to create ligature points
- Use of lighter to damage a product or set fire to it
- Urination (water damage) on sensors to prevent operation or corrode products
- Impact of vibration (small and regular movement)
- Use of chewing gum or toe nail clippings in keyways
- More modern items such as E-cigarettes, lithium batteries, transformers, lead pencils in plug sockets can all be used for attacking products

Something that is often overlooked in mental health, with the focus on abusive attacks, however, is wear and tear based on significantly increased cyclical operations in mental health environments. For example, 100k cycles of locking operation on nursing base door might only be six months usage in extreme examples.

In the mental health environment it is very important to know how products fail and therefore important to test products to destruction. Understanding the failure mode could help staff understand when intervention is required and create safer environments by avoiding products that fail in a dangerous way. Some considerations for how products fail are shown below:

- Fail safe (i.e. small granules) or dangerous (i.e. sharp, heavy loose item or swallow risk – toxic or sharps in internals)
- Concealment or ligature risks when gaps are formed after damage
- Products no longer functioning as designed and creating problems from ligature risks to extremes of failure preventing critical operation (i.e. anti-barricade system, locks or door system)
- Fixing method of the item (i.e. door or window) to structure can be damaged, creating problems from ligature risks, to extremes of failure where products become dangerous or failed fixings can allow a patient to abscond
- If components become detached from products or they fail with sharp edges, these can become tools or weapons

Less obvious damage that can have a detrimental effect on patient recovery and wellbeing is, aesthetic damage. Scratching and defacing products can also occur, largely to cause disruption to service or as a means of vandalism.

There are a large number of British, European and International standards that cover the operation, strength, durability and classification of products such as doors, windows, sanitary ware and furniture. However, although many allow for different levels of use and abuse, they do not specifically address the unique environment of a mental health unit. Some specific standards written by the healthcare industry such as the Department of Health, Health Building Notes and Health Technical Memorandum do address mental health but in many instances do not specify tests for the full range of possible scenarios that products may need to safely perform in. They are also brief on detail, allowing for a wide range of interpretation of how to test, resulting in some cases, to tests that are not representative of real life and skew the ability to choose the most suitable product.

Three Standards that specifically cover the requirements of the care of mental health are;

- Health Building Note 03-01: 'Adult acute mental health units'. This guidance covers the design of acute in-patient units in England, for adults aged 18 years and upwards,
- DH (2011) 'Environmental Design Guide: adult medium secure services'
- DH (2010) 'High secure building design guide: overarching principles - for Ashworth, Broadmoor, Rampton Hospitals'.

It is very important that users, designers and manufactures familiarize themselves with all the appropriate standards and regulations that mandate requirements for the products that they produce. This Design Guide does not cover acts and regulations and performance



characteristics such as weathertightness, watertightness, and fire. Nor does it cover the classification and security performance of locks. It only deals with robustness characteristics of strength, durability and failure mode.

## **5.2. Test Procedures**

### **5.2.1. Doors and Windows**

#### **5.2.1.1. Introduction**

There are a significant number of British and European standards that define test methods and performance criteria for the durability and strength of doors and windows. Where possible this Design Guide tries to use existing standardised methods that industry are already using, rather than come up with new methods and procedures. In researching the existing standards two different routes to demonstrate adequate performance to meet the minimum requirements of mental health were identified. These are

- Testing Approach 1. This route demonstrates the performance of doors and windows using standard test methods and classifications to meet specific pre-defined environmental conditions. Products classified under BS 6372 as severe duty should meet the minimum strength and durability requirements of products used in mental healthcare for low risk patients. The forces applied in the testing are representative of significant abuse by people using their bodies or readily available implements and 'tools'.
- Testing Approach 2. This route demonstrates the performance of doors and windows based on the classification used in 3 commonly used security standards that specify test methods for demonstrating intruder resistant, or attempts to break out. Doors and windows classified under the security standards at the lower levels should meet the minimum strength and durability requirements of products used in mental healthcare under most foreseeable use scenarios including deliberate attacks and attempts to defeat the products. The forces applied in the testing are representative of attacks using limited tools (similar to those specified in this Design Guide) and human force. The forces and test methods used in the testing and classification of doors and windows at the higher level are based on assailants having access to significant tools such as wrecking bars, power tools, hydraulic jacks and industrial cutting tools. Doors meeting these requirements might only be required in very special cases.

The two approaches described above define test methods that can be used to demonstrate the minimum performance of products suitable for low risk patients in mental healthcare. Meeting these requirements would allow a product to given a ROB1 classification to this Design Guide.

However the methods are generic and do not necessarily cover all the requirements of a mental healthcare environment. Some tests such as repeated door slamming are not covered in the basic requirements. Some the loads and impacts in the performance levels specified the two approaches also do go far enough to cover all the scenarios. A third testing approach is therefore required to enable manufacturers to differentiate and demonstrate that their products meet these extended requirements and too achieve higher classifications to

this Design Guide. This route details test methods and scenarios that are either extensions of the standard test methods or characteristics that are not specified in the standard tests.

## **5.2.1.2. Test Methods**

### **5.2.1.2.1. Testing Approach 1 - Standard Test Methods For Demonstrating Strength And Durability Performance Of Doors And Windows Under Severe Duty Cycles**

#### **5.2.1.2.1.1. Test samples**

The requirements for test sample submission are the same as those described in clause 3.1. For doors, the manufacturer must submit the doorset with all its associated hardware including where appropriate, closers and anti-barricade devices. If multiple options are available for the doorset such as; sizes of door, hardware, and safety devices, the Test Laboratory must advise the manufacturer of the different combinations to be tested. Similarly windows must be submitted with all their associated hardware

#### **5.2.1.2.1.2. Requirements**

##### **5.2.1.2.1.2.1 Classification Standards**

Two standards one British and the other European identifies characteristics and classes of performance appropriate for windows and internal/external pedestrian doorsets intended for the UK. These are:

EN 14351-1:2006+A2:2016 'Windows and doors — Product standard, performance characteristics — Part 1: Windows and external pedestrian doorsets'

BS 6375-2:2009 'Performance of windows and doors – Part 2: Classification for operation and strength characteristics and guidance on selection and specification'

BS 6375 is the national application document for BS EN 14351 and helps designers and users on the selection of performance characteristics for windows and doorsets intended for the UK market.

#### *Note*

*BS EN 14351 is the harmonized European Standard for windows and doors and is the standard that has to be referenced if the product is to be CE marked. The characteristics identified in BS EN 14351 also have a number of performance levels.*

BS 6375 identifies four levels of performance in clause 6.1 of BS 6375-2:2009 which are as follows:

- Light - Secondary external doorsets to dwellings
- Medium - External doorsets to dwellings, providing primary access Office doorsets providing access to areas not visited by members of the public and school classrooms)

- Heavy - doorsets for shops, hospitals wards and other buildings which provide access to designated public areas
- Severe - doorsets for stockrooms, school and hospital corridors etc. commonly opened by driving trolleys against them (i.e. casual or unintended abuse)

#### **5.2.1.2.1.2.2 Door Strength Standards**

BS 6375 refers to BS EN 1192:2000 'Doors - Classification of strength requirements'

This standard provides a means of classifying doors according to their vertical load, static torsion, soft and heavy body impact and hard body impact, when tested to the appropriate standard listed below:

- BS EN 947:1999 'Hinged or pivoted doors - Determination of the resistance to vertical load'.
- BS EN 948:1999 'Hinged or pivoted doors - Determination of the resistance to static torsion'.
- BS EN 949:1999 'Windows and curtain walling, doors, blinds and shutters - Determination of the resistance to soft and heavy body impact for doors'
- BS EN 950:1999 'Door leaves - Determination of the resistance to hard body impact'

The categories of duty specified in BS 6375-2:2009 i.e. from light duty to severe duty equate to class 1 to 4 in BS EN 1192:2000

#### **5.2.1.2.1.2.3 Window Standards**

The existing Department of Health Standard, "Health Building Note 00-10 Part D: Windows and associated hardware" offers guidance on the technical design and output specifications of windows and associated hardware in healthcare facilities.

Within HBN 00-10 Part D it states that products must comply with a range of applicable standards. Some of those associated with security and robustness are listed below:

- BS 6262 series of standards, - Glazing for buildings
- Approved Document K
- PAS 24:2016 Enhanced security performance requirements for doorsets and windows in the UK Doorsets and windows intended to offer a level of security suitable for dwellings and other buildings exposed to comparable risk
- 'Secured by design – hospitals'
- BS EN 356:2000 Glass in building – security glazing. Testing and classification of resistance against manual attack. British Standards Institution, 2000.
- BS EN 14351-1:2006+A1:2010 Windows and doors — Product standard, performance characteristics — Part 1: Windows and external pedestrian doorsets. Must be CE marked
- BS 6375 series of standards, - Performance of windows and doors
- BS EN 1991-1-4+A1: 'Windows and doors. Resistance to repeated opening and closing. Test method.

### **5.2.1.2.1.2.3.1 Window Strength Standards**

BS 6375 refers BS EN 13115:2001 Windows — ‘Classification of mechanical properties — Racking, torsion and operating forces’.

This provides a means of classifying the performance of opening windows according to their strength in resisting, racking load, static torsion and their operating forces. It defines 4 classifications for racking load, and static torsion. This standard refers to the following two standards to define the test methods

- BS EN 14608:2004 Windows – ‘Determination of the resistance to racking’
- BS EN 14609:2004 Windows — ‘Determination of the resistance to static torsion’

Impact strength of windows is detailed in BS EN 13049:2003 ‘Windows — Soft and heavy body impact — Test method, safety requirements and classification’.

This standard applies to all infill of whatever materials, including glass but is not intended to evaluate the strength of the glass, but to assess the safe fixing of glass or other materials.

Within BS EN 13049 it specifies 5 classifications of performance using the impactor specified in BS EN 12600:2002, ‘Glass in building — Pendulum test — Impact test method and classification for flat glass’

### **5.2.1.2.1.2.4 Opening and Closing Durability Standards**

The opening and closing durability of doors and windows can be tested to the following two standards:

BS EN 1191:2012 ‘Windows and doors - Resistance to repeated opening and closing - Test method’

BS EN 12400:2002 ‘Windows and pedestrian doors — Mechanical durability — Requirements and classification’

These standards are commonly used to determine the resistance and durability to repeated opening and closing of windows and pedestrian doorsets. BS EN 1191 covers all construction materials and operating systems for any window or pedestrian doorset, and includes; the frame, the opening component (including any additional moving components), operating devices, (for example, the handle) gaskets and building hardware, in normal operating conditions.

BS EN 1191:2012 defines the test method and BS EN 12400:2002 provides a classification and suggested usage category.

BS EN 12400:2002 has a classification system from 1 to 8, with classes 1 to 3 recommended for windows. Class 3 equates to ‘heavy duty’. For doors, classes 7 and 8 equate to ‘heavy’ and ‘severe’ duty.

The durability testing of self-closing mechanisms is covered by two standards:

- BS EN 1154:1997 Building hardware — Controlled door closing devices — Requirements and test methods

- BS EN 14600:2005 – ‘Doorsets and openable windows with fire resisting and/or smoke control characteristics - Requirements and classification’

BS EN 1154 states that the test must be conducted to the requirements of BS EN 1191:2012.

#### **5.2.1.2.1.2.5 Lock and Hardware Standards**

There are a number of common standards that cover the compliance of locks and hardware that include durability within their test methods:

BS EN 12209:2016 – ‘Building hardware — Mechanically operated locks and locking plates — Requirements and test methods’

BS EN 1303:2015 – ‘Building hardware - Cylinders for locks - Requirements and test methods’

BS EN 14846:2008 ‘Building hardware — Locks and latches — Electromechanically operated locks and striking plates — Requirements and test methods’.

prEN 15685 – ‘Building hardware - Requirements and test methods - Multipoint locks, latches and locking plates’

BS EN 1906:2012 – ‘Building hardware — Lever handles and knob furniture — Requirements and test methods’

There are also Doors and Hardware Federation best practice guides DHF TS 010:2016 for Electromagnetic locking devices and another, covering cylinders for locks to BS EN 1303:2005

#### **5.2.1.2.1.3 Assessment**

##### **5.2.1.2.1.3.1. Strength - doors**

Manufacturers who wish to seek compliance and classification with BS EN 1192:2000 under this Design Guide must as a minimum meet the requirements of class 4 (severe) for door strength. These doors would be suitable for low risk areas.

Before and after strength testing the operating force for the door set must be tested in accordance with BS EN 12046-2:2000 Part 2: ‘Doors Operating forces - Test method’, and BS EN 12217:2015 – ‘Doors - Operating forces - Requirements and classification’. Class 1 must be used for internal doors and class 2 for external doors.

If a door under the scope of this Design Guide is fitted with a self-closing mechanism, whether or not it is designed as a fire door, it must be tested during the durability test program and meet the requirements of C5 classification as defined in BS EN 14600.

### 5.2.1.2.1.3.2. Strength - windows

Manufacturers who wish to seek compliance and classification for their windows with BS EN 13115:2001 must have been tested in accordance with EN 14608 and EN 14609 and meet a minimum of class 4. These windows would be suitable for low risk areas.

The impact strength of windows must be tested to the requirements of BS EN 13049:2003 and meet a minimum of class 3. These windows would be suitable for low risk areas.

Prior to and after those tests manually operated windows must be tested in accordance with class 1 to EN 12046-1:2003 'Operating forces - Test method - Part 1: Windows'.

### 5.2.1.2.1.3.3. Durability

All windows tested to BS EN 1191:2012 must as a minimum meet the requirements of class 4 as defined in BS EN 12400 to be classified in this Design Guide. All doors must, as a minimum, meet the requirements of class 6, as defined in BS EN 12400, when tested to BS EN 1191:2012.

Door closers must as a minimum meet class 5 defined as "subject to very frequent usage" when classified to BS EN 14600:2005. If a window under the scope of this Design Guide is fitted with a self-closing mechanism they must meet a minimum requirement of C3 classification as defined in BS EN 14600.

Locks and hardware must be tested to one of the standards, as appropriate to the product, listed above in clause 5.2.1.2.1.2.5. As a minimum, they must be tested to 200,000 cycles. Locks tested to BS EN 12209 must be tested to Grade X. Hardware tested to BS EN 1906 must comply with Grade 4 for category of use and grade 7 for durability.

### 5.2.1.2.1.3.4. Susceptibility of being used as a ligature anchor point

After the strength and durability testing specified above the product must be tested to the reduced ligature requirements defined in clause 4.3.2.2.2.

### 5.2.1.2.1.3.5. Summary of Requirements

Table 2 Doors

| Design Guide Performance Class |                           | ROB 1 Minimum requirements |
|--------------------------------|---------------------------|----------------------------|
| Test Category                  | Test Requirement          | Standard duty tests        |
| Door Strength                  | BS EN 1192                | Class 4                    |
| • vertical load'               | BS EN 947                 | Class 4                    |
| • static torsion'              | BS EN 948                 | Class 4                    |
| • soft and heavy body impact   | BS EN 949                 | Class 4                    |
| • hard body impact'            | BS EN 950                 | Class 4                    |
| Mechanical durability          | BS EN 12400<br>BS EN 1191 | Class 6                    |

|                         |  |                                   |
|-------------------------|--|-----------------------------------|
| Self-closing mechanisms | BS EN 14600<br>BS 1154                   | Class 5                           |
|                         |  |                                   |
| Hardware                | BS EN 1906                               | Grade 4 Use<br>Grade 7 Durability |
| Locks                   | BS EN 12209<br>BS EN 1303<br>BS EN 14846 | Grade X                           |
|                         |  | 200,000 cycles                    |
|                         |  | Grade Y                           |

**Table 3 Windows**

| Design Guide Performance Class   |                           | ROB 1 Minimum requirements |
|--|---------------------------|----------------------------|
| Test Category  | Test Requirement          | Standard duty tests        |
| Window Strength  | BS EN 13115               | Class 4                    |
| <ul style="list-style-type: none"> <li>Resistance to racking'</li> </ul>     | BS EN 14608               | Class 4                    |
| <ul style="list-style-type: none"> <li>static torsion'</li> </ul>            | BS EN 14609               | Class 4                    |
| <ul style="list-style-type: none"> <li>soft and heavy body impact</li> </ul> | BS EN 13049               | Class 3                    |
| Mechanical durability  | BS EN 12400<br>BS EN 1191 | Class 4                    |
| Self-closing mechanisms  | BS EN 14600<br>BS EN 1154 | C3                         |
| Glazing  | BS EN 356:2000            | P2A                        |

### 5.2.1.2.2. Testing Approach 2 - Standard Test Methods For Demonstrating Intruder (or Absconder) Resistant Characteristics Of Doors And Windows

#### 5.2.1.2.2.1 Introduction

There are three commonly used standards to assess the intruder resistant characteristics of pedestrian doors, windows, curtain walling, grilles and shutters. They all use expert test engineers with standard tool sets to try and defeat the security measures of the products (albeit, each is subtly different), but they have different approaches to the specification and testing of the product material and strength characteristics. The principles of the tests in the three different routes can be used to assess the resistance of doors and windows from attack on either side of the product.

The LPS 1175 route uses a range of tools and attack times allied with the skills and knowledge of an expert test engineer to determine the intruder resistance of a door or window. The standard is not dependent on materials or specific designs and so does not specify specific strength or impact tests. However experience has shown that doors and

windows complying with SR1 will have similar strength characteristics to doors approved to PAS 24.

PAS 24 and BS EN 1627 on the other hand have a number of door and window strength and robustness tests as an element of compliance to supplement the attack tests by an expert test engineer with a range of tools and times to gain entrance. PAS 24 specifies a single standard set of test loads to be applied to a door or window to see if access can be gained. BS EN 1627 specifies a standard set of strength and durability tests, but gives a range of possible loads and classifications. Both the standards cross reference a number of other standards that are appropriate to assess the security of doorsets and windows from attack from patients in care units.

The classifications referenced in BS EN 1627 are useful as the basis for demonstrating enhanced strength and durability for use in mental healthcare units, over and above those demonstrated in the different duty level testing described in section **5.2.1.2.1.** above.

#### **5.2.1.2.2.2 Requirements**

Whichever security standard method is used, all doors and windows must be attacked from the patient facing side. External facing doors and windows must be tested by attacking them from both sides. In these instances the Test Laboratory may need twice the number of samples to conduct the tests. When conducting tests to PAS 24 and BS EN 1627 the tools used for the attack in the internal face of the door shall be in accordance with clause **3.3.**

#### *Note*

*As LPS 1172 primarily relies on different tool sets for the attack testing the use of the tools determines most of the robustness characteristics of the product.*

#### **5.2.1.2.2.2.1. Route 1 - LPS 1175**

The Loss Prevention Certification Board (LPCB) has developed a standard that is widely used in industry called for LPS 1175 issue 8 'Requirements and testing procedures for the LPCB certification and listing of intruder resistant building components, strongpoints, security enclosures and free-standing barriers'.

LPS 1175 is a standard that can be applied to any product regardless of design or materials. It tests the intruder resistance of the product and its associated hardware. The standard has a number of security ratings based on the tools that might be used and the time that the security measures must prevent entry. The following is a guide to the different levels

- Domestic and Low commercial risks – Tool categories A (SR1) and B (SR2)
- Commercial risks – Tool categories C (SR3) and D (SR4)
- High Security risks – Tool categories E (SR5) and F (SR6)
- Extremely high security risks – Tool categories G (SR7) and H (SR8)

The exact nature of security needed is a matter for the building managers and security experts and appropriate risk assessments. However it is thought that SR1, SR2 and SR3 are the most likely to meet the requirements needed for mental healthcare units and facilities.



Whilst LPS 1175 is largely focussed on intruders breaking in to a building through a door or window it can equally be used for assessing the resistance to breaking out a building.

The companion standard to LPS 1175 for security glazing is LPS 1270 – ‘Requirements and testing procedures for the LPCB approval and listing of intruder resistant security glazing units’. This standard describes tests for classifying the intruder resistance of security glazing units, regardless of design or materials used in its construction. If certification is sought to LPS 1175 for intruder attack, the glazing must be certified to LPS 1270.

#### **5.2.1.2.2.2.1. Route 2 - PAS 24**

For windows that are fitted to ground floors and other areas that could be attacked from outside, HBN 00-10 Part D recommends compliance with;

PAS 24:2016 “Enhanced security performance requirements for doorsets and windows in the UK - Doorsets and windows intended to offer a level of security suitable for dwellings and other buildings exposed to comparable risk”.

This standard specifies test methods and acceptance criteria relevant to the enhanced security performance of doorsets and windows. It is primarily aimed at attacks from casual or opportunist burglars. However the standard is cross referenced with a number of other standards in this Design Guide and may be the appropriate standard to assess the security of doorsets and windows from attack from patients in care units. For glass the standard refers to;

BS EN 356:2000 ‘Glass in building - Security glazing - Testing and classification of resistance against manual attack’. This standard is commonly used in Europe and specifies requirements and test methods for security glazing. This standard is referenced in HBN 00-10 Part D, clause 4.26 where it states “*For security purposes, laminated glass should be included within all ground floor and easily accessible windows; as a minimum, performance specification P2A (BS EN 356) should be installed*”.

BS EN 356: 2000 classification is based on a standard hard body drop test from different heights and an axe test, whereas LPS 1270, classifies glass according to its resistance to different levels of attack based on the tools and time available to an intruder. Within BS 356 there are 8 different ratings. The first 5 ratings use a hard spherical impactor and the 3 higher ratings additionally use an axe impactor.

#### **5.2.1.2.2.2.1. Route 3 - BS EN 1627**

The European Standard for security has been adopted by the UK in standard; BS EN 1627:2011. – ‘Pedestrian doorsets, windows, curtain walling, grilles and shutters - Burglar resistance - Requirements and classification’.

BS EN 1627 presents a third compliance method. This European Standard specifies requirements and classification systems for burglar resistant characteristics of pedestrian doorsets, windows, curtain walling, grilles and shutters. BS EN 1627 has 6 levels of classification and references BS EN 356 for glazing compliance. It also defines the 6 levels of classification for infillings, hardware, and mechanical strength in addition to the manual burglary attempts.

The classifications are broken into two main categories

- Resistance classes 1, 2 and 3 are intended to address the levels of attack that normally avoid noise and unnecessary risk in terms of time.
- Resistance classes 4, 5 and 6 are associated with attacks that use a range of powerful tools, and noise and time is not an issue.

BS EN 1627:2011 is one of a series of standards for burglar resistant pedestrian doorsets, windows, curtain walling, grilles and shutters, the others are:

- EN 1628:2011, Pedestrian doorsets, windows, curtain walling, grilles and shutters — Burglar resistance — Test method for the determination of resistance under static loading
- EN 1629:2011+A1:2015 – ‘Pedestrian doorsets, windows, curtain walling, grilles and shutters — Burglar resistance — Test method for the determination of resistance under dynamic loading’
- EN 1630:2011, Pedestrian doorsets, windows, curtain walling, grilles and shutters — Burglar resistance — Test method for the determination of resistance to manual burglary attempts

### **5.2.1.2.2.3. Assessment**

#### **5.2.1.2.2.3.1. Route 1**

If LPS 1175 is used as the compliance route for doors and windows in a mental healthcare unit they must as a minimum meet the requirement of classification SR1 for internal doors and windows and SR2 for external doors and windows. In some higher security facilities levels SR2 to SR3 may be applicable for all products. These security classification levels can be further enhanced by a longer attack time of 20 minute to demonstrate suitability for the highest category situations.

#### **5.2.1.2.2.3.2. Route 2**

If PAS 24 is used as the compliance route, doorsets must as a minimum meet all the requirements specified within the standard, however, if compliance with BS EN 1627:2011, class RC3 can be demonstrated the results from this can be accepted instead of testing the product to the requirements specified in annex B of PAS 24.

To claim conformity to PAS 24 for windows, they must as a minimum meet the requirements of BS EN 356:2000 class P1A or higher and either Annex C of PAS 24 or BS EN 1627:2011, class RC2N.

#### **5.2.1.2.2.3.3. Route 3**

If BS EN 1627 is used as the compliance route for doorsets and windows they must, as a minimum, meet resistance class 1 (RC1) for internal doors and windows and RC2 for external doors and windows. In some higher security facilities levels RC2 to RC4 may be applicable for all products.

#### 5.2.1.2.2.3.4. Summary Table

Manufacturers of doors and windows that wish to demonstrate the strength and durability of their products using one of the three standards listed above must as a minimum achieve the classifications listed in table 4:

**Table 4**

| Standard   | Minimum classification    |                     |
|------------|---------------------------|---------------------|
|            | Internal only             | Internal & external |
| LPS 1175   | SR1                       | SR2                 |
| PAS 24     | Only one compliance level |                     |
| BS EN 1627 | Class 1                   | Class 2             |

#### 5.2.1.2.2.3.5. Susceptibility of being used as a ligature anchor point

After the strength and durability testing specified above, the product must be tested to the reduced ligature requirements defined in clause 4.3.2.2.2.

### 5.2.1.2.3. Testing approach 3 – Demonstration of Enhanced Robustness, Durability And Security

#### 5.2.1.2.3.1. Requirements - Doors and Windows

##### 5.2.1.2.3.1.1. Additional Requirements for Doorsets to Achieve Classification ROB 2 and above

###### a) DD171:1987

A British draft for development standard; DD171:1987 – ‘Guide to specifying performance requirements for hinged or pivoted doors (including test methods)’, classifies doorsets in the same way as the more modern standards previously referenced in this Guide, i.e. light duty through to severe duty. It also defines some additional tests that are not included in the standards covered in approaches 1 and 2. These are:

- Clause 4.3 Test method A8.1; Slamming shut impact.
- Clause 4.4 Test method A8.2: Slamming open impact.
- Clause 4.9 Test method A13: Closure against obstruction.
- Clause 4.10 Test method A14: Resistance to Jarring and Vibration.
- Clause 4.11 Test method A15: Abusive forces on door handles

#### Important Note

If a restricted opening angle is specified by the manufacturer that is facilitated with a specific door stop or other means of opening angle restriction as supplied by doorset manufacturer the slamming open test must be performed in accordance with A8.2 but against the defined stop or restrictor mounted on a defined floor substrate.

The above requirements have also been incorporated by the Door and Hardware Federation into their standard; DHF TS 006:2011 ‘Specification for enhanced lifetime & severe duty performance of hinged and pivoted doorsets’. They have increased the severity of some of the tests to better reflect the latest knowledge.

The 5 additional characteristics covered in DD 171 listed above are all ones that are relevant in a mental healthcare unit. Demonstrating compliance with these requirements will enable products to be given higher classifications in this Design Guide.

### 5.2.1.2.3.1.2. Additional Requirements for Doorsets and Windows to Achieve Classification ROB 2 and above

#### b) BS EN 1627

The impact test defined in BS EN 1192 (approach 1) is BS EN 949, however this method only requires one impact point in the centre of the door. BS EN 1627:2011 specifies an impact test in clause 7.2 - ‘Dynamic loading’, that requires impacts in accordance with BS EN 1629:2011+A1:2015. This standard indicates multiple impact points based on the BS EN 12600 impactor. Products wishing to be classified higher than the minimum level must be dynamically tested to the test method defined in EN 1629:2011+A1:2015.

### 5.2.1.2.3.1.3. Demonstrating Enhanced Performance of Specific Characteristics Based on the Standard Methods Defined Under Test Approaches 1 and 2

The individual tests that are defined under test approach 1 and 2 can be increased in severity to demonstrate enhanced performance characteristics that may be required for certain circumstances. The following test methods in Table 5 should be used for demonstrating enhanced performance to classification ROB 2 and above.

**Table 5.**

| Parameter                                    | Test Method   | Product           |
|--|---|-------------------|
| Mechanical Strength                          | BS EN 1628  | Doors and Windows |
| Dynamic Strength, soft and heavy body impact | BS EN 1629  | Doors and Windows |
| Hard body impact                             | RS-2015-01-01<br>BS 1125  | Doors and Windows |
| Mechanical durability                        | BS EN 1191  | Doors and Windows |
| Self-closing mechanisms                      | BS EN 1191 with ref to BS EN 1154 & BS EN 1155                                      | Doors and Windows |
| Locks  | BS EN 12209 -Mechanical<br>BS EN 1303 -Cylinders<br>BS EN 14846 –Electro-Mechanical | Door              |
|  |   | Doors and Windows |
|  |   | Doors and Windows |
| Hardware                                     | BS EN 1906  | Doors and Windows |
| Resistance of Glazing                        | BS EN 356   | Windows           |

The product will only receive the enhanced product rating up to a level that does not cause cracking, breakage or failure.

### 5.2.1.2.3.2. Assessment

For doors and windows to be classified under this Design Guide to ROB2 or above they must meet the minimum requirements defined in section 5.2.1.2. and the enhanced performance criteria defined below. Where the test criteria is equivalent to that used in the relevant classification standard it has been specified in the tables. If the criteria is outside of the standard classification, the performance required has been specified.

#### 5.2.1.2.3.2.1 DD171:1987, Doors

Doors must be tested to the methods described in DD171 and to the performance criteria shown in Table 5 6 below:

**Table 6.**

| Design Guide Performance Class      |                    | ROB 2                       | ROB 3       | ROB 4       | ROB 5       |
|-------------------------------------|--------------------|-----------------------------|-------------|-------------|-------------|
| Classification Std                  | DD 171             |                             |             |             |             |
|                                     | <b>Test Method</b> | <b>Enhanced Performance</b> |             |             |             |
| <b>Test Category</b>                |                    |                             |             |             |             |
| Slamming shut impact                | A8.1               | Severe<br>150 times         | 200 times   | 300 times   | 500 times   |
| Slamming open impact                | A8.2               | Severe<br>50 times          | 100 times   | 150 times   | 250 times   |
| Closure against obstruction         | A13                | Severe<br>200N              | 300N        | 400N        | 500N        |
| Resistance to Jarring and Vibration | A14                | Severe<br>200 Impacts       | 250 impacts | 400 impacts | 600 impacts |
| Abusive forces on door handles      | A15                | Severe<br>750N              | 1000N       | 1500N       | 2000N       |

#### 5.2.1.2.3.2.2. BS EN 1627 Doors and Windows

For classification of ROB 2 and above to this Design Guide, all doors and windows must be dynamically tested to the methods described in BS EN 1629 and to the energy levels stipulated in Table 7 below:

**Table 7.**

| Design Guide Performance Class              |                    | ROB 2                       | ROB 3 | ROB 4 | ROB 5 |
|---|--------------------|-----------------------------|-------|-------|-------|
| Classification Std                          | BS EN 1627         |                             |       |       |       |
|   | <b>Test Method</b> | <b>Enhanced Performance</b> |       |       |       |
| <b>Test Category</b>                        |                    |                             |       |       |       |
| Dynamic Strength-soft and heavy body impact | BS EN 1629         | RC2                         | RC3   | 600J  | 800J  |

### 5.2.1.2.3.2.3. Enhanced Performance of Specific Characteristics Based on the Standard Methods

For classification of ROB 2 and above to this Design Guide, all individual characteristics and performance criteria of doors and windows must be tested to the methods and energy levels shown in Table 8 below:

**Table 8.**

| Design Guide Performance Class  |                         |                       | ROB 2                | ROB 3            | ROB 4             | ROB 5             |
|---------------------------------|-------------------------|-----------------------|----------------------|------------------|-------------------|-------------------|
|                                 | Classification Standard | Test Method           | Enhanced Performance |                  |                   |                   |
| Test Category                   |                         |                       |                      |                  |                   |                   |
| Static Loading                  | BS EN 1627              | BS EN 1628            | RC 2                 | RC 3             | RC 4              | RC 5              |
| Mechanical durability Doors     | BS EN 12400             | BS EN 1191            | C7                   | C8               | >1,000,000 cycles | >1,000,000 cycles |
| Mechanical durability Windows   | BS EN 12400             | BS EN 1191            | C5                   | C6               | C7                | C8                |
| Self-closing mechanisms Doors   | BS EN 12400             | BS EN 1191            | 500,000 cycles       | 1,000,000 cycles | >1,000,000 cycles | >1,000,000 cycles |
| Self-closing mechanisms Windows | BS EN 12400             | BS EN 1191            | 100,000              | 200,000 cycles   | 500,000 cycles    | 1,000,000 cycles  |
| Hard body impact                |                         | 10J                   | 12J                  | 23J              | 35J               | 50J               |
| Locks                           | BS EN 1627              | BS EN 12209           | 500,000 cycles       | 1,000,000 cycles | >1,000,000 cycles | >1,000,000 cycles |
|                                 | BS EN 1627              | BS EN 1303            |                      |                  |                   |                   |
|                                 | BS EN 1627              | BS EN 14846           |                      |                  |                   |                   |
| Hardware                        | BS EN 1627              | BS EN 1906 Use        | Grade 4              | Grade 4          | Grade 4           | Grade 4           |
|                                 |                         | BS EN 1906 Durability | 500,000 cycles       | 1,000,000 cycles | >1,000,000 cycles | >1,000,000 cycles |
| Resistance of Glazing           | BS EN 1627              | BS EN 356             | P2A                  | P3A              | P4A               | P5A               |

#### 5.2.1.2.3.2.4. Enhanced Performance of Doors and Windows Based on the Security Standard Methods

For classification of ROB 2 and above to this Design Guide, using only the security standards, the door or window must comply with the following criteria shown in Table 9 below:

**Table 9**

| Design Guide Performance Class |                         |  | ROB 2                       | ROB 3             | ROB 4   | ROB 5   |
|--------------------------------|-------------------------|--|-----------------------------|-------------------|---------|---------|
|                                |                         |  |                             |                   |         |         |
|                                | <b>Test Requirement</b> |  | <b>Enhanced Performance</b> |                   |         |         |
| <b>Test Category</b>           |                         |  |                             |                   |         |         |
| Doors                          |                         |  |                             |                   |         |         |
| Security                       | LPS 1175                |  | SR2                         | SR3               | SR4     | SR5     |
|                                | PAS 24                  |  | Compliance                  | No test available |         |         |
|                                | BS EN 1627              |  | Class 3                     | Class 4           | Class 5 | Class 6 |
|                                |                         |  |                             |                   |         |         |
| Windows                        |                         |  |                             |                   |         |         |
| Security                       | LPS 1175                |  | SR2                         | SR3               | SR4     | SR5     |
|                                | PAS 24                  |  | Compliance                  | No test available |         |         |
|                                | BS EN 1627              |  | Class 3                     | Class 4           | Class 5 | Class 6 |

#### IMPORTANT NOTE:

In the table above there are ratings for different levels of security. If a manufacturer is seeking or claiming compliance with one of those standards, intrinsic within that compliance will be performance requirements for many of the other characteristics in **table 9**.

#### 5.2.1.2.3.3. Results

The test report must record the maximum performance achieved without failure, and the appropriate classification band within which the product should be placed. The test report must record any cracking, or deformations of the product, including photographs, and dimensions of any cracks or deformations. If a product fails, the failure mechanism of the product must be recorded and reported and include photographs and measurements of all damage to the product and any materials, parts or components that have become detached from the product. The Test Engineer must comment on the potential of the failure being used for self-harm or weaponisation.

## **5.2.2 All Products – Robustness and Impact Testing**

### **5.2.2.1. Introduction**

As mentioned previously, two existing standards that are already used for defining the performance of all products used in adult high and medium secure services are:

- DH (2011) 'Environmental Design Guide: adult medium secure services'
- DH (2010) 'High secure building design guide: overarching principles - for Ashworth, Broadmoor, Rampton Hospitals'.

These standards describe overarching principles for the design of adult high and medium secure inpatient services in addition to setting out the security and robustness requirements for these services. They state that areas used by patients should be robust and resistant to sustained or immediate attack.

Annex B of DH (2011) covers the testing requirements for all the key components and elements used within a high and medium secure mental health care facility. It covers 5 types of attack, these being:

- Type 1: an attack by a patient on a component or element of construction by the use of an implement or weapon;
- Type 2: an attack by a patient on a component or element of construction by punching or kicking;
- Type 3: an attack by a patient on a component or element of construction by the impact of the full body weight of a person;
- Type 4: the testing of the item and its fixings up to and including destruction;
- Type 5: Specific test regimes: glass-reinforced plastic bed

These standards have been adopted already and are currently being used for demonstrating adequate performance for medium and high security facilities. Some of the tests specified have a degree of subjectivity but may capture the ingenuity and determination seen in mental healthcare.

It is proposed within this Design Guide to use a range of standardised impact tests described below. The intention is that these should provide greater repeatability and reproducibility than some of the manual attacks specified in some standards.

### **5.2.2.2. Requirements Impact Test Methods**

#### **5.2.2.2.1. Large Soft Body Impacts**

There are a number of pendulum tests that are intended to simulate physical attacks by shoulder blows or kicks. Three examples are shown below

- BS EN 14428 specifies an impact test method that uses a 45kg soft punch bag like pendulum impactor approximately 700mm in diameter and 300mm high



- ISO 7982:1988 'Vertical building elements — Impact resistance tests — Impact bodies and general test procedures'. This standard uses a 50kg impactor conically shaped of approximate diameter 400mm and 600mm high
- BS EN 949 specifies an impact body of total mass (30 – 0,6 )kg, consisting of a spherical leather bag of diameter approximately 350 mm
- The pendulum impactor, specified in EN 1629:2011+A1 conforms to EN 12600:2002 and consist of two pneumatic tyres, steel cable, a release hook and steel weights so that the total mass of the impactor is 50 kg ± 0,1 kg. This impactor is approximately 380mm diameter and 178 mm high.

The BS EN 12600 impactor appears to be the most appropriate for the needs of this Design Guide. However manufacturers submitting tests results conducted by a UKAS accredited laboratory to the appropriate scope using the other impactors and achieving the same impact energy will be considered.

As this impactor is simulating physical attacks by shoulder blows or kicks it should be used on products up to a maximum height of 2.0m from the floor.

#### **5.2.2.2.2. Small Soft Body Impacts**

ISO 7982:1988 also defines a small soft body impact test that is intended to simulate physical attacks by fists or knee. The impactor consists of a 3kg spherical ball 100mm in diameter.

This impactor can be used on all products that are within reach of a person i.e. up to 3m from the floor.

#### **NOTE**

There is little test data available for this test method. Testing is required to validate if the impact energy is appropriate. An alternative test using a size 3 adult Handball that is 19cms in diameter and weighs 450 gr is being considered. The mass of the ball would be increased to 10kg and suspended from a pendulum.

#### **5.2.2.2.3. Hard Body Impacts**

Hard body impact tests are intended to simulate misuse and abuse through lack of care by people and physical attacks with an aim to cause damage. The hard body attack tests can be used in two ways;

- to determine the serviceability of products
- to determine how and when a product may fail or break

For serviceability evaluation the energy levels of the impact are set to evaluate how a product stands up to misuse and abuse through repeated impacts and what damage results from those impacts, ranging from aesthetic damage through to damage that could eventually lead to total failure. An impact energy of 6 Joules using a steel ball of 0.5kg (50mm in diameter) is a commonly used for this test.

To determine the failure resistance of a product, an impact energy of 10 Joules, as a minimum, using a steel ball of 1 kg (63.5mm in diameter) is a commonly used test. These

tests simulate physical attacks with an aim to cause damage. The product must resist the impact without failure.

There are a number of standards that define hard body impact and some use a pendulum, and others a simple ball drop.

- BS EN 356:2000 'Glass in building - Security glazing - Testing and classification of resistance against manual attack'. This standard specifies a 4kg spherical steel impactor drop test onto the test sample.
- BS EN 950:1999 'Door leave - Determination of the resistance to hard body impact'. This standard specifies a 0.5kg spherical steel impactor on a pendulum
- FILE REFERENCE: RS-2015-01-01 'Testing Process for Robustness of Sanitary Ware used in locations susceptible to damage', This is a standard that has been developed by the Ministry of Justice (MOJ), Bathroom Manufacturer Association (BMA) members and other stakeholders. Within the standard there are 3 impact test methods defined as follows;
  - 5.3 Repetitive Nuisance Load Testing.
  - 5.4.1 Steel Ball Pendulum Test
  - 5.4.2 Soft Body Pendulum Test

The MOJ and BMA standard for sanitary ware is already accepted in the industry. The hard body impact test method defined in clause 5.4.1 of the standard specifies a 1kg steel spherical impactor on a pendulum. This method derives from BS 1125:1987. It is this test method that is specified in this Design Guide, although this Design Guide uses two different ball sizes in its test method.

#### **5.2.2.2.4. Sanitary Ware**

The MOJ / BMA Standard RS-2015-01-01 is used as a means of demonstrating adequate performance for back to wall WC pans and wall mounted wash hand basins to be used in mental health units. It includes impact tests, cleanability, material durability and a test to destruction. As a minimum these products must comply with this standard.

The large soft body impacts specified in the standard uses an impactor defined in BS EN 14428:2015+A1:2018 – 'Shower enclosures - Functional requirements and test methods'. The MOJ / BMA Standard does not directly cover the robustness of shower enclosures, however BS EN 14428 specifies characteristics for shower enclosures for domestic purposes that also includes, hotels, accommodation for students, hospitals and similar buildings. This European Standard is a harmonised standard and compliance with it will enable CE marking to be applied by the manufacturer under the Construction Products Regulation. It addresses among other characteristics cleanability, endurance and impact resistance. The endurance test requires the shower door to be subjected to 20,000 cycles of opening and closing. It is therefore recommended that all shower enclosures used in mental health care units should as a minimum be compliant with BS EN 14428.

#### **5.2.2.2.5. Furniture and Fixed Products**

Fixed furniture includes products such as beds, wardrobes and decorative covers. Fixed components include items such as, coat hooks and mirrors. Furniture and fittings should be robust, reduced ligature, prevent opportunities for concealment, and meet infection control

requirements. They should be designed, fitted and fixed with the appropriate security fixings to ensure that they cannot be dismantled, removed or used by patients for self-harm as a weapon, missile or escape aid, for barricading or for any other illicit purpose.

Moveable furniture can include items such as chairs and tables. Within a patient's room chairs might be made of very lightweight materials such that they cannot cause harm or be used as a weapon or made of very heavy materials intended to make them very difficult to lift, move or break.

Two commonly used standards for seats are:

BS EN 1728:2012 Furniture — Seating — Test methods for the determination of strength and durability'. This European Standard specifies test methods for the determination of strength and durability of all types of seating without regard to use, materials, design/construction or manufacturing process.

BS EN 16139:2013 Furniture — Strength, durability and safety — Requirements for non-domestic seating. This standard specifies test methods from BS EN 1728 .

Although neither standard addresses the unique environment of mental health care, they nonetheless give some guidance on appropriate test loads and methods of test.

There is also another British standard, BS EN 12727:2016 Furniture — Ranked seating — Requirements for safety, strength and durability whilst not directly comparable with seating used in healthcare, it is subject to significant abuse. The impact test energy stipulated in this Standard is 40J.

#### **5.2.2.2.6. Summary of Impact Test Methods**

A uniform set of tests for all products, wherever possible, should be used for this Design Guide. The following three impact test methods should be used wherever possible.

- EN 12600:2002 - **Large Soft Body Impacts**
- ISO 7982:1988 - **Small Soft Body Impacts**
- RS-2015-01-01 - **Hard Body Impacts** for pendulum tests. A drop test can also be used for horizontal surfaces using the method described in BS EN 356.

#### **5.2.2.3. Assessment All Products**

##### **5.2.2.1. General**

For medium and high secure facilities the existing Department of Health standards referred to in the Introduction clause **5.2.2.1.** are already accepted in the industry and are therefore a method to demonstrate enhanced performance for products.

The enhanced test methodologies in this Design Guide are also design to meet the onerous environment that products must perform in medium and high secure facilities. For products to be classified to this Design Guide, they must be tested to the energy levels shown in table

8. The table indicates the minimum classification and the enhanced classification of ROB 2 or above.

The manufacturer must supply full drawings and specifications on the product covering its construction, materials, and how it should be used, installed, and mounted. The Test Engineer, using their experience, and examination of the products drawings and specifications, must draw up a test program of impact points on the product that could be vulnerable from the three different attack methods; fists and knees (**Small Soft Body Impacts**); shoulder charges or kicks ( **Large Soft Body Impacts**); misuse or vandalism (**Hard Body Impacts**). Particular areas of vulnerability are junctions and joints, and changes of material properties. The test program must ensure that the product has been comprehensively covered for all worst case scenarios.

All fixed products should be installed into the test fixture in a manner representative of that in service. All moveable products such as furniture must be restrained against a wall or other suitable structure to prevent the product from moving during the impact.

The product must not crack, break or fail after each impact. Only one sample must be used for all tests. The product will only receive the enhanced product rating up to a level that does not cause cracking, breakage or failure.

All products must be tested to the large soft body impact test and hard body impact test. Very small products, or areas on a product that cannot be impacted by the large soft body impactor, and vulnerable to a punch or knee impact, must be tested to the small soft body impact test. Only one sample must be used for all tests

#### **5.2.2.3.2. Doors and Windows**

Doors and windows must be tested and assessed as specified in the sections **5.2.1** above. However the hard body impact tests described below must be applied to all products.

#### **5.2.2.3.3. Sanitary Ware**

Sanitary ware within the scope of the MOJ / BMA Standard must, as minimum, comply with standard RS-2015-01-01. The impact tests detailed within this Design Guide can alternatively be used, providing that comparable energy levels can be demonstrated. Sanitary ware not within the scope of RS-2015-01-01 must be tested to the requirements of this Design Guide.

#### **5.2.2.3.4. Furniture and Fixed Components**

The weight of all moveable furniture must be recorded and reported. Lightweight furniture that can be picked up must be assessed if they cause harm or be used as a weapon. Very heavy materials intended to make them very difficult to lift, move or break must also be assessed if they can be used as a barricade.

#### **5.2.2.3.5. Hard body impact all products**

All products must be subjected to hard body impacts using a 0.5kg steel ball at an impact energy of 6J to evaluate serviceability and using a 1kg steel ball at a minimum of 10J impact energy to evaluate robustness against determined attack. The tests can be conducted by

either pendulum or drop test. Drop testing may be the only way to access some areas of the product.

#### **5.2.2.3.5.1. Serviceability**

The target impact point on the product must present a perpendicular face to the impactor. The product must be impacted in accordance with the prepared test plan. One sample must be used for all tests.

There must be no failure or visible indication of damage such as cracking or parts dislodged. The product must be fully serviceable after the tests. All indications of the impact on the product must be recorded, including photographs, and dimensions of indentations or small deformities.

The impact test that left the most visible mark or indication of the impact must be repeated 10 times to represent a nuisance attack. As above there must be no failure or visible indication of damage such as cracking or parts dislodged. The product must be fully serviceable after the test. All indications of the impacts on the product must be recorded, including photographs, and dimensions of any indentation or small deformity.

#### **5.2.2.3.5.2. Robustness**

The target impact point on the product must present a perpendicular face to the impactor. The product must be impacted in accordance with the prepared test plan. If the product could be affected by shear failure or other failure modes from angled attacks these must also be included in the test program. If angled attacks are required the sample must be presented such that the correct angle is achieved through the natural swing of the pendulum. The pendulum must not be swung to create angles. One sample must be used for all tests.

The product must not fail and must still be fully serviceable after the tests. Any cracking, or deformations of the product must be recorded, including photographs, and dimensions of any cracks or deformations.

If the manufacturer wishes to test their product to higher energy levels the product must be tested in the same pattern and same way as described for the 10J test. A new sample may be used for each energy level tested.

#### **5.2.2.3.5.3. Test to Failure**

Using the information gathered from all the impact tests a failure test program must be developed based on where the testing has indicated a worst case for the product. If a product has passed all the tests including those at the enhanced load and energy levels an enhanced hard body impact test must be conducted where the product must be subject to multiple impacts at the highest energy level i.e. 50J until failure is precipitated or it has survived 30 impacts.

Products that have begun to fail during the test program must be impacted at the same point, and with the same impactor, at the same energy level, multiple times until complete failure occurs. The progression of the failure must be recorded and reported by the Test Engineer.

#### 5.2.2.3.5.4. Robustness and Impact Testing - Enhanced Performance Criteria

Table 10.

| Design Guide Performance Class |                            | ROB 1               | ROB 2                | ROB 3   | ROB 4 | ROB 5 |
|--------------------------------|----------------------------|---------------------|----------------------|---------|-------|-------|
|                                | Test Method                | Minimum Requirement | Enhanced Performance |         |       |       |
| Test Category                  |                            |                     |                      |         |       |       |
| Soft and heavy body impact     | EN 12600                   | Class 3             | Class 4              | Class 5 | 500J  | 700J  |
| Small Soft Body Impacts        | ISO 7982                   | 40J                 | 50J                  | 60J     | 80J   | 100J  |
| Hard body impact               | RS-2015-01-01<br>BS EN 356 |                     |                      |         |       |       |
| • Serviceability               |                            | 6J                  | -                    | -       | -     | -     |
| • Robustness                   |                            | 10J                 | 12J                  | 23J     | 35J   | 50J   |
| • Failure test                 |                            | -                   | -                    | -       | -     | 80J   |

#### 5.2.2.3.5.5. Susceptibility of being used as a ligature anchor point

After the testing specified above at the minimum acceptable level, i.e. classification ROB 1, the product must be tested to the reduced ligature requirements defined in clause 4.3.2.2.2.

#### 5.2.2.4. Results

The test report must record the maximum performance achieved without failure, and the appropriate classification band within which the product should be placed. The test report must record any cracking, or deformations of the product, including photographs, and dimensions of any cracks or deformations. If a product fails, the failure mechanism of the product must be recorded and reported and include photographs and measurements of all damage to the product and any materials, parts or components that have become detached from the product. The Test Engineer must comment on the potential of the failure being used for self-harm or weaponisation.

## **6.0. Part 3: Assessment of Additional Requirements for Doorsets, Hardware and Windows Performance**

### **6.1. Introduction**

Both part one and two of this Design Guide, sections **4.0.** and **5.0.** are aimed at covering all products used in facilities used for the care of patients with mental illnesses. This includes door sets, hardware and windows performance assessment requirements. However, there are some essential design features that apply uniquely to doorsets, hardware and windows. This part 3 of the Design Guide, deals with the testing and verification of performance of these essential design features.

One feature of doors and windows is that many can be manufactured and sold with different options on size, hardware, locks, and special features such as vision panels. A manufacturer has two options when they submit their door or window to the Test Laboratory.

The first option is to submit the sample as a fixed design. The Test Laboratory will test the product as submitted and the test report will reflect the performance of that product only. If at a later date the manufacturer wishes to amend the design or fit different components, these amendments will have to be approved by the Test Laboratory to maintain the certification. Some cosmetic changes that would not change the performance of the door may be able to be approved without test but any change that could affect performance will require additional testing or a complete re-test.

The second option is for the manufacturer to submit an application to the Test Laboratory that includes a range of options that the core product could be produced and supplied with. The manufacturer must supply a complete set of drawings and specifications covering the entire range of options. The Test Laboratory must draw up a worst case test program that in their opinion would cover the entire range proposed by the manufacturer. Different structural configurations will almost certainly require additional testing and test samples. The test report and certificate must reflect all the options, and the manufacturer will be able to sell their products with any combination of options without needing further approval from the Test Laboratory.

The above options can also apply to the structure that the product is design to be installed into. For example, if a manufacturer claims a door can be fitted in any wall from a solid block wall to a stud wall with plasterboard, the Test Laboratory is likely to want to test the product, as a minimum, at either end of the extremes. For high security applications each major structural option may be tested.

For doors intended for very low risk applications an engineering judgement may be used on different options rather than full testing.

## **6.2. Doors**

### **6.2.1. Anti-Barricade and Lock Override Procedure**

#### **6.2.1.1. Introduction**

An unintended consequence of providing more patient privacy is the increased opportunity for a patient to use private rooms (bedroom, WC, etc) with a single door as an unsupervised area and therefore increased risk of self-harm. The door is often barricaded, particularly when the door is the only means of entry/exit. Typically, items of furniture, or patients using their own body force are used to prevent the door being opened. This is generally done to slow down /prevent staff access to increase the probability of a completed self-harm incident or attack on another patient/staff member. One means to counteract this, is to use a door, frame, and locking system that can open outward in an emergency situation, overcoming resistance. These systems are usually referred to as Anti-barricade.

#### Means of Barricading

1. Blocking from within using furniture, or body
2. Jamming/wedging doors in closed position using towels or newspapers in gap between door and frame
3. Tampering with lock key way to prevent key entering or turning the bolt
4. Lock failure through component wear or physical damage – potentially water damage for electronic locks
5. Patients holding on to lock on the inside, with hands (or using feet)
6. Patients applying pressure in any direction to the inside face of the door or on the internal ironmongery components

An example of what can happen if a barricade is successful has been documented in health bulletin “EFA/2017/002 - Anti-Barricade devices” which reads as follows:

*“There are some environments in which staff are more likely to be exposed to violence and aggression. A risk assessment would normally include identifying rooms in which an aggressor might use furniture or their body weight to barricade the door.*

*Anti-barricade devices can be used to mitigate these situations. There are a number of different designs which work in different ways. New retrofit systems are also becoming available and they may offer a better level of protection when compared with existing devices.*

*An incident occurred in a hospital ward in which an aggressor attacked a member of staff and barricaded the door by pushing against it. This prevented colleagues from accessing the room when the emergency attack alarm was activated to assist.*

*The 2-way swing door was fitted with an anti-barricade device. The device functions by allowing a door stop (Figure 1) to be pushed-in, allowing the door to open outwards so that staff can access the room. The device relies on low friction between the surfaces to function correctly.*

*It is believed the force exerted by the aggressor caused sufficient friction to prevent the stop sliding. Contributory factors may have included over painting of the door frame, and components of the anti-barricade mechanism may have rotated slightly and jammed in*



*the housing. As a result, the aggressor was able to maintain the barricade for around three minutes, during which the attack continued. Staff were able to gain access eventually, but the delay meant that the staff member sustained injuries that may have been avoided.”*

Designers and users should note the requirement for additional floor area required for single swing outward opening doors and these should be considered in all risk assessments. These doors will require additional corridor space and could pose a weaponisation risk if there is no mechanism to control the speed of a rapidly opened door. When assessing anti-barricade systems, careful consideration will be given to the speed of access, the tools required with a staff member in a stressed situation, and the robustness of the solution to withstand attack in normal operation.

There are many different designs of anti-barricade devices which are commercially available including latches, hinges and special locks. The test methods detailed below are intended to cover all designs.

#### **6.2.1.2. Requirement**

The anti-barricade device must still work in accordance with the manufacturer’s instructions when subjected to foreseeable abuse by patients. It must not be a source of weaponisation or a means for self-harm.

#### **6.2.1.3. Assessment**

##### **6.2.1.3.1. Sample Submission**

Manufacturers must submit to the test laboratory a full set of drawings, and specifications on how the product is to be used, installed, maintained and inspection regimes. The documentation must describe the full scope and operational range of the product and highlight any operational limitations or exemptions. Manufacturers must submit to the test laboratory 3 samples of the product to be tested. Where applicable, the samples must be mounted in/on a sub-structure that meets the specification stated in their installation drawings and instructions and in its intended orientation. The overall size of surrounding sub-structure is to be agreed with the laboratory. Alternatively a manufacturer may install their product into a suitable structure at the test laboratory (**note**; it is the responsibility of the manufacturer to ensure the product is installed correctly). It is assumed that the anti-barricade device and door are a matched set and sold and installed as a complete unit. If the anti-barricade device can be used with a number of different door types these must be considered by the Test Laboratory and covered by the testing regime and test reports and additional tests may be required.

The product must be installed into the test rig in accordance with BS EN 1628 clause 5.0.

##### **6.2.1.3.2. Core Function**

The manufacturer must include within their submitted documentation, operating instructions (either written or by video) for the anti-barricade device. At the commencement of the test

program the manufacturer must physically demonstrate to the Test Laboratory how the device operates under all the operating conditions in accordance with the supplied instructions. After the demonstration, the Test Engineer is allowed 10 minutes to read the instructions and familiarize themselves with the device. The Test Engineer must then operate the anti-barricade device whilst being timed without assistance from the manufacturer (this must include time taken to access any toolkit if it is required). The engineer must have ten attempts at operating the device and each must be timed. The average time of the 10 successful operations of the device must be recorded in the test report.

Following the 10 timed operations the Test Engineer must examine the product in detail to assess any finger traps or other potential health and safety issues that could injure hospital/building staff. Any items identified must be noted in the test report.

If during the operation of the anti-barricade device tools are used or any part of the device becomes detached, the Test Engineer must assess how the manufacturer has protected these items from being used as weapons by patients.

The manufacturer must demonstrate to the Test Engineer how the anti-barricade device is reset after operation. The Test Engineer must also reset the anti-barricade device. In doing so the Test Engineer must attempt to partially reset the device in such a way that it is not obvious that it is incorrectly reset.

The manufacturer must demonstrate all the operating conditions of the product to the Test Laboratory to ensure the Test Engineers are fully informed on its operation. The Test Engineers must fully understand how the products operate and the nature of all locking and release mechanisms.

Health Building Note 03-01: "Adult acute mental health units", states in clause 10.41 Emergency anti-barricade systems sometimes create a space between the door and frame. Project teams should ensure that visual and sound privacy is not compromised in the design solution. The Test Laboratory must assess the product against this requirement and comment in the test report

#### **6.2.1.3.3. Physical attack and manipulation tools**

The following is a list of common tools found in patients' possession, or in their rooms. The Test Laboratory will have a reference set of these items at their disposal to ensure that the tests are representative of the real-life challenges within mental health environments. The list is constrained to the items that are commonly found in mental health environments, although other tools could be smuggled in, so there is always a need for good check-in procedures to avoid this.

For creating barricades (in locks and gaps between doors):

- Body pressure on the door and lock, in various ways through hand, body, feet (with and without shoes) – freestanding and using the adjacent wall for additional resistance and force
- Bed sheets / clothing / hooded cord (range of thickness of fabric) – jamming a door or cupboard to wrench off
- Mastic (standard) removed

- Knotted bed sheet (compressible anchor point)
- Phone charger cords or headphone cables
- Paperclips
- Blue tack, chewing gum or similar
- Solidifying substances - we're aware of toothpaste and hairspray mixes used in mental health
- Superglue – shouldn't be on a ward, but commonly/easily smuggled in?
- Toe nail clippings
- Plastic bags
- Shoelaces
- Belts/dressing gown cords
- Bras, including underwire
- Buttons with cord attached, bin lid with cord attached
- Plastic cutlery, as original or manipulated with heat or force
- Newspapers and magazines

#### **6.2.1.4. Test Procedure**

##### **6.2.1.4.1. Introduction**

The Test Engineers, using the knowledge they have gained from the manufacturer's demonstrations, their own operations (10 of) and their examination of the manufacturer's drawings and documentation, must devise worst case test scenarios to try and defeat the product operating correctly. The Test Engineer must apply loads to the door through a hydraulic ram representative of someone deliberately trying to barricade the door through using their body, and use any of the tools listed above to tamper with the anti-barricade device and/or wedge or jam it to prevent it releasing correctly.

*Note: dimensions and test loads are based on a 99% percentile male*

Testing will assume three scenarios:

1. Barricading from a patient acting on impulse or with little or no planning.
2. Barricading by a patient with some planning and manipulation.
3. Barricading by a patient with a great deal of planning and determined attack.

The test methods described below refer to the load being applied to the door. This includes all elements of the door, its frame, hardware, beading, vision panels.

##### **6.2.1.4.2. Test Case 1: Barricading from a patient acting on impulse or with little or no planning.**

A load must be applied to the door and its frame to simulate a person lying or sitting against the door. A uniformly distributed test load of 1.3kN must be applied through a suitable loading pad 560mm x 740mm (load can be applied with the pad in either orientation) to the door progressively and without shock over a period of 10 to 20 seconds. With the load

applied a Test Engineer must attempt to operate the anti-barricade device and the time to release must be recorded.

This test must be repeated with the load being applied in different positions on the door in a zone from the mid height of the door to the bottom, and across the full width.

#### **6.2.1.4.3. Test Case 2: Barricading by a patient with some planning and manipulation.**

##### **6.2.1.4.3.1. Test 2A**

A load must be applied to the door and its frame to simulate a person deliberately trying to prevent entry to the room. It is assuming that the person is wedging themselves against any easily available 'resistance points' such as neighbouring perpendicular walls or using friction from the flooring and using their legs and feet to push against the door.

A uniformly distributed test load of 2.5kN must be applied perpendicular to the door through a suitable loading pad 300mm x 115mm (load can be applied with the pad in either orientation) to the door progressively and without shock over a period of 10 to 20 seconds. With the load applied a Test Engineer must attempt to operate the anti-barricade device and the time to release must be recorded.

This test must be repeated with the load being applied in different positions on the door in a zone from the bottom of the door to 600 mm from the bottom, and across the full width.

**6.2.1.4.3.2. Test 2B:** A load must be applied to the door and its frame to simulate a person deliberately trying to prevent entry to the room by wedging themselves against any easily available 'resistance points' and using their arms and hand to push against the door.

A uniformly distributed test load of 1.3kN must be applied perpendicular to the door through a suitable loading pad 96mm x 96mm (load can be applied with the pad in either orientation) to the door progressively and without shock over a period of 10 to 20 seconds. With the load applied a Test Engineer must attempt to operate the anti-barricade device and the time to release must be recorded.

This test must be repeated with the load being applied in different positions on the door in a zone from 600 mm from the bottom to 1800mm for the bottom of the door and across the full width.

**6.2.1.4.3.3. Test 2C:** A load must be applied to the door and its frame to simulate a person deliberately trying to bend the door frame/anti- barricade device.

A uniformly distributed test load of 1.3kN must be applied to the door, and /or associated hardware and trims at an angle as close as possible to being parallel to the door face, but never more than 30 degrees to the door face, through a suitable loading pad 96mm in height that enables the force to be applied to the door progressively and without shock over a period of 10 to 20 seconds. With the load applied a Test Engineer must attempt to operate the anti-barricade device and the time to release must be recorded.

This test must be repeated with the load being applied in different positions on the door/anti-barricade frame in a zone from the ground up to 1800mm in height.

**6.2.1.4.3.4. Test 2D:** A load must be applied to the door and its frame to simulate a person deliberately trying to force the door frame/anti-barricade device upwards or downwards. One method of loading by a patient could be created by using an improvised wedge

A uniformly distributed test load of 1.3kN must be applied vertically to the door at an angle as close as possible to being parallel to the door face, but never more than 30 degrees to the door face, through a suitable loading pad 96mm in length that enables the force to be applied to the door progressively and without shock over a period of 10 to 20 seconds. With the load applied a Test Engineer must attempt to operate the anti-barricade device and the time to release must be recorded.

This test must be repeated with the load being applied in the upward direction and the downward direction.

**6.2.1.4.3.5. Test 2E:** The Test Engineer using the tools specified in clause 3.3. must try and disable or prevent the anti-barricade device from operating normally by active manipulation or tampering such as dismantling or loosening components or by wedging for example the door or other components. It must be assumed that the anti-barricade device could be tampered with, while the door is open or closed. The Test Engineer must where possible also attempt to create loading at different angles using the tools available. The Test Engineer has 20 minutes to attempt their attack.

The Test Engineer must record the time to activate and release the anti-barricade device after it has been tampered with.

**6.2.1.4.4. Test Case 3: Barricading by a patient with a great deal of planning and determined attack.**

**6.2.1.4.4.1 Test 3A:** With the anti-barricade device tampered with as described in clause **6.2.1.4.3.5.** Test 2E, a worst case test load must be applied, taking into consideration the results from Test 1 and Tests 2A and 2B. In addition, a further test must be conducted simulating a patient pulling the door set inward with a force of 1.3kN.

The Test Engineer must record the time to activate and release the anti-barricade device after it has been tampered with and with the load applied.

**6.2.1.4.4.1 Test 3B:** After the anti-barricade device and door have undergone the robustness testing described in clauses 5.2.1.2.1. and **5.2.1.2.2.** three further tests must be conducted to simulate, three levels of planning

- Slam the door closed three times and attack the door for 30 seconds using any of the methods described in clause **6.2.1.4.3.5.**

- Slam the door closed three times and attack the door for 10 minutes using any of the methods described in clause **6.2.1.4.3.5**.
- Attack the door using test cases 2 A, B, C, D and E described above (clauses **6.2.1.4.3**.)

In each of the tests detailed above the anti-barricade device must continue to work as intended and designed, enabling the door to be opened outwards and access gained.

#### **6.2.1.4.5. Results**

The time to operate and release the anti-barricade device must be recorded for all test cases in the same way as the timing was conducted for normal use. If any products fail under any of the tests, the mode of failure must be recorded and reported. If the failure mode results in the product, or parts from the product, being able to be used for self-harm, or as weapons, this must also be recorded and reported.

### **6.2.2. Door Closers**

#### **6.2.2.1. Introduction**

As stated in the section on noise, clause **6.4.1** one means of helping reduce noise from door slamming is to use an appropriate door closer. There are a number of concealed closers on the market. If these are incorporated into a door set they must be tested to the appropriate requirements of reduced ligature and anti-barricade requirements covered in this Design Guide. The durability testing of door closers if fitted and incorporated into a door or window used in mental healthcare is tested at the same time as the durability testing of the door or window as stated in clause 5.2.1.2.1.3.3.

Generally all fire doors should be fitted with an automatic self-closing device complying with BS EN 1154/1155 or BS EN 1634-1 (Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware), although fire doors to patients' bedrooms in facilities providing in-patient mental health services can be exempt as stated in HTM 05-03.

British Standard, BS EN 1154:1997 ("Building hardware — Controlled door closing devices — Requirements and test methods"), and its amendments allows door closer manufacturers to CE mark their compliant products.

It is recommended that any door closer installed into a door set has, as a minimum, been tested and classified to BS EN 1154/1155. The standard does not include mental health care in its scope, but does have some grades of potential misuse, stating that it is for doors used by the public, and others with little incentive to take care, i.e. where there is some chance of misuse of the door. BS EN 1154/1155, clause 4 details a classification system, it is recommended that only products meeting the highest classifications for durability (clause 4.2), safety (clause 4.6), and corrosion (clause 4.7) are used in mental health care.

The standard also carries a note stating; “For applications subject to extremes of abuse, or for particular limitations of opening angle, door closers incorporating a backcheck function or provision of a separate door stop should be considered (see 5.2.13)”.

In further iterations of this Design Guide it is hoped that a test regime designed specifically for mental health care can be developed.

If door closers are incorporated into door sets submitted for testing to this Design Guide the Test Laboratory must list all certification and CE marking claims such as Declaration of performance (DoP) in the test report.

#### **6.2.2.2. Assessment and Test Report**

The Test Laboratory must record in the test report any test results and certifications conducted by a UKAS accredited laboratory of testing on the product that have been claimed, and evidence provided, by the manufacturer. The Test Laboratory must record the ligature performance of the product, and if fitted to an anti-barricade door set, its performance in those tests. The Test Laboratory must also record any features, claimed by the manufacturer that have been designed into the door specifically for a mental care environment and demonstrated to the Test Laboratories satisfaction.

#### **6.2.3. Fire**

Fire requirements are not covered by this Design Guide as there is significant legislation in this area. All doors and windows must comply with the appropriate legislation for its intended application.

Department of Health Standard: “Health Technical Memorandum 05-02: Firecode Guidance in support of functional provisions (Fire safety in the design of healthcare premises) 2015 edition”

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/473012/HTM\\_05-02\\_2015.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/473012/HTM_05-02_2015.pdf) deals extensively with fire requirements in all health care facilities including mental health and should be consulted in the design of all products.

#### **6.2.4 Light Attenuation**

##### **6.2.4.1. Introduction**

Sleep deprivation is a major issue in mental health care provision and sometimes the root cause issue for the patient’s ill health. With night time observations and corridor lights, light can spill into patient’s rooms on some door sets. The light can spill from around the edge of the door, from the anti-barricade device, hinges, and vision panels. This can lead to

disturbed sleep patterns. As a counter measure some patients hang towels over the top of the door to block the light from getting through.

There are two European standards that cover blinds that also have blackout blinds within their scope so are applicable to blinds fitted to vision panels, they are:

- BS EN 14500:2008 “Blinds and shutters - Thermal and visual comfort - Test and calculation methods”
- BS EN 14501:2005 “Blinds and shutters - Thermal and visual comfort - Performance characteristics and classification”

The working groups helping to develop this Design Guide have advised that a test should be developed to measure how effective door sets are at blocking out light at night.

#### NOTE

The test procedure described below is indicative, until some tests have been conducted on typical door sets to establish a baseline. Through this testing a more comprehensive and qualitative method can be developed. It is hoped that with clinical help a benchmark can be set that will help designers of doors. However, in the meantime, giving manufacturers a consistent test method to evaluate their doors will help industry to come to a position of what good and poor performance looks like.

#### **6.2.4.2. Indicative Test Procedure and Assessment**

A door set, with its anti-barricade device if applicable, must be submitted to the test laboratory mounted in a representative structural surround. If the door can be fitted with different seal options or vision panels the Test Laboratory must devise a worst case test program that may include multiple tests using different options. The Test Laboratory must place door set and its surround into a test rig such that no light from the exterior face can leak onto the inner face. An array of fluorescent lighting tubes must be mounted in the test rig facing the exterior of the door set and 500mm from the door face. The lighting must be arranged in such a way as to provide a uniform spread of light across the whole surface of the door set extending to a minimum of 100mm greater than the boundaries of the door set in its structural surround. Any blinds that may be fitted to a vision panel in the door must be closed. The door must be in its normal latched position. Switch on the lights and allow 10 minutes for the light output to stabilise. Measure the illuminance of any light shining through to the inner face of the door using a suitable illuminance meter.

#### **6.2.4.3. Test Report**

The Test Engineer must describe, and evidence with photographs in the test report the areas of light leakage and its illuminance. The engineer must also report on the compliance of any blinds that are used with BS EN 14500 and BS EN 14501.



## **6.3. Windows**

### **6.3.1. Introduction**

The Department of Health standard: “Health Building Note 00-10 Part D: Windows and associated hardware”

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/273867/20131223\\_HBN\\_00-10\\_PartD\\_FINAL\\_published\\_version.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/273867/20131223_HBN_00-10_PartD_FINAL_published_version.pdf) offers guidance on the technical design and output specifications of windows and associated hardware such as window restrictors. The standard also refers to

- “Additional guidance for adult mental health facilities in relation to the specification of windows is given in: Health Building Note 03-01 – ‘Adult acute mental health units’
- DH (2011) ‘Environmental Design Guide: adult medium secure services’
- DH (2010) ‘High secure building design guide: overarching principles - for Ashworth, Broadmoor, Rampton Hospitals’.

All these standards should be read in conjunction with this Design Guide.

### **6.3.2. Cleanability**

#### **6.3.2.1. Introduction**

High standards of environmental hygiene and clinical practice in healthcare facilities have been identified as being important in minimising the risk of the transmission of infection. It is important that infection prevention and control is designed into all products that are used in the care of patients. The environment in mental health care units can be even more challenging, as some patients may deliberately set out to contaminate and destroy clean environments.

There are a significant number of standards and guidance already used in the healthcare system. The following are some that must be considered:

- Revised healthcare cleaning manual
- NHS Cleaning Manual
- National Standards of Cleanliness
- Health Building Note 00-09: Infection control in the built environment
- Health Building Note 00-10 Part D: Windows and associated hardware
- The Health and Safety Executive’s (2013) Approved Code of Practice (ACOP) Regulation 16 states that all windows and skylights in a workplace must be of a design or be so constructed that they may be cleaned safely
- BS 8213-1:2004. Windows doors and rooflights. Design for safety in use and during cleaning of windows, including door-height windows and roof windows. Code of practice
- The Construction (Design and Management) Regulations 2007 require designers to minimise foreseeable risks to people doing work on, or people affected by the work of, any project arising from cleaning.

### 6.3.2.2. Requirement

Excrement and other materials are often smeared on windows and window mesh, mainly with the goal of causing disruption to the service. The ease of cleaning the secure mesh on bedroom windows was identified as a key topic of discussion at the working group workshops.

The form and type, material, finish, accessories and accessibility of windows should be considered in respect of the maintenance, cleaning, repair and replacement of the whole or part of the window and its components. All fittings and finishes should be selected to facilitate maintenance and cleaning. The manufacturer must submit a comprehensive maintenance manual with all window assemblies that includes instructions on cleaning and maintenance, methods of replacement of glass, fittings, and safety devices.

Features listed below should be considered:

- Avoid dirt-catching and hard-to-clean crevices, joints, sharp internal angles and corners that allow dust, bacteria and clutter to accumulate
- Welds and joints should be smooth and free of defects visible to the unaided eye
- Internal ledges in all windows should be avoided. Sloping ledges should be considered
- Install glass so that it is flush fitting to both sides of the frame with no fixings or screws to create an easy to clean, wipe down surface to maximise hygiene and cleanability
- Integral blinds
- Smart glass
- Self-cleaning glass
- Appropriate, durable finishes
- Window assemblies and particularly meshes should be removable by maintenance staff for cleaning purposes
- Finishes should be designed with at least a maintenance free life of 10 years. The Department of Health standard – “Health Building Note 00-10 Part D: Windows and associated hardware” contains many references on suitable standards for finishes

### 6.3.2.3. Test Procedure

The Test Laboratory must assess the cleanability of the window system and any mesh that is fitted.

Two tests are to be conducted.

- Test 1, the window system under test is undamaged and is as supplied by the manufacturer
- Test 2, the window systems has been attacked by a lit cigarette, and abraded by one of the tools specified in clause **3.3**.

British Standard BS EN ISO 19712-3:2013 Plastics - Decorative solid surfacing materials - Part 3: Determination of properties - Solid surface shapes (ISO 197123:2007) defines a

method of determining the 'Resistance to cigarette burns' in clause 9.1 of the standard. This method must be used for test 2. This British Standard, although aimed at plastics, has a number of tests defined within it on cleanability. It is recommended that in the absence of any other standard, the test methods detailed in the Standard could be used for windows of any material.

For each test the Test Engineer must liberally spread supermarket grade treacle over the window glass, mesh, and components. A Test Engineer(s) must then be timed, using the manufacturer's supplied cleaning instructions and a suitable cleaning agent on how long it takes to visually remove all traces of the treacle from the window system.

#### **6.3.2.4. Assessment and Test Report**

The test report must contain

- Number of staff required to clean the window system and mesh for each test
- The tools required (i.e. actioned by cleaning or maintenance staff) for each test
- Time taken for each test
- Location during cleaning (without the room or from outside – cleaning from inside could be better if the window leads to a communal patient courtyard as the cleaning can be carried out in a locked room, without risk of cleaning tools being accessed or staff being attacked)

Using the experience of cleaning the window the Test Laboratory must comment on the design features and any ledges, crevices, or other features that hindered the efficient cleaning of the window system for each test. Where the cleanability of the window has been degraded in Test 2 the report must describe how and what caused the degradation.

The test report must also contain any certifications claimed and supported by evidence by the manufacturer such as compliance with BS 8213-1:2004. It must also comment on design features that enable cleaning of exterior surfaces on windows designed for installation at height.

### **6.3.3. Airflow and Daylight Transmission**

#### **6.3.3.1. Introduction**

Access to air from outside plays a critical role in bedrooms and patient wellbeing. A well designed room should provide fresh air and to allow the patient to control the temperature within the room.

Natural daylight and scenes of nature are also known factors in recovery design. Accessing that natural light and the quality of the light transferred through the window and mesh is very important, as is the size of viewable area compared to the overall window size.

The Department of Health standard: “Health Building Note 00-10 Part D: Windows and associated hardware” contains significant guidance on the two issues above, in particular designers and manufacturer should refer to clauses 3.1 to 3.17 of this standard. The standard also refers to a number of British Standards against which manufacturers should design their products to.

The Building Research Establishment (BRE) has an assessment methodology called BREEAM. Compliance with this methodology is mandatory in most healthcare facilities and is referred to in HBN 00-10 and many other Department of Health standards.

The BREEAM New Construction 2018 (UK) requirements manual, section 5.0 deals with Health and Wellbeing, and within that section there are three sub-sections Hea 01, Hea 02 and Hea 04 which are relevant to this standard. See:

[https://www.breeam.com/NC2018/#05\\_health/hea01\\_nc\\_a.htm%3FTocPath%3D5.0%2520Health%2520and%2520Wellbeing%7C\\_\\_\\_\\_\\_1](https://www.breeam.com/NC2018/#05_health/hea01_nc_a.htm%3FTocPath%3D5.0%2520Health%2520and%2520Wellbeing%7C_____1)

### **6.3.3.2. Requirements**

BREEAM New Construction 2018 (UK) section 5.0 Health and Wellbeing requirements.

#### **6.3.3.2.1. Clause Hea 01 - Visual comfort**

This section deals with four areas:

- Control of glare from sunlight
- Daylighting
- View out
- Internal and external lighting levels, zoning and control

Attached in Appendix 4 is an extract from the BREEAM manual covering the Healthcare requirements for daylighting by way of an example. There are also Healthcare specific requirements for ‘View out’, ‘Internal and external lighting levels, zoning and control’.

#### **6.3.3.2.2. Clause Hea 02 - Indoor air quality**

Within this section there are specific requirements for ventilation. It also cross refers to CIBSE AM10 “Natural Ventilation in Non Domestic Buildings”

Other standards referred to in this section of BREEAM are:

Clinical areas with controlled environmental conditions: HTM 03-01 Specialised ventilation for healthcare premises (England, Wales and Northern Ireland), HTM03-01: Specialised ventilation for Healthcare premises - Part A Design and Validation; 2007, SHTM 03-01 Ventilation for healthcare premises Part A: Design and Validation (Scotland), SHTM03-01: Ventilation for Healthcare premises - Part A Design and Validation; 2014. or BS ISO

17772-1:2017/ISO 17772-1:2017 Energy performance of buildings - Indoor environmental quality - Part 1: Indoor environmental input parameters for the design and assessment of energy performance of buildings (excluding naturally ventilated buildings), whichever requires the higher performance.

#### **6.3.3.2.3. Clause Hea 04 Thermal comfort**

The Healthcare requirements in this section state:

*“The appropriate industry standard for healthcare is Health Technical Memorandum 03-01 Specialised ventilation for healthcare premises HTM 03-01. Specialised ventilation for healthcare premises. Department of Health; 2007. Thermal comfort levels in patient and clinical areas must be in accordance with the temperature ranges set out in HTM 03-01, Appendix 2. Furthermore, internal summer temperatures must not exceed 28 °C dry bulb for more than 50 hours per year (as defined in HTM 03-01, paragraph 2.15). Other occupied spaces not covered in HTM 03-01 Appendix 2 should be in accordance with CIBSE Guide A Environmental Design.”*

#### **6.3.3.3. Assessment**

The requirements listed above from BREEAM and CIBSE are largely targeted at building design rather than product specific. The siting of a window in a room is critical to achieving its optimal performance. The manufacturer must demonstrate in their submitted documentation to the Test Laboratory that the relevant requirements detailed above (BREEAM, CIBSE and HBN 00-10), have been considered in their design.

The relevant product performance standards for demonstrating compliance are:

- BS EN 14500:2008 “Blinds and shutters - Thermal and visual comfort - Test and calculation methods”
- BS EN 14501:2005 “Blinds and shutters - Thermal and visual comfort - Performance characteristics and classification”

These European Standards define test and calculation methods and methods of characterisation for the determination of the reflection and transmission characteristics to be used to determine the thermal and visual comfort performance classes of external blinds, internal blinds and shutters.

They also specify the method to determine opacity characteristics of dim-out/black-out external blinds, internal blinds and shutters.

- BS EN 410:2011 “Glass in building — Determination of luminous and solar characteristics of glazing”

This European Standard specifies methods of determining the luminous and solar characteristics of glazing in buildings. These characteristic can serve as a basis for lighting, heating and cooling calculations of rooms and permit comparison between different types of glazing.

#### **6.3.3.4. Test Report**

The test report must contain any certifications, claimed and supported by evidence, by the manufacturer such as compliance with BS EN 410, BS EN 14500 and BS EN 14501. It must also comment on all efforts that the manufacturer has made in demonstrating adherence to BREEAM and CIBSE standards.

#### **6.3.4. Window Restrictors**

##### **6.3.4.1. Introduction**

For the purposes of this document, the term “restrictor” is used to define any mechanical device that limits the movement of an opening light so that an opening of not more than 100 mm is achieved at any point even with the application of a significant additional opening force. It can either be fixed (that is, cannot be overridden) or can only be overridden by means of a removable key or other device. They must only be fitted using tamper-proof fixings. The size of the opening can be validated using a 100 mm sphere or other such measuring device.

HBN 00-10 Part D makes numerous references to window restrictors that include the following:

##### *Important note*

*This guidance recognises that window restrictors tested to current British Standards may be inadequate in preventing a determined effort of an adult to force a window open beyond the 100 mm restriction. The relevant tests for restrictors cited in BS EN 14351-1 and BS EN 13126-5 have been developed to prevent accidental falling from windows. BS EN 14351-1 recommends that restrictors must be able to hold a window in place for 60 seconds when a static load of 350 Newtons is applied to that window.*

*However, these static loads may not be sufficient to prevent determined patients who want to force the window beyond its 100 mm restriction. None of the British and European Standards deal with deliberate attempts to defeat the restrictor using impact forces, which may be the situation encountered in hospitals and care homes.*

*In the absence of an established performance standard, it is recommended that loads on window restrictors used in healthcare are tested using forces in excess of those quoted in BS EN 14351 and BS EN 13126-5. (Note also that BS EN 13126-5 recommends a maximum opening of 89 mm to prevent the passage of small children).*

*Two publications (see below) contain the most up-to-date ergonomic data on adult push forces from a standing position. The data in these documents can be used as a guide to the amount of force to be exerted when testing the restrictor.*

##### *References*

*Peebles, L. and Norris, B.J. (1998) Adultdata: the handbook of adult anthropometric and strength measurements – data for design safety. Department of Trade and Industry, London.*  
*Smith, S.A., Norris, B.J. and Peebles, L. (2000) Older adultdata: the handbook of measurements and capabilities of the older adult – data for design safety. Department of Trade and Industry, London.*

## Notes

With regard to restrictors and falls from windows, the following DH Safety Alert Notices and guidance from the Health & Safety Executive need to be taken into account:

- Estates and Facilities Alert Notice 2013/002 – Issued: 23rd January 2013 ‘Window restrictors’. Gateway Reference: 18651
- Estates and Facilities Alert Notice 2012/001 – ‘Integral side-stay mechanism window restrictors fitted with plastic spacers and used in many window applications’.
- Health Services Information Sheet (HSIS5) – ‘Falls from windows and balconies in health and social care’.
- Health and Safety Executive’s web page on “Risk of falling from windows”.
- Health Technical Memorandum 55 – ‘Windows’. See also ‘Window restrictors alert’

Other design options are also available. For example, windows are available that incorporate a discreet tamper-proof safety screen. These have the added benefit of allowing better natural ventilation as the window need not be restricted to a 100 mm opening.

BS EN 1191:2012, Windows and doors - Resistance to repeated opening and closing - Test method should also be consulted as this also includes testing windows with a restrictor.

### **6.3.4.2. Requirement**

The note above makes reference to BS EN 14351 and BS EN 13126-5, however as it states the loads specified are intended to restrain children and does not take into consideration the special requirements of mental healthcare where the occupant of a room may make determined efforts to break or disable the restrictor. In Part 2 of this Design Guide it was explained that BS EN 6375 is the national application document for BS EN 14351 and therefore it has been the basis for the minimum strength requirements of doors and windows. Therefore the testing of restrictors under this Design Guide must be tested to the test methods defined in BS EN 13126-5:2011+A1 (Building hardware - Hardware for windows and door height windows - Requirements and test methods - Part 5: Devices that restrict the opening of windows and door height windows), but to the parameters derived from BS EN 6375 and consistent with the robustness testing in Part 2 of this Design Guide.

### **6.3.4.3. Assessment**

The product must be tested in accordance with the methods described BS EN 13126-5. And to the test parameters in **table 11**. Two samples correctly mounted in a representative sub-structure must be submitted for testing. If the restrictor can be fitted to a range of products the Test Laboratory must devise a worst case test program that covers the entire range of options. As a minimum they must be tested on each different type of window material used. Additional samples may be required. The manufacturer must submit a full set of installation drawings, operational instructions and recommended inspection and maintenance routines.

**Table 11**

| Design Guide Performance Class |                                | ROB 1               | ROB 2                | ROB 3          | ROB 4          | ROB 5            |
|--------------------------------|--------------------------------|---------------------|----------------------|----------------|----------------|------------------|
|                                | Test Method                    | Minimum Requirement | Enhanced Performance |                |                |                  |
| Test Category                  |                                |                     |                      |                |                |                  |
|                                | BS EN 13126-5                  |                     |                      |                |                |                  |
| Durability                     | Clause 7.3                     | 50,000 cycles       | 100,000 cycles       | 200,000 cycles | 500,000 cycles | 1,000,000 cycles |
| Restrictor strength            | Clause 7.4                     | 1.5kN               | 2kN                  | 3kN            | 6kN            | 10kN             |
| Percussion test                | Clause 7.6<br>BS 1125 impactor | 8J                  | 10J                  | 12J            | 23J            | 35J              |
| Soft and heavy body impact     | Clause 7.7                     | 220J                | 340J                 | 460J           | 600J           | 800J             |

**6.3.4.4. Test to Failure**

If the product is only tested to the minimum requirements given in table 11 a test to failure must be conducted. Conduct the test described in clause 7.4.3 and providing the product is still operational after the test to 1.5kN, the load must be increased at a rate of approximately 10N per second until the product fails completely or in a way that alters the way it was intended to operate, for example the 100mm opening restriction has opened to such an extent that it presents opportunities for self-harm, or abscondment.

**6.3.4.5. Results**

The Test Laboratory must record in the test report:

- Any test results and certifications conducted by a UKAS accredited laboratory of testing on the product to EN 13126-5:2011+A1 that have been claimed, and evidence provided, by the manufacturer
- The performance of the product in the reduced ligature testing program
- The results of the “enhanced performance” test
- It must also re-measure the 100mm restriction limits and record any differences from the designed restriction
- The loads at which the product failed during the ‘test to failure’ tests. The mode of failure must also be recorded and comment on the possibility of weaponisation of any failed part



## **6.3.5. Pass Through/Concealment**

### **6.3.5.1. Requirements**

All window assemblies that are fitted with restrictors or ventilation grills must be assessed for pass through/ concealment. Risk of pass through must be assessed using a variety of different sized items from small to large, factoring in common pass-through items such as cigarettes, drugs, self-harm implements, etc. The assessment must cover:

- Ability of pass-through of a range of size of materials
- Any risks of concealing items from within the room, perhaps in the opening/closing mechanisms

### **6.3.5.2. Assessment**

The Test Laboratory must assess the possibility of pass through and concealment using the following tools:

- 0.5mm to 4mm use the test wires used for the reduced ligature testing and or a set of calibrated feeler gauges for very small gaps
- 4mm to 25mm use a calibrated Inspection Gauge Ball Set
- Greater than 25mm, use wooden ball gauges in 10mm increments up to 100mm

Gaps over 100mm will be deemed as not preventing pass through.

### **6.3.5.3. Test Report**

The test report must detail the size and nature of all gaps and spaces measured.

## **6.4. Doors and Windows**

### **6.4.1 Noise**

#### **6.4.1.1. Introduction**

Noise created when a door is in use can affect the overall institutional feeling of a mental health hospital. This is particularly prominent during night time when observations are often carried out by opening the door to check the patient (is in bed and breathing).

Department of Health Standard:- "Specialist services' Health Technical Memorandum 08-01: Acoustics"

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/144248/HTM\\_08-01.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/144248/HTM_08-01.pdf) gives comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare. Whilst not specifically aimed at mental health care it does make

reference in many places to the special requirements for mental health care. In its executive summary it states:

*Acoustic design is fundamental to the quality of healthcare buildings. Sound affects us both physiologically and psychologically. Noise, which can be defined as “unwanted sound”, can increase heart rate, blood pressure, respiration rate and even blood cholesterol levels.*

*Good acoustic conditions improve patient privacy and dignity, and promote essential sleep patterns. Such conditions are key to healing. Good acoustic design brings other benefits in terms of patient and staff comfort and morale, as well as improved efficiency and usability of equipment.*

This standard has numerous tables on acceptable noise levels in many different scenarios. It covers doors specifically in paragraphs 2.72 to 2.86. Clause 2.85 states: “Doors should be fitted with soft-action closers when located in noise-sensitive areas such as speech and language therapy, audiology (see Health Building Note 12-01, Supplement C – ‘Audiology’), and mental health accommodation, as well as general ward, consulting and treatment areas.”

Openable windows are mentioned in clauses 2.87 and 2.89.

Glazing in rooms if not design properly can also add to the nuisance noise in rooms. Effective reduction of sound transmission through a window can only be achieved by a high standard of design, manufacture and installation. The following standards BS 6262 (parts 1 to 6): ‘Glazing for buildings’. should be taken into consideration:

The standard recognises that there can be design conflicts to must be considered when specifying particular performance parameters. One such example is that if a room were to be very sound insulated it may help a patient to sleep but may block out any calls for help. The standard also refers to one specific consideration i.e. doors that need to swing both ways (for example on rooms that must have anti-barricade properties) should be considered to find out whether they can accommodate effective acoustic seals.

The standard refers to industry best practice acoustic standards such as BS EN ISO 140-3:1995 (recently superseded by the ISO 10140 series of standards) that specifies test requirements for building elements and products, and ISO 717 series of standards that cover the rating of sound insulation in buildings and of building elements.

Unfortunately the standard does not state the appropriate acoustic attenuation on a door for Mental Healthcare application.

The working group that helped advise on this guidance document suggested 5 areas for consideration:

- **Door slamming** – this is something that can already be controlled through use of a mechanical door control (aka door closer) that has the necessary speed controls and backcheck and correctly set up. If no door control is used, slamming can be even louder and cause more damage (due to increased force).
- **Door latching and internal locking mechanism** – record noise of the door closing into the frame, either by hand (manual controlled close) or with door closer incorporated (mechanically driven close).

- **VP operation/key touching** – record noise for observation panel operation, including the internal mechanism and contact of the key to operate.
- **Door lock key operation** – what noise levels are recorded during lock operation?
- **Key chain noise [Bunches of] Key noise** – the noise of keys and key chains is often highlighted by patients as creating a sense of being in an institution. Not necessarily part of the testing regime but a design guidance point.

All these elements can be measured and guidance on impulsive noises, and maximum noise events could be developed for a next iteration of this Guidance Document but we would need to carry out clinically lead research to establish the correct levels.

One simple solution to one form of noise problem would be for health units to consider reducing nuisance noises such as walking up and down corridors at night.

Another standard that could be useful to designers is Building Bulletin 93 that was written for the design of schools but have some similarities with healthcare buildings.

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/400784/BB93\\_February\\_2015.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/400784/BB93_February_2015.pdf) There is a growing requirement for higher performance door sets, in the education and healthcare sector with specifications regularly calling for performance of rooms to achieve up to a 50 dB RW rating.

#### **6.4.1.2. Assessment**

Although there are no specific requirements listed for noise testing above, it is recommended that the Test Laboratory must conduct tests to the ISO 10140 series of standards and record and report the results so that comparative performance can be used to set benchmarks for future iterations of this Guide. The Test Laboratory must record in the test report, any test results and certifications conducted by a UKAS accredited laboratory of acoustic testing on the product that have been claimed, and evidence provided, by the manufacturer. The Test Laboratory must also record any acoustic and noise reducing features, claimed by the manufacturer that have been designed into the door, and demonstrated to the Test Laboratories satisfaction.

## **APPENDIX 1**

### **DIAGRAMS**

This appendix has been set aside for explanatory diagrams of test methods

## **APPENDIX 2**

### **REFERENCE INFORMATION ON LIGATURES**

This appendix has been set aside for explanatory diagrams of different Ligatures and their loads

## APPENDIX 3

### Example of BREEAM Criteria

#### Hea 01 Visual comfort

##### **Up to two credits - Daylighting (building type dependent)**

4 Daylighting criteria have been met using either of the following options:

- 4.a The relevant building areas meet good practice daylight factors and other criteria as outlined in Table 5.1 below and Table 5.2 on the next page OR
- 4.b The relevant building areas meet good practice average and minimum point daylight illuminance criteria as outlined in Table 5.3 on page 77.

Additional alternative route for healthcare building types only:

- 4.c The relevant building areas meet the median daylight factors and minimum daylight factors in Table 5.4 on page 78 (see Methodology on page 83).

Table 5.1 Minimum values of average daylight factor required

| Building or area type   | Credits | Average daylight factor required | Minimum area (m <sup>2</sup> ) to comply | Other requirements                       |
|---|---------|----------------------------------|--|--|
| Staff and public areas  | 1       | 2%                               | 80%                                      | EITHER (a) OR ((b) and (c)) in Table 5.2 |
| Occupied patient's areas (dayrooms, wards) and consulting rooms |         | 2%                               | 80%                                      |  |
| Staff and public areas  | 2       | 2%                               | 80%                                      | EITHER (a) OR ((b) and (c)) in Table 5.2 |
| Occupied patient areas (dayrooms, wards) and consulting rooms   |         | 3%                               | 80%                                      |  |

Table 5.2 Daylighting uniformity criteria

| Ref | Criteria  |
|-----|---|
| (a) | A uniformity ratio of at least 0.3. Or, a minimum point daylight factor of at least 0.3 times the relevant average daylight factor value in <a href="#">Table 5.1</a> . Spaces with glazed roofs, such as atria, must achieve a uniformity ratio of at least 0.7. Or, a minimum point daylight factor of at least 0.7 times the relevant average daylight factor value in <a href="#">Table 5.1</a> . |
| (b) | At least 60% of the room has a view of sky from desk or table top height (0.85m in multi-residential buildings, 0.7m in other buildings).   |
| (c) | The room depth criterion $d/w + d/HW < 2/(1-RB)$ is satisfied where:<br>d = room depth<br>w = room width<br>HW = window head height from floor level<br>RB = average reflectance of surfaces in the rear half of the room.<br><a href="#">Table 5.5</a> gives maximum room depths in metres for different room widths and window head heights of side-lit rooms.                                      |

Table 5.3 Space type and illuminance requirements - both criteria (average illuminance and minimum point illuminance) should be met.

## **APPENDIX 4**

### **Guidance points from ligature performance workshop**

The following points were recorded from the workshops held prior to developing this Design Guide. These points are recorded for consideration when selecting products and designing mental health environments. The points have been excluded from the main part of this document testing to ensure the scope of the project is deliverable. It is anticipated that future developments of this Guide will incorporate some of these aspects into the formal testing and accreditation scheme.

#### **Self-harm**

- Can't eliminate as there are risks of intentional harm all around, example of corner of wall used to head-butt
- Where you might focus attention is compare specific points from different products to try and reduce risk, focusing on biggest/most obvious self-harm risks. Examples of this might sharp edges on beds or door hardware backplate, and protruding items i.e. turn on vision panel
- All considerations here have to be carefully considered as to the impact on usability and ensuring the correct priorities are selected for the care pathway i.e. dexterity issues for older age occupants

#### **You can't have it all – how best to compromise for the right user group**

- All products must be assessed in the overall context of the care pathway requirements – i.e. elderly patient group need easy grip handles, with lower risk of ligature, or balancing risk against recovery i.e. risk-free room would be empty, but not aid recovery
- Changing care pathway during a building's life, estates/clinical staff will need to consider what products also need to change

#### **Risk is a lowest common denominator, what about products interaction with each other?**

- All products tested and assessed in isolation, however, important to understand that the ligature performance of the room will be based on the biggest risk in the room (one ligature risk is enough for a completed suicide)
- Carefully consider the placement of products relative to each other and ensure combinations of products do not create risks (e.g. series of load release coat hooks placed together, and cord being wrapped up and over edges to secure load)
  - Future development: Test the entire room? Live tests (acoustic example)?
  - Or certified designers/installers?

#### **Remember to test the product's core function**

- Example of load release curtains that fall down with side load i.e. when opening or closing of curtain
- Another example of load release coat hook not holding a dressing gown or wet towel that it's needed for

### **Ensuring correct installation and maintenance – MOTs for products?**

- Would it help to get a statement from manufacturers on how often products need assessed, or maintained
- Could companies offer MOT for their products in MH? Essential for CQC to approve?

### **Load release – not suitable for all**

- Weaponisation risk in aggressive environments, carefully consider what comes loose and whether this poses a greater risk than already exists i.e. fist punch, kick or shoes
- Risk of slips, trips and falls with dementia users requires careful consideration when assessing load release products, i.e. using an item for balance whilst walking, might create risk of falls and you might want to think carefully about how you manage the ligature risk
- Is it fit for its intended purpose (i.e. a coat hook that doesn't hold a dressing gown)?
- Risk of concealment in mechanism in forensic environments
- Load release curtain hooks might look identical to the untrained eye (subtle/<1mm differences), yet with different loading characteristics – use clear markings or preventing interchangeability to eliminate possibility of human error. Look at transferrable good practices from the different gas nozzles in patient bedrooms in physical health, colour coded and inability to put an oxygen hose in the wrong socket.

### **Alarm systems**

- Important that these are considered within overall operational procedure, i.e. what happens when the alarm goes off?
- How often are the alarms tested?
- What if an alarm is switched off? How do other staff know? Risk of accidentally switching off?



## **APPENDIX 5**

### **Guidance points from door sets and windows performance workshop**

These were a series of notes recorded from the workshop that highlight points for consideration when selecting products and designing mental health environments. We have excluded these points from the testing regime to ensure the scope of the project is deliverable. We might develop some of these aspects into the formal testing and accreditation scheme in future.

#### **Consideration of keys, for patients and staff**

- There was a lot of discussion about the benefits of locking systems that allow patients to have independent access (locking and unlocking) to their own room, helping avoid restrictive practices. The main issue with mechanical key systems is the self-harm risk that a key can present. Some electronic locking systems can provide credentials that are safe for patients and could be considered.
- Safeguarding patients and staff when keys were lost was also reviewed, the sometimes hidden cost of keys being taken by temporary staff or full cylinder suites needing to be replaced at a huge cost.

#### **Simple and intuitive anti-barricade systems**

- Careful consideration must be given to the ease of use (intuitiveness) of anti-barricade systems which are used under duress and adrenalin
- Avoid various different types of anti-barricade system on each ward and think carefully about use of a single key type for observation and anti-barricade override to avoid key noise.
- Speed of access into the room is also important and, in some hostile situations, multiple people entering together – clear opening of door in anti-barricade mode is therefore important.
- It is recommended that full anti-barricade test is carried out on door sets and hardware under staff supervision prior to project handover.

#### **Staff safety during anti-barricade procedure**

- Whilst the main focus during the anti-barricade procedure is on getting access to the patient to provide help, staff safety is also paramount.
- Finger trapping and/or full door ramming of the person must be given due consideration.

#### **Maximum opening angle of the door**

- Anti-barricade hinges and pivots have a maximum opening angle and these should be carefully considered when placing doors in walls. Ensuring the door does not operate outside these will extend the life of the door and hinging system.
- Mechanical testing carried out on doors as part of the DIMHN/BRE tests must clearly state maximum opening angles.

#### **Don't forget fire certification**

- There is a high risk of fire in mental health environments, where patients will sometimes try to create a fire for self-harm or to disrupt the service, yet the fire certification of products is not given the same level of scrutiny as other sectors of the built environment. The assumption of the working groups is that this is due to the focus on assessing products' ligature and robustness performance.
- Door sets fire evidence should be checked and verified, paying attention to maximum leaf sizes permitted within the door sets evidence/assessment (by UKAS accredited body). These are often referred to "Global Assessments" provided by BM Trada, Exova (Warrington Fire) and International Fire Consultants (IFC) – and others. Check and ensure they are UKAS accredited. Some also offer 3rd party accreditation for the door set supplier, which includes further assessment of the manufacturers' processes – Q-Mark and Certifire are the most commonly used.
  - Gap sizes on doors should be 3-4mm (unless stated otherwise in assessment)
- Door closers must also provide Declaration of Performance (DoP) which state what the product has been tested to perform to in BS EN 1154 (mechanical door closers) or BS EN 1155 (electro-magnetic or electro-mechanical door closers).
  - Careful consideration should be correct adjustment of door closers to avoid slamming
  - Some door closers effectiveness can also be affected by the lack of air movement (i.e. closed window) and you might want to consider the gap at the bottom of the door to allow improved airflow and ensure the door closes reliably
  - Door closers are allowed to be omitted from fire doors on bedrooms (only) in mental health facilities in England (ref HBN 03:01). This does require staff management of doors in the event of a fire.
  - Free swing closers are available which eliminate closing force day-to-day (electronically), yet close in the event of a fire alarm. These can be ideal where permanent observations require an open door or the goal is to create a less institutional environment. They can also be good for patients with low strength (Eating Disorders or Mother & Baby).

### **Wear and tear**

There is a lot of focus on robustness, but what about the wear and tear of hinges or other components?

- Assess the life cycle testing carried out on hinges and locks – these key operational items can see decades of use in as short as 12 months on some mental health door sets (i.e. staff/nurse base)
- Premature wear of hinges or other hardware could create unsupervised ligature risks

### **Windows and courtyards**

- Consider the robustness of window sills and the fixings when used in courtyard areas.
- Can window sills be used for jumping on other items?
- Consider the privacy control to avoid other patients looking into bedrooms

### **Climb risk of window sills (internal and external)**

- Carefully review sill depth and angle on curtain walling systems to avoid risk of climbing.
- Particularly important for areas with large curtain walling systems in place where patient could climb to height for self-harm purposes.

**Door thresholds**

- Need to be carefully considered for risk of trip with older aged users.
- For dementia users, contrasting flooring colours can also present 'trip' hazards and creates risks of falls.

**Dexterity of door handles, operational advantage to staff**

- Carefully consider the ease of use of door handles and locking hardware for those with poor dexterity, sometimes in conflict with ligature performance
- For anti-barricade scenarios, ideal to ensure staff have a mechanical advantage to overcome resistance from patients