



BSI Standards Publication

Flood protection products – Specification

Part 4: Demountable products

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Foreword

Publishing information

This PAS was sponsored by the Environment Agency. Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 31 July 2014.

Acknowledgement is given to the following organizations that were involved in the development of this PAS as members of the steering group:

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- Environment Agency
- Flood Protection Association
- HR Wallingford
- Jacobs U.K. Limited
- JBA Consulting
- National Flood Forum
- Royal Institution of Chartered Surveyors (RICS)
- The University of Manchester

Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

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This PAS is not to be regarded as a British Standard. It will be withdrawn upon publication of its content in, or as, a British Standard.

The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Supersession

This part of PAS 1188 supersedes PAS 1188-4:2009, which is withdrawn.

Relationship with other publications

PAS 1188, *Flood protection products – Specification*, is issued in four parts:

- *Part 1: Building aperture products;*
- *Part 2: Temporary products;*
- *Part 3: Building skirt and wall sealant systems;*
- *Part 4: Demountable products.*

Guidance is available from *Six steps to flood resilience: Guidance for local authorities and professionals* [1] and *Delivering benefits through evidence: Temporary and demountable flood protection guide* [2]. Other publications on flood resistant and

resilient construction are, *Preparing for floods: Interim guidance for improving the flood resistance of domestic and small business properties* [3] and, *Improving the flood performance of new buildings: Flood resilient construction* [4] and other recent relevant publications (see publications [5] to [8]).

Parallel guidance is available for property owners in, *Six steps to property level flood resilience: Guidance for property owners* [9] and, *SMARTeST Work package 2 – Report D2.3: Guidance for code of practice* [10].

Guidance is also available from the National Flood Forum (www.floodforum.org.uk) and Flood Protection Association (www.thefpa.org.uk) websites.

Attention is drawn to the need to consider the prevention of the ingress of flood water into buildings through building fabric (i.e. walls and floors), horizontal pipes, waste water fittings and floor gullies. Anti-flood devices for buildings are covered in BS EN 13564-1.

Information about this document

This is a full revision of PAS 1188-4:2009, and introduces the following principal changes:

- informative references have been updated;
- subclause **3.8**, marking, has been amended and updated with list items c), d), e), f) and g) moved to Annex C;
- subclause **B.4.2**, has been amended to allow testing up to 3000 mm above test facility floor level for the static head leakage test;
- Annex C has been updated to include a deployment guide and user manual;
- some editorial amendments have been undertaken.

Product certification and testing. Users of this PAS are advised to consider the desirability of third-party certification of product conformity with this PAS. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

Assessed capability. Users of this PAS are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the EN ISO 9000 series by an accredited third-party certification body.

Test laboratory accreditation. Users of this PAS are advised to consider the desirability of selecting test laboratories that are accredited to EN ISO/IEC 17065 by a national or international accreditation body.

Use of this document

It has been assumed in the preparation of this PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Requirements in this standard are drafted in accordance with *Rules for the structure and drafting of UK standards*, subclause **J.1.1**, which states, “Requirements should be expressed using wording such as: ‘When tested as described in Annex A, the product shall ...’”. This means that only those products that are capable of passing the specified test will be deemed to conform to this standard.

Contractual and legal considerations

This publication does not purport to include all necessary considerations and specifications for the production of the relevant products. Users are responsible for their own compliance with all applicable laws, compliance with the industry practice and the correct application of this publication.

Compliance with a PAS cannot confer immunity from legal obligations.

Particular attention is drawn to the following specific regulations and associated documents:

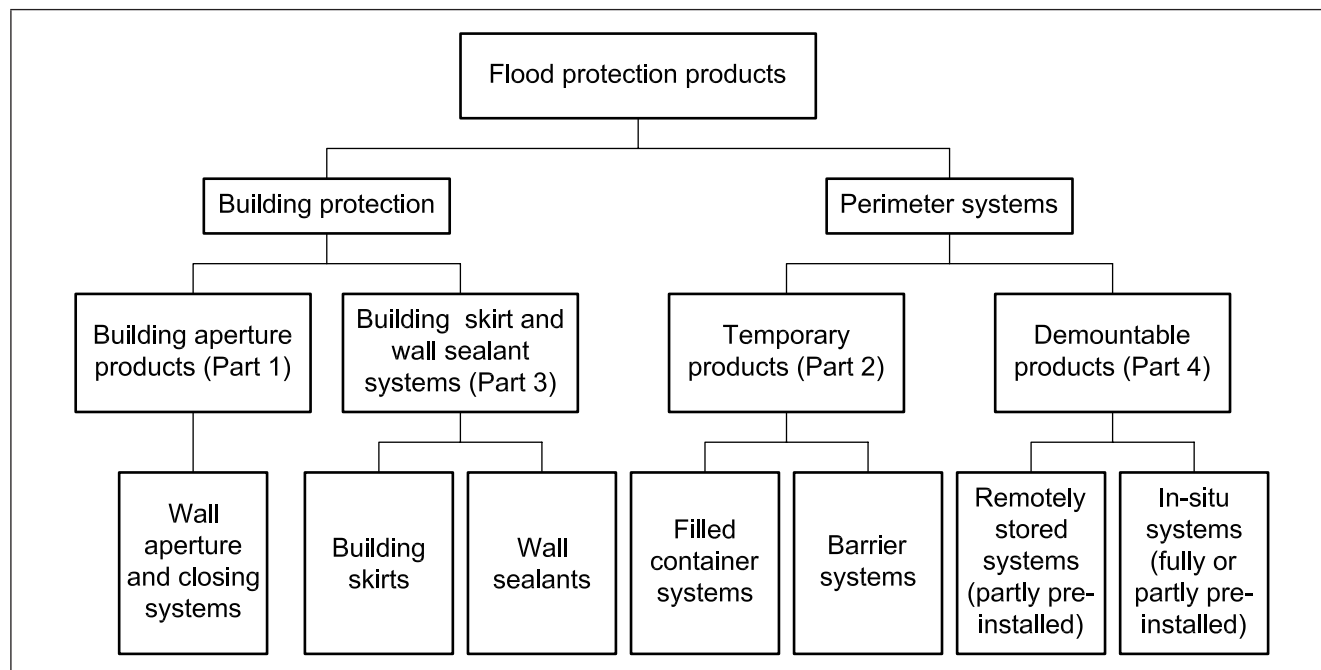
- Statutory Rules of Northern Ireland 1991, Technical Booklet L [11];
- Statutory Rules of Northern Ireland 1994, Technical Booklet E [12];
- Statutory Rules of Northern Ireland 1994, Technical Booklet K [13];
- Statutory Rules of Northern Ireland 1994, Technical Booklet N [14];
- Statutory Rules of Northern Ireland 2000, Technical Booklet R [15];
- The Building Regulations (England and Wales) 1991, Approved Document B [16];
- The Building Regulations (England and Wales) 1991, Approved Document F [17];
- The Building Regulations (England and Wales) 1991, Approved Document H [18];
- The Building Regulations (England and Wales) 1991, Approved Document J [19];
- The Building Regulations (England and Wales) 1991, Approved Document M [20];
- The Building Regulations (England and Wales) 2006, Approved Document C [21];
- The Building Standards (Scotland) Regulations 1990, Technical Standard D [22];
- The Building Standards (Scotland) Regulations 1990, Technical Standard E [23];
- The Building Standards (Scotland) Regulations 1990, Technical Standard F [24];
- The Building Standards (Scotland) Regulations 1990, Technical Standard K [25];
- The Building Standards (Scotland) Regulations 1990, Technical Standard M [26];
- The Building Standards (Scotland) Regulations 1990, Technical Standard Q [27];
- The Disability Discrimination Act 1995 [28];
- The Fire Precautions Act 1971 [29];
- The Gas Safety (Installation and Use) Regulations 1998 [30].

NOTE For rooms containing gas appliances attention is drawn to the Gas Safety (Installation and Use) Regulations 1998 [30] and manufacturers' instructions regarding the free circulation of air both in and out of the building. In such instances special care may be taken with the use of air ventilation bricks.

0 Introduction

The general classification of flood protection products and relationship between groups of products with each other is shown in Figure 1. Figure 1 also indicates which parts of the PAS 1188 series is relevant for each classification.

Figure 1 Flood protection products: general classification



NOTE 1 Attention is also drawn to the need to ensure a safe evacuation of persons in the event of an emergency and to access and egress for persons with impaired movement. This is particularly important for basements, where there is a risk that flooding could occur rapidly and to a depth sufficient to be a risk to life. In basement situations consideration may also be given to other measures such as water level alarm systems and automatic pumping systems.

NOTE 2 Other risks also need to be considered including gas safety (particularly if bottled gas is being used for temporary heating and cooking) and adequate ventilation of exhaust fumes from equipment such as generators and pumps. Boilers with low level vents are not to be used during flooding if the vent has been covered.

NOTE 3 Attention is drawn to the Construction Design and Management Regulations 2007 [31] and parts relevant to the roles and responsibilities of designers.

1 Scope

This PAS specifies requirements for the designation, testing, factory production control, installation documentation and marking for different types and configurations of flood protection products intended to be demountable, for use away from buildings, but may be sealed against structures or buildings at section ends, in the UK or locations with similar exposures, i.e. where there is a temperate climate.

This PAS specifies the method of testing and an allowable leakage rate.

NOTE 1 The PAS test conditions (see Annex B) represent typical conditions that can be experienced during a flood. This includes testing the product on a concrete base for leakage and structural failure under static water levels, random waves up to 0.1 m high and parallel currents up to 1.0 m/s.

NOTE 2 This PAS does not cover testing with contaminated or saline water; however, product manufacturers are required to provide information about the performance of their products in these conditions (see Annex C).

NOTE 3 Flood protection products that conform to this PAS might not be suitable for all locations, exposures and foundation types. Further guidance is set out in Delivering benefits through evidence: Temporary and demountable flood protection guide [2], Six steps to property level flood resilience: Guidance for property owners [9] and guidance can also be obtained from the Flood Protection Association or from the National Flood Forum or Scottish Flood Forum or other qualified professional advisers.

NOTE 4 Extreme loading conditions such as those resulting from turbulent water or static water head (above designated maximum water depth) or debris impact are not covered by testing in this PAS. In these locations the product and system are specifically designed and/or tested to withstand such stresses.

NOTE 5 Demountable flood protection products are normally installed in conjunction with a pumping arrangement to remove any excessive leakage.

NOTE 6 The installation of flood protection products described in this PAS are not intended to provide permanent flood protection. These flood protection products are installed or activated in the event of an imminent flood and removed or deactivated as soon as danger from flooding is over.

This PAS is not applicable to flood protection products for installation across building apertures such as individual doors, windows, air-bricks and air vents or around buildings; these are covered by PAS 1188-1 and PAS 1188-3.

This PAS is not applicable to temporary flood protection products which are not location specific in their use, are intended to be wholly installed during a flood event and wholly removed afterwards; these are covered by PAS 1188-2.

2 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

NOTE Definitions of demountable flood protection product types are provided in Annex A.

2.1 demountable flood protection product

flood protection product that is capable of being dismantled or removed from its setting and reassembled or reinstalled on permanent mountings

2.2 demountable flood protection system

moveable flood protection system that is either fully pre-installed and requires operation during or following warning of a flood event or a system that requires part-installation into pre-installed guides or sockets within a pre-constructed foundation

NOTE A demountable flood protection system is made up of demountable sections and permanent sections that act together to form a demountable flood protection system when fully installed.

2.3 designated maximum water depth (DMWD)

depth above the base on which the flood protection product is installed and for which the flood protection product is intended to physically retain water

NOTE The DMWD is the water depth at which the flood protection is tested (see Annex B).

2.4 factory production control

permanent, internal control of production exercised either by the manufacturer or by their representative on the responsibility of the manufacturer

NOTE 1 Factory production control comprises operational techniques and all measures necessary to regulate and maintain the conformity of the product to the requirements of this specification.

NOTE 2 Requirements for factory production control are specified in Annex D.

2.5 flood protection product

material or equipment used to limit or restrict the flow of water, which when installed, forms part or all of the flood protection system

2.6 flood protection system

system that aims to reduce the risks of flooding to people and property

NOTE 1 A flood protection system includes all the constituent parts of the flood protection product and the operational environment, such as barriers, joints, foundations, end connections, interaction with the subsoil, and all operational activities required during installation, including flood risk plans.

NOTE 2 Flooding can be from any source.

NOTE 3 Groundwater flooding can occur for long periods possibly extending to weeks or months.

2.7 leakage

water passing through or over, at the end of any intersection or between the flood protection product and the laboratory floor

NOTE For water passing over a flood protection product see *overtopping* (see 2.8).

2.8 overtopping

water passing over the flood protection product, driven by wave action when the static water level is below the top of the flood protection product

NOTE Overtopping contributes to the leakage in the wave leakage test (see B.6.3).

3 Requirements

3.1 Design

The structural stability of the demountable flood protection product under overload/overtopping conditions shall be demonstrated by calculation. The calculation(s) shall prove the stability of the flood protection product under a static water head of 0.03 m above the crest of the barrier combined with a static water head of 0.1 m on the reverse side of the product.

3.2 Designation

NOTE For detailed definitions of demountable flood protection products see Annex A.

Demountable flood protection products shall be designated as one of the following:

- a) "free-standing barrier (part pre-installed)";
- b) "frame barrier (part pre-installed)";
- c) "sectional barrier (fully pre-installed)";
- d) "flood gates (fully pre-installed)"; or
- e) other (to be described by the manufacturer).

3.3 Designated maximum water depth (DMWD)

The DMWD for demountable flood protection products shall be a minimum of 600 mm.

3.4 Installation and removal of a flood protection product

Non-permanent components of a demountable flood protection product shall be capable of being installed and removed in accordance with the manufacturer's guidance.

3.5 Leakage

When tested in accordance with Annex B, the recorded rate of leakage with either static water (see B.6.2) or with currents (see B.6.4) shall not exceed 40 L/h/m length of product measured along its base where it forms the seal. For the wave leakage test (see B.6.3), no failure criterion is given, although the total leakage, including overtopping, shall be used to categorize the wave protection in accordance with Table 1.

Table 1 Wave protection categories

Leakage (including overtopping) recorded for wave test in accordance with Annex B L/h/m	Wave protection category
>100	Low protection against waves
40 to 100	Medium protection against waves
<40	High protection against waves

3.6 Deployment guide and user manual

A deployment guide and user manual shall be provided with every product and shall, as a minimum, contain the information listed in Annex C.

3.7 Factory production control

A factory production control system shall be operated in accordance with Annex D.

3.8 Marking

Flood protection products shall be permanently marked with the following information:

- a) the number and date of this PAS, i.e. PAS 1188-4:2014¹⁾;
- b) the name or trademark of the manufacturer or their appointed agent, where applicable;
- c) symbols or instructions relating to the proper installation;
NOTE These may include, for example, arrows depicting right way up.
- d) for components of the product, the date of manufacturing of the component and unique batch number of the component;

NOTE Marking on sealing components can be placed on the tin or can.

¹⁾ Marking PAS 1188-4:2014 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

- e) where authorized and applicable, the product conformity mark of a third party certification body; and
- f) website reference for downloadable copy of deployment guide and user manual and address from which a hard copy can be obtained.

Annex A
(informative)**Definitions of demountable flood protection products**

NOTE 1 See also Six steps to flood resilience: Guidance for local authorities and professionals [1].

NOTE 2 This list of temporary flood protection products is not exhaustive.

A.1 free-standing barrier (part pre-installed)

self supporting barrier made of sections that are joined together to form a continuous barrier without the need for supporting frames

NOTE 1 The sockets or grooves remain permanently installed.

NOTE 2 The stability of this type of barrier relies upon connection to its foundation.

A.2 frame barrier (part pre-installed)

barrier made of panels placed horizontally between stanchions supported by permanent foundations

NOTE 1 The panel and stanchion guides are usually lined with seals to ensure watertightness.

NOTE 2 The stanchions can be permanently installed or capable of being attached to permanently installed connections within the foundation.

NOTE 3 The stability of this type of barrier relies upon connection to its frame and foundation.

A.3 sectional barrier (fully pre-installed)

barrier made of sections that are joined together to form a continuous barrier and is fully pre-installed requiring operation to close it during an emergency

NOTE 1 Operation can be either manual or automatic.

NOTE 2 The barrier is normally hidden away in an underground (or sometimes above ground) compartment, or attached to an adjacent structure or permanent protection.

A.4 flood gates (fully pre-installed)

barrier made of a single or a pair of rigid sections, designed to close a gap within a flood wall and is fully pre-installed, but requires operation to close it during an emergency

NOTE 1 Operation can be either manual or automatic.

NOTE 2 The barrier is normally attached to an adjacent structure or permanent protection, and can either be rolled, hinged or raised into position.

Annex B
(normative)**Method of test for leakage and movement****B.1 General**

B.1.1 The deployment guide and user manual (see Annex C) shall be assessed for usability prior to testing. Where the content of the deployment guide and/or user manual is unclear or the instructions cannot be physically implemented the deployment guide and/or user manual shall be updated for clarity.

NOTE The deployment guide and user manual should be checked to ensure that they are logical and that there are no ambiguities or contradictions in the text for installing, operating, removing, cleaning, drying and storing the test specimen.

B.1.2 As part of the test, the test specimen shall be handled in accordance with the deployment guide and user manual for the following:

- a) before the leakage test:
 - 1) preparation;
 - 2) installation of fixed sections;
 - 3) deployment of moveable/removable sections.
- b) after the leakage test:
 - 1) removal;
 - 2) cleaning and drying.

B.1.3 For a fully pre-installed test specimen, before a leakage test is undertaken the test specimen shall have been installed in accordance with the manufacturer's instructions and recommendations. For a system that requires part-installation, the permanent sections shall have been installed in accordance with the manufacturer's instructions and recommendations.

NOTE 1 Leakage is defined in this specification (see 2.7).

NOTE 2 During testing there is a risk of the test specimen moving and giving way due to high water pressure. Particular attention is drawn to the potential risk to persons standing behind the test specimen. Testing should be stopped immediately if there is any uncertainty regarding the safety of persons.

B.2 Principle

A demountable flood protection product test specimen is installed in a test facility simulating static water, waves and currents, and the leakage rate measured and recorded, along with the extent of movement of the crest. The tests are carried out with non-saline, non-contaminated water.

B.3 Test conditions

Carry out all tests at a water temperature of $(15 \pm 14) ^\circ\text{C}$.

B.4 Apparatus

B.4.1 *Test facility*, capable of accommodating the test specimen (see **B.5**) and creating the DMWD.

B.4.2 *Test facility*, of creating the following static water depths:

- a) up to 3 000 mm above test facility floor level for the static head leakage test (see **B.6.2**);
- b) up to 300 mm below the DMWD for the wave leakage test (see **B.6.3**);
- c) up to 100 mm below the DMWD for the current leakage test (see **B.6.4**).

NOTE Products may be tested up to any water depth within the values stated above in mm.

B.4.3 *Equipment capable of generating currents of 1.0 m/s parallel to, and random waves of height (100 ± 10) mm and mean wave period of 2.2 s perpendicular to, the face of the building aperture product.*

B.4.4 *Equipment designed to measure static water levels, water surface elevations (from which wave height is calculated) and current velocities, to an accuracy of 1 mm, 1 mm and 0.01 m/s respectively.*

B.4.5 *Equipment to measure leakage rate over the time periods, specified in B.6 to a tolerance of $\pm 5\%$ or 0.5 L whichever is the greater.*

B.4.6 *Equipment to measure any horizontal movement of the test specimen, that occurs between the start and end of the test to a tolerance of ± 2 mm.*

B.5 Test specimen

The test specimen shall include intermediate joints and internal and external corners, where these are a part of the flood protection product design.

B.6 Test procedure

B.6.1 General

B.6.1.1 Carry out the tests set out in **B.6.1.2**, **B.6.1.3** and **B.6.1.4** on a test specimen incorporating at least one intermediate joint and representative of the designated type in order to obtain the leakage rate. Reuse the same test specimen each time.

B.6.1.2 Install test specimen and carry out:

- a static head leakage test in accordance with **B.6.2.1** to **B.6.2.5**;
- a wave leakage test in accordance with **B.6.3**; and
- a current leakage test in accordance with **B.6.4**.

B.6.1.3 Remove the test specimen, reinstall the test specimen and then carry out:

- a static head leakage test in accordance with **B.6.2.1** to **B.6.2.5**;
- a wave leakage test in accordance with **B.6.3**; and
- a current leakage test in accordance with **B.6.4**.

B.6.1.4 Remove the test specimen, reinstall the test specimen and then carry out a static head leakage test in accordance with **B.6.2.6**.

NOTE 1 The deployment guide and user manual provided by the manufacturer should be followed regarding reuse of the test specimen. Particular attention should be paid to guidance on whether the test specimen should be allowed to dry out before being reused.

NOTE 2 For the repeat tests it is not necessary to remove and refit any components designed to remain fixed to the ground.

B.6.2 Static head leakage tests

B.6.2.1 Install a test specimen in the test facility following the manufacturer's installation instructions within the deployment guide and user manual.

B.6.2.2 For each of the static head leakage tests in **B.6.2.3** to **B.6.2.6**, measure any horizontal movement of the test specimen by noting the position of the product before and after the tests. Take photographs of the test specimen before and after the test and record any test specimen deformation.

B.6.2.3 Fill the test facility to one-third of the DMWD to a tolerance of ± 5 mm. Measure the total leakage over a period of 1 h and record the result. Maintain the depth of water to within ± 10 mm for the duration of the test.

B.6.2.4 Fill the test facility to two-thirds of the DMWD to a tolerance of ± 5 mm. Measure the total leakage over a period of 1 h and record the result. Maintain the depth of water to within ± 10 mm for the duration of the test.

B.6.2.5 Fill the test facility to the DMWD to a tolerance of ± 5 mm. Measure the total leakages over the first and last hours of an 18 h period and record both values. Maintain the depth of water to within ± 10 mm for the duration of the test.

B.6.2.6 Carry out the tests described in **B.6.2.3** and **B.6.2.4** and fill the test facility to the DMWD to a tolerance of ± 5 mm. Measure the total leakages over the first and last hours of a 48 h period and record both values. Maintain the depth of water to within ± 10 mm for the duration of the test.

NOTE The intermediate depth tests at one-third and two-thirds of the DMWD should be carried out at appropriate points in the filling of the basin, rather than when the basin is being drained.

B.6.3 Wave leakage test

B.6.3.1 Install the test specimen in the test facility following the manufacturer's installation instructions in the deployment guide and user manual.

B.6.3.2 Fill the test facility to ± 5 mm of the wave testing depth in accordance with Table B.1 and apply random waves with a JONSWAP spectrum with a significant wave height of (100 ± 10) mm and mean wave period of 1.03 s, perpendicular to the face of the test specimen.

NOTE For further information on the JONSWAP spectrum see BS 6349-1.

B.6.3.3 Measure the total leakage, including that over the crest of the test specimen, over a period of 0.5 h and record the result. Categorize wave protection in accordance with Table B.1, either by measuring over the whole test specimen length or by measuring pro-rata over a representative sample length (minimum 1 m). Maintain the depth of water to within ± 10 mm during the period of the test.

Table B.1 Wave and current testing depths
Dimensions in mm

DMWD	Wave testing depth	Current testing depth
> 900	DMWD – 300	DMWD – 100
801 to 900	600	800
701 to 800	550	700
601 to 700	500	600
600	450	500

B.6.3.4 At the DMWD measure any horizontal movement of the test specimen by taking readings before and after the test. Take photographs of the test specimen before and after the test and record any test specimen deformation.

B.6.4 Current leakage test

B.6.4.1 Install a test specimen in the test facility following the manufacturer's installation instructions.

B.6.4.2 Fill the test facility to ± 5 mm of the current testing depth in accordance with Table B.1. Apply a flow of water parallel to the face of the test specimen to achieve a mean velocity of (1.0 ± 0.1) m/s. Measure the flow over a length of 10 m, 5 m either side of the vertical centreline of the test specimen, (100 ± 5) mm below the water surface and (1 ± 0.5) m from the external face of the test specimen. Measure the total leakage over a period of 1 h and record the result. Maintain the depth of water to within ± 10 mm for the duration of the test.

B.6.4.3 At the DMWD, measure any horizontal movement of the test specimen at the water surface by taking readings before and after the test. Take photographs of the test specimen before and after the test and record any test specimen deformation.

Annex C
(normative)**Deployment guide and user manual**

C.1 A deployment guide shall be printed on water resistant paper and, as a minimum, include the following:

- a) a statement that the product is designed for the temporary mitigation of flood risk and should be seen as part of a suite of measures to reduce the risk of flood water;
- b) procedures for ensuring safe and effective installation, operation and removal of the flood protection product including health and safety advice on installation (including the mass of individual components and specialist lifting requirements if applicable), operation (including speed of deployment), access/egress (in all stages of the flood) and removal procedures;

NOTE 1 A manufacturer may provide a website address to an online demonstration video or provide a copy of the video.

NOTE 2 The instructions and guidance should be clear and understandable. This could be achieved by the use of pictorial diagrams and symbols.

- c) advice on the suitability of products for use by different user groups;
NOTE For example, some products might not be suitable for use by older people; products only suitable for installation by adults and any hazards to children stated.
- d) the time in minutes required to undertake full deployment of the flood protection product;
NOTE For multiple units forming a contiguous length of defence, this is the time in minutes to deploy each unit.
- e) advice on cleaning, drying and storage procedures;
- f) whether the product is designed to be "reusable" or "non-reusable";
- g) possible failure mechanisms, including overtopping and overload, and advice on safety precautions to be taken whilst using the flood protection product;
- h) product supplier or manufacturer's website address and contact details/helpline number (if applicable);
- i) a statement advising that further important information relevant to use of the product is provided in the user manual.

C.2 A user manual shall be provided with the flood protection product and, as a minimum, include the following:

- a) a statement on the need for a flood protection risk assessment and design evaluation for structural stability to be carried out by a suitably qualified civil engineer, structural engineer or those deemed competent prior to installation of the product;

NOTE 1 The manual should include website addresses of the Environment Agency and other sources of advice, including the National Flood Forum and Scottish Flood Forum.

NOTE 2 Appropriate professional qualifications might include, for example, being a corporate member of the Chartered Institution of Water and Environmental Management, the Institution of Civil Engineers, the Royal Institution of Chartered Surveyors, or similar professional body.

- b) a statement of the flood protection product's use including appropriate installation locations, the types of flooding to which the flood protection product is applicable and the need for advance warning of flooding (see 2.6);

NOTE The suitability of the product to protect against raised flood levels over long periods should be considered by the manufacturer and appropriate guidance given.

- c) the relevant designation of the flood protection product, including wave protection category in accordance with Table 1;
NOTE For example, Sectional barrier (fully pre-installed) – Rigid – Manual – Medium protection against waves.
- d) the designated maximum water depth (DMWD) in metres to which the flood protection product has been tested;
- e) the leakage rate in L/h/m length of product measured along its base below the DMWD;
- f) clear identification of any components required to be stored “off-site” or if all components remain “in-situ”;
- g) long-term durability and design life of the flood protection product and components;
NOTE For example, the period in years after which the flood protection product should be replaced, including advice on storage and inspection prior to reuse of components, such as gaskets.
- h) maintenance procedures and the maximum number of uses and interval between services, whichever is reached first;
- i) for fully pre-installed barriers, the designation “manual” or “automatic”, where manual refers to the need for human intervention for its operation, and automatic refers to barriers which are designed to operate without human intervention;
NOTE For example, the opening and closing of an automatic product might be triggered by water level or flow.
- j) advice on the need for, frequency and procedure for in-situ testing of flood protection products;
- k) the designation “flexible” or “rigid”, where flexible (such as geotextiles and geosynthetic fabrics) or rigid (such as steel, aluminium, concrete, glass-reinforced plastic, wood or fibreglass) refer to the form of material the barrier is made of;
NOTE For example components may have to be stored in a warehouse or other storage facility away from the installation location.
- l) advice on the suitability of a flood protection product for abutting with different types of buildings and/or other structures;
- m) advice on disposal of life expired, contaminated or failed flood protection products and components;
- n) appropriateness for locations with saline or polluted waters, indicating in particular, if at risk from pollutants such as hydrocarbons and solvents;
- o) details on previous field trials and whether or not the flood protection product has been independently verified;
- p) quick reference troubleshooting guide;
- q) a website address to a downloadable copy of the deployment guide and user manual and a postal address from which a hard copy can be obtained.
NOTE Offer, if relevant, an installation demonstration of the protection product on site, at the discretion of the manufacturer.
- C.3** Flood protection products designed to be used in conjunction with a pump shall state this requirement in the deployment guide and user manual.

C.4 The following statement shall be presented clearly on accompanying literature:

This product has been tested against the standard set of tests as defined in PAS 1188-4:2014 which represent typical conditions that might be experienced during a flood in the UK. This includes testing the product for leakage under static water levels [state the DMWD] above ground level, waves up to 0.1 m high, and parallel currents up to 1.0 m/s. The testing undertaken under this PAS excludes all other components of the flood protection system.

Conformance of the product to PAS 1188-4:2014 does not mean it is suitable for all locations. If the user is in any uncertainty as to the suitability of a product they should seek professional guidance.

NOTE The instructions and guidance should be clear and understandable. This could be achieved with the use of pictorial diagrams and symbols.

Annex D
(normative)

Requirements for factory production control

D.1 Organization

D.1.1 General

Factory production control shall be operated in accordance with a documented system given in a quality manual.

D.1.2 Responsibility and authority

The responsibility, authority and the interrelationships between all personnel who manage, perform, or verify work affecting quality shall be defined.

NOTE This applies particularly to personnel who need the organizational freedom and authority to:

- a) *initiate action to prevent the occurrence of product nonconformity;*
- b) *identify and record any product quality problems.*

D.1.3 Management representative for factory production control

At every place of production, a representative, with detailed knowledge of the flood protection products being manufactured and production experience, shall be appointed by the manufacturer. They shall be responsible for managing and supervising factory production control procedures and for ensuring that the requirements of this annex are implemented and maintained.

D.2 Quality manual

The manufacturer's documentation and procedures shall define the production and process control used during manufacturing of the product. The manufacturer shall provide the following details in a quality manual:

- a) the quality aims and the organizational structure, responsibilities and authority of the management with regard to product conformity;
- b) the procedures for specifying and verifying the raw materials and other constituent materials;

- c) the manufacturer's production control and other techniques, processes and systematic actions to be used;
- d) the inspections and tests to be carried out before, during and after manufacture, together with their frequency (see D.3) and possible retest procedures (see D.4);
- e) the procedures for handling, storage, packaging, marking and labelling the product;
- f) the procedures for all personnel to receive training in the activities affecting quality (see D.7).

D.3 Inspection and testing

D.3.1 General

All necessary facilities, equipment and personnel shall be available to carry out the inspections and tests. The manufacturer, or manufacturer's representative, may employ, under contract, a subcontractor who has the facilities, equipment and personnel to carry out the inspection and tests on its behalf. The manufacturer shall be responsible for control, calibration, and maintenance of testing, measuring, and inspection equipment, whether owned by or on loan to the manufacturer or a subcontractor.

Inspection and testing shall be performed by competent personnel qualified for such tasks on the basis of documented, appropriate education, training and/or experience.

Equipment shall be used in a manner which ensures that any measurement uncertainty is not greater than the required measurement capability.

D.3.2 Production test equipment

Tests to demonstrate conformity of the finished product to the relevant product standard shall be performed using equipment in accordance with the test methods referred to in the relevant product standard.

The production test equipment shall be calibrated and/or checked against equipment traceable to relevant internationally or nationally recognized reference test standards. Where no such reference exists, the basis used for internal checks and calibration shall be documented. Test equipment shall be checked and/or calibrated in accordance with the manufacturer's documented procedures. The calibration records shall be maintained for a period of 10 years.

The manufacturer shall ensure that handling, preservation, and storage of test equipment is such that its accuracy and fitness for use is maintained.

When production is intermittent, the manufacturer shall ensure that test equipment which may be affected by the interruption is suitably checked and/or calibrated before use.

The calibration of all test equipment shall be repeated if any repair or failure which could upset the calibration of the test equipment occurs.

D.3.3 Inspection and testing of raw materials and other constituent materials

The manufacturer shall check that raw materials and other constituent materials conform to the requirements specified. In determining the checks required, consideration shall be given to the control exercised by the supplier and the documented evidence of conformity.

The manufacturer shall ensure that incoming raw materials and other constituent materials are used or processed only after they have been verified as conforming to the specified requirements. Where incoming material is released for urgent production purposes prior to verification it shall be identified and recorded in order to permit immediate recall in the event of nonconformity.

D.3.4 Inspection and testing during manufacture

In order to manufacture products that conform to the product standard, the manufacturer shall control their process and perform in-process inspection and tests as described in the quality manual.

D.3.5 Finished product inspection and testing

The manufacturer shall regularly inspect and, where appropriate, test the finished products. Tests shall be carried out in accordance with this PAS.

D.3.6 Inspection and test status

The inspection and test status of the products shall be identified by means which indicate the conformity or nonconformity of the product with regard to inspections and tests performed (e.g. passed, failed or due to be reclassified).

D.3.7 Inspection and test records

The results of finished products inspection and testing shall be recorded. The record shall include the product identification, the date and time of manufacture, and for each product the test methods, the test results, the required limits, the inspection result and the identification of the person carrying out the inspection.

Where products do not meet the requirements of the product standard, records shall include the remedial measures taken.

The manufacturer's log shall be kept for at least 10 years.

D.4 Actions in the case of nonconforming products

Where a nonconforming product is identified, the manufacturer shall immediately take the steps necessary to identify the cause and rectify the deficiency. Products that do not conform to the requirements of the product standard shall be marked accordingly. When the deficiency has been identified and rectified, the test or inspection in question shall be repeated without delay according to the quality manual, to provide evidence that the defects have been overcome.

In the event that products are dispatched before the result of the inspection is available, prompt notification shall be given to the customer to prevent any consequential damage and a record maintained of such notification.

D.5 Handling, storage, packaging, and marking of products

In accordance with the quality manual (see **D.2**) the manufacturer shall:

- a) provide methods of handling that prevent damage or deterioration;
- b) provide suitable storage areas or stock rooms to prevent damage to or deterioration of the product;
- c) control the packaging, storage and the marking processes.

D.6 Traceability of products

Delivered individual products or product batches shall be identifiable and traceable with regard to their production origin.

D.7 Training of personnel

The manufacturer shall establish and maintain procedures for the identification of training needs and shall provide for the training of all personnel in activities affecting quality.

Personnel performing specific assigned tasks shall be competent and qualified on the basis of appropriate education, training and/or experience, as required.

Records of training shall be kept up-to-date.

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