

Concrete Canvas Ltd

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Agrement Certificate

19/5685

Product Sheet 1

CONCRETE CANVAS GEOSYNTHETIC CEMENTICIOUS COMPOSITE MATS AND BARRIERS

CONCRETE CANVAS

This Agrément Certificate Product Sheet⁽¹⁾ relates to Concrete Canvas⁽²⁾ for use in soil erosion control and weed suppression applications such as channel lining, slope protection, bund lining, remediation of concrete structures affected by environmental degradation and cracking, and culvert lining. The product acts as a protection layer and provides additional impermeability.

(1) Hereinafter referred to as 'Certificate'.

(2) Concrete Canvas is a registered trademark.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Structural performance — the product, when used in accordance with the requirements of this Certificate, will have adequate structural characteristics when used for erosion control or weed suppression applications (see section 6).

Climatic performance (freeze/thaw resistance) – the product, when installed and hydrated with the requirements of this Certificate, will have adequate climatic performance to satisfy the long-term performance requirements (see section 7).

Durability — when used in accordance with the requirements of this Certificate, the product may be considered to have a life expectancy in excess of 120⁽¹⁾ years (see section 9).

(1) Excludes the effects of adverse loading and abrasion.



The BBA has awarded this Certificate to the company named above for the product described herein. This product has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Paul Valentine
Technical Excellence Director

Claire Curtis-Thomas
Chief Executive

Date of First issue: 6 August 2019

The BBA is a UKAS accredited certification body – Number 113.

*The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk
Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.
Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.*

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Regulations

In the opinion of the BBA, the use of Concrete Canvas is not subject to the national Building Regulations.

Construction (Design and Management) Regulations 2015 Construction (Design and Management) Regulations (Northern Ireland) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See section: *3 Delivery and site handling* (3.2, 3.5 and 3.6) of this Certificate.

Additional Information

CE marking

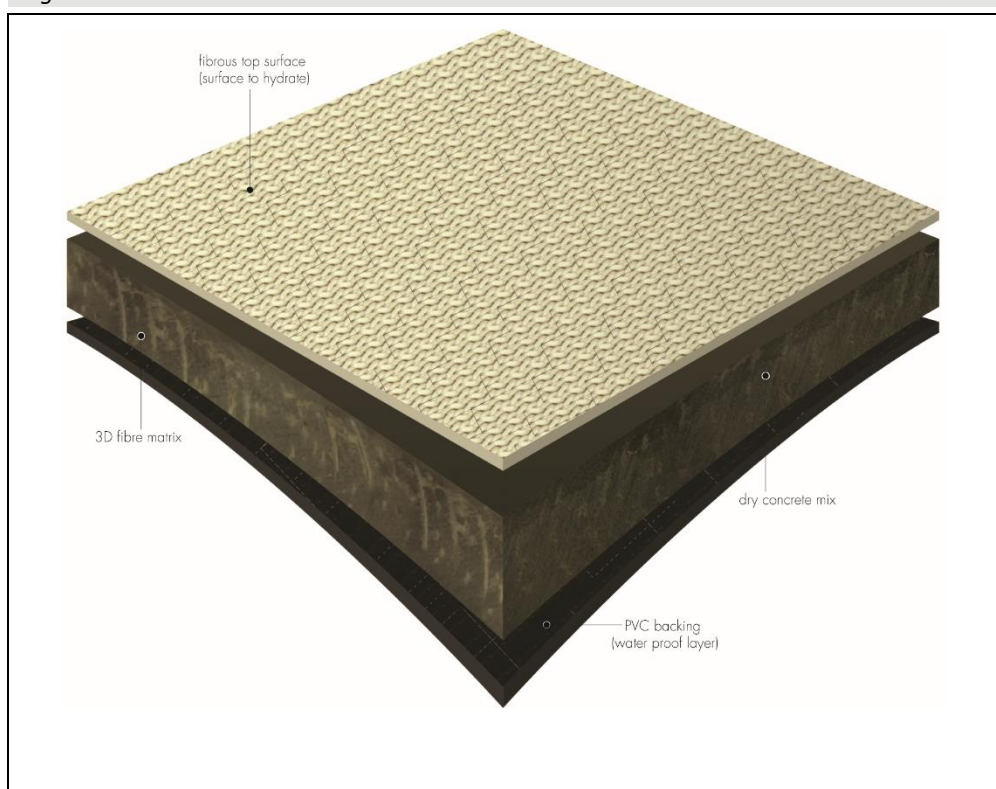
The Certificate holder has taken the responsibility of CE marking the product, in accordance with ETA 19/0086.

Technical Specification

1 Description

1.1 Concrete Canvas is a flexible concrete impregnated fabric for use in a range of geotechnical applications (see Figure 1). The product consists of a three-dimensional fibre matrix containing a high early strength gain concrete mix that hardens when hydrated to form a thin, durable and waterproof concrete layer and is provided with a PVC backing to enable the waterproof capability, while the internal fibre matrix provides the tensile strength once the concrete is set and prevents any crack propagation. Concrete Canvas can be hydrated by either spraying or by being fully immersed in water. Once hydrated, the product has a working time of up to 2 hours and will set in 24 hours.

Figure 1 Concrete Canvas



1.2 Concrete Canvas is available in three types: CC5, CC8 and CC13, and the properties are given in Table 1.

Table 1 Properties of Concrete Canvas

| Product type | Concrete thickness (mm) | Bulk roll size (m ²) | Roll width (m) | Mass (unset) (kg·m ⁻²) | Concrete mean density (unset) (kg·m ⁻³) | Change in density when set (%) |
|--------------|-------------------------|----------------------------------|----------------|------------------------------------|---|--------------------------------|
| CC5 | 5 | 200 | 1.0 | 7 | 1430-1540 | +30 to 35 |
| CC8 | 8 | 125 | 1.1 | 12 | 1430-1540 | +30 to 35 |
| CC13 | 13 | 80 | 1.1 | 19 | 1430-1540 | +30 to 35 |

1.3 Ancillary items used with the product to form a Concrete Canvas system, but outside of the scope of this Certificate include:

- Edge fixings — the perimeter edges of the Concrete Canvas system must be captured to prevent water ingress or wind uplift. For soil substrates, the Concrete Canvas material is secured in an anchor trench using J-pegs, which is then backfilled. For concrete/steel substrates, the Concrete Canvas material is secured using adhesive sealants and stainless steel mechanical fixings, a concrete fillet or using a gasket, stainless steel clamping bar and suitable mechanical fixings.

2 Manufacture

2.1 The product is manufactured from:

- a top polyester layer to contain the dry powder mix
- a three-dimensional fibre matrix containing a specially formulated dry concrete mix which hardens on hydration
- a PVC backing bottom layer, to contain the dry concrete mix and provide a low permeability liner.

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

2.3 The management system of Concrete Canvas Ltd has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by ACS Registrars Ltd (Certificate UK/01/0539489441).

3 Delivery and site handling

3.1 Concrete Canvas is available in three roll formats: bulk rolls, man portable batched rolls and wide rolls. The quantity per roll differs between the various thicknesses of product.

3.2 All bulk rolls weigh between 1500 and 1600 kg and are supplied on 150 mm diameter cardboard cores. Bulk rolls are packed into a polythene bag that is vacuumed and thermally sealed. The whole pallet is wrapped with shrink-wrap.

3.3 Batched rolls are supplied on 75 mm diameter cardboard cores with carry handles, and are packed into individual LDPE sleeves that are thermally sealed and fitted on pallets. Each pallet is secured with corrugated cardboard and shrink-wrapped.

3.4 Individual lengths and quantities are often packaged on request and always protected with a plastic bag, corrugated cardboard and shrink-wrap.

3.5 Concrete Canvas must be stored under cover in dry conditions away from direct sunlight and in the manufacturer's sealed packaging. It is not recommended to store in shipping containers in direct sunlight where temperatures may exceed 40°C for prolonged periods. If stored correctly, the product has a shelf life of 24 months.

3.6 All product bundles and rolls must be handled with care to avoid damage to coatings, and require suitable mechanical plant for lifting. An assessment must be made about the appropriate number of people required to lift the units to satisfy manual lifting limits.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Concrete Canvas.

Design Considerations

4 Use

4.1 Concrete Canvas is for use in erosion control and weed suppression applications, such as channel lining, slope protection, bund lining, remediation of existing concrete structures affected by environmental degradation and cracking, and culvert lining. The product acts as a protection layer and provides additional impermeability.

4.2 Concrete Canvas must be protected from debris and exposure to chemicals that the product is not designed for. The product must be inspected, maintained and repaired in accordance with section 8, in order to serve the design life given in section 9.

4.3 The product must only be used in areas with limited foot traffic for inspection, maintenance and repair.

4.4 Typical applications by product type are:

- CC5 — applications generally have minimal requirements for abrasion and wear, will be exposed to flow velocities up to $2 \text{ m}\cdot\text{s}^{-1}$, are not designed to anticipate impact loads and are generally installed above a dense subgrade that will provide significant support, such as concrete or rock. Erosion protection and weed suppression applications include: slope protection, bund lining, and remediation of concrete hydraulic structures
- CC8 — applications would generally expect greater abrasion and wear requirements than CC5, or they would be expected to be exposed to flow velocities up to $8.6 \text{ m}\cdot\text{s}^{-1}$ or be applied on less compacted subgrades which may provide less support for the product. Erosion protection and weed suppression applications include: channel lining, slope protection, bund lining, culvert invert lining and remediation of concrete hydraulic structures
- CC13 — applications would generally expect greater abrasion and wear requirements than CC5 or CC8, or they would be expected to be exposed to flow velocities greater than $8.6 \text{ m}\cdot\text{s}^{-1}$, be subject to design requirements for impact or dynamic loads or be applied on less compacted subgrades which may provide less support for the product. Erosion protection and weed suppression applications include: channel lining, slope protection, bund lining, culvert invert lining and remediation of concrete hydraulic structures.

4.5 Concrete Canvas is applied as an erosion control or weed suppression facing, to an underlying structure/soil surface. This underlying structure/soil surface must be designed by a suitably qualified engineer in accordance with appropriate standards to support itself, the additional loading from the set Concrete Canvas, and any in-service loading (such as water, wind, ice or surcharge).

4.6 For hydraulic applications, the design of a Concrete Canvas system should be based on the principles of hydraulic engineering to determine the likelihood of Concrete Canvas material movement under hydraulic load. Intermediate anchoring such as earth percussion anchors or check slots may be required to secure the Concrete Canvas material to the underlying surface.

4.7 Jointing — the Concrete Canvas material must be joined together to create a monolithic system. Mechanical fixings such as stainless steel screws or stainless steel concrete fixings can be used. Adhesive sealants can be included in combination with mechanical fixings to reduce joint permeability. The Concrete Canvas material can also be thermally bonded for applications where mechanical fixings are not suitable. The joint is formed using either a manual or automatic thermal welding machine.

4.8 Hydration — the Concrete Canvas material must be actively hydrated to ensure the set physical properties are achieved. Potable water can be used but is not necessary, raw/natural water and saltwater can be used. A minimum water quantity of 50% by unset mass is required for adequate hydration (eg CC8 weighs $12 \text{ kg}\cdot\text{m}^{-2}$ and a minimum volume of $6 \text{ l}\cdot\text{m}^{-2}$ is needed). The Concrete Canvas material cannot be over-hydrated and an excess of water is always recommended. See section 11.6 for hydration guidance.

5 Practicability of installation

The product is designed to be installed by a competent general builder, or a contractor, experienced with this type of product, and can be installed under normal site conditions.

6 Structural performance

6.1 The design of structures using the product should be carried out by a suitably qualified and experienced engineer considering the following concepts:

- overall stability of the structure to be lined in the product
- external stability of the structure to be lined in the product
- internal stability of the structure to be lined in the product
- substrate preparation to minimise voids underneath the product
- the product type required to accommodate anticipated loading and abrasion conditions
- the layup orientation of the product to provide shingling of overlap joints, enable practical installation and minimise material wastage
- the specification of the overlap joints considering the impermeability and weed suppression requirements of the application
- the edge (perimeter fixings) to prevent wind and water ingress beneath the product
- intermediate fixings (if required) to prevent material movement as a result of wind or hydraulic loading conditions
- project specific details such as accommodating pipe penetrations, junctions and baffling.

6.2 When installing on soft soil substrates, the product should not be trafficked during installation. If trafficking is required for future maintenance or inspection, the subgrade can be improved by placing and compacting gravel to improve the bearing capacity, a protective layer may be required over the product dependent on the traffic loads required.

6.3 Watercourse linings, weirs and/or other hydraulic or erosion protection structures may require special consideration in regard to scour, uplift, wave action, seepage etc.

6.4 Where a cohesive material, eg clay, is protected, to reduce the risk of a build-up of hydrostatic pressure in these conditions it may be necessary to provide additional granular layers or a drainage mat beneath the product to allow water to drain away.

6.5 It is essential that Concrete Canvas lined projects are properly designed in accordance with the Certificate holder's guidelines taking into account project specific requirements and site conditions. The Certificate holder can provide standard design details, case studies and installation guidelines on request to facilitate this process. The design must be carried out under the responsibility of a suitably qualified and experienced engineer.

6.6 Declared mean initial and final flexural strengths [tested at 24 hours (+/-4 hours) from hydration], static puncture resistances, pyramid puncture resistance, strength of internal linking fibres [dry (uncured) samples] of the product are presented in Table 2. Samples were prepared in accordance with ASTM D8030/D8030M-16 and (with the exception of flexural strengths as stated above) tested no earlier than 28 days from initial hydration.

Table 2 Strength properties of Concrete Canvas

| Product type | Mean initial flexural strength (machine direction) (MPa) | Mean final flexural strength (machine direction) (MPa) | Static puncture resistance (kN) | Pyramid puncture resistance (kN) | Strength of internal linking fibres (kN·m) |
|--------------|--|--|---------------------------------|----------------------------------|--|
| CC5 | 4.0 | 10.0 | 2.0 | 4.0 | 4.0 |
| CC8 | 4.0 | 6.0 | 4.0 | 7.0 | 4.5 |
| CC13 | 4.0 | 6.0 | 4.0 | 12.5 | 5.0 |

6.7 The product was tested for dynamic puncture resistance determined in accordance with EN ISO 13433 : 2006. Samples were prepared in accordance with ASTM D8030/D8030M-16 and tested no earlier than 28 days from initial hydration. From the five samples tested per product range, the impact caused the concrete to crack, but the probe did not make a full penetration through the product. Therefore the perforation depth was recorded as zero.

6.8 The Designer must specify the jointing method (for example, screwed, screwed and sealed, thermal bonding, etc), taking into account joint strength, permeability and substrate composition in accordance with the Certificate holder's guidelines appropriate to the application.

6.9 For hydraulic structures, the Designer must ensure the design takes into consideration the water velocity, turbulence and abrasion resistance requirements. The channel flow characteristics may be calculated using the channel profile geometry and the Certificate holder's published Manning's numbers and maximum permissible velocity and allowable shear stress.

7 Climatic performance (freeze/thaw resistance)

The freeze/thaw resistance of the hardened (cured) product is determined in accordance with EN 12467 : 2012 with two exceptions: the evaluation is based on flexural strength and the number of cycles has been increased from 100 to 240 to cover a durability of 120 years. The product retained more than 95% of initial flexural strength and more than 86% of its final flexural strength.

8 Maintenance and repair

Routine maintenance is not normally required, however, annual inspection must be carried out and if any damage is recognised appropriate repair must be undertaken as per the Certificate holder's specifications.

9 Durability

The product, if designed, installed and maintained in accordance with this Certificate, will have a design life in excess of 120 years.

The product type must be specified considering the long-term likelihood of dynamic loading, abrasion, hydraulic loading and turbulent flow conditions. Specification of the incorrect product type may adversely affect the design life.

Installation

10 General

10.1 Due to the versatile nature of the product and the variety of possible applications, installation must be in accordance with this Certificate and the Certificate holder's application specific installation instructions.

10.2 Prior to installation of the product the following installation details should be specified by the designer:

- the product type required
- the layup orientation of the product (eg transverse or longitudinal for channels, vertical or horizontal for slopes)
- the product overlap joint specification
- the edge (perimeter) fixing details and connection details to existing infrastructure
- determine if intermediate fixings are required to suit the application and if so, determine the spacing and specification of fixing
- project specific details such as accommodating pipe penetrations, junctions and baffling.

10.3 The Installation Method Statement must be approved by the Designer prior to commencing installation of the product.

11 Procedure

Subgrade Preparation

11.1 Placing of the product must be on a prepared subgrade free from angular rocks, roots, grass and vegetation. All foreign materials and protrusions must be removed, and all cracks and voids must be filled and the surface made level, or uniformly sloped. The prepared surface must be free from loose earth, rocks, rubble and other foreign matter.

Placing

11.2 Placing of the product must be in accordance with the Installation Method Statement approved by the Designer. The Installer must unroll the product using methods that will not damage it, and will protect the underlying surface from damage (for example a spreader bar for bulk and wide rolls). If necessary, the Installer must place temporary ballast (commonly sandbags along the leading edge) on the product, which will not damage it, to prevent wind uplift. The installer must arrange the Concrete Canvas layers so that joints are aligned in accordance with the design drawings and, for hydraulic applications, should be overlapped (shingled) in the direction of water flow, so water flows over joints. For hydraulic applications, this is facilitated by starting at the downstream end and working towards the source of water flow. If necessary the Installer must place ballast, such as sandbags, on top of the laid Concrete Canvas prior to hydration to ensure that it lies flat to the substrate on undulating ground to prevent voids from forming underneath the material. Personnel must not wear damaging shoes, and trafficking of the product must be kept to a minimum to avoid staining of the surface, particularly with wet footwear prior to hydration. Smoking is not to be permitted on the product.

11.3 Heavy vehicular traffic must not be permitted directly on the product unless the subgrade has been prepared with sufficient California bearing ratio (CBR) strength to support vehicle traffic without causing rutting. The Certificate holder considers rubber-tyre vehicles and trucks acceptable on the un-hydrated Concrete Canvas if wheel contact is less than 55 kPa. In areas of heavy traffic the product must be protected by placing an adequate protective cover over the top of the product.

Fixings — perimeter and intermediate fixings

11.4 Perimeter and intermediate ground fixings must be installed in accordance with the Designers details and the following requirements:

- perimeter fixings — Concrete Canvas must be firmly secured to the ground around the perimeter of the installation in order to prevent movement and eliminate water and wind ingress which can result in material uplift. This must be achieved by capturing the product in a concrete anchor trench or by using ground pegs (eg galvanized J-pegs) or earth percussion anchors combined with an anchor trench backfilled with aggregate or soil. Concrete Canvas may also be secured around its perimeter by fixing to existing concrete infrastructure using mechanical fixings, such as stainless steel concrete anchor bolts
- intermediate fixings — on large structures where wind uplift forces may be significant, intermediate fixings may be required to prevent uplift. Calculation of wind loads must be in accordance with BS EN 1991-1-4 : 2005. Intermediate fixings may be required to prevent movement and uplift and these fixings must be specified by the Designer and have sufficient load bearing capacity and durability to satisfy the project requirements. Check slots may also be incorporated into hydraulic structures to limit the extent of Concrete Canvas material movement in the event of unforeseen water ingress. The Certificate holder can provide check slot details on request
- anchor trench backfill — the material used to backfill anchor trenches should be described as “non-erodible backfill” and dependent on the erosion forces that the material in the anchor trench will be subjected to over the design life of the product. For example, soil and vegetation may be suitable at the crest of a slope with no running water, in situ concrete may be necessary in the invert of a channel.

Jointing

11.5 On large projects, the Installer must cover the last strip of un-hydrated Concrete Canvas (eg with a plastic tarpaulin) and raise it above ground level at the end of the day to protect it from moisture or rainfall which may cause partial hardening and impinge on the next phase of jointing work.

Hydration

11.6 A stiff brush may be used to clean the surface of the product prior to hydration, in order to remove footprints and dust accumulation and to prevent staining on the set material. Hydration of Concrete Canvas must be undertaken by the Installer in accordance with the Certificate holder’s Hydration Guidelines.

12 Tests

Tests were carried out and the results assessed to determine:

- thickness as per BS EN 1849-2 : 2009 on dry (uncured) samples
- mass per unit area and density as per BS EN 1849-2 : 2009 on dry (uncured) samples
- flexural strength as per ASTM D8058, 2017
- static puncture resistance in accordance with BS EN ISO 12236 : 2006
- dynamic puncture resistance in accordance with BS EN ISO 13433 : 2006
- pyramid puncture resistance in accordance with BS EN 14574 : 2015
- strength of internal linking fibres in accordance with BS EN ISO 13426-2 : 2005, Test B
- weathering (UV) in accordance with BS EN 12224 : 2000
- microbiological resistance in accordance with BS EN 12225 : 2000
- leaching resistance in accordance with BS EN 14415 : 2004
- thermal ageing in accordance with BS EN 14575 : 2005
- abrasion resistance as per ASTM C1353, 2015
- freeze/thaw in accordance with BS EN 12467 : 2012.

All cured samples were prepared in accordance with ASTM D8030.

13 Investigations

13.1 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

13.2 Site visits were carried out to assess the practicability, ease of handling and installation of the product under various site conditions.

Bibliography

ASTM C1353/C1353M, 2015 *Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abrader*

ASTM D8030/D8030M-16 *Standard Practice for Sample Preparation for GCCM*

ASTM D8058, 2017 *Test Method to Determine the Flexural Strength of Geosynthetic Cementitious Composite Mats using the Three Point Bending test*

BS EN 1849-2 : 2009 *Flexible sheets for waterproofing. Determination of thickness and mass per unit area. Bitumen sheets for roof waterproofing*

BS EN 1991-1-4 : 2005 + A1 : 2010 *Eurocode 1 — Actions on structures — General actions — Wind actions*

BS EN 12224 : 2000 *Geotextiles and geotextile-related products. Determination of the resistance to weathering*

BS EN 12225 : 2000 *Geotextiles and geotextile related products – Methods for determining the microbiological resistance by a soil burial test*

BS EN 12467 : 2012 + A1 : 2016 *Fibre-cement flat sheets. Product specification and test methods*

BS EN 14415 : 2004 *Geosynthetic Barriers – Test method for determining the resistance to leaching*

BS EN 14574 : 2015 *Geosynthetics. Determination of the pyramid puncture resistance of supported geosynthetics*

BS EN 14575 : 2005 *Geosynthetic barriers – Screening test method for determining the resistance to oxidation*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

BS EN ISO 12236 : 2006 *Geosynthetics. Static puncture test (CBR test)*

BS EN ISO 13426-2 : 2005 *Geotextiles and geotextile-related products. Strength of internal structural junctions. Geocomposites*

BS EN ISO 13433 : 2006 *Geosynthetics. Dynamic perforation test (cone drop test)*

ETA 19/0086 *Concrete Canvas and Concrete Canvas Hydro*

14 Conditions

14.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page – no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- is valid only within the UK
- has to be read, considered and used as a whole document – it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English Law.

14.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

14.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

14.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

14.5 In issuing this Certificate the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

14.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care.