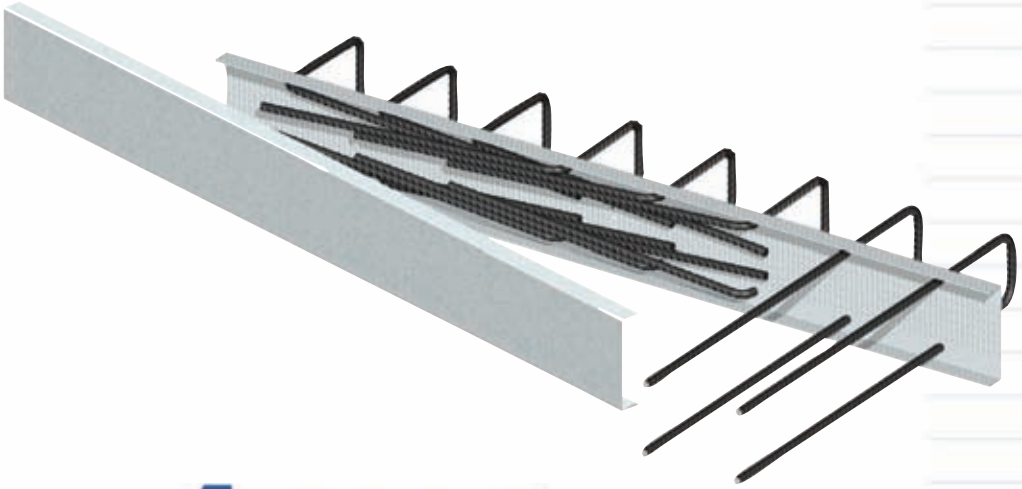
CARES Technical Approval Report TA2 5017

Assessment of the Ancon Eazistrip Reinforcement Continuity System Product and the Quality System for Production

Ancon Eazistrip

Reinforcement Continuity System



Ancon®
BUILDING PRODUCTS

CARES
TECHNICAL APPROVAL

UKAS PRODUCT CERTIFICATION 5017

Product

Ancon Eazistrip Reinforcement Continuity System

Produced by:

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1 Product Summary

Eazistrip is a reinforcement product designed to maintain continuity across wall to floor and wall to wall construction joints in concrete structures.

Eazistrip consists of selected reinforcement, pre-bent and housed in a purpose-designed carrier casing manufactured from indented galvanised steel.

The Eazistrip unit is fixed to the shutter and cast into the front face of the wall. After the formwork is struck, the carrier case lid is removed to reveal the connection legs (or starter bars) lying inside the casing. These legs are bent out by the contractor, ready for lapping the main reinforcement of the next concrete pour.

The casing remains embedded in the wall, providing a rebate and key for the subsequent pour of the adjoining member and eliminates the need for traditional preparation such as scabbling at the joint.

1.1 Scope of Application

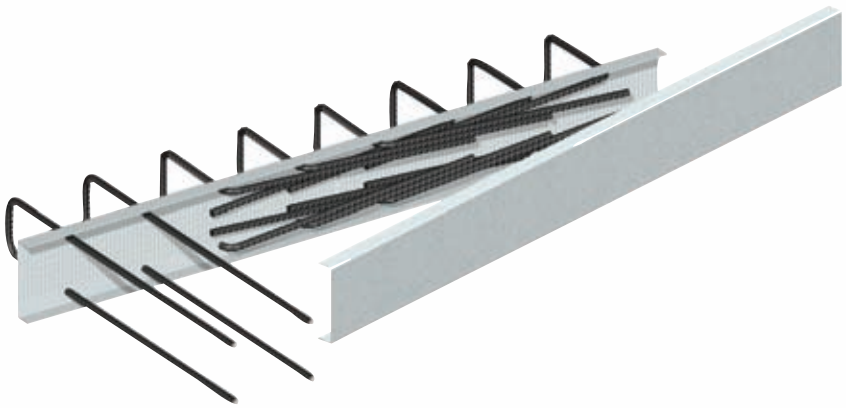
This approval covers use of the Eazistrip reinforcement continuity system in reinforced concrete structures designed in accordance with BS8110: Part 1, which are subject to static loading in non-cryogenic environments.

1.2 Design Considerations

In the UK, the use of continuity system construction jointing methods, which require the site bending of in-situ reinforcement, is a matter for the engineer's approval. Re-bending of reinforcement is a matter of product suitability and workmanship. This technical approval demonstrates that the performance of construction joints designed to BS8110 is not adversely affected by the use of the Eazistrip continuity system. Design for shear along the axis of a joint of this type is not covered in BS8110 and some guidance on it is given in section 3.2 below.

1. ***BS8110 Paragraph 7.2*** states "It is permissible to bend grade 250 reinforcement projecting from concrete provided that care is taken to ensure that the radius of bend is not less than that specified in BS 8666. Grade 500 bars should not be bent, rebent or straightened without the engineer's approval."

2. ***BS 8110 clause 3.12.8.22*** states "End anchorages in the form of hooks and bends should only be used to meet specific design requirements and should conform to BS 8666."



3. ***BS8110 clause 3.12.8.24*** states that in relation to the minimum radius of bends "In no case should this be less than twice the radius of the test bend guaranteed by the manufacturer of the bar, nor less than the radius required to ensure that the bearing stress at the mid-point of the curve does not exceed the values given in 3.12.8.25".

It is the designers responsibility to ensure that reinforcement is adequately designed in accordance with the code and detailed to ensure end anchorages and bearing stresses are appropriate. However, rebending of reinforcement at the construction joint is a matter of product suitability and workmanship. This technical approval demonstrates that the performance of construction joints is not adversely affected by use of the Eazistrip reinforcement continuity system.

1.3 Conclusion

It is the opinion of CARES that the Ancon Eazistrip is satisfactory for use within the limits stated in paragraph 1.1 when installed and used in accordance with the manufacturer's instructions and the requirements of this certificate.

B. Bowsher
Executive Director

November 2007

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2 Technical Specification

2.1 General

The Eazistrip reinforcement continuity system is a quick and easy way of maintaining continuity of reinforcement at construction joints in concrete. The system is manufactured by Ancon Building Products in a CARES quality assured manufacturing unit.

The system consists of a galvanised steel casing with a dimpled surface to provide an effective bond and key with the concrete. Pre-bent bars are housed within the casing and are enclosed by a protective steel cover; each end of the unit is provided with a polystyrene block in order to prevent the ingress of concrete.

The type of reinforcement used is selected by Ancon Building Products to provide a suitable degree of ductility, ensuring that it complies with the tensile requirements of BS4449:2005 Grade B500B after prefabrication and re-bending on site. The material is CARES approved, assuring consistent compliance with the product standard. Material processing is CARES approved to ensure full traceability from steel mill to customer.

Eazistrip is available in bar sizes 10, 12 and 16mm, the bars are formed to a minimum bend radius of: (Table 1).

Bar Size	Bend Form Radius	Bend Form Diameter
10mm	30mm	60mm
12mm	36mm	72mm
16mm	50mm	100mm

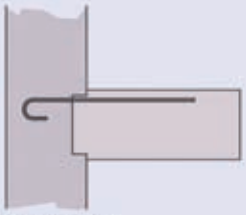
Table 1

Eazistrip is available in a wide range of customer specified shapes and options, refer to Figure 1. Eazistrip units can also be supplied radiused to suit circular structural elements.

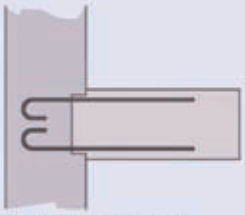
The manufacturer's sales literature offers scheduling information for the engineer and contractor.

All the manufacturing processes comply with ISO 9001:2000 and the bars are cropped and bent according to BS8666:2005.

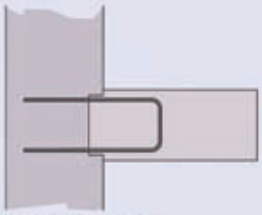
Shape Types



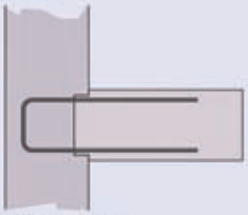
Type H Hook
(standard in 60mm and 80mm box)



Type 2H Double Hook
(not available in 60mm and 80mm box)



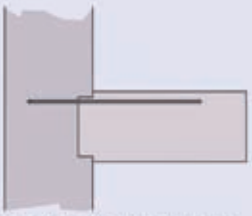
Type RU U Bar
(not available in 60mm and 80mm boxes)



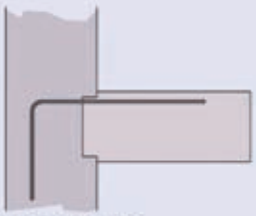
Type U U Bar
(not available in 60mm and 80mm boxes)

Type S Straight Bar

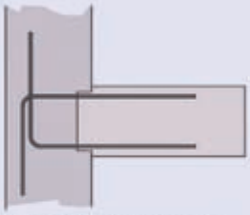
Type S2 Double Straight Bar



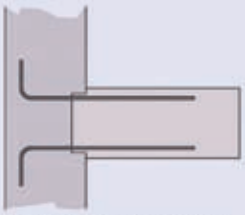
Type SH Angle with leg in horizontal plane



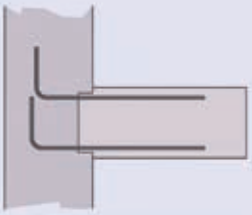
Type RA Angle



Type RA1 Double Angle



Type RA2 Double Angle



Type RA3 Double Angle

Figure 1

3 Product Performance and Characteristics

3.1 Reinforcement Tensile Properties

Mechanical tests on the reinforcement showed that the material, after bending and straightening, complied with the tensile requirements of BS4449 Grade B500B, exhibiting values for Total Elongation at Maximum Load (A_{gt}) of greater than 5%.

3.2 Strength of Joints

Wall to floor joints

Structural tests showed that the flexural strength and shear strength of construction joints formed with the Eazistrip reinforcement continuity system are no less than those of equivalent traditionally formed construction joints.

Wall to wall joints

The resistance of a joint to shear along its axis depends on contact between the dimples of the casing and the concrete to either side of it and on the ability of the continuity reinforcement (or external actions) to resist the forces normal to the joint engendered by the shear transfer. The results of a limited series of tests, with effectively pure shear loading, are consistent with the design expression

$$V_{Rd} = 0.7\ A_s f_{yd} \leqslant 0.4\ \sqrt{f_{cu}}\ A_c$$

Where V_{Rd} = design shear resistance
A_s = area of continuity reinforcement normal to the joint
f_{yd} = design yield stress of continuity reinforcement (= 435 N/mm^2 for grade 500 bars)
f_{cu} = characteristic cube strength of concrete
A_c = area of concrete in contact with rear face of casing.

(The tests were made with 190 mm wide casing in joints between parallel sections of 240 mm wide walls. The upper limit in the equation is simply the value corresponding to the largest ratio of reinforcement used in the tests).

3.3 Serviceability Limit States

3.3.1 Deflection

The deflection of elements is not a function of this product insofar as joints formed using Eazistrip were able to ensure full structural continuity during testing and did not exhibit any significant additional rotation relative to the joint.

3.3.2 Cracking

In the tests conducted, the widths of flexural cracks in the joint regions at reinforcement stresses of 300 N/mm^2 were slightly over the 0.3mm required for areas of constant bending moment according to BS8110. Although BS8110 does not cover cracking at joints, e.g. corners at slab/wall interface, the value found is no worse than that experienced in traditional construction joints.

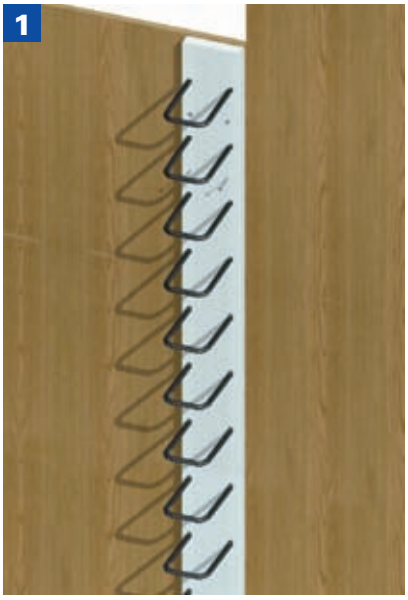
3.3.3 Calculation of Crack Widths

Crack widths at joints are not generally assessed in BS8110 designs but where a calculation is required, the following equation can be used:

$$\omega = \frac{\sigma_s^2 \, \phi_s}{4 E_s \tau}$$

Where σ_s = the steel stress in the crack,
ϕ_s = the bar diameter,
τ = the average bond stress,
ω = the crack width at the level of the centre of the steel,
E_s = the elastic modulus of the steel.

4 Installation



Nail the Eazistrip through the casing to the formwork or alternatively securely tie the projecting anchorage reinforcing bars back to the main reinforcement. In both cases the Eazistrip boxes should be securely fixed to avoid displacement during concreting. The casing should be tight against the formwork. Pour concrete.

Strike the formwork to reveal the steel cover.

Remove the steel cover to expose the pre-bent bars.

4

Straighten the bars using the appropriate sized Ancon Eazistrip re-bending tool for the size of bar. The bars should be straightened only once. To avoid damage to adjacent concrete, it is prudent to allow a concrete curing period of seven days. See "Straightening of Bars" for more information.

5

Once the bars are straightened and aligned they are ready for lapping with the concrete element reinforcement, provided by others.

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4.1 Straightening of Bars

The bars in the Eazistrip box must be straightened using the appropriate sized Ancon Eazistrip rebending tool (Figure 2). This is a steel tube designed to fit over the bar, the internal diameter being slightly larger than the maximum dimension over the ribs of the bar. One end of the tube has a section cut away; this provides support to the outside of the bend during straightening of the bar and limits the point contact of the tube on the bar. Use of the tool allows the re-bending process to be carried out in a smooth continuous action (avoiding jerky action), the tube being moved along the bar and around the bend as it is straightened. Scaffold tubes or similar must not be used to straighten bar. To enable the re-bending tool to be fitted on to the bar, the bar should be pulled the minimum distance from the Eazistrip steel casing to enable this. The re-bending tool should then be slid along the bar to the start of the bend radius. The bar straightening process should be smooth and progressive with the tube allowed to move along the bend towards the metal casing as it is straightened. The tool should contact the Eazistrip steel casing at the completion of the straightening process.

The tube is then removed and the straightened bar checked for alignment and cover with the adjoining reinforcement. The Eazistrip reinforcing bars should not be straightened when the temperature of the steel is below 5°C. Where straightening is necessary below 5°C, indirect warming of the steel to a temperature not exceeding 100°C is permitted. The use of scaffold tubes, or other inappropriate tools will result in excessive kinks in the region of the bar bend and result in undesirable work hardening which may damage the bar and affect the strength of the bar. Re-bending must be undertaken using only the Ancon Eazistrip re-bending tool. Bending the bar in excess of the recommendations will also result in work hardening of the rebar and should therefore be avoided.

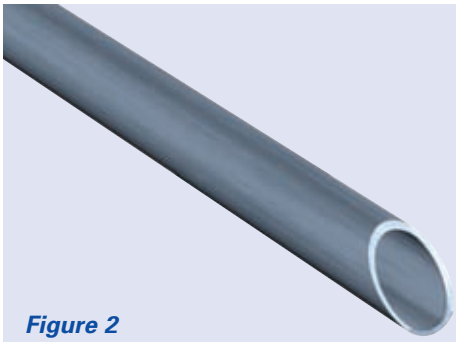


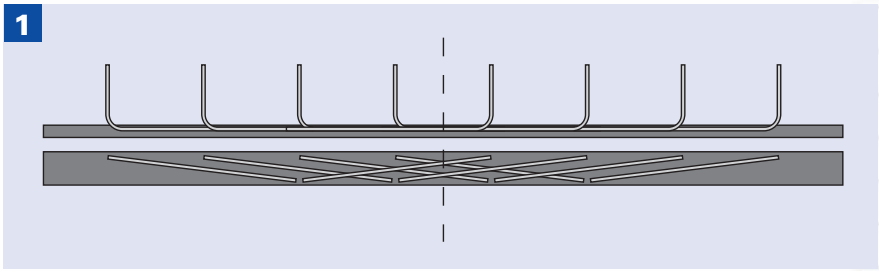
Figure 2

4.2 Storage

Eazistrip should be suitably stored in order to protect it from mechanical damage and corrosion.

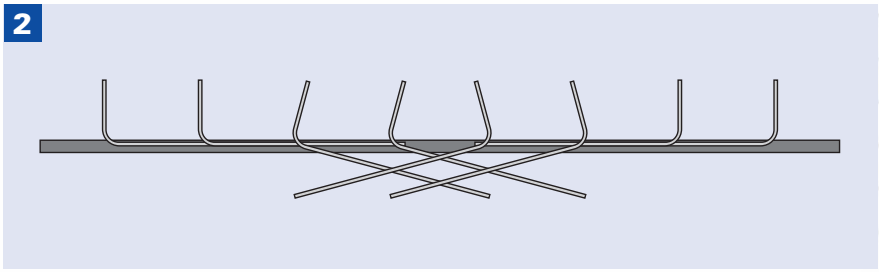
On-Site Cutting

1



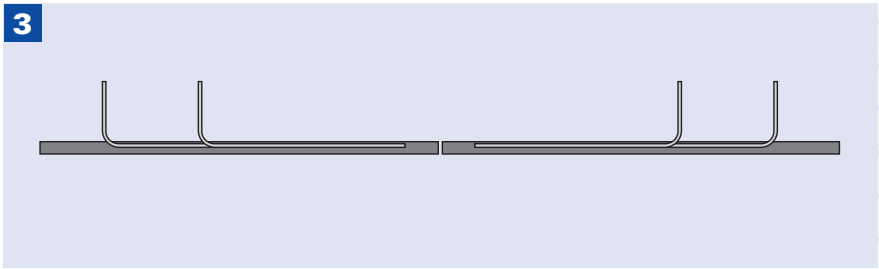
Identify the location of the intended cut.

2



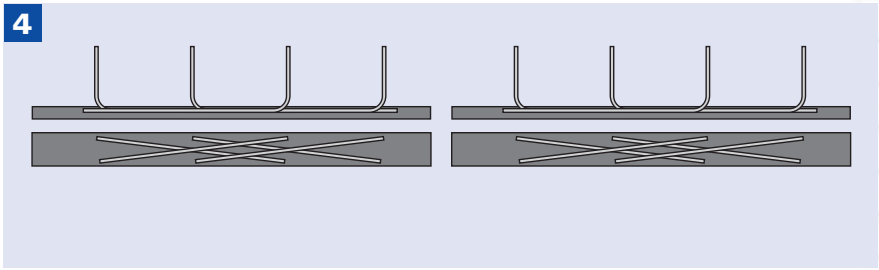
Slide the protective cover from the box and remove the bars which pass over the cut location.

3



Cut through the steel casing using a disc cutter.

4



Replace the bars to face the opposite direction to their original position. Cut the cover to the same lengths as the steel casing and replace to protect the bars. The ends of the boxes must be sealed, using polystyrene blocks, to prevent the ingress of concrete.

Note: *Protective gloves should be warn when removing covers, straightening bars, cutting boxes and during general handling of Eazistrip.*

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5 Safety Considerations

Normal practice is to palletise Eazistrip units for mechanical handling. Attention should be given to recognised manual handling procedures and regulations. Individual casing units weighing up to 25kg may be handled manually provided due care is taken; the weight of each unit is normally identified on each casing label.

Heavier units may require mechanical handling equipment. Protective gloves should be worn when removing covers, straightening bars, cutting boxes and during general handling.

Heat should not be applied to the Eazistrip casing as it is galvanised and may produce dangerous fumes.

6 Product Testing and Evaluation

6.1 General

The Eazistrip reinforcement continuity system was evaluated in two stages:

6.1.1. The reinforcement was subject to independent mechanical testing to establish its suitability for bending during the prefabrication process and rebending through 90 degrees during the straightening process on site and subsequent compliance with the tensile requirements of BS4449.

6.1.2 Eazistrip reinforcement continuity system samples were subject to a programme of full scale structural testing in concrete to evaluate the performance of the construction joints under combinations of high shear and high flexural loading.

6.2 Mechanical Testing

The selected reinforcement was tested to determine the appropriate bend radii.

Reinforcement was subject to the CARES bendability test, which consisted of bending the reinforcement through 90 degrees over a steel former, straightening and examination of the inside of the bend for signs of fracture. The test was conducted twice on each sample.

Reinforcement was also subject to the CARES tensile test regime, which consisted of bending the reinforcement through 90 degrees over a steel former and straightening with the Eazistrip tool prior to tensile testing to measure the Ultimate Tensile Strength, Yield Strength and Elongation at Maximum Load (A_{gt}). The selected reinforcement were found to comply with the tensile requirements of BS4449:2005 Grade B500B. (Clause 7.2.3, Table 4).

6.3 Full Scale Structural Testing

Full-scale structural tests have been conducted on construction joints formed using the Ancon Eazistrip continuity system to determine flexural strengths, vertical shear strengths and crack widths for wall/floor joints and the longitudinal shear strengths for wall/wall joints.

The largest bar 16mm bar was chosen for the majority of the wall/floor tests as being the largest bar size used in the Eazistrip reinforcement continuity system and which imposes the greatest stresses on the surrounding concrete and the most severe demands on the reinforcement in relation to bending and straightening.

The tests showed that flexural and shear strengths of wall/floor joints were to the safe side of values calculated by BS8110 with safety factors removed, and that crack widths could be safely calculated by the equation in section 3.3.3. The longitudinal shear strengths were all on the safe side of the equation in section 3.2.

The test arrangements are shown in Figs 3, 4 & 5.

Figure 3
General wall/slab test arrangement showing jack, with load cells near the centre of slab and at the support remote from the wall.

Figure 4
Post load test, showing ultimate shear failure mode; a continuous polystyrene strip was cast into the wall beneath the Eazistrip joint to simulate poor compaction of the concrete. The wall/slab connection remains essentially intact.

Figure 5
Longitudinal shear test arrangement with Eazistrip cast into one side of the joint. The load was applied by jack through the enclosed test frame.

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7 Quality Assurance

The Ancon Eazistrip continuity systems are produced under an ISO9001 quality management system certified by CARES.

The quality management system scheme monitors the production of the continuity system and ensures that materials and geometry remain within the limits of this technical approval.

8 Building Regulations

8.1 The Building Regulations (England and Wales)

Structure, Approved Document A

Ancon Eazistrip continuity system, when used in BS8110 based designs using the data contained within this technical approval, satisfy the relevant requirements of The Building Regulations (England and Wales), Approved Document A.

Materials and Workmanship, Approved Document, to support regulation 7

This technical approval gives assurance that the Ancon Eazistrip continuity system satisfies with the material requirements of BS8110.

8.2 The Building Regulations (Northern Ireland)

Part B, Materials and Workmanship

This technical approval gives assurance that Ancon Eazistrip continuity system satisfies with the material requirements of BS8110 by virtue of regulation *B3, Deemed to satisfy provisions regarding the fitness of materials and workmanship.*

8.3 The Building Standards (Scotland) Regulations

Part B, Fitness of Materials

This technical approval gives assurance that Ancon Eazistrip continuity system satisfies the material requirements of BS8110 by virtue of *Clause B2.1*

Part C, Structure

Ancon Eazistrip continuity system, when used in BS8110 based designs using the data contained within this technical approval, satisfies the requirements of *The Building Standards (Scotland) Regulations 1990, Part C, C2.1 clause b. construction,ii.*

9 References

- BS 4449: 2005: Steel for the reinforcement of concrete - Weldable reinforcing steel - Bar, coil and decoiled product - Specification.
- BS 8666: 2005: Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete - Specification.
- BS8110: Part 1: 1997: (amended 2007) Structural Use of Concrete, Code of Practice for Design and Construction.
- BS EN ISO 9001: 2000: Quality management systems - Requirements.
- CARES Appendix TA1-2; Quality and Operations Schedule for the Technical Approval of Reinforcement Continuity Systems.
- Taylor Woodrow Technology Centre, Load testing of Ancon continuity reinforcement systems in concrete samples, Technical Report No N950/07.
- Prof. P. E. Regan, Evaluation of the results of tests of the Ancon Eazistrip continuity System, Oct 2007.

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10 Conditions

1. The quality of the materials and method of manufacture have been examined by CARES and found to be satisfactory. This technical approval will remain valid provided that:

   a. The product design and specification are unchanged.
   b. The materials and method of manufacture are unchanged.
   c. The manufacturer complies with CARES regulations for technical approvals.
   d. The manufacturer holds a valid CARES Certificate of Product Assessment.
   e. The product is installed and used as described in this report.

2 CARES make no representation as to the presence or absence of patent rights subsisting in the product and/or the legal right of Ancon to market the product.

3 Any references to standards, codes or legislation are those which are in force at the date of this certificate.

4 Any recommendations relating to the safe use of this product are the minimum standards required when the product is used. These requirements do not purport to satisfy the requirements of the Health and Safety at Work act 1974 or any other relevant safety legislation.

5 CARES does not accept any responsibility for any loss or injury arising as a direct or indirect result of the use of this product.

6 This Technical Approval Report should be read in conjunction with CARES Certificate of Product Assessment No 5017. Confirmation that this technical approval is current can be obtained from UK CARES.

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