



# Ancillary products for reinforced concrete construction

## **Continuity systems and punching shear systems**

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# Introduction



**Earlier parts of these Guides have described how CARES has undertaken certification for products which have been the subject of product standards and, by specific reference to properties, processes and products, how its certification schemes provide confidence in the compliance of these products.**

As the reinforced concrete market develops, certain products and systems have emerged which are designed to provide added value to the contractor and the end product user through improved performance, however that is assessed. Very often, these new

products are not covered by a product standard but are proprietary items designed for a specific construction situation. Nevertheless, users require confidence, often by external independent verification and, in order to deal with this, CARES has designed a system of certification to provide this.

Part 11 of this Guide describes the principles and practices of this system, which is called Technical Approval by CARES.



# CARES Technical Approval Procedure of Continuity systems and punching shear systems

The procedure begins with a detailed discussion between the applicant firm and CARES, including any technical expert deemed necessary, to establish:

- The extent of the product family to be assessed.
- The scope of use and its intended purpose and any specific installation requirements.
- The general principles of testing and evaluation.

Following a successful review and assessment of other potential applicants, the new Technical Approval Scheme proposal will be discussed at the appropriate CARES Technical Committee, whilst maintaining client confidentiality.

Each CARES Technical Committee comprise of various interested parties and senior structural engineers relevant to each product area. There are currently 5 CARES Technical Committees in the UK (Steel, Coupler, Post Tensioning, Construction Products and Sustainability), with similar Committees set up in other selected countries to ensure true representation in the region. This procedure ensures CARES impartiality in the process and allows for progression of both new and existing technical approval schemes in line with updated standards, building practises and legislation. This Technical Approval procedure ensures that a comprehensive series of relevant tests are performed on each product in relation to those characteristics considered important to meet its declared purpose and its intended area of use. The product performance requirements are included in an assessment schedule which is produced by CARES and its agents, approved by the CARES Technical Committee experts and applied by CARES assessment team and nominated test houses.

As part of the certification recommendation procedure there is an evaluation of the technical data of the producer, as applied to the product, which includes those procedures for installation and technical assistance.

Any amendment to the product production or design considered significant to its performance is assessed and further tests are initiated as required. On completion of testing the assessment report and the certificate, which includes the certificate of approval, are approved by a group selected from the CARES Board, before it is signed and issued.

All product assessment schedules include quality management system requirements in accordance with ISO9001:2015 and these systems are assessed and audited twice-yearly by CARES auditors' expert in the products and processes involved.

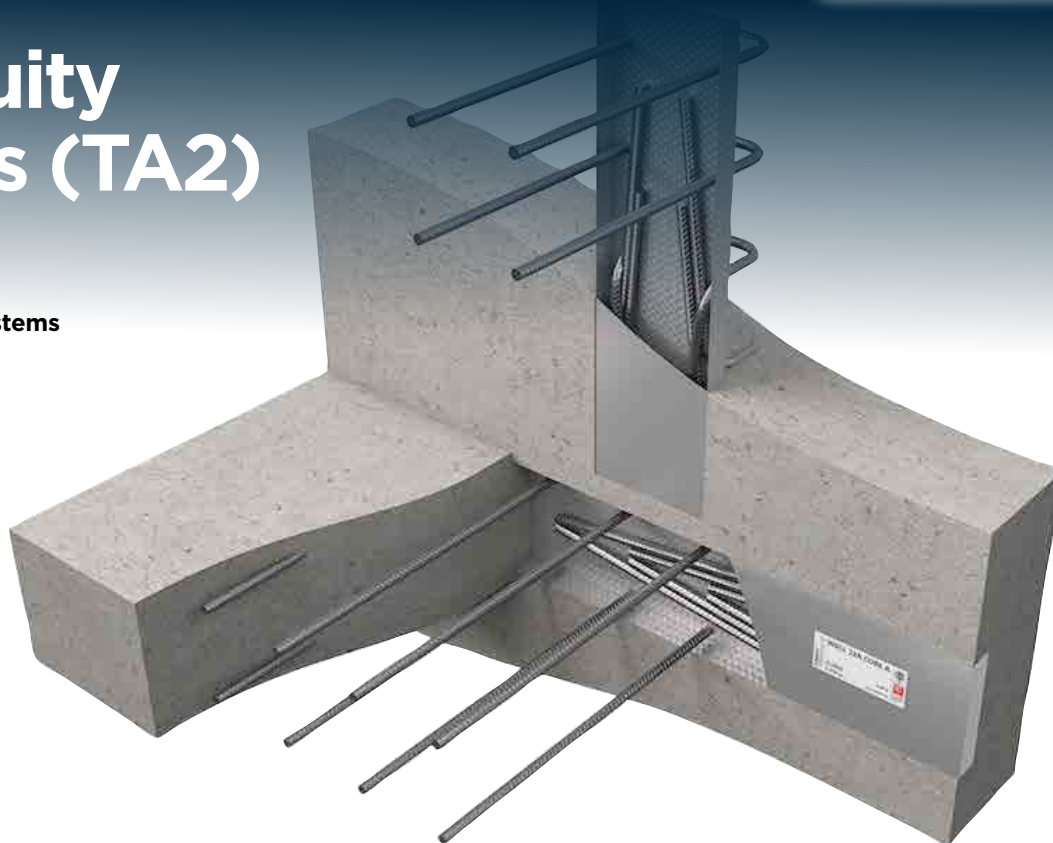
## Key differences

The key differences between the CARES Coupler Technical Approvals and its Product Certification Schemes are:

- Creation of bespoke tests and testing programme to be included within the assessment schedule. Such testing may be defined in a product standard or alternatively designed by CARES.
- CARES do try to follow the basic ethos of standards writing in this respect, including reference to the balanced membership of the relevant CARES technical committee in the approval of any Assessment Schedule issued or updated.
- Design considerations.
- Safety considerations.
- Detailed technical reporting as well as certification.
- Correct and up to date installation instructions for the couplers

# Continuity systems (TA2)

**Figure 1. Continuity systems**



## Basic principles

Traditional methods for forming construction joints on site can require the site bending and re-bending of reinforcing steel, which can adversely affect the material properties. Reinforcement continuity systems are designed to maintain continuity across construction joints in concrete structures in a time saving and cost effective manner.

The typical reinforcement continuity system consists of reinforcement, pre-bent and housed in a purpose-designed carrier casing. On-site, the unit is fixed to the shutter and cast into the front face of the wall or floor. After the formwork is struck, the carrier case lid is removed to reveal the connection legs (starter bars) folded inside the casing. Using a specially designed tool, these legs are bent out by the contractor, ready for splicing the main reinforcement of the consequent pour. The casing remains embedded in the wall or floor, providing a rebate and key for the subsequent pour of the adjoining member, eliminating the need for traditional preparation, such as scabbling at the joint.

## CARES assessment

The CARES Technical Approval covers the use of these systems in accordance with EC2. Any site-bending or re-bending of reinforcement protruding from concrete is a matter for the Engineer's approval. This is therefore a fundamental consideration in the assessment process, as successful re-bending of reinforcing steel is a matter of steel suitability, bend parameters and workmanship. Parts 2 and 3 of the CARES Guides explain the varying properties of reinforcing process routes and properties relating to steel sold into the market today.

Ductility is the key property here and the producer must ensure the correct purchase specification for steel to ensure that the necessary cold working of the

reinforcing steel does not adversely affect the final properties ensuring the steel still meets the requirements of BS4449.

CARES undertake mechanical testing to ensure that steel of each process route, type, size and supplier is appropriately selected by the continuity strip producer prior to its use. After bending and straightening, steel must be shown to comply with the tensile property requirements of BS4449. Also after bending and straightening twice, the reinforcement must not have any surface rupture. Regular independent testing is also performed as part of the CARES assessment.

Full scale in-situ structural testing is also performed to evaluate the performance of construction joints under combinations of high flexural and shear loading. These tests demonstrate that the flexural strength and shear strength of construction joints formed with these systems are comparable to equivalent, traditionally formed construction joints.

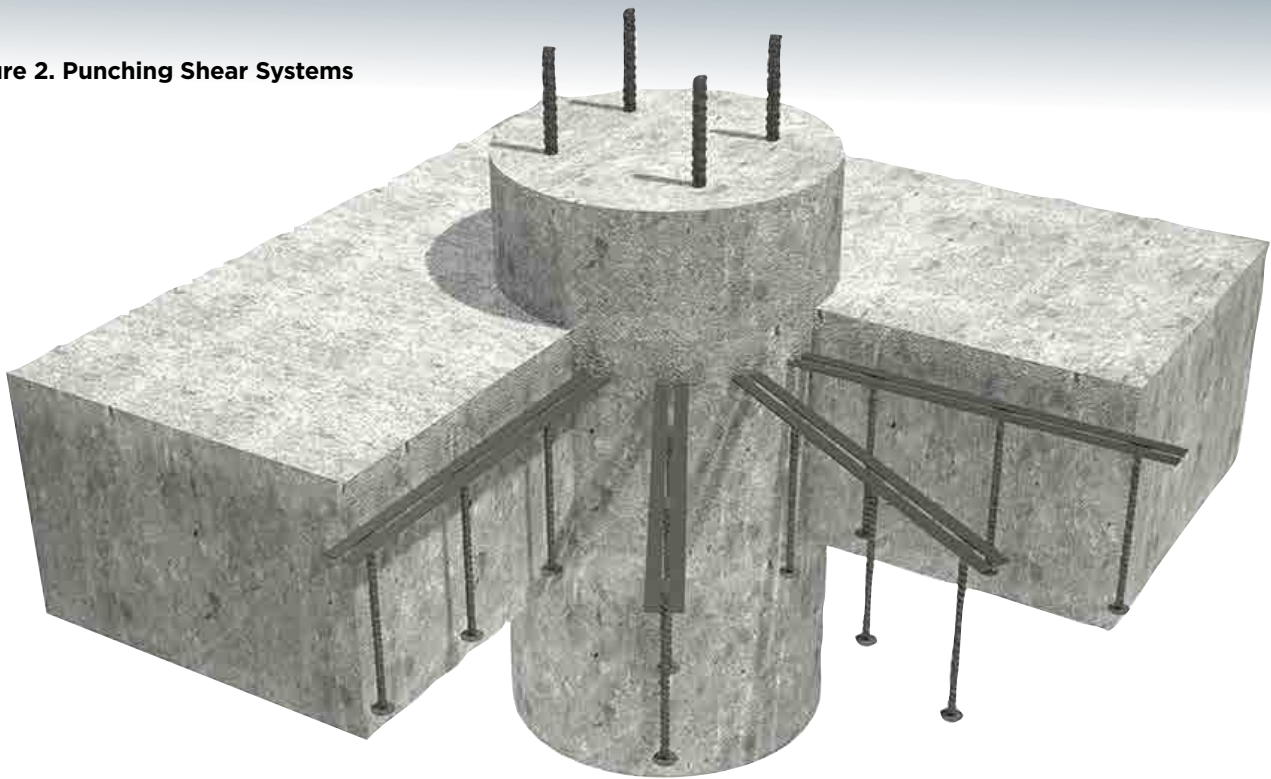
There have been reports that there are continuity systems in use which use CARES approved rebar claiming that the full system is therefore a CARES approved system. Unless there is a CARES Technical Approval then the system has not been subjected to the necessary structural testing, the ongoing surveillance and ongoing mechanical testing and therefore have a high risk of failure in use,

Copies of the various CARES Technical approvals can be found on the CARES website:

**(Technical Approvals Reports - Cares Steel Certification)**

# Punching Shear Systems (TA7)

**Figure 2. Punching Shear Systems**



## Basic principles

A concentrated load on a slab causes high punching shearing stresses on the section around the load. Traditionally shear link reinforcement is used to resist punching shear however shear studs connected to rails are a popular alternative, offering a prefabricated solution that is relatively easy to install.

Shear studs are fabricated from ribbed reinforcing steel, usually with hot forged enlarged ends; the shaft of each stud provides the shear reinforcement and the stud heads and ribs on the shaft provide anchorage and bond with the concrete. EC2 enables the calculation of area punching shear reinforcement required and also gives guidance on its spacing.

## CARES assessment

CARES assessment comprises:

- a) Mechanical testing of the studs to ensure that the stud's tensile properties comply with BS4449 and that the stud heads remain attached under full tensile load.
- b) Structural testing in concrete to verify that the producers stud system and design and detailing guidance provide adequate punching shear resistance.

## Product Requirement

Product testing:

- a) Tensile strength: The studs are tested to determine their tensile strength in accordance with BS4449 and must comply with the tensile properties of BS4449 for the specified grade of reinforcement. The tensile load must be applied via the head and the mode of failure must be by ductile failure of the shaft and not by detachment of the head.
- b) Elongation at maximum force: The studs must be tested to determine their total elongation at maximum force in accordance with BS4449 and must comply with the requirements of BS4449 Table 10.
- c) Structural testing: reinforced concrete slab/column samples, designed in accordance with the manufactures guidance and subject to punching shear loads. The slabs/columns must achieve the necessary punching shear capacity and the mode of failure must be ductile and flexural in nature.

CARES ongoing factory production control surveillance and regular testing of studs are key to ensure the maintenance of properties in accordance with BS4449. As with all the CARES product schemes, product traceability is key.



# The CARES Scheme

Whilst being different in nature to the CARES Product Certification scheme, in that it does not deal with standardised products, the CARES Technical Approval Scheme uses many of the same principles as they are described in Part 1 of this Guide.

The Technical Approval procedure ensures the following:

- That the product, its specific application and the scope of certification are fully understood. This is subject to the scrutiny of CARES to ensure that it is within its area of defined expertise and that full support for assessment requirements are available
- The formulation of an assessment schedule by CARES and its agents, approved by experts selected from its Board of Management and applied by its auditors and nominated test houses. All product assessment schedules include quality system requirements and include consideration of the design requirements both for the product itself and for its application.
- The formulation of a comprehensive testing programme giving full consideration to each of those performance characteristics considered important to meet its declared purpose.
- Surveillance sampling and subsequent independent of products, ensuring witnessing of the installation and confirmation that the procedures contained within the Technical Approval report are clear and remain valid (If applicable).
- An assessment of the quality management systems of producers both initially and periodically by CARES auditors' expert in the products and processes involved. This includes any sub-contracting production and testing used by the applicant manufacturer. This assessment is based on the requirements of ISO9001:2015.
- An evaluation of the technical data of the manufacturer, as applied to the product, including those procedures for installation and technical assistance. Any amendment to the product production or design considered significant to its performance is assessed and further tests are initiated as required if CARES approval is to be maintained.
- On completion of testing an assessment report and Technical Approval report are produced, both of which detail the product scope and scope of use that has been assessed and approved. It is important to note that the technical approval report must be accompanied by a specific CARES Certificate of Approval as proof that the approval is current and valid.
- The producer is encouraged to assist with the preparation of the Technical Approval report ensuring the accuracy of the final document and clear and up to date information on use and installation of the product, as necessary.



# Technical Approval Report



**Figure 3: CARES Technical Approval and Certificate of Approval**

The Technical Approval Report is an important document for the end product user in that it defines the conditions of use of the product and therefore, in effect, its limitations. Important conditions in relation to the validity of the approval to be recognised include:

- The product design and specification remain unchanged from that assessed.
- The materials and method on manufacture remain unchanged.
- The product is installed and used as detailed in the report.

The Technical Approval Report must be read in conjunction with the relevant CARES Certificate of Approval. Figure 3 shows a CARES Technical Approval alongside its associated Certificate of Approval.

All CARES Technical Approvals are published in PDF format on CARES' website:

**[www.carescertification.com](http://www.carescertification.com).**

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# Your guide to specifying Learn how to procure CARES certified steel products

To specify CARES certification that meets government and private sector quality assurance and responsible sourcing requirements use the text from the guide in your project specifications.

specification  
guide



## References

1. BS 4449: 2005+A3:2016 Steel for the reinforcement of concrete - Weldable reinforcing steel - Bar, coil and decoiled product - Specification.
2. BS EN 1992-1-1: 2004 Eurocode 2 Design of concrete structures- Part 1-1: General rules for buildings.
3. BS 8110: Part 1:1997 "Structural use of concrete. Code of practice for design and construction".
4. ISO 9001: 2015 "Quality Management Systems- Requirements".

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