CARES Scheme for Approval of Post Tensioning Systems for Concrete Structures in Australia

Appendix APT01
Quality and Operations Schedule for the Production and Supply of Prestressing Anchorages for Post-Tensioning Systems

Contents

Amendment Control Sheet

Amendment summary	Date
First issue	18.02.2021
(Latest amendments highlighted throughout Appendix by an adjacent line)	

0. INTRODUCTION

This CARES quality and operations assessment schedule relates to the quality system requirements for the production and supply of prestressing anchorages for post-tension systems for use in concrete structures in Australia.

1. SCOPE

This quality and operations assessment schedule describe the minimum quality and operational requirements for the production of prestressing anchorages to meet the requirements of AS / NZS 1314:2003 Prestressing Anchorages, Appendix A, clause A3.

It is acknowledged that Appendix A of the standard is Informative, but in respect of this scheme, it is regarded as Normative.

1.1 Schedule of Operations

The organisation shall document the production processes, materials, equipment, and human resources relevant to this Schedule in a CARES Schedule of Operations. The Schedule of Operations shall be used by CARES during the assessment and subsequent surveillance inspections and shall be updated when required.

The Schedule of operations shall indicate the component part drawing reference numbers, including revision status, as well as key component suppliers and relevant purchasing specifications and their revision status.

2 DEFINITIONS

Anchorage. A mechanical device, usually consisting of several components, designed to retain the force in the stressed tendon and transmit it to the concrete.

Authority. The UK Certification Authority for Reinforcing Steels (CARES), a company limited by guarantee

Anchor. The component that contains the wedge block and transfers the prestressing load onto or into the structure.

Client. The body for which the works are being carried out.

Coupling. An anchorage designed to join tendons end to end, which may include an already stressed tendon or joins to an un-stressed tendon

Customer. The body engaging the organisation for the purpose of supplying the products described in this schedule.

Post-tension system. An arrangement of tendons and anchorages designed to carry out post-tensioning.

Organisation. The body responsible for the production and supply of anchorages and regarded as responsible for the design and ownership of the PT kit.

Quality plan. The document setting out the specific quality practices, procedures, resources, and sequence of activities relevant to the product.

Quality system. The organisation's Organisational structure, responsibilities, procedures, processes, and resources for implementing quality management.

Recognised Testing Establishment. An Organisation or University which has a history and expertise in testing according to the requirements of the product testing standard

Stressing. The operation of inducing tension in the tendon

Supplier. A body approved by the organisation for the provision of specified materials, equipment, or services.

Tendon. One or a number of prestressing steel elements, i.e., wire, strand or bar complying with AS/NZS 4672

Wedge block: The steel block in which wedges are seated and grip the tendons, and where stressing may take place according to the PT kit manufacturer's instructions / client specifications.

Wedges. The component which grips the tendon on release of tension during the pre-stressing operation. Its function is to prevent slippage when tension is released.

3 OPERATION OF THE SCHEME

The Scheme will operate as follows:

3.1. Certification of the Organisation

Certification of the organisation will be granted after a satisfactory assessment of the organisation's procedures, operations, and products by CARES in accordance with the requirements of this Schedule and AS/NZS ISO 9001.

3.2. Maintenance of approval.

In order to maintain approval, the organisation shall be subject to:

a) Quality management system inspections twice per year.

b) Product testing and evaluation in accordance with this schedule

c) The periodic fees levied by the Authority.

d) Periodic Audit of key component suppliers for the PT kit assemblies if not manufactured in-house. Such audits will be undertaken every three years following initial approval, or sooner in case of any quality concerns or approved product design changes as determined by the Authority.

4. QUALITY MANAGEMENT SYSTEM REQUIREMENTS

The organization shall operate a quality management system that complies with AS/NZS ISO 9001 and this schedule. This Schedule interprets those elements that are particularly relevant to the production anchors for of post-tensioning systems to ensure consistent product quality and continued compliance with this schedule.

4.1. Documentation Requirements, Control of Records

The organization shall establish and maintain records to show conformity with this schedule and shall define their retention period and their disposition.

Records relating to the technical details of anchors shall be retained for a minimum period of 12 years and a copy of these shall, when required, be sent to the client.

Where documents and records are stored electronically, the data shall be regularly backed up to ensure no loss of data and readily retrievable with minimal loss of information in case of failure.

4.2. Management Responsibility

Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improving its effectiveness by:

a) Communicating to the organization the importance of meeting customer as well as statutory and regulatory requirements.
b) Establishing the quality policy.
c) Ensuring that quality objectives are established.
d) Conducting management reviews.
e) Ensuring the availability of resources and control of such

4.2.1 Quality Management System Planning

The organisation shall produce a quality plan for each anchor type and size. The quality plan shall identify the: human resources, responsibilities, processes, materials, equipment, controls, purchasing specifications, inspection, measuring and test equipment, reference standards and levels of acceptability required to meet the contract requirements.

4.3. Provision of Resources

The organisation shall identify the resource requirements in the quality plan and provide adequate resources, including materials, equipment, inspection, measuring and test equipment and trained personnel for the management, supervision and performance of the work and verification activities.

4.3.1. Competence, Awareness and Training

The organization shall:

a) Determine the necessary competence for personnel performing work affecting product quality, including inspection and verification activities.

b) Provide training or take other actions to satisfy these needs.

c) Evaluate the effectiveness of the actions taken, and where required certificate the trained individuals.

d) Ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives.

e) Maintain appropriate records of education, training, skills, and experience.

4.4. Purchasing

The organisation shall have a documented procedure for purchasing materials and services from suppliers. All materials and services shall be purchased from sources approved by the organisation.

4.4.1. Purchasing Information

The purchase orders shall include all aspects of the material or service specification, which are important in ensuring satisfactory product performance, quality, traceability, and identification. For each PT component purchased there shall be a controlled purchase specification to ensure no deviation of material from that supplied and tested in the original assessment programme.

Purchasing specifications shall be readily available for review and shall not be changed unless agreed with the authority in line with the requirements of clause 5.4.

4.4.2. Evaluation of Suppliers

The organisation shall have a documented procedure for the evaluation and selection of suppliers. Records of acceptable suppliers shall be maintained. The assessment shall account for all aspects of the service or material specification, which are important in ensuring satisfactory quality and identification of the material or service.
Where parts of the manufacturing / treatment of components is outsourced to other organisation's without CARES certification these shall have an AS/NZS ISO 9001 certification or similar and be subject to periodic surveillance audits both by the company seeking CARES certification and by CARES themselves to the relevant technical standards as detailed in the purchase specifications.

4.5. Product Identification and Traceability

The organisation shall have a documented procedure to maintain traceability during all stages of production through to delivery. Traceability records shall be included in Quality Records and shall include the following:

a) Records of the source and specification of materials used for the production of prestressing anchorages.

b) Records of post-tensioning system component production and testing.

c) Unique identities of produced PT components traceable to the above records.

4.6. Determination of Requirements Relating to the Product

The organization shall review the requirements related to the product. This review shall be conducted prior to the organization's commitment to supply a product to the customer and shall ensure that:

a) Product requirements are defined.

b) Contract or order requirements differing from those previously expressed are resolved.

c) The organization has the ability to meet the defined requirements.

Records of the results of the review and actions arising from the review shall be maintained.

5. PRODUCTION AND SERVICE PROVISION

5.1. Preservation of the Product

5.1.1. Receipt

The organisation shall have a documented procedure for the receipt of incoming material that includes inspection of material and, where appropriate, correlation of advice notes and test certificates. The procedure shall incorporate the receipt of customer property.

5.1.2. Storage

The organisation shall have a prescribed procedure, which ensures that materials are stored and segregated in a manner, which prevents their corrosion, damage, deterioration, and contamination. *For clarification, unacceptable corrosion is regarded as that which cannot easily be removed by hand and permanently marks the surface of the part (such as surface pitting)*

a) Where applicable, the organisation shall have a documented procedure for recording and identifying all materials held in stock and subsequently processed. The procedure shall ensure materials are identified to the original cast or batch information, as applicable. This system shall include material supplied by the customer.

b) All test and inspection information shall be maintained as specified in the appropriate standard. Material shall not be released from storage until verification of conformity to specified requirements has been received.

5.1.3. Handling

The organisation shall have a documented procedure for handling materials and equipment that prevents them from becoming damaged, contaminated, or corroded. (See above for clarification of unacceptable corrosion)

5.1.4. Packing and Delivery

The organisation shall ensure that products are adequately packed and protected up to and including delivery to the customer, ensuring no corrosion or deterioration of the kit components supplied.

5.2. Control of Monitoring and Measuring Devices

The organisation shall have a documented procedure which ensures that all equipment that is used for processing, measuring, and testing is identified, defined, and regularly calibrated and maintained in accordance with a prescribed calibration and maintenance programme. The calibration and maintenance programme shall include any contract-specific requirements.

The procedure shall comply with ISO10012-1.

Measuring equipment shall be capable of measuring to the required resolution (including contract specific requirements) and shall be of a known and appropriate accuracy.

5.3. Internal and External Audit

The organisation shall have a documented procedure for the planning, implementing and objective reporting of internal quality audits in order to verify the effectiveness of the quality system.

The internal audit shall:

a) Verify that quality activities comply with requirements specified in the organisation's quality management system.

b) Determine the effectiveness of the quality management system.

External audits of kit component suppliers shall:

a) Verify that the production facilities ensure continued compliance with requirements specified in the purchase specifications / Quality Plan issued by the organisation.

b) Determine the effectiveness of the supplier's quality management system.

c) Ensure the necessary Quality controls, testing and inspection are in place to ensure continued compliance with this scheme and / or the appropriate product standard.

The results of both types of audits shall be recorded and shall include:

a) Objective evidence of audit findings.

b) Recommendations for corrective actions in a timely manner

c) Verification of corrective actions.

The results of both internal and external audits shall be included in the management review.

5.4. Monitoring and Measuring of Processes and Product

The organization shall have a documented procedure for the production of the various PT component parts. The procedure shall specify the key production processes with reference to suitable production equipment, monitoring of processes, sampling, inspection, testing, materials, standards, specifications and criteria for workmanship and maintenance of production equipment.

The procedure shall ensure that:

a) Products are manufactured from the correct type and grade of material using the correct processes.

b) Products are dimensionally and geometrically correct.

c) Retention of necessary certificates of conformity for kit components.

Full details of the required inspection requirements for PT kit components supplied externally to the organisation are detailed in Appendix A.

The procedure shall also ensure that the PT components comply with the original specification of the PT kit which is tested and approved. The following variables shall not be changed without the prior agreement and assessment by CARES:

a) A change in component material or grade or raw material type
b) A change in the dimensions of the component(s)
c) A change in production process or production location / supplier

The organisation shall have a documented procedure that ensures inspection and testing is conducted in accordance with the quality plan, appropriate reference standards as detailed in AS / NZS 1314:2003 and contract specifications.

Records of inspection and test information shall be maintained as specified by the customer and the appropriate standard or specification.

5.5. Control of Nonconforming Product

The organisation shall have a documented procedure for processing nonconforming work and materials, which shall include:

a) Adequate product segregation and identification of nonconforming product.

b) Review of nonconforming work and appropriate corrective action.

5.6. Improvement

The organization shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective actions, and management review. Corrective action procedures shall provide for dealing with customer complaints relating to product subject to this CARES Scheme. Records of all complaints received, and action taken shall be retained.

5.7. Corrective Action

The organisation shall have documented procedures for corrective action to eliminate the cause and potential cause of nonconformities. The procedures shall include complaints to the organisation and complaints from customers relating to workmanship and materials, which are subject to this CARES Schedule. Records of all complaints and the corrective action taken shall be maintained and quality complaints reported to CARES on a quarterly basis.

5.8. Technical Service

When requested by a customer or client, the organisation shall provide technical advice to customers regarding the use of the PT system and associated components which are the subject of this schedule where required.

The organisation shall ensure all approved PT kits have an approved installation procedure in line with the intended operation of the PT kit and its original performance tests as detailed in section 6.

6. PRODUCT REQUIREMENTS

Prestressing anchorages shall comply with the requirements of AS/NZS 1314:2003 and specifically:

AS/NZS1314 Section 8.2 Tendon-anchorage assemblies and couplings (Appendix B: Gripping Efficiency Test and Appendix D: Non - Stressing Anchorage Efficiency) and

AS/NZS1314 Section 8.3 Anchorages (Appendix C: Stressing Anchorage Efficiency test and Appendix D: Non - Stressing Anchorage Efficiency test).

The pre-stressing steel element used shall be obtained from firm(s) holding a valid product conformity certificate of approval supplied by the Australian Certification Authority for Reinforcing Steel (ACRS) complying with AS/NZS 4672 and shall be of a type that is compatible with the anchorage used in line with the PT kit manufacturer installation instructions.

6.1 Product Testing

For the initial approval and any agreed changes in product design, the prestressing anchorages shall be subject to the initial assessment test programme as defined in paragraph 6.1.1 following.
The samples to be tested shall be representative of those used in practice and shall be of the same type and size and selected at random from the same batches of anchorage components and strand or bar.
Prior PT kit testing may be considered in the assessment process but will be reviewed as part of the initial application review process.
The tests shall be undertaken by an independent NATA accredited (or ILAC equivalent) laboratory or recognised testing establishment which is acceptable to the Authority (e.g., University with a history of similar construction component type testing).

Some tests may be conducted at the suppliers or other agreed premises if the proposed test methodology, equipment, and trained personnel are vetted by an independent structural engineer of proven experience in such structural component testing.

The Authority reserves the right to review the suitability of such independent personnel and witness any of the tests to be carried out at any of the prescribed testing laboratories or establishments as part of the approval process.

Assessment of the suitability of the independent structural engineer may include, but not limited to:

i. Structural Engineering Qualifications,
ii. Chartered Engineer status
iii. Experience in use of the component(s) being tested, with verification by review of applicable witness test reports.
iv. Regarded and acknowledged as an experienced authority in the application, use and testing of such components.
v. Confirmation of independence from the client

6.1.1 Assessment Test Programme

Each mechanical prestressing anchorage type shall be subject to the number of tests as detailed in AS/NZS 1314:2003 for the following tests.

a) Assessment of the Gripping Efficiency based on AS/NZS 1314:2003 Appendix B.

b) Assessment of the Stressing Anchorage Efficiency based on AS/NZS 1314:2003 Appendix C.

Where the PT kit is designed to be used as either unbonded only, or bonded / unbonded then the test used will be b) a cyclic test followed by a static test to failure.

Systems designed only for bonded systems may use either a) static test or b) cyclic test

c) Assessment of the Non- Stressing Anchorage Efficiency based on AS/NZS1314:2003 Appendix D.

Where the PT kit is designed to be used as either unbonded only, or bonded / unbonded then the test used will be b) a cyclic test followed by a static test to failure.

Systems designed only for bonded systems may use either a) static test or b) cyclic test

For clarity and in addition to the requirements of clause 8.1 of AS/NZS 1314:2003, the following minimum number of samples shall be provided for testing, as detailed for each scenario below:

a) If a manufacturer produces a range of anchorages, couplings or assemblies that are geometrically similar and only differ in the number of tendons accommodated, then it is acceptable to test only 30% of each strand sizes from that range of anchorage.

b) Components which differ by geometry which may influence the distribution of stress in the slab or the strand are regarded as a separate range and will also require to be tested as above in a)

c) Component which are geometrically similar but have been processed by a different process route, then each component type must be included in the testing regime detailed above.

d) Where different wedge designs are employed (e.g., two piece or three-piece wedges) then the proposed test plan by the client must include testing of both variations.

Clause B3.2 of AS/NZS 1314 requires that the bearing area between the frame and the test specimen shall be representative of the actual bearing area used by the system being tested. In this respect the actual bearing area used by the system is taken as the designed bearing area of the system. In case of conflict with the dimensions dictated by the prism cross sectional area (CSA) given in figures C2 and D2 due to safety / practical considerations, then such deviation shall comply with the requirements of EAD160004–00-0301clause C4.1.1. Such deviation shall be reviewed and confirmed acceptable by the independent Structural Engineer (clause 6.1) and shall form part of the final product certificate.

The allowable slab depth / thickness shall be agreed following the review and will be noted on the final approval certificate to ensure clarity to the users of the approved system.

The finalised test programme shall be agreed between the Authority and the Organisation prior to commencement of the testing, following scrutiny by the independent Structural Engineer as detailed in clause 6.1.

6.1.2 Prescribed Test Plan

The organisation shall have a documented prescribed testing and inspection plan which is sufficiently detailed as the model test plan as contained in Appendix A of the scheme.

Where there are deviations to the model test plan in Appendix A, then the manufacturer shall provide sufficient evidence as to the reason for this intended change, for agreement of the Authority prior to the final assessment stage 2.

Such reasoning may include that given by ANSI/ASQ Z1.4 (Sampling Procedures and

Tables for Inspection by Attributes).

Inspection and testing records of any approved component supplier may be regarded as compliant with Appendix A (or similar) providing this can be confirmed by the initial audit by the Authority and subsequent audits by the organisation. Such records of inspection and testing shall be supplied in the form of test certificates or certificates of conformity signed by an authorized and competent signatory of the approved component supplier.

As a minimum, dimensional and visual checks shall be carried out on receipt by the organisation as detailed in Appendix A (or as agreed with the Authority in the assessment process)

Full traceability of all components is required and shall be demonstrated by both the approved suppliers and the organisation, with retention of appropriate records in accordance with clauses 4.1 and 4.5.

7. NORMATIVE REFERENCES

The following standards are relevant to the application of this scheme document.

Unless agreed otherwise during the application process, the latest version of the product or management system standards will apply. The applicable standard and date shall be stated in the CARES product and/or management system certificate published on the CARES website.

AS / NZS ISO 9001: 2016 Quality Management Systems – Requirements.

AS / NZS 1314:2003 - Prestressing Anchorages

AS / NZS 4672.1:2007 – Steel prestressing materials Part 1: General requirements

AS / NZS 4672.2:2007 – Steel prestressing materials Part 2: Testing requirements

EAD 160004–00–0301:2016 – Post Tension Kits

ANSI/ASQ Z1.4:2018 - Sampling Procedures and Tables for Inspection by Attributes.

***fib* bulletin 75**, Polymer duct systems for internal bonded post – tensioning

Appendix A: Inspection requirements for PT kit components

Component(s)	Test /control method	Minimum number of samples	Minimum frequency of control	Criteria /standard
Anchor	1. Check of relevant certificate: Mechanical and Physical properties	100%	Continuous	In accordance with the relevant AS/NZS standard with respect to physical and mechanical properties or, in their absence a relevant International standard
	2. Dimensional check	5% with a minimum of 2 components	Continuous	Dimensional check in accordance with the approved component drawing
	3. Wedge seat	As above	Continuous	Use of appropriate calibrated wedge to check seating
	4. Visual inspection	100%	Continuous	No defects, deleterious inclusions, or evidence of corrosion
Wedge block	1. Check of relevant component certificate: Mechanical and Chemical properties	100%	Continuous	In accordance with the relevant AS/NZS standard with respect to mechanical and chemical properties or, in their absence a relevant International standard
	2. Dimensional check	3% with a minimum of 2 components	Continuous	Dimensional check in accordance with the approved component drawing
	3. Visual inspection	100%	Continuous	No defects, deleterious inclusions, or evidence of corrosion

Component(s)	Test /control method	Minimum number of samples	Minimum frequency of control	Criteria /standard
Wedges / Nuts	1. Check of relevant component certificate: Chemistry	100%	Continuous	Conforms to component specification as detailed in the organisation's purchase specification / Quality Plan
	2. Dimensional check	5% with a minimum of 2 components	Continuous	Dimensional check in accordance with the approved component drawing, also see Anchor block, check 3) above for wedge seat.
	3. Hardness	0.50% with a minimum of 2 components	Continuous	Conforms to component specification as detailed in the organisation's purchase specification / Quality Plan, per Annex E2. of AS/NZS 1314, detailing Minimum specified hardness Minimum depth of surface hardness (case depth) Maximum core hardness
	4. Visual inspection	100%	Continuous	No defects, deleterious inclusions, or evidence of corrosion
Couplings	1. Check of relevant component certificate: Mechanical and Chemical properties	100%	Continuous	In accordance with the relevant AS/NZS standard with respect to mechanical and chemical properties or, in their absence a relevant International standard
	2. Dimensional check	3% with a minimum of 2 components	Continuous	Dimensional check in accordance with the approved component drawing
	3. Visual inspection	100%	Continuous	No defects, deleterious inclusions, or evidence of corrosion

Component(s)	Test /control method	Minimum number of samples	Minimum frequency of control	Criteria /standard
Bursting reinforcement / Helix	1. Check of relevant component certificate: Chemistry	100%	Continuous	In accordance with the relevant AS/NZS standard or, in their absence a relevant International standard
	2. Visual inspection	100%	Continuous	No defects, damage to ribs or surface or evidence of excessive corrosion
Galvanised Steel strip duct material	1. Check of relevant component certificate of conformity	100%	Continuous	In accordance with the relevant AS/NZS standard or, in their absence a relevant International standard
	2. Dimensional check - thickness	5% with a minimum of 2 components	Continuous	Minimum duct thickness to be detailed in the certificate in accordance with CARES Model Specification - Australia
	3. Visual inspection	100%	Continuous	No defects, damaged ducting, or evidence of corrosion
Corrugated plastic / polymer ducting	1. Check of relevant component certificate of conformity	100%	Continuous	According to *fib* Bulletin 75, chapter 9
	2. Visual inspection	100%	Continuous	No defects or holes or crimping of the plastic ducting

Further notes:

1. Any components not listed above will be discussed and agreed prior to the assessment phase between the Organisation and Authority and included in the organisation's prescribed test plan.
2. All components shall have full traceability to the manufacturer and material source.
3. For clarification, unacceptable corrosion is regarded as that which cannot easily be removed by hand and permanently marks the surface of the part (such as surface pitting)

END.