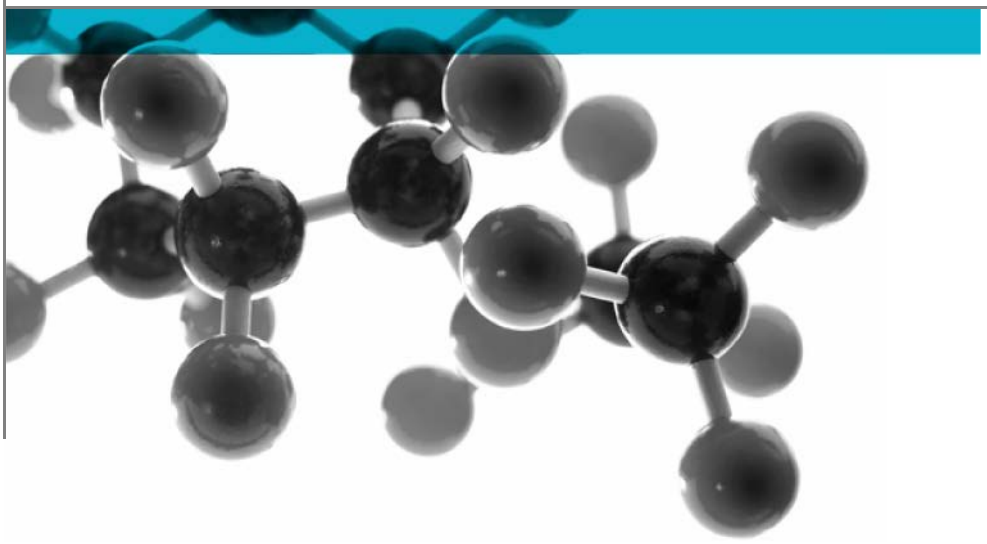
Exova
Chiltern House
Stocking Lane
Hughenden Valley
High Wycombe
Buckinghamshire
HP14 4ND

T: +44 (0) 1494 569 600
F: +44 (0) 1494 564 895
E: europe@exova.com
W: www.exova.com

Testing, calibrating, advising.

Ty Unnos Box Beams - Factory Production Control Guidelines



Factory Production Control (FPC) guideline for manufacturers of Coed Cymru box beams

A Report For:
Coed Cymru
The Old Sawmill
Tregynon
Newtown
Powys
SY16 3PL

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Exova – the new name for BM TRADA

On December 1st 2015, Chiltern International Fire Ltd and TRADA Technology Ltd (both trading as BM TRADA) commenced trading under the name Exova.

To coincide with this change, our Technical Reports, Test Reports, Product Assessments, company stationery and marketing collateral have been updated to reflect the Exova branding.

The validity of all documents previously issued by Chiltern International Fire Ltd and TRADA Technology Ltd including certificates, test reports and product assessments is unaffected by this change. A letter to this effect is available upon request by e-mailing europe@exova.com

About Exova

Exova is part of the Exova Group one of the world's leading laboratory-based testing groups, trusted by organisations to test and advise on the safety, quality and performance of their products and operations. Headquartered in Edinburgh, UK, Exova operates 143 laboratories and offices in 32 countries and employs around 4,500 people throughout Europe, the Americas, the Middle East and Asia/Asia Pacific. With over 90 years' experience, Exova specialises in testing across a number of key sectors from health sciences to aerospace, transportation, oil and gas, fire and construction.

Be assured that while the name will change, your service provision and primary contacts have not. What will be available to you is a wider team of testing experts and an extended range of testing capabilities.

If you have any questions, please do not hesitate to contact a member of the team and we will do our best to answer them. We appreciate your business to date and we look forward to working with you in the future.

Kind regards

Exova

T: +44 (0) 1494 569 600
E: europe@exova.com

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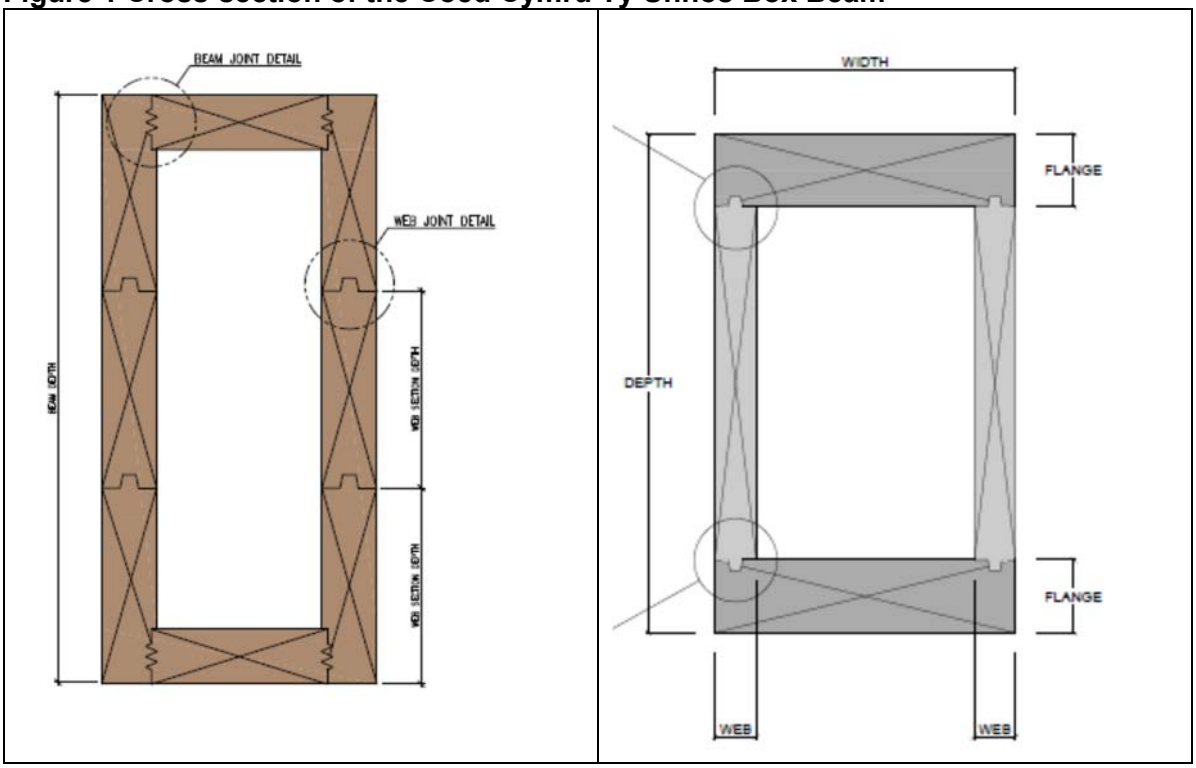
1 Introduction

Coed Cymru have developed a structural timber box beam known as a “Ty Unnos Box Beam” and have a European Technical Approval ETA-12/0421 that defines the product, its application and performance and allows a CE-mark to be applied to the manufactured product.

The above ETA was issued in November 2012 by BM TRADA Certification (now Exova BM TRADA) in accordance with Council Directive 89/106/EEC of 21 December 1988. The ETA was developed in accordance with the European Technical Approval Guideline ETAG 011 dated January 2002.

The Ty Unnos Box Beams are rectangular, hollow structural members manufactured from Welsh grown Sitka Spruce or Douglas fir softwood graded to C16 strength class, or greater, in accordance with EN 14081 and EN 338. Small section timber is used, being edge and end jointed to provide the full beam dimensions. The beams are intended for use as load-bearing components in building structures in Service Class 1 & 2 conditions, as defined in EN 1995-1-1 (EC5). Although referred to as beams, the scope of application also includes columns. Two typical cross-sections of beams are shown in Figure 1, standard sizes are listed in Appendix L.

Figure 1 Cross-section of the Coed Cymru Ty Unnos Box Beam



Coed Cymru is the holder of the above ETA but intends to licence the manufacture of the Ty Unnos Box Beams to other organisations. Under the Construction Products Regulation currently in force, manufacturers of the box beams will need to operate a suitable Factory Production Control (FPC) system in order to demonstrate ongoing compliance with the requirements of the ETA. Coed Cymru has therefore contracted Exova to produce guidance to facilitate the development of an FPC system by licenced manufacturers.

2 Background

2.1 Introduction to Factory Production Control

Factory production control (FPC) is an essential part of all construction product certification schemes. An FPC system that is systematically documented and meticulously implemented is likely to increase the efficiency and profitability of the factory. FPC is a documented system that brings together all operations and record-keeping needed to ensure and demonstrate that the product meets the requirements of a relevant Technical Specification. In general there are two types of documents to consider:

- controlled documents, such as procedures and templates, that may be updated in a controlled way, with older versions archived
- records of, for instance, production, competency or improvement actions. Records should be kept without amendments as evidence that the FPC system is maintained

A FPC system is intended to demonstrate that the performance of each batch of production is in accordance with the requirements given in the relevant Technical Specification that the manufacturer wishes to claim compliance with and/or CE mark its product against. The Technical Specification could be a European Standard, a European Technical Approval or a set of requirements established as part of a certification scheme operated by a certification body. The Technical Specification usually refers to other Standards that cover certain aspects in detail. Each Technical Specification for a construction product contains an FPC section. But these may vary slightly because each is produced by a different technical committee.

In the case of CE marking, the Construction Products Regulation, published in 2011, makes CE marking compulsory (for those construction products for which there is a Harmonised Standard) across the entire EU, including the UK, from 1st July 2013.

A European Standard, abbreviated to EN, is a technical publication that is used as a guideline or definition across the entire European Union. Standards are created by bringing together all interested parties including manufacturers, consumers and regulators of a particular material, product, process or service. The European Commission mandates that a product must be CE marked by firstly deciding how ‘safety critical’ the product is. Then the Commission instructs the European Committee for Standardisation (CEN) to produce a Harmonised Standard (hEN), which is the Technical Specification for that product.

Although there are more than 400 Harmonised European Standards to cover a vast range of product types, not every construction product will fall within the scope of a Harmonised Standard. For these products, the European Organisation for Technical Assessments (EOTA) provides an alternative route to CE Marking by means of a European Technical Assessment (formerly Approval) (ETA), but in this case CE marking remains voluntary.

CE marking generally requires the involvement of either a Notified Body (also known as a Notified Certification Body) and/or a Test Laboratory (known as a Notified Test Laboratory), depending on how safety-critical the product is. In the EU, a Notified Body is an organisation that has been notified in its Member State by the European Commission as being suitable and competent to carry out product assessments against the requirements of one of the European Regulations, such as the Construction Products Regulation.

The manufacturer CE marks its product to show that it complies with the relevant Harmonised Standard or ETA. The CE mark is based on the manufacturer's declaration of performance, which means that by making this declaration the manufacturer takes responsibility that the product will perform as specified. Notified Certification Bodies and Notified Test Laboratories do not take responsibility for the product's performance. They simply assure that they have independently checked the performance of the product and/or the factory production control, as appropriate to the specific product. Affixing the CE mark is the manufacturer's claim that each product complies with the specified requirements.

The Construction Products Regulation has introduced the term 'level of Attestation and Verification of Constancy of Performance' (AVCP), which replaces the term 'level of Attestation of Conformity' (AoC). There are five AVCP Systems that detail the responsibilities of the Notified Body and the manufacturer in the certification process. System 1+ is the most safety-critical and System 4 is the least. The responsibilities of the manufacturer and Notified Body for each of the AVCP levels is shown in Table 1.

The Technical Specification defines the AVCP level for a product on the basis of its end use. For example, if a door serves as a fire door then the AVCP level is 1. But if it is only serves as an acoustic door then the AVCP level is 3. At all levels, the manufacturer is responsible for operating the FPC system. At AVCP levels 1+, 1 and 2+, the FPC system has to be audited by a suitable Notified Body.

In the case of Ty Unnos Box Beams, the ETA states that the FPC must be subject to AOC Level 1 (now AVCP System 1). Hence the manufacturer is responsible for FPC and for testing of samples taken at the factory. A Notified Body has to take responsibility for Initial Type Testing (ITT), initial inspection and ongoing surveillance of FPC.

Table 1: Who does what

M = Manufacturer, NCB = Notified certification body, NTL = Notified test laboratory

Activity	Level of conformity Highest safety risk ← Lowest safety risk				
	System 1+	**System 1**	**System 2+**	**System 3**	**System 4**
FACTORY PRODUCTION CONTROL					
Operate the factory production control system	M	M	M	M	M
Initial audit assessment	NCB	NCB	NCB		
Surveillance audit	NCB	NCB	NCB		
TESTING					
Initial type testing	NTL	NTL	M	NTL	M
Further testing of samples	M	M	M		
Audit testing of samples	NTL				

2.2 Defining and establishing an FPC system

The objective of an FPC system is to bring together all operations and record-keeping needed to ensure and demonstrate that the product meets the requirements of the Technical Specification. The FPC Manual contains the systematic set of written procedures needed by a manufacturer to operate the FPC system. The Manual provides a common basis for manufacturing the product as it requires all those involved to use the same set of procedures and details to ensure the performance required of the product are met consistently.

The manufacturer is responsible for organising and implementing the FPC system. It owns the FPC and must make it work. If the manufacturer follows an appropriate FPC system it will improve reliability and reduce waste and is likely to increase efficiency and hence reduce costs.

The documentation and procedures must suit the product and manufacturing process. The FPC system must be designed so there is sufficient confidence in the manufacturing process to ensure that the product will consistently achieve the performance claims made in the declaration of conformity made by the manufacturer.

To achieve this confidence the FPC should meet the following key objectives:

- Include effective documented procedures and instructions aimed at meeting the requirements of the Technical Specification.
- Monitor the effective implementation of these procedures and instructions.
- Establish a process to correct any deviations from the procedures and instructions, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, review and revise the FPC to rectify the cause of non-conformity.
- Nominate an individual who has overall responsibility for the FPC and can report issues directly to top management.

2.3 FPC processes

Having established the key objectives for the FPC, with reference to the Technical Specification, the manufacturer then develops the various processes needed to achieve them. The main processes that need to be controlled are listed below. However, there may be other processes for manufacturers to control, which are not listed here, but are necessary to achieve the key objectives.

The manufacturer:

- establishes an appropriate organisational structure and management system for factory production, and nominates a person responsible for factory production control
- ensures that those performing any task receive appropriate training and that the justification for stating that they are competent for that task is recorded
- prepares the Product Specification, including drawings where appropriate

- reviews the contract with the customer to ensure the product request is covered by the scope of approval
- prepares the specification of raw materials and components, and verifies that deliveries comply with that specification
- prepares and operates a system for controlling the amount of and condition of stock
- performs and records the control measures and tests listed for monitoring product conformity
- rectifies any non-conformities discovered in the process
- ensures that individual products or batches of products and the related manufacturing details are completely identifiable and traceable, by maintaining complete records of individual products or product batches

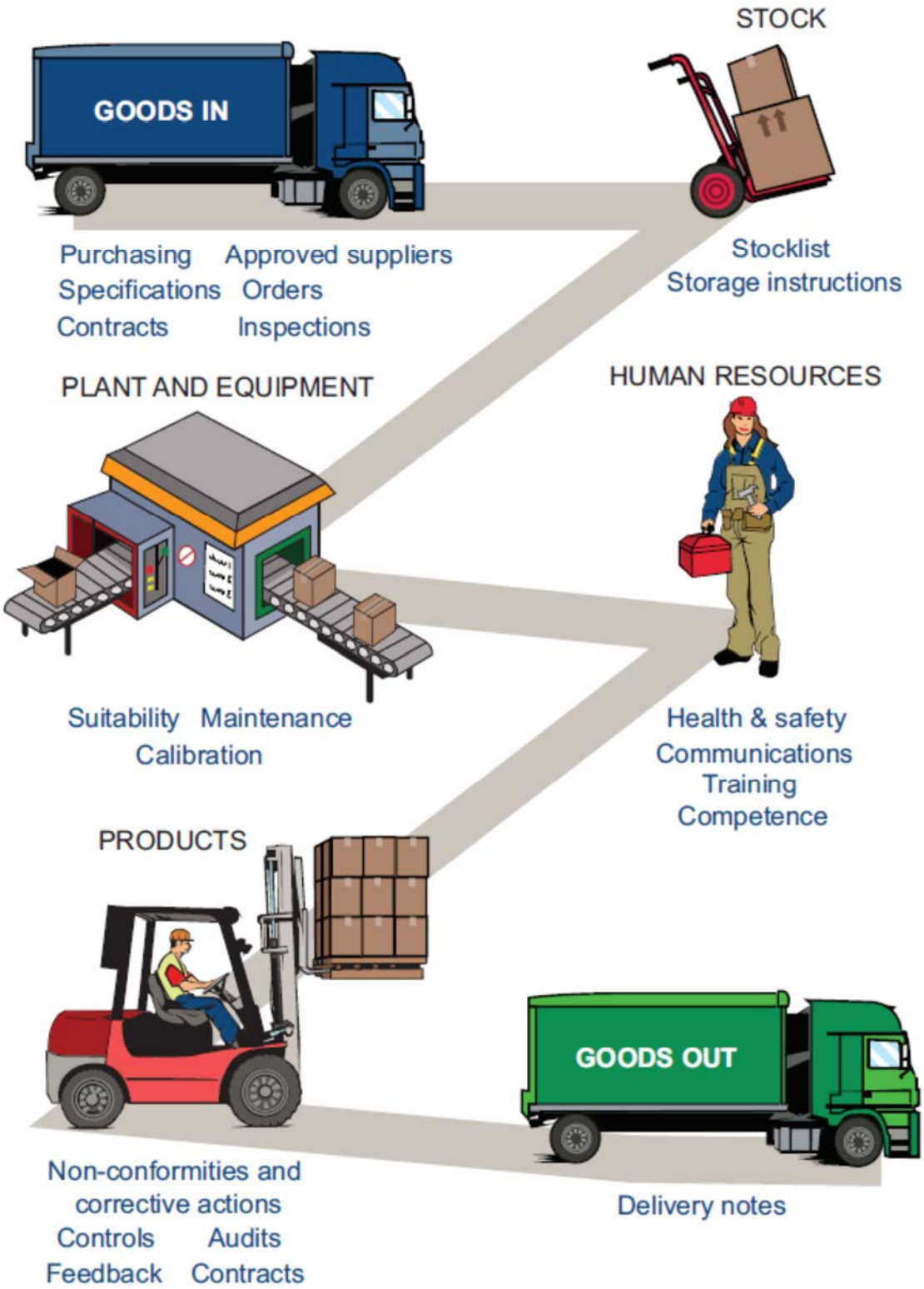
Figure 2 shows typical documents that the manufacturer keeps that record the quality of the production process.

Records of individual products or product batches include:

- the related manufacturing history and performance characteristics
- records of customers

Example record sheet templates are given in the appendices. These should not be adopted into an FPC system without review that they are appropriate for the individual factory.

Figure 2 FPC documents describing the quality of production in the factory, from goods inwards to goods outwards.



2.4 Monitoring of conformity

Monitoring conformity of the product is vital. This means that, as part of the ongoing monitoring process, the manufacturer obtains and retains evidence to demonstrate that each production batch of the product complies with the performance levels stated in the initial Declaration of Performance.

The manufacturer makes conformity assessments during the intermediate and main production stages of the product and records the results and the actions taken. This is achieved by defined FPC processes throughout the manufacturing process. The Technical Specification may require sample testing, or measuring of the product, raw materials or components, or perhaps environmental conditions to ensure that certain performance levels are achieved and maintained.

The manufacturer:

- tests and/or measures products according to the frequency and methods given in the Technical Specification or relevant Standard
- has or has available the necessary equipment and personnel that enable the necessary verifications and tests to be carried out (this requirement may be met by subcontracting with one or more organisations or persons with the necessary skills and equipment)
- calibrates or verifies and maintains the control, measuring and test equipment in good operating condition, whether or not it belongs to them, with a view to demonstrating conformity of the product with its Technical Specification
- records, at critical stages, product operations, environmental conditions and their results, including any tests.

The manufacturer establishes and maintains appropriate records that provide evidence of control of product manufacture. These records show clearly whether the product has satisfied the acceptance criteria. Where the product fails to satisfy the acceptance criteria, the manufacturer follows provisions for non-conforming products.

These control measures and tests must be undertaken by demonstrably competent individuals, using equipment that is calibrated for the correct range. Any uncertainty of measurement of the device is used to modify the tolerance limits and any drift in the device is monitored.

The results of the control measures and tests must be properly recorded. These may include:

- product description
- date of manufacture/batch number
- dimensions and tolerances
- temperature and humidity
- test methods

- acceptance criteria
- test results
- non-conforming product and actions taken
- signature or specific mark of the person responsible for the control and/ or verification.

If control or test results show that the product does not meet the requirements (for example, if the statistical variation of test results exceeds the limits allowed by the Technical Specification), the manufacturer takes the necessary Corrective Action to achieve more consistent quality. Once the fault has been corrected, the manufacturer repeats the test or verification in question.

The manufacturer also establishes procedures for:

- identifying and isolating non-conforming products
- notifying customers who have taken delivery of products before test and verification results were available, including what actions to take to check and/or return products for repair or replacement
- repeating the verification, including tests, after correcting the non-conformance.

2.5 Scope of Ty Unnos ETA 12/041

Ty Unnos Box Beams are rectangular, hollow structural members manufactured from Welsh grown Sitka Spruce or Douglas Fir softwood graded to C16 strength class, or greater, in accordance with EN 14081 and EN338.

The concept of the product is to take sections of relatively small dimensional timber and, by edge and end jointing them, form them into an engineered wood product, being full scale structural members. Ty Unnos Box Beams consist of four main engineered components, two acting as flanges and two as webs. The two flanges are formed from timbers of the same cross-section, finger-jointed to the required length. The webs are also formed from finger jointed timbers of the same cross-section, but are generally less deep than the flange. To obtain the depths required, the finger-jointed timbers are tongued and grooved along their long edge, then glued together edgewise. The web and flange components are then glued together with structural adhesives, to form the Ty Unnos Box Beams. Only structural adhesives that comply with the Type II specification defined in EN301 or Type II of EN15425 are permitted.

This assessment covers Box Members, used as beams and/or columns, within the following size limitations:

- Overall width: 180 to 350mm
- Overall depth: 180 to 500mm
- Minimum void width or depth: 100mm
- Minimum web or flange thickness: 40mm
- Individual lamellae shall not be smaller than 40mm x 45mm

Ty Unnos Box Beams have been assessed as axial / flexural members for use in Service Class 1 and 2 conditions as defined in EN 1995-1-1 (EC5)

This ETA considers all configurations within the size limitations given above. It has been confirmed that the properties of configurations within these limitations can be derived by calculation in accordance with EC5.

2.6 Preparing the FPC Manual

Section 3 presents a generic FPC Manual for the Ty Unnos Box Beams, which can be used by a manufacturer to develop a site specific FPC Manual. The site specific manual must take account of all factors at the manufacturer's site that might impact upon the quality of the products produced. This might include, staff, purchasing procedures, record keeping, manufacturing equipment and product testing.

The FPC Manual is a key document that contains manufacturer's policies/ objectives, procedures, work instructions and any other documents relating to FPC. The Manual may be in an electronic format and need not be printed. However it must have in place appropriate mechanisms for its control.

Section 3 outlines what each section of the FPC Manual should include. It follows the structure below.

1. Organisation

2. Contract review

3. Control

4. Product manufacture QA/QC

5. Testing and calibration

6. Marking

7. Training and competence.

Section 3 text given in the form of a table represents the Exova recommended headings and content for each section of the FPC Manual. Text below the tables is in the form of notes specific to the Ty Unnos Box Beam fabrication.

3 Generic Factory Production Control Manual

3.1 Organisation

Responsibility and authority	Describe the responsibility and authority of personnel who manage, perform and verify work affecting quality and conformity. Be clear about who is responsible for identifying quality problems, taking actions to record and rectify non-conformities and prevent their recurrence.
Company representative	Identify a person (by name or by role) with appropriate authority, knowledge and experience to supervise the FPC and to ensure that the requirements of the FPC Manual are implemented and maintained. The nominated person is also normally the primary contact between the manufacturer and, where appropriate, the Notified Body.
Controlled Documents	All documents associated with the FPC system, e.g. FPC manual, record sheet templates, specifications, shall be subject to a document approval process and shall be controlled by an authorised person. Procedures for approval and control of documentation are given in Appendices B1 to B4. Example record sheet templates are given in the appendices. These should not be adopted without review that they are appropriate for the individual factory
Records	Record all the results of the FPC system. Retain these records for a minimum of five years and in a manner that allows easy retrieval and prevents loss. Records may be in paper or electronic format.
Management Review	The operation of the FPC system shall be subject to regular internal review by senior management. A minimum frequency of 6 months is recommended. Staff involved with the operation of the FPC system should attend review meetings to monitor and improve the operation of the FPC system. A flow chart for this is given in Appendix A.

3.2 Contract review – compliance with scope

Customer requirements and contracts	Review orders, contracts or tenders to ensure that: • the product is within the scope of approval • the requirements for each product are adequately defined in terms of quantity, specification, packaging, delivery, installation, intended use and disposal, as appropriate • resources are adequate and capable of meeting the order and contractual requirements. Maintain records of this activity for all tenders, contracts and orders.

	Define and record the method for communicating amendments to contracts and orders.

For Ty Unnos Box Beams checks on whether an order is within the scope of approval should consider the following factors against those defined in the ETA:
- Species and grade of timber used
- Type of adhesive used
- Type of preservative treatment, if any
- Dimensions of beams
- Intended Service Class
- Required reaction to fire class
- Any other factors which may be outside the scope of the ETA

Design of the beams should follow the method laid down in the ETA.

3.3 Control of raw material specification for the production of box beams

Raw material Specification	Prepare and maintain a Product Specification for each raw material, component and finished product. Review the specification at regular intervals and inform the Notified Body of any changes.

Timber specification

Timber to be:
- Welsh grown Sitka spruce or Douglas fir softwood
- The cross-sections of individual lamellae shall not be smaller than 40mm x 45mm
- The individual lamellae may be finger jointed in length in accordance with EN 385 (now superseded by EN 15497: 2014)
- Graded in accordance with BS EN 14081 to strength class C16 or better as defined in BS EN 338. Grading may follow a visual grading rule, e.g. BS 4978, or be by machine.
- Straight, sound and shake free
- Kiln-dried to a moisture content of between 8% and 15%. Moisture content to be checked on a batch by batch basis with a suitably calibrated moisture meter. Timber with a higher moisture content may be kiln dried to within the specification.
- Stored under cover and kept dry

Timber that fails to meet the above criteria should be rejected and identified e.g. by marking the ends of the timber with red paint. Such failed timber may be used for other purposes, returned to the supplier or disposed of. The FPC manual must include procedures for identifying and recording reject timber, see Section 3.4.

Adhesive specification

Record the type and specification of the adhesive to be used in fabricating the beams. Suppliers shall be recorded according to “Purchasing” procedure below and details of the

adhesive purchased from each supplier, together with a Declaration of Performance and relevant batch numbers shall be recorded.

A time of writing, the adhesive to be used is Jowat Faser PUR 686.60. This is a Type II specification as defined in BS EN 301 and of a structural quality.

Preservative treatment specification

Where a preservative treatment is applied, record the type and specification of the preservative to be used. Suppliers shall be recorded according to “Purchasing” procedure below and details of the preservative purchased from each supplier, together with a Declaration of Performance and relevant batch numbers shall be recorded.

At time of writing the preservative is identified as Wykabor DB Class 2 to BS EN 335-2 : 1992.

Purchasing	Identify all suppliers in an approved supplier list. Record at least: • supplier address • supplier location • contact details • the specification of the raw material, component or service supplied. Ensure that the supplier selection criteria and approval process is recorded.
Document control	Maintain procedures to control all documents and data that relate to the Technical Specification and FPC. Keep all Initial Type Test results. Keep a master list of all documents and data associated with production, including specifications of raw materials and components. This list should contain at least: • the document reference • issue status • number of pages • approval authorisation. All documents have a unique identity, page number and authorisation. Keep documents available at relevant locations and remove, but retain, any superseded or obsolete documents from current document location. Define and record the method for back up and retrieval of documentation and data, whether in hard copy or electronic format.

	Maintain copies of relevant Standards and other specifications associated with the product. Set up a system for ensuring that only up-to-date Standards are used. Documents in electronic format are acceptable, provided they are readily accessible.

3.4 Product manufacture and process control

Process control and production	Certified box beams can only be manufactured from raw materials that conform to the specification in the appropriate ETAG and Section 4.3 above. The raw materials used must be checked and recorded when received and rechecked and recorded when selected for use in the manufacturing process. The documented methodology and process of manufacture should be consistent, clear, traceable and auditable.

Box Beam raw material selection

Check and record details of raw material inwards against box beam specifications and contract order. Guidance and example documentation is given below.

Timber for box beam manufacture

An example of suitable documentation is given in Appendix E.

1. Timber packs are be delivered covered and not exposed to the elements.

2. Inspect timber packs on receipt. Mark each pack clearly for future identification purposes, and record identifying code.
   - Check and record: supplier; species; size; quantity; structural grade; identifying code.

3. Take moisture content readings, ensuring meter is within calibration date, set to the correct timber type and deep prong pins are used. If timber is above 15%MC follow kilning procedure.
   - Check and record: moisture content; action taken if further drying is required

4. Packs are to be unloaded onto timber bearers ensuring that the pack is stored level and sheeted or stored undercover to prevent exposure to weather.

5. Any timber that does not comply with the specification i.e. non-compliant, must be marked accordingly and not used for box beam manufacture.

Kiln drying high moisture content timber

Where timber is received with a moisture content above 15%, it must be kiln dried to within the specification tolerance of 8% - 15% prior to use, or rejected and treated as non-conforming product.

Operation of the kiln, or subcontracting of the kiln-drying, must be covered by a suitable procedure within the FPC manual.

An example of suitable documentation is given in Appendix F.

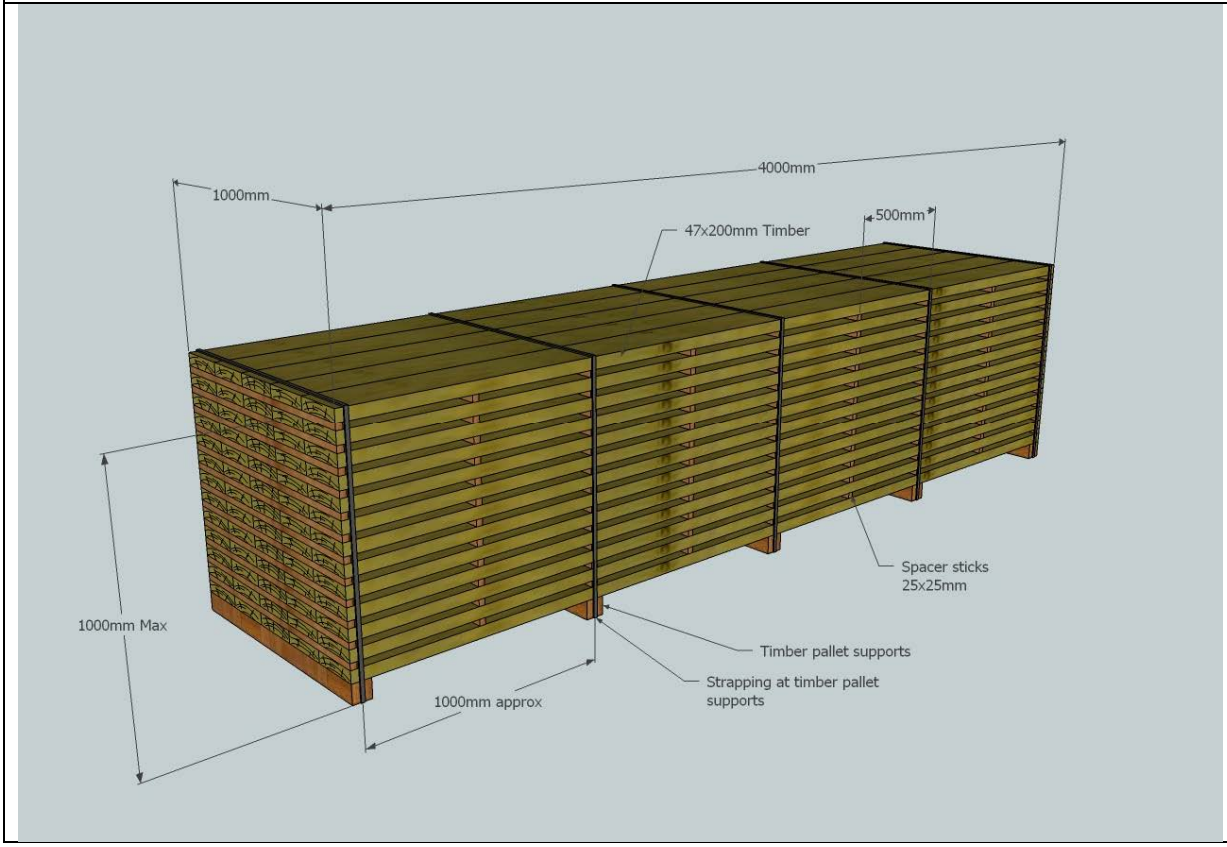
1. Timber to be restacked for drying using minimum 20mm battens between layers. Position battens at each end of stack layer and at a maximum distance of 500mm in between. Ensure battens in each layer are vertically aligned. See Figure 3.

2. Place timber packs within the kiln, allow access for operator to check moisture content.

3. When moisture content is within the specified tolerance, clearly mark the moisture content on the pack and record the details.

4. Store the dried timber either undercover or appropriately sheeted to prevent uptake of moisture.

Figure 3 Example of timber stacked for air or kiln drying



Adhesives and preservatives for box beam manufacture

The FPC Manual should define procedures for checking and recording each delivery of adhesives or preservatives, and use of these within the production system must be traceable by supply and batch number.

Draw up documentation which must include:

- supplier details
- product specification
- delivery date
- quantity
- batch number
- use by date
- procedure for stock control.

Box beam Manufacture

Machining

An example of suitable documentation is given in Appendix G.

1. Select suitable timbers for fulfilling scope of contract. Material used in the web needs to accommodate two tongues, see Figure 4.

    - Check and record: Timber quantity; size; pack number; moisture content

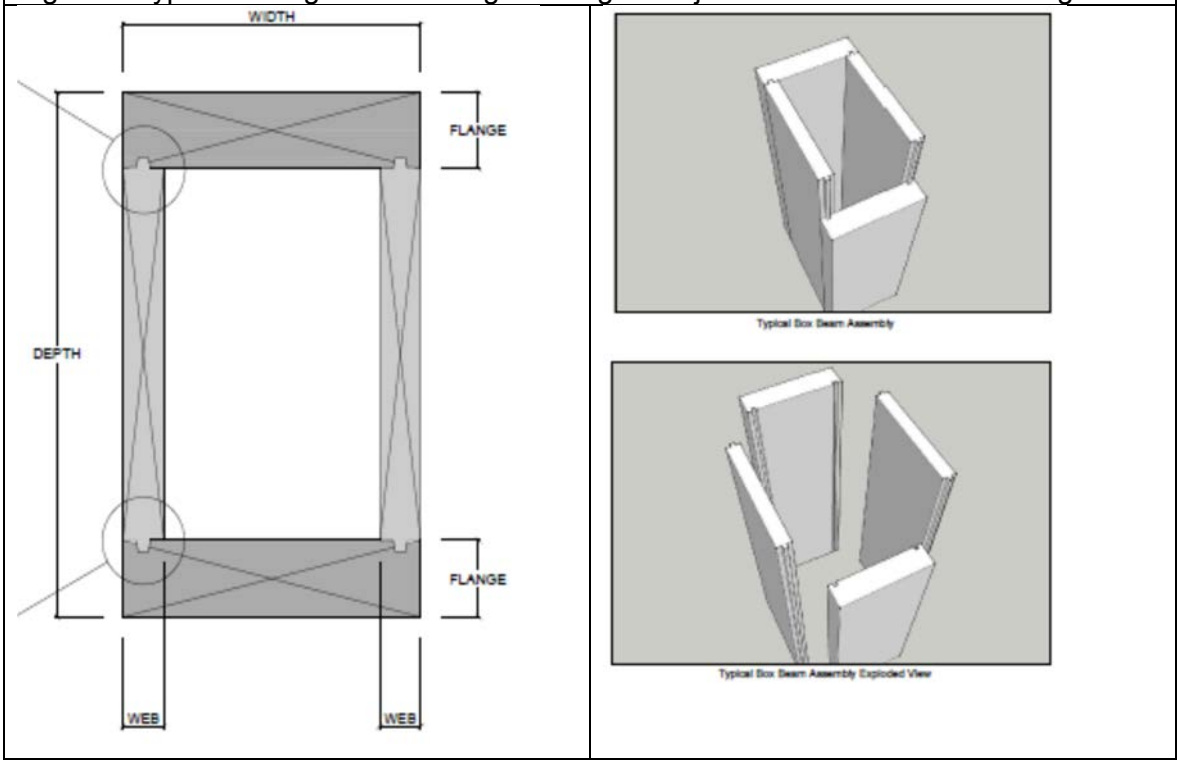
2. Machine the tongue and groove along the length of the web and flange timbers as per the section shown in Figure 4.

    - Check and record machining tolerances: thickness +/-1mm; width +/-2mm,

3. A maximum of 24hrs is permitted between machining of the timber components and the gluing and pressing of the box beams.

    - Check and record: date and time.

Figure 4 Typical arrangement of tongue and groove joints between web and flanges



Gluing and pressing

An example of suitable documentation is given in Appendix H.

4. The adhesive used to assemble the beams must comply with Type II specification as defined in BS EN 301 and be of a structural quality – Jowat Faser PUR 686.60.
   - Check and record adhesive details: make; type; batch number; expiry date.

5. Ensure that the machined timber is clean and free from saw dust and shavings. Apply suitable beads of adhesive to each of the female sections of the D tongue joint so that when the assembly is compressed a small amount of the adhesive is expelled from the joint; this is to show that sufficient adhesive has been applied.

6. Once the adhesive is applied, hand assemble the box beam and immediately place in a suitable press. Apply pressure to the outer flange faces compressing the assembled timber into a box beam. Pressure required as stated by Jowat for load bearing applications for softwood is between 0.6 – 1.0N/mm2.
   - Check and record: pressure applied; pressing time per beam.

7. The box beam should be left in the press for a time that allows the adhesive to set as stipulated by the adhesive manufacturer's technical guide. Removing too early may result in a non-satisfactory adhesion of the Box beam. The Box Beam may be removed prior to complete setting provided it is mechanical fixed whilst under pressure in the press using screws with 5mm diameter x 80mm threaded length at a spacing of no more than 500mm.
   - Check and record details of: mechanical fixtures; spacing distance; visibility of sufficient glue.

Curing

8. Carefully remove the box beam from the press, ensuring that the box beam joints are seated correctly and sufficient adhesive is visible. Allow the adhesive to fully cure with a minimum of handling as per glue manufacturers' specification.
   - Check and record: joints are seated correctly; sufficient glue is visible.

9. After full curing of the adhesive, excess glue may be removed.
   - Check and record: finished beam size.

Destructive Testing

An example of suitable documentation is given in Appendix K.

A programme of regular destructive tests should also be defined to monitor the adhesive bond on all connections, shear strength and the strength of completed beams. The aim of the FPC should always be to ensure that adhesive bonds are stronger than the C16 timber.

Frequency and quantity of tests has to be agreed with the certification body. Results must be recorded and appropriate action taken if product fails the test. The following guidance is extracted from ETAG011 Section 3 for attestation and evaluations of conformity where calculation assisted by testing is used as the basis for design.

Full size testing of products is necessary. Testing however can be limited to one variation of the product, for instance to one beam depth. It is also the producer's responsibility that the material properties are in conformity with the ETA. This will generally require additional testing in accordance with accepted standards for such product characteristics.

Property	Test Method	Minimum number of specimens	Requirement
Bending resistance/ stiffness*	Technical Report 002, clause 6.2.	e.g. 1 beam per 30000 meters produced beams and production line or at least 1 beam per week.	Characteristic / mean value based on results from at least 10 beams > value given in the ETA. Single value > than 0.80 of ETA value is acceptable.
Shear resistance / stiffness*	Technical Report 002, clause 6.4	e.g. 1 beam per 30000 metres produced beams and production line or at least 1 beam per week.	Characteristic / mean value based on results from the latest 10 beams > value given in the ETA. Single value > 0.80 of ETA value is acceptable.
Compressive force resistance*	Technical Report 002, clause 6.5	e.g. 1 column per 30000 metres produced columns and production line or at least 1 column per week.	Characteristic / mean value based on results from at least 10 columns > value given in the ETA. Single value > than 0.80 of ETA value is acceptable

Adhesive bond shear strength *	To be developed for the particular product and shall be described in the test plan which shall be agreed on by the manufacturer and the approval body. Both shear strength and wood failure ratio shall be determined.	At least 3 per shift and production line	Shall be given in the test plan.

* the test procedure in the Technical Report shall be used. Alternative procedures may be used provided that a statistically significant relationship can be established between the specified property and the measured property.

Cutting

An example of suitable documentation is given in Appendix I.

Box beam orders may have length and end angle requirements. Starting at one end square-off or cut to correct angle and then cut to length/angle at the opposite end. The length is to be within the tolerances as set out in the design/cutting chart. Mark-up with component number.

- Check and record: component number; design requirements; actual cut length and dimensions; confirm beam is within tolerances.

Preservative treatment

An example of suitable documentation is given in Appendix J.

If the beams are to be preservative treated, it is essential that the type of preservative used does not affect the strength and stiffness properties of the timber. The preservative must also be compatible with the adhesive. The preservative that meets this specification is Wykabor DB, which complies with Class 2 of BS EN 335-2:1992.

1. It is recommended that the whole beam is immersed in a bath of preservative, thereby ensuring full coverage of treatment.
   - Check and record: Project reference, date, operator; Beam reference and quantity; Preservative - manufacturer, type, batch and use by date;

2. It must be noted that no further machining is to be carried out on the box beam after treatment. If additional machining is required the machined area MUST be subsequently treated with Wykabor DB.

Non-conforming products	The factory production control system defines and includes procedures for: • control, identification, evaluation, segregation and disposal of non-conforming products • corrective and preventive actions

	• 'product recall' for non-conforming products that may have already been delivered to a customer.
Inspection and testing	Undertake all inspection and/or testing under controlled conditions: • incoming inspection – check components and materials to ensure correct quality and quantity • in-process and final inspection – check the product at key stages along the production process and before despatch to ensure that requirements of the Technical Specification are met. Keep records of incoming, in-process, final inspections and testing, relative to each batch of each product.

FPC should provide for all incoming materials to be checked against the specifications, in accordance with Section 3.3. This should include quality control checks on the web, flange and adhesive materials for specification and moisture content, dimensional checks before and after preparation, verification of adhesive spread, fit of component parts and curing temperature. Manufacturing tolerances for the finished beams are given in Table 2.

Table 2 Manufacturing Tolerances (based on EN336)

Member Dimension	Tolerance (mm)
Overall member Length	-0 + 3.0
Overall member Depth (target size 180 to 500mm)	-2.0 +4.0
Flange / Web Thickness	-1.0 +3.0
Flange / Web depth	-2.0 +4.0

Sample requirements

For each box beam order, a typical sample with a minimum length of 350mm is required. The sample must be retained and clearly marked with the project reference and date of manufacture.

Handling, storage packaging and delivery	The Quality Plan contains procedures for handling, storage, packaging and delivery to ensure that the product is handled, stored and (where appropriate) delivered in a manner that prevents damage or deterioration.

Packaging, Transport and Storage

Provisions with the FPC manual should ensure that Ty Unnos Box Beams are protected against harmful wetting during transport and storage. The box members should arrive on site with a typical flange moisture content of 16%.

Storage and handling systems should ensure that the members are not lifted or stored in such a way as to cause damage. The members should be stored out of ground contact at all times.

Ty Unnos Box Beams shall be stored to minimize changes in moisture content, caused by the weather, by storing under cover but permit free passage of air around the beams.

They should be protected from excessive sun, rain or moisture. Site storage is intended to be temporary, prior to erection. The fabrication and delivery of beams should therefore be arranged to minimize the storage time, both at the fabricator's premises and on site.

Coed Cymru recommends that the box beams should be wrapped in protective plastic covering to protect them from short-term exposure to inclement weather.

The manufacturer must ensure that the information of these provisions is passed on down the supply chain to all those concerned.

Any members damaged during storage or transport must be discarded. Only sound members should be installed.

Corrective and preventive actions	The factory production control system contains a procedure for corrective and preventive actions. Retain records of any corrective and preventive actions identified and how and when they were implemented.

3.5 Testing and calibration

Inspection, measuring and testing equipment	Control, calibrate and maintain measuring and test equipment in suitable working order to ensure that any testing carried out using it is correct and accurate. Establish procedures to specify: • that equipment must be used in accordance with documented procedures and the equipment manual • a unique identification of equipment • that only suitable trained staff can conduct testing
Calibration	Define a procedure in the Quality Plan that details calibration of measuring/test equipment. This procedure includes a 'Calibration Schedule' which contains the following information as a minimum: • a list of all equipment used in the FPC system (with unique identification numbers)

	• frequency and accuracy of calibration (in accordance with the relevant test standard) • the date of next calibration. Keep records of all calibration undertaken. These will be required for review during an audit. A flow chart of an example calibration process is given in Appendix D.
Audit testing	Carry out audit testing (where required and specified) on product samples taken from recent or current production.

3.6 Marking and documentation

Certification logos or marks	For independent product certification schemes, the controlling body will have terms and conditions for use of the relevant mark on products, stationery and literature. The requirements for use of a CE mark are legal requirements and are given in the CPR and in more detail in the relevant Technical Specification.

Where a manufacturer's product is to carry the Exova BM TRADA Q-Mark, ensure that only those products covered within the Q-Mark scope are advertised as Q-Marked products. This applies to all forms of advertising including leaflets, websites and presentations.

Documentation	Under the CPR, the manufacturer is responsible for preparing a Declaration of Performance for its product and this must be made available to all in the supply chain who may be involved in the distribution or use of the product.

It is a requirement of the ETA that documentation supplied with the beams includes:

- Clear designation of upper and lower flanges
- Minimum bearing length at the support
- Information on storage and lifting
- Identification of batch number of manufacture
- Installation guidance

Installation of the beams should be in accordance with the technical manual of the manufacturer and guidance accompanying the beams shall facilitate this.

The following points are especially critical:

- Ty Unnos box members shall be installed on the basis of a specific structural design for each installation, using the load-bearing capacities given in Annex 2 of the ETA.

- Actions at supports shall not exceed the bearing resistance given in Annex 2 of the ETA
- The members shall be installed by appropriately qualified personnel, following an installation plan and relevant construction details worked out for each individual building project. The installation plan shall be based on the manufacturer's general guide and provisions for installation.
- The flanges must not be drilled, notched or material otherwise removed on site.
- Significantly damaged box beams should not be used.
- As with similar timber based products, it is recommended that eye protection and dust masks be used when cutting.

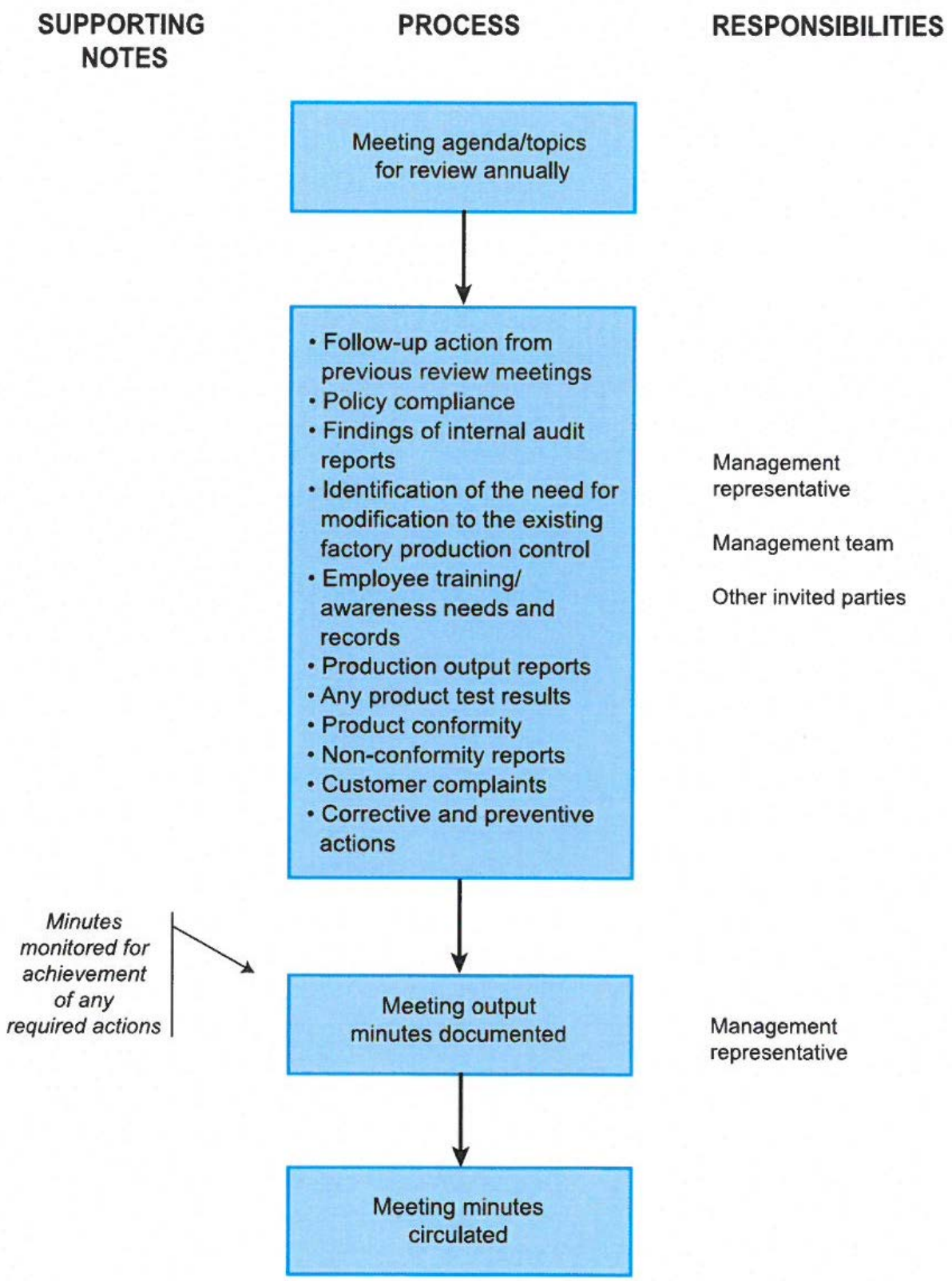
3.7 Training and competence

Training and competence	Maintain procedures for training and establishing competence of all personnel involved in activities that affect quality. Ensure that personnel performing specific assigned tasks are suitably qualified and competent, based on appropriate education, training and experience. Maintain records detailing the methods of training and approved areas of operation for each employee. For each critical production task, list the criteria for competence and maintain a list of employees and subcontractors qualified to perform that task. A flow chart for training and awareness is given in Appendix C.

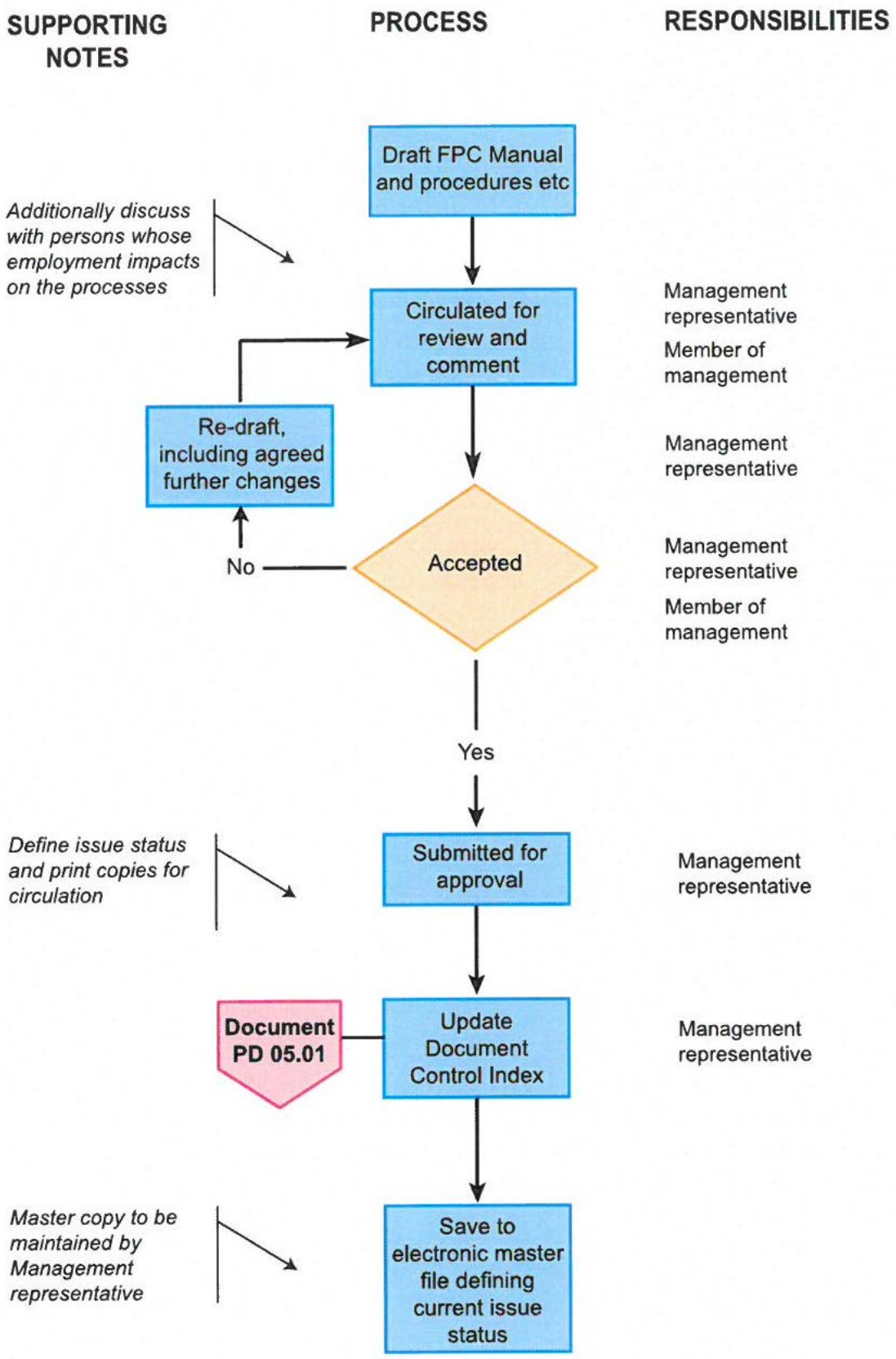
4 Authorisation

	Issued by:	Under the authority of:
Signature:	Victor Kearley	
Name:	Dr Vic Kearley	Dr Hugh Mansfield-Williams
Title:	Principal Technical Officer	Technical Manager

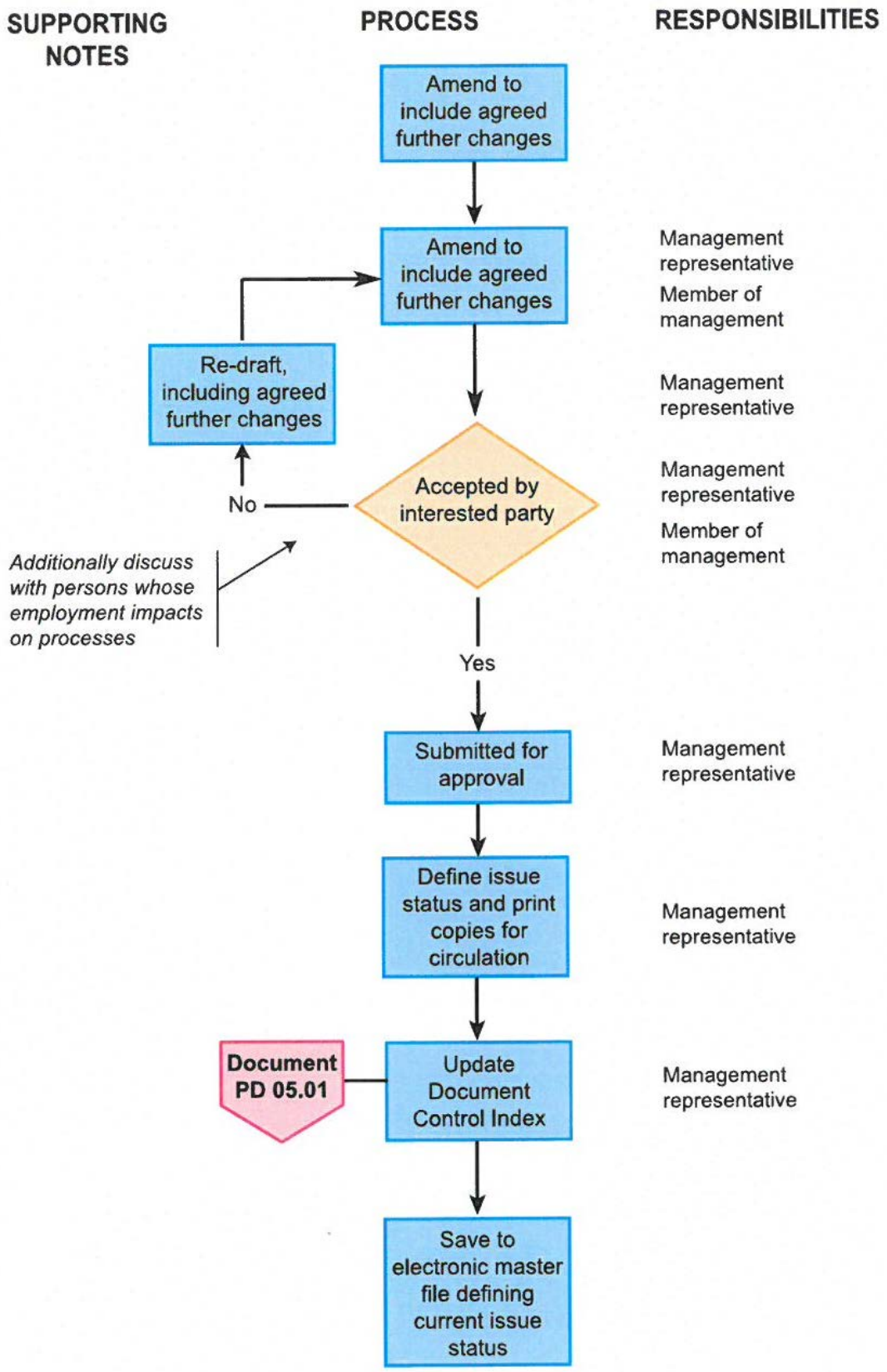
Appendix A Flow chart for management review meetings



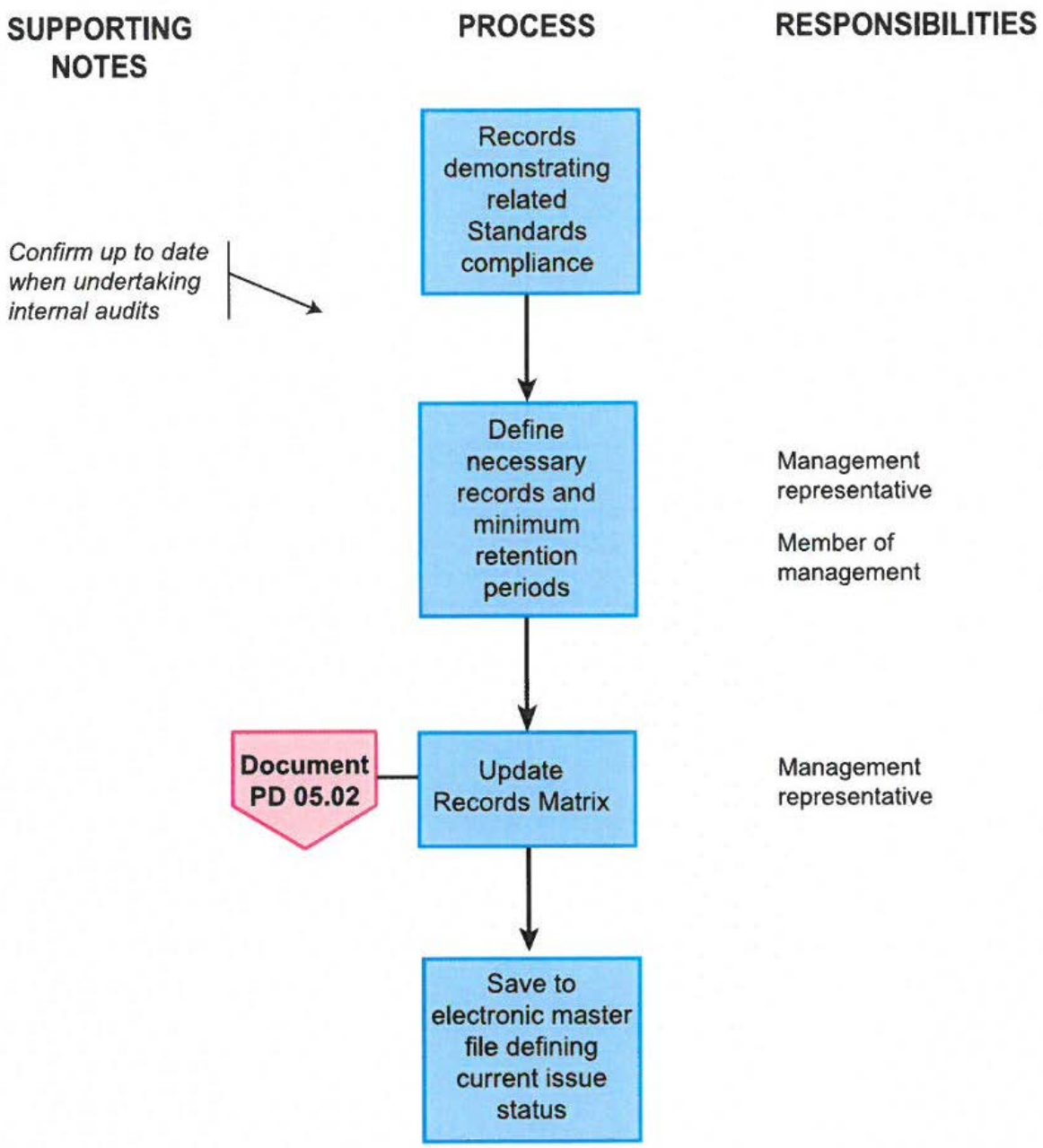
Appendix B1 Flow chart for document approval



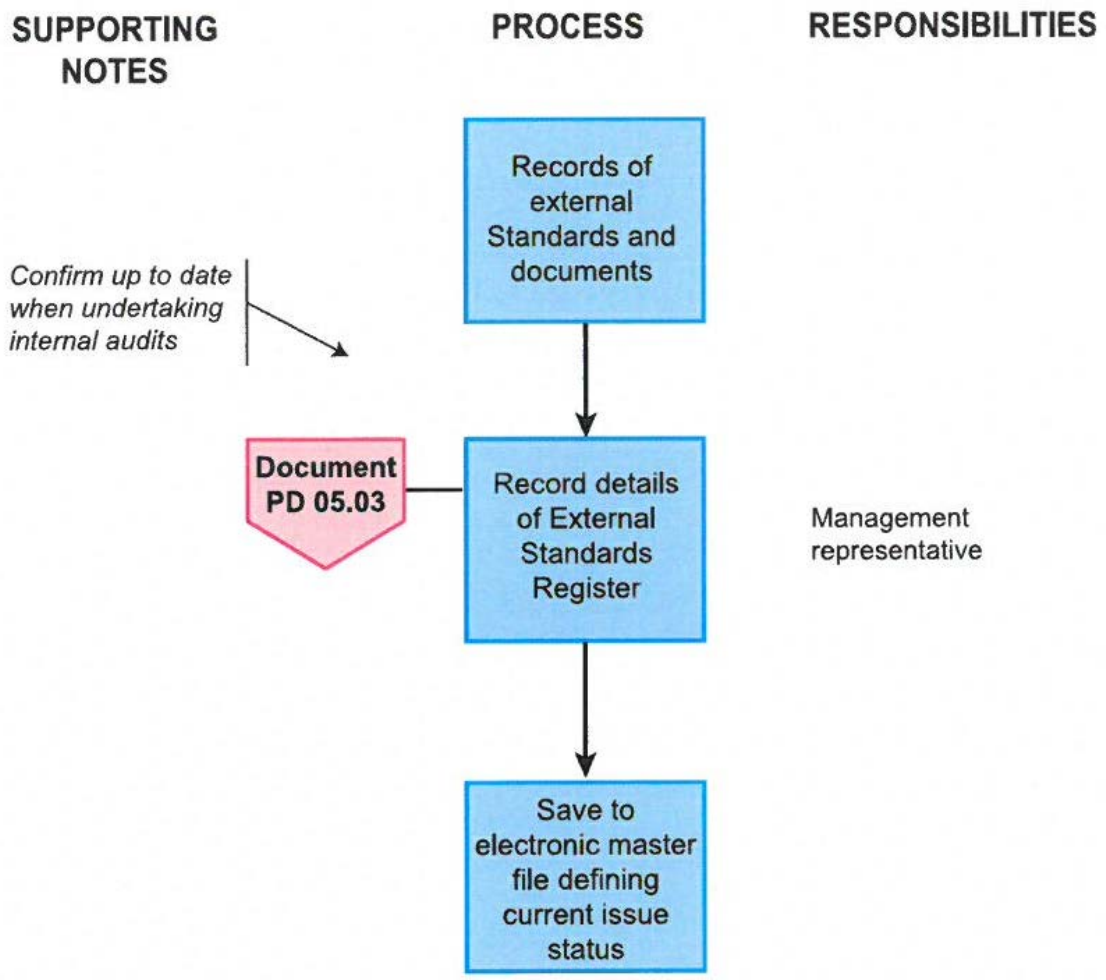
Appendix B2 Flow chart for document amendment



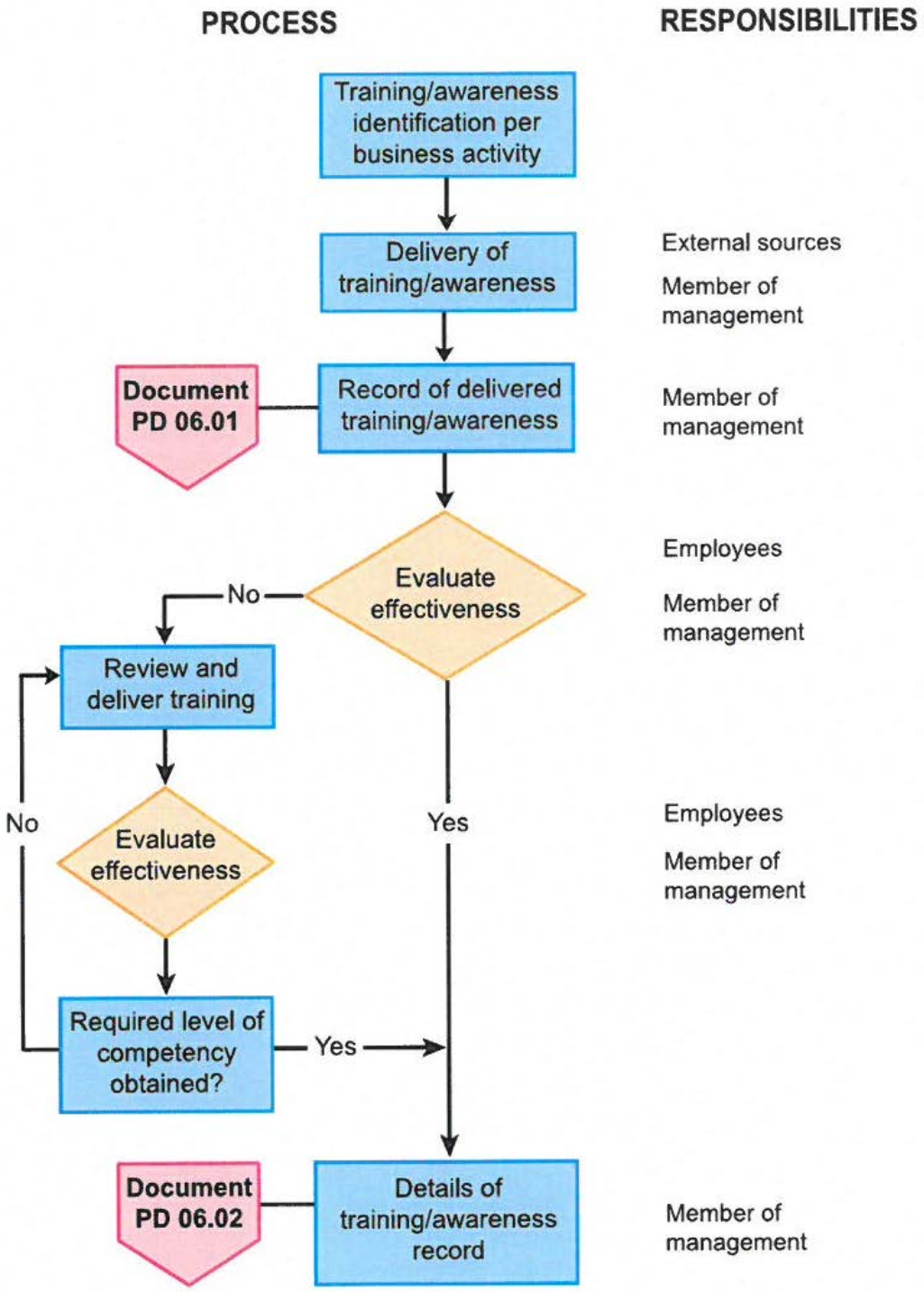
Appendix B3 Flow chart for record control



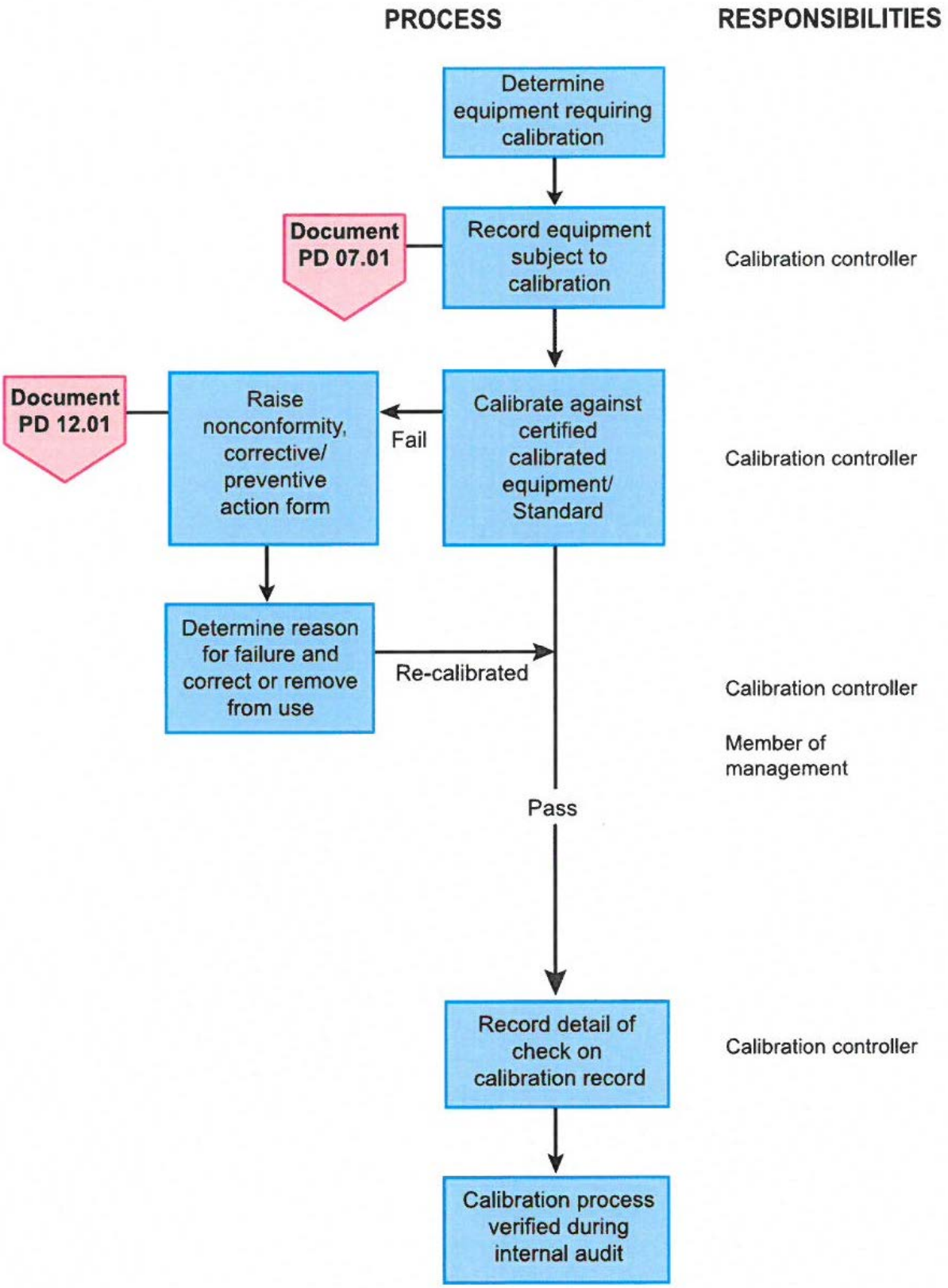
Appendix B4 Flow chart for external document control



Appendix C Flow chart for training and awareness



Appendix D Flow chart for calibration process



Appendix E Timber Delivery Inspection check list - example.

Delivery date: _____ Purchase order No: _____

Supplier: _____ Delivery note number: _____

Type of timber: Douglas fir ☐ Other ☐ Moisture meter No/ref - _____

Spruce ☐ FSC certificated ☐

If other specify - _____

Pack ref/numbe	Qty	Grade			Visual inspection	Moisture Content		Action					Received by	
		Nil	C16	C24		Lowest %	Highest %	Accept Pass	Fail	Return	Store/air dry	Kiln Dry	Signed	Print
E.G. PK01	*120*	-	✓	-	✓	18	23	✓				✓	M.BALL	M.BALL

Notes:

Appendix F Kiln Drying Inspection check list - example

Start date of drying: _____

Finish date of drying: _____

% Moisture guideline min / max = 8% min to 15% max

Moisture meter no/ref: _____

				Operator		
Pack number	% Moisture after kiln drying	Qty of boards	% Moisture marked on pack	Print name	Signed	Dated
E.G. PK01	*12*	*150*	✓	*M.BALL*	M.BALL	*12/07/2015*

Notes/comments

Appendix G Machining Inspection check list - example

Project Reference: _____ Build reference: _____

Date and time: _____ Operator name: _____

Timber tolerance	Width = +/- 2mm	Thickness = +/- 1mm

% Moisture tolerance	Max = 15%	Min = %8

Moisture meter no/ref: _____

Pack number	% Moisture		Pass	Fail	Component		Blank Size	Finished size	Within tolerance	Qty	Beam ref	Beam ref & build ref marked
	Min	Max			Flange	Webb						
E.G.PK01	*10*	*13*	✓	-	✓	-	*219 x 44*	*210x40*	✓	*18*	*T-1*	✓

Notes/comments

Appendix H Box beam assembly inspection check list - example

Project Reference: _____ Build reference: _____

Date and time: _____ Operator name: _____

Box beam tolerance Width = +/- 2mm Thickness = +/- 1mm *Assembly of box beams must be within 24hrs of machining*

Component ref	Qty	External design size	External finished size	Within tolerance ✓ ✗	Is blank long enough	Adhesive make used	Adhesive type	Adhesive expiry date	Are additional screws used	Is adequate adhesive visible
TU-BB 01	*50*	*210 x 210*	*211 x 210*	✓	✓	*Jowart*	*PUR 686.60*	*Nov-14*	✓	✓

Notes/comments

adequate adhesive used

Appendix I Box beam cutting inspection check list examle

Project Reference: _____ Build reference: _____

Date: _____ Operator name: _____

Box beam tolerance Width = +/- 2mm Thickness = +/- 1mm Length = +/-2mm

Component ref	Qty	External design size mm	Required design length mm	Actual cut length	Special requirements (Ends cut at an angle/notched)	Within tolerance ✓ ✗
E.G. TU-BB 01	*50*	*210 x 210*	*4200*	*4201*	*45 deg cut to one end*	✓

Notes/comments

Appendix J Box beam treatment inspection check list - example

Project Reference: _____ Build reference: _____

Date: _____ Operator name: _____

Health and Safty instructions for preservative read, understood and followed: YES / NO

Component ref	Qty to dip	Qty dipped	Preservative manufacturer	Preservative type	Use by date		Fully dipped ✓ ✗
E.G. TU-BB 01	*50*	*45*	*Wykamol Group*	*Wykabor DB*	*Dec-15*		✓

Notes/comments

Appendix K Box beam structural inspection/test check list - example

Project Reference: _____ Build reference: _____

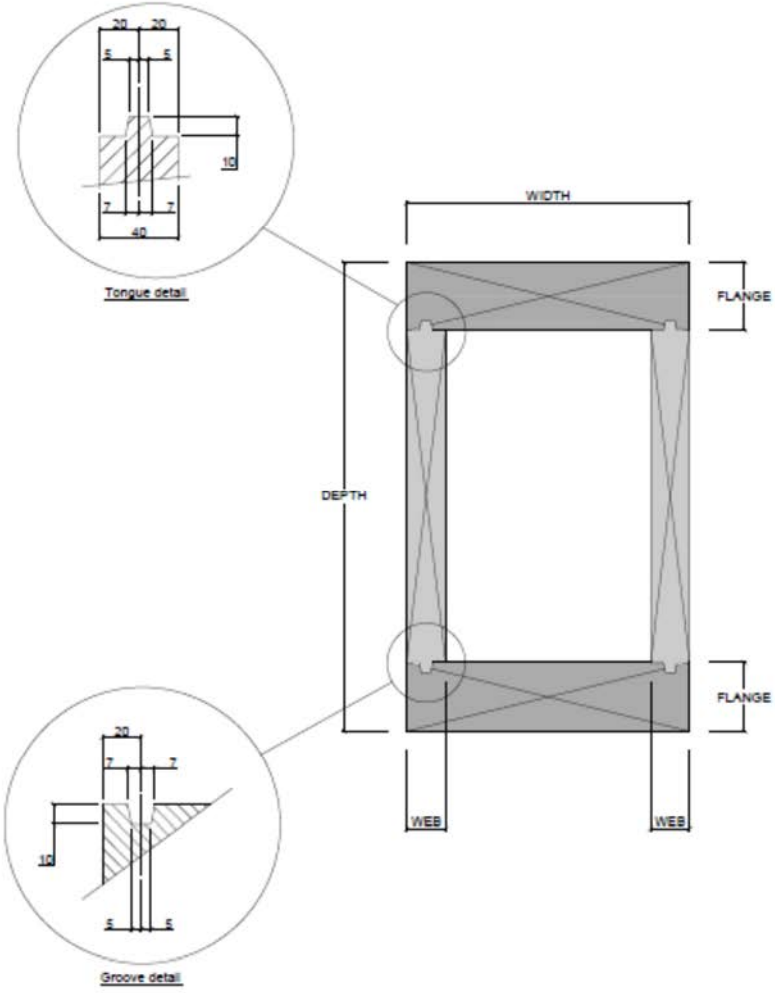
Date: _____ Operator name: _____

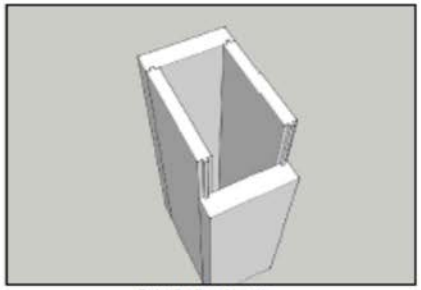
Pass criteria - Fracture occurs through timber Fail criteria - Fracture occurs along glue line

Sample component ref	Pass	Fail	If fail reason of failure	Test photographed	Action taken	Sample identifed and dated
E.G. TU-BB 01	✓	-	*N/A*	*Yes*	*None required*	✓

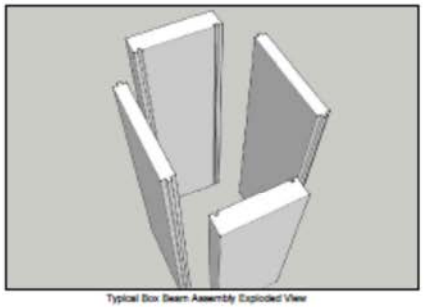
Notes/comments

Appendix L Standard box beam section sizes





Typical Box Beam Assembly



Typical Box Beam Assembly Exploded View

Standard Ty Unnos box beam sizes

Beam ref	Width	Depth	Flange	Web
TU-BB1	290	420	70	40
TU-BB2	210	420	70	40
TU-BB3	290	360	40	40
TU-BB4	210	360	40	40
TU-BB5	290	330	70	40
TU-BB6	210	330	70	40
TU-BB7	290	270	40	40
TU-BB8	210	270	40	40
TU-BB9	290	210	40	40
TU-BB10	210	210	40	40

Notes:

COED CYMRU

COED CYMRU,
The Old Sawmill,
Treegynon,
Newtown,
SY16 3PL
01686 650 777

Standard Box Beam Section Sizes

Figure 1