



BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION LIMITED

BCSA Standard

Competence in Preloaded Bolting

Level 3 – Bolting Coordinator

Level 2 – Bolting Inspector

Level 1 – Bolting Practitioner

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1 Introduction

Preloaded bolted connections are in general usage in steel bridgework and other heavy steel constructions. They are designed according to national and international standards and are, in general classified by the design performance of the completed connection.

The methods of managing the assembly of bolted connections are critical in the constructional steelwork industry and the following scheme provides for appropriate training, which will lead to qualification of personnel.

The objectives of this standard are, with the aid of industry, to give confidence in the effectiveness of training through performance demonstration at the appropriate level. This can be achieved by completion of a BCSA approved training course and passing the examination test.

The standard provides for qualification for personnel at three levels: Level 3 Bolting Coordinator, Level 2 Bolting Inspector and Level 1 Bolting Practitioner.

The main responsibilities for each level are:

- Level 3 – Bolting Coordinator
 - Drafting of method statements
 - Providing technical support and training

To qualify as a Bolting Coordinator the candidate will need to pass the E Learning competency test and then prepare company specific procedures and method statements as well as provide training for the company's Level 2 – Bolting Inspector and Level 1 – Bolting Practitioner.

- Level 2 – Bolting Inspector
 - Oversee the control of the site operations
 - Inspection of the completed work

To qualify as a Bolting Inspector the candidate will need to pass the E Learning competency test and will be trained as a Bolting Inspector by the company Level 3 – Bolting Coordinator. A Bolting Inspector must be able to demonstrate by assessment and validation that they have the required experience and can oversee the preparation, assembly and inspection of preloaded bolted connections in accordance with company method statements.

- Level 1 – Bolting Practitioner
 - Working to a method statement for preloading.



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To qualify as a Bolting Practitioner the candidate will be trained by the company Level 3 – Bolting Coordinator and must be able to demonstrate by assessment and validation that they have the required experience and can carry out the preparation, and assembly of a preloaded bolted connection in accordance with company method statements.

2 BCSA Bolting Competency Training Course

A BCSA approved E Learning course of training in preloaded bolted structural connections is available for candidates to register for and complete (for which a fee is payable). The course includes a theory examination which consists of 25 questions, which are of the single answer, multiple choice type. The pass rate is set at 75%.

Successful completion of the course examination will result in a Certificate of Bolting Competency being issued which will be valid for three years for the candidate.

Candidates who fail the multi choice examination at the end of the E Learning course may make a further two attempts of the examination with the option to review the failed examination before attempting again.

If all three examination attempts result in failure to achieve the required 75% pass mark the E Learning Course will need to be taken again in full (at full cost).

Training courses shall encompass the topics of the syllabus given in Appendix 1.

2.1 Level 3- Bolting Coordinator

Candidates for Level 3 – Bolting Coordinator must successfully complete the BCSA approved E Learning course of training and examination in preloaded bolted structural connections and achieve the Certificate of Bolting Competency. The Certificate of Bolting Competency is valid for three years.

Level 3 – Bolting Coordinator personnel shall also have the ability to demonstrate that they can develop and introduce the appropriate company specific management systems to satisfy this standard. This will include:

- Having suitable knowledge of all relevant reference standards and their implications for proper functioning of preloaded bolted connections (see Section 5 References).
- Ensuring the company purchasing procedures clearly identifies the relevant standards for the fasteners and associated equipment and covers the verification and suitability testing of supplied fasteners where required.
- Preparing method statements for executing preloaded bolted connections that covers all the requirements given in Appendix 2.
- The training and assessment of Level 2 – Bolting Inspectors and Level 1 – Bolting Practitioners.



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To advance from the Certificate of Bolting Competency to the Bolting Coordinator Certificate candidates should:

- Have a practical background in engineering practices with a minimum of twelve (12) month's experience in an execution of constructional steelwork related discipline.
- Prepare a company specific method statement that describes the process for; assembly, preparation and inspection of a preloaded bolted connection, using the tensioning techniques used by the company and in accordance with this standard. (See Appendix 2 for method statement content)
- Provide training and undertake the assessment for the Level 2 – Bolting Inspectors and Level 1 – Bolting Practitioners within the company.

Bolting Coordinator candidates will be required to submit an application form (Appendix 3) and CV detailing appropriate experience for assessment by the BCSA (for which a fee is payable). The application form asks for specific details of experience and training and must be signed by the applicant to the effect that such details are correct.

Following receipt of all the required documentation the BCSA will assess it to ensure it demonstrates the competence required of a Level 3 – Bolting Coordinator. As part of the assessment process the BCSA will carry out a telephone interview with the Level 3 - Bolting Coordinator candidate to clarify any necessary issues and assess the general competence of the candidate. If satisfied that the candidate has demonstrated the competence required of a Level 3 – Bolting Coordinator, the BCSA will issue a Bolting Coordinator Certificate.

The Bolting Coordinator Certificate will contain a date with notice that it expires in three years from issue of that certificate. The certificate will also state the type of bolts used as expressed in the company specific method statement.

Qualification as a bolting coordinator also implies that the candidate is qualified as a bolting inspector.

The certificate for the Bolting Coordinator will be issued on behalf of BCSA to the organisation or person that pays the examination fee.

Level 3 - Bolting Coordinator Certificates are only valid provided:

- They are within date
- They are on paper bearing the BCSA logo. The certificate must also be signed by an officer of BCSA.
- They include the name of the individual to whom the certificate is awarded
- They carry a unique certificate number

Any discovery of false statements on application forms, CV's or submitted certificates shall render any associated Bolting Competency and Level 3 - Bolting Coordinator



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certificates null and void. The certificates will not be renewed without further test if the BCSA receives an authenticated complaint during the period of validity. Further instruction and retest may be required.

For the Level 3 – Bolting Coordinator Certificate to be renewed at expiry the holder must demonstrate that competence has been maintained. The certificate holder must complete the E Learning training and examination as given above and provide evidence of continuous work activity in the coordination of preloaded bolted connections. This can be satisfied by the submission of a brief CV summarising the recent projects that the Bolting Coordinator has carried out. To renew the certificate the holder must complete and submit to the BCSA the Bolting Coordinators application form (Appendix 3) and include a copy of the new Bolting Competency Certificate from the E Learning course.

2.2 Level 2 – Bolting Inspector

Candidates for Level 2 – Bolting Inspector must successfully complete the BCSA approved E learning course of training and examination in preloaded bolted structural connections and achieve the Certificate of Bolting Competency. The Certificate of Bolting Competency is valid for three years.

Level 2 – Bolting Inspector personnel shall also have the ability to supervise and monitor the company specific method statements to ensure their full and proper application. This will include:

- Having suitable knowledge of the relevant reference standards with respect to inspection of preloaded bolted connections (see Section 5 References)
- Understanding the function of bolts, tightening principles and factors that can influence the proper execution of preloaded bolted connections, including:
 - Equipment calibration
 - Condition of faying surfaces
 - Fit-up of the connection elements
 - Condition of the fastener assemblies
 - Storage and handling of fasteners
 - Tightening method and sequence
- The selection, calibration, preparation and maintenance of the appropriate bolting equipment.
- Direct and supervise Level 1- Bolting Practitioner personnel implementing method statements on site or in the workplace.
- Checking assembled connections for compliance with specification requirements.

To advance from the Certificate of Bolting Competency to the Bolting Inspector Certificate candidates should:



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- Have a practical background in engineering practices with a minimum of six (6) month's experience in an execution of constructional steelwork related discipline.
- Have experience of supervising the preparation and assembly, and undertaken the inspection of preloaded bolted connections, in accordance with the company method statements.

Following appropriate training in the company specific procedures, Bolting Inspector candidates are required to take a practical validated assessment to demonstrate their proficiency in the supervision of the preparation and assembly, and the inspection of preloaded bolted connections in accordance with an established method statement. The validator may require oral confirmation of steps during the process.

Level 3 Bolting Coordinators may conduct the assessment and then validate the Level 2 – Bolting Inspector candidates. Appropriate training, assessment and validation may be established by the company with internal certification signed by the Level 3 Bolting Coordinator. The validation process will be assessed by BCSA through the Level 3 – Bolting Coordinator application process (see Section 2.1).

The Bolting Inspector Certificate will contain the same expiry date as given on the candidates Certificate of Bolting Competency (i.e. three years from issue of that certificate).

Level 2 - Bolting Inspector Certificates are only valid provided:

- They are within date
- They are on paper bearing the company logo
- They are signed by the Level 3 – Bolting Coordinator
- They include the name of the individual to whom the certificate is awarded
- They carry a unique certificate number

For the Level 2 – Bolting Inspector Certificate to be renewed at expiry the certificate holder must complete the E learning training, examination and competence assessment as given above to demonstrate that competence has been maintained.

2.3 Level 1 – Bolting Practitioner

Level 1 – Bolting practitioner personnel shall have a basic knowledge of the principles relating to the preparation and assembly of preloaded bolted connections and have the ability to:

- Understand the various types of preloaded fasteners in common use including:
 - High strength structural bolts
 - Direct tension indicators
- Prepare and maintain bolting equipment
- Work according to a prepared method statement to:



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- Prepare for assembly, preloaded bolted connections
- Assemble preloaded bolted connections
- Tightening/tensioning bolt assemblies using appropriate equipment
- Demonstrate safe working practices

Candidates should have a minimum of six (6) month's experience in the execution of constructional steelwork (or work under a supervised programme of development) and following the appropriate training in the company specific procedures they are required to take a practical validated assessment to demonstrate their proficiency in the preparation and assembly of preloaded bolted connections in accordance with an established method statement. The validator may require oral confirmation of steps during the process.

Level 3 Bolting Coordinators may conduct the assessment and then validate the Level 1 – Bolting Practitioner candidates. Appropriate training, assessment and validation may be established by the company with internal certification signed by the Level 3 Bolting Coordinator. The validation process will be assessed by BCSA through the Level 3 – Bolting Coordinator application process (see Section 2.1).

Level 1 – Bolting Practitioner Certificates are valid for three years from the date of successful completion of the company specific training, assessment and validation.

Level 1 – Bolting Practitioner certificates are only valid provided:

- They are within date
- They are on paper bearing the company logo
- They are signed by a Level 3 – Bolting Coordinator.
- They include the name of the individual to whom the certificate is awarded
- They carry a unique certificate number

For the Level 1 – Bolting Practitioner Certificate to be renewed after three years the holder must complete the company specific training, assessment and validation as given above to demonstrate that competence has been maintained.

3 Complaints and Appeals

An aggrieved party in a dispute which considers itself to have reasonable grounds for questioning the competency of a certified Level 3 - Bolting Coordinator may petition the BCSA for cancellation of the certificate. Such a petition must be accompanied by all relevant facts, and if in the opinion of the BCSA an adequate case has been presented, a full investigation of the circumstances under dispute will be initiated. If the petition is substantiated to the satisfaction of the BCSA, the certificate will be withdrawn.

Appeals against failure to certify or against non-renewal of the certificate may be made by the practitioner or the employer upon application in writing to the BCSA.



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4 Records of Training and Certification

The Employer shall keep records of the identity of the Level 3 -Bolting Coordinator and the assessments and validation certificates he/she has carried out for the Level 2 – Bolting Inspectors and Level 1 – Bolting Practitioners.

BCSA shall maintain records of the certificates issued for the Level 3 – Bolting Coordinators.

5 References

BS 4395-1 and -2 Specification for high strength friction grip bolts and associated nuts and washers for structural engineering General grade washers

BS 4604 Specification for the use of high strength friction grip bolts in structural steelwork. Metric series General grade

BS 5400-6 Steel, concrete and composite bridges Specification for materials and workmanship, steel

BS EN 14399-1 to -10 High strength structural bolting for preloading system HR or HV. Direct tension indicators for bolt and nut assemblies

BS EN 1090-2 Execution of steel structures and aluminium structures technical requirements for steel structures

BS EN 1993-1-8 Supplementary provisions for the design of joints

PD 6705-2 – Recommendations for the execution of steel bridges to BS EN 1090-2

Highways Agency Specification for Highway Works – Volume 1 Series 1800

Structural Steelwork and **Volume 2 Series NG 1800** Structural Steelwork Notes for Guidance

SCI Guidance Notes 2.06 and 7.05 Connections in bridges

National Structural Steelwork Specification (NSSS) for Building Construction (BCSA & SCI 203/07)



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Appendix 1: Examination Syllabus

1 Bolting Practitioner

1.1 Practical

Preparation and assembly of and tightening / tensioning a preloaded bolted connection in accordance with a provided method statement.

1.2 Knowledge

In verbal interview, candidates will need to demonstrate sufficient knowledge of the following:

Terminology

High strength bolts, preloaded connections, friction grip connections, tension control bolts, direct tension indicators, nut- and bolt-face washers, torque, tension, bolt and connection classification, faying surface.

Materials

Plate connection elements, bolting materials and classification, washer types, and lubricants.

Preparing preloaded bolted connections

Interpretation of technical data on structural connections, connection and assembly methods, identification of materials against specifications, examination of materials for damage, cleanliness, distortion and surface irregularities, actions to be taken when irregularities are found.

Assembling preloaded bolted connections

Alignment of connection elements, bolt hole alignment, inspection of faying surfaces, selection and fitting washers as appropriate, correct fitting of nuts.

Tightening methods

Mechanical torque wrenches, controlled torque tightening with advantages and disadvantages, lubrication effects, tightening / tensioning sequences and passes, accuracy and consistency of technique.

Safety

General overview of safety and health, using PPE, safe use of hydraulic, electrical and compressed air equipment, potential hazards of tightening, handling of equipment and materials.



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2 Bolting Inspector

2.1 Practical

Inspection of three preloaded bolted connections undertaken using three different tightening methods, and identification of defects that might occur and methods of rectification.

2.2 Knowledge

Candidates will need to demonstrate successful completion of the BCSA approved course and examination, knowledge of the Level 1 syllabus and knowledge of the following:

Specifications or parts of specifications relevant to inspection

See References and manufacturers' data sheets for proprietary preloadable fasteners.

Inspection checks

Checking of fastener seating and gaps between connection elements, completion of inspection sequence, data analysis, reporting and documentation. Operation of sequential methods for fastener inspection.

Measurement methods

Principles and techniques of tension, torque and part-turn measurement. Dimensional checking of fit-up of connections.

Preparation and maintenance of equipment

Identification, checking and calibration of torque wrenches, bolt tensioners, hydraulic equipment, compressed air and electrical power. Use of load cells. Test procedures for fasteners under site conditions. Capacity of selected equipment for work in hand, routine maintenance and remedial actions. Quarantine procedures.

Bolt tightening / tensioning

Equipment selection, fitting connection and adjustment of equipment, safe application and maintenance, completion of tightening sequence and subsequent passes.



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3 Bolting Coordinator

3.1 Knowledge

Candidates will need to demonstrate successful completion of the BCSA approved course and examination, knowledge of the Level 1 and 2 syllabuses and knowledge of the following:

Specifications

See References and manufacturers' data sheets for proprietary preloadable fasteners.

Functions of bolts

Elongation and yield, length/diameter ratios, bolt loading and deformation, applied and residual bolt loads, bolt relaxation, effects of time and environmental conditions on connections.

Fit-up of connections

Specified tolerances Effect of fit-up on proper functioning of preloaded bolted connections.

Product verification and suitability testing

Procedures for verifying product conformance to product standard requirements. Standards and procedures for product suitability testing.



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Appendix 2: Method Statement Content Checklist

The company specific method statement must include the following information:

1. **Company Name and Address**
2. **Date of issue** (include period of review)
3. **Name of Level 3 Bolting Co-ordinator**
4. **Type of fasteners used?**

Ask the company which of the following types of fasteners it uses.

European standards

BS EN 14399-3 – HR preloadable bolts
BS EN 14399-4 – HV preloadable bolts (should not be using these)
BS EN 14399-5 – Plain washers
BS EN 14399-6 – Chamfered washers (under the bolt head)
BS EN 14399-7 – Countersunk
BS EN 14399-8 – Fit bolts (close tolerance, preloadable bolts)
BS EN 14399-9 – DTIs
BS EN 14399-10 – Tension Controlled Bolts

British standards

BS EN 4395-1 (both of these standards have been replaced by BS EN 14399)
BS EN 4395-2 (but remain current during the transition period)
BS 7644-1 – DTIs (still current but replaced by BS EN 14399-9)
BS EN 7644-2 – nut face and bolt face washers (Still current but replaced by BS EN 14399-5)

5. **What methods of tightening are used?**

European standards

The methods of tightening are defined in BS EN 1090-2 and include:

- Torque Method
- HRC Method
- DTI Method
- Combined method

The UK combined method (part turn method) based on a calibration to BS EN 1090-2 may also be used. (see PD6705-2).

British standards

BS 4604-1 (both standards have been withdrawn and replaced by



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BS 4604-2 (BS EN 1993-1-8)

BS EN 1993-1-8 makes ref to BS EN 1090-2 for the methods of tightening. So no matter what bolts are used (European or British) the tightening methods in BS EN 1090-2 should be used.

6. Purchasing

This should be in line with BCSA's 'Model Specification for the Purchase of Structural Fasteners and Holding Down Bolts.'

Does the Quality Management System address purchasing and is it in line with BCSA's model specification?

- Does it include the full bolt specification?
- Is the specification in line with the bolts used?
- Are test certificates supplied?
- What does the company do with the test certificates?
- Ask to see a copy of an order and the corresponding delivery note.
- What checks are carried out to ensure that the bolts received are the ones ordered?
- What does the company do with those bolts that don't comply with the order?

7. Verification and Suitability Testing

Requirements for the verification of product conformance to product standard requirements. (See Highways Agency's Specification for Highway Works Series 1800 - Structural Steelwork CI 1800.5.2 and 1812.2.1 (2)).

Requirements for product suitability testing (See Highways Agency's Specification for Highway Works Series 1800 - Structural Steelwork CI 1800.5.2 and 1812.2.1 (3)).

The Highways Agency's Specification for Highway Works Series 1800 - Structural Steelwork can be found at <http://www.dft.gov.uk/ha/standards/mchw/vol1/index.htm>

8. Delivery and Storage of Bolts

How are the bolts supplied ?

- (a) pre-assembled or
- (b) unassembled

If supplied unassembled what method is use to retain the correct matching bolts, nuts and washers?

How are the bolts stored?

- (a) in the workshop and
- (b) on site



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What happens to contaminated bolts?

9. Traceability

How is the traceability of bolts maintained?

- (a) from workshop to site and
- (b) on site

10. Pre-installation

Is T-wash, Tallow used on the bolts prior to installation if so how is this done and what records are retained?

11. Installation information to include:

General issues

Describe the method used for aligning the connections prior to Stage 1 tightening.

How is the alignment of the connection checked?

Who checks it?

What happens if (a) the holes don't line up and (b) the residual gap is more than 2mm.

If the gap can't be closed is anyone notified?

Who is notified and by whom?

Prior to Stage 1 tightening are the bolts checked for damage and, if so, how and by who?

What happens to damaged bolts?

Is the tightening equipment calibrated and how frequently and by who?

Include a calibration certificate for the BCSA assessment?

Stage 1 – Tightening

Describe the tightening sequence that is used and who decides the sequence?

How this is communicated (tool box talks)?

Who installs and tightens the bolts?

If Stage 1 inspection is required who carries out the inspection?

What happens if the bolts have been incorrectly tightened?

Stage 2 - Tightening

Describe the tightening sequence that is used and who decides the sequence?

How this is communicated (tool box talks)?

Who installs and tightens the bolts?

If Stage 2 inspection is required who carries out the inspection?

What happens if the bolts have been incorrectly tightened?

12. Inspection

Describe the method of inspection you use?



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Who carries out the inspection?

If problems are identified (a) what measures are taken (remedial action and review of installation system) and (b) who is notified about the problem?

What happens to un-used bolts?

What happens if you run out of bolts on site?

13. Quality Management System

Cross reference with the company's QMS

Does it contain:

The roles and responsibilities of the Level 1, 2 and 3 Bolting Co-ordinators?

Are these in line with the BCSA standard?

Are the roles and responsibilities clearly defined?

14. Training

Give the cross reference for the training for the Level 1 and 2 bolting personnel as defined in the QMS, including details of who provides the training.

For a Level 1 Bolting Practitioner the training should address the following areas:

- Basic knowledge and principles
- Understand the different types of fasteners used by the company
- Can maintain the equipment
- Able to understand a method statement
- Able to
 - Prepare the connection
 - Assemble the connection
 - Install and tighten the bolts using the correct equipment
 - Safe working practices
- Should have 6 months experience on steel structures
- Must be assessed/validated to demonstrate their ability to:
 - Correctly assembly a connection
- Identify evidence of assessment/validation
- When were they assessed/validated and by who
- Certificates are only valid for 3 years
- What happens if they fail the test?

For a Level 2 Bolt Inspector the training should address the following issues:

- Must have knowledge of Level 1 plus
- Suitable knowledge of standards with respect to inspection of bolts (i.e. 1090-2)
- Understand the function of bolts
- Understand the factors that can influence the performance of bolts
 - Calibration of equipment
 - Condition of faying surfaces
 - Fit-up of connection



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- Condition of fasteners
- Storage and handling
- Tightening
- Selection and calibration of bolt equipment
- Ability to supervise Level 1
- Check connections comply with specification
- E Learning competency examination – demonstrating the ability to inspect
- Certificates are only valid for 3 years



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Appendix 3: Bolting Coordinator Application Form

Name:	
Company:	
Address:	
Telephone No:	
E Mail Address:	
Date:	
Signature:	

On successful completion of a BCSA approved course of training in preloaded bolted structural connections the candidate may submit a copy of the Certificates of Bolting Competency and must be able to demonstrate knowledge and understanding of the following:

Have suitable knowledge of all relevant reference standards and their implications for proper functioning of preloaded bolted connections

Please indicate whether or not you have copies of the appropriate documents available to you and that you are familiar with their content:

Standard or Guidance note:	Y/N
BS 4395-1 and -2 Specification for high strength friction grip bolts and associated nuts and washers for structural engineering General grade washers	
BS 4604 Specification for the use of high strength friction grip bolts in structural steelwork. Metric series General grade	
BS 5400-6 Steel, concrete and composite bridges Specification for materials and workmanship, steel	
BS EN 14399-1 to -10 High strength structural bolting for preloading system HR or HV. Direct tension indicators for bolt and nut assemblies	
BS EN 1090-2 Execution of steel structures and aluminium structures technical requirements for steel structures	
BS EN 1991-1-8 Actions on structures	
PD 6705-2 – Recommendations for the execution of steel bridges to BS EN 1090-2	
SCI Guidance Notes 2.06 and 7.05 Connections in bridges	
National Structural Steelwork Specification (NSSS) for Building Construction (BCSA & SCI 203/07	



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**To renew an existing Level 3 Bolting Coordinator Certificate please indicate here and include a summary CV outlining the work carried out in the role in the previous 3 years.
The information below is not required for a renewal certificate.**

Ensure the company purchasing procedure clearly identifies the relevant standards for the fasteners and associated equipment:
Confirm the title and document number for the company specific procedure here and provide a copy for BCSA to assess:

Prepare a method statement for executing a preloaded bolted connection, covering:

- Preparation for assembly of the preloaded bolted connection
- Assembly of the preloaded bolted connection
- Specifying appropriate equipment
- Tightening/tensioning bolts
- Checking assembled connections for compliance with specification
- Safe working practices.

Confirm the title and document number for the company specific procedure here and provide a copy for BCSA to assess:

Provide evidence of training and competence of the Level 1 Bolting Practitioners and Level 2 Bolting Inspectors currently operating within the company:

Evidence can be copies of training certificates for at least two bolting practitioners and one bolting inspector:

Please list the names of the practitioners and inspectors here:

1)

2)

3)

4)

Please submit the completed application form and copies of the relevant documents (including a current CV) to training@steelconstruction.org