

# SSTC Self-Study Course on High-Strength Bolting

The purpose of this Course is to provide the participant comprehensive knowledge of high-strength bolted connections. The participant is provided information on bolted joints, bolting materials, the four principal bolt installation methods, and proper inspection. Each of the seven sections stands alone, allowing the participant to study a particular topic in detail without needing to cross-reference other sections. Each of the first six sections contains a 25 question multiple choice quiz to reinforce and test the participant's understanding, with a 50 question multiple choice capstone quiz for the inspection topic to further reinforce and verify the participant's knowledge of the subject matter.

Upon completion, the participant should be able to properly apply the construction and inspection provisions of the AISC and RCSC Specifications regarding bolted connections, whether as an installer, supervisor, or inspector.

- 1. Bolted Joints**
- 2. Bolting Materials and Use**
- 3. Turn-of-Nut Method**
- 4. Twist-Off-Type Tension-Control Bolt Method**
- 5. Direct Tension Indicator Method**
- 6. Calibrated Wrench Method**
- 7. Bolting Inspection**

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## 1. Bolted Joints

The purpose of this section is to explain and clarify the code requirements and the proper methods for specifying and using bolted joints. Following completion of this section, the participant should be able to understand the type of bolted joint specified for a specific connection, and to understand the installation and inspection requirements based upon the joint designation.

1. Joint Types
2. Shear/Bearing Load Transfer - Snug-Tightened and Pretensioned Joints
3. Snug-Tightened Joints
4. Pretensioned Joints
5. Slip-Critical Joints
6. Direct Tension Load Transfer
7. Required Minimum Bolt Pretension - Pretensioned and Slip-Critical Joints
8. RCSC Specification References
9. Dimensions and Making of Bolt Holes

## 2. Bolting Materials and Use

The purpose of this section is to explain and clarify the code requirements and the proper methods for specifying bolts, nuts and washers as fastener assemblies in structural steel connections. Following completion of this section, the participant should be able to properly specify the type of bolting materials required for a project, identify these materials, control the material's quality upon receipt, and select the proper materials for installation.

1. Structural Fasteners
2. Dimensions and Making of Bolt Holes
3. Jobsite Storage
4. Lubrication
5. Requirements for Washers
6. Bolt Stickout and Approximate Bolt Lengths
7. Suitable Nuts for Structural Bolts
8. Bolt Head Markings
9. Manufacturer and Supplier Marks
10. Dimensions of Structural Bolts
11. Nut Markings and Dimensions for Structural Nuts
12. Dimensions of ASTM F436 Washers
13. Dimensions of ASTM F959 Direct Tension Indicators

### 3. Turn-of-Nut Method

The purpose of this section is to explain and clarify the code requirements and the proper methods for specifying or performing bolt installation using the turn-of-nut method. Following completion of this section, the participant should be able to properly use high-strength bolts designated for turn-of-nut installation, perform pre-installation testing, snug the joint, install the fastener assembly, pretension the joint, and conduct visual inspection of the completed work.

1. Pre-Installation Verification Testing Requirements
2. Pre-Installation Verification - Turn-of-the-Nut Pretensioning Method when bolts are long enough to fit into the Skidmore-Wilhelm
3. Pre-Installation Verification - Turn-of-the-Nut Pretensioning Method when bolts are too short to fit into the Skidmore-Wilhelm
4. Required Minimum Bolt Pretension - Pretensioned and Slip-Critical Joints
5. Pretensioning - Turn-of-Nut Method
6. Inspection Procedure
7. Lubrication
8. Requirements for Washers
9. Snug Tight Condition
10. Systematic Tightening
11. Bolt Stickout
12. Reuse of Bolts Previously Pretensioned
13. Required Rotation for Turn-of-Nut Method

### 4. Twist-Off-Type Tension-Control Bolt Method

The purpose of this section is to explain and clarify the code requirements and the proper methods for specifying or performing bolt installation using the twist-off-type tension-control bolt method. Following completion of this section, the participant should be able to properly use high-strength bolts designated for twist-off installation, perform pre-installation testing, snug the joint, install the fastener assembly, pretension the joint, and conduct visual inspection of the completed work.

1. Pre-Installation Verification Testing Requirements
2. Pre-Installation Verification - Twist-Off-Type Tension-Control Bolt Pretensioning Method when bolts are long enough to fit into the Skidmore-Wilhelm
3. Pre-Installation Verification - Twist-Off-Type Tension-Control Bolt Pretensioning Method when bolts are too short to fit into the Skidmore-Wilhelm
4. Required Minimum Bolt Pretension - Pretensioned and Slip-Critical Joints (kips)
5. Pretensioning - Twist-Off-Type Tension-Control Bolt Method
6. Inspection Procedure - Twist-Off-Type Tension-Control Bolt Pretensioning Method
7. Lubrication
8. Requirements for Washers
9. Snug-Tight Condition
10. Systematic Tightening
11. Bolt Stickout
12. Reuse of Bolts Previously Pretensioned
13. DTI Calibration for Pre-Installation Verification Tests when bolts are too short to fit into the Skidmore-Wilhelm

## 5. Direct Tension Indicator Method

The purpose of this section is to explain and clarify the code requirements and the proper methods for specifying or performing bolt installation using the direct-tension-indicator method. Following completion of this section, the participant should be able to properly use high-strength bolts designated for direct-tension-indicator installation, perform pre-installation testing, snug the joint, install the fastener assembly, pretension the joint, and conduct visual inspection of the completed work.

1. Pre-Installation Verification Testing Requirements
2. Pre-Installation Verification - Direct Tension Indicator (DTI) Pretensioning Method when bolts are long enough to fit into the Skidmore-Wilhelm
3. Pre-Installation Verification - Direct Tension Indicator (DTI) Pretensioning Method when bolts are too short to fit into the Skidmore-Wilhelm
4. Required Minimum Bolt Pretension - Pretensioned and Slip-Critical Joints
5. Pretensioning - Direct Tension Indicator Method
6. Inspection Procedure - Direct Tension Indicator Method
7. Lubrication
8. Requirements for Washers
9. Snug Tight Condition
10. Systematic Tightening
11. Bolt Stickout
12. Reuse of Bolts Previously Pretensioned

## 6. Calibrated Wrench Method

The purpose of this section is to explain and clarify the code requirements and the proper methods for performing high-strength bolt installation using the calibrated wrench method. Following completion of this section, the participant should be able to properly use bolts designated for calibrated wrench installation, perform pre-installation calibration and testing, snug the joint, install the fastener assembly, pretension the joint, and conduct visual inspection of the completed work.

1. Pre-Installation Verification Testing Requirements
2. Pre-Installation Verification - Calibrated Wrench Pretensioning Method when bolts are long enough to fit into the Skidmore-Wilhelm
3. Pre-Installation Verification - Calibrated Wrench Pretensioning Method when bolts are too short to fit into the Skidmore-Wilhelm
4. Required Minimum Bolt Pretension - Pretensioned and Slip-Critical Joints
5. Pretensioning - Calibrated Wrench Method
6. Inspection Procedure - Direct Tension Indicator Method
7. Lubrication
8. Requirements for Washers
9. Snug Tight Condition
10. Systematic Tightening
11. Bolt Stickout
12. Reuse of Bolts Previously Pretensioned
13. DTI Calibration for Pre-Installation Verification Tests when bolts are too short to fit into the Skidmore-Wilhelm

## 7. Bolting Inspection

The purpose of this section is to explain and clarify the code requirements for inspection, including the requirements for the individual elements of the bolted connections (holes, bolting materials, faying surfaces), observation of the project operations and the installation methods, and the arbitration of disputes should they arise. Following completion of this section and the prior sections, the participant should be able to properly apply the construction and inspection provisions of the AISC and RCSC Specifications regarding bolted connections, whether as an installer, supervisor, or inspector.

1. Principles of Bolting Inspection
2. Bolt Holes
3. Bolt Head Markings
4. Bolt Manufacturer and Supplier Marks
5. Nut Markings
6. Jobsite Storage
7. Pre-Installation Verification Testing Requirements
8. Lubrication
9. Requirements for Washers
10. Systematic Tightening
11. Snug-Tightened Joints
12. Required Minimum Pretension - Pretensioned and Slip-Critical Joints
13. Inspection Procedure - Turn-of-Nut Pretensioning Method
14. Inspection Procedure - Twist-Off Type Tension-Control Bolt Pretensioning Method
15. Inspection Procedure - Direct Tension Indicator Method
16. Inspection Procedure - Calibrated Wrench Pretensioning Method
17. Bolt Stickout
18. Reuse of Bolts Previously Pretensioned
19. Arbitration of Disputes - when bolts are long enough to use a Skidmore-Wilhelm
20. Arbitration of Disputes -when bolts are too short to use a Skidmore-Wilhelm
21. DTI Calibration

## FAQs (Frequently Asked Questions)

### 1. As an Engineer, why would I want to take this Course?

As a design professional, it is important to know the current information being used in the steel construction industry. Writing good specifications, and knowing how the project is to be properly fabricated, erected and inspected is also vital to a successful project. The section on "Bolted Joints" is of particular interest to Engineers, as the selection of bolted joint types has a significant effect upon project requirements, construction cost, and inspection cost. The other sections are very helpful in being able to address fabrication, erection and inspection questions and issues on bolted connections.

### 2. As a person working for a Fabricator or Erector, why would I want to take this Course?

It is essential to understand the Engineer's specifications and to properly implement the project requirements, as well as meet the code requirements as set forth by AISC and RCSC. This Course can provide you the basis for standard procedures for implementation in your shop or in the field, reducing cost and quality problems and conflicts with inspectors. Shops that seek AISC Quality Certification or other approvals can use completion of this Course to demonstrate ongoing education and efforts to improve quality, as well as document the qualifications of office, shop supervision, bolting personnel and inspection personnel.

### 3. As an Inspector, why would I want to take this Course?

Besides improving your knowledge and skill at performing bolting inspection, this Course can be used to document your knowledge of bolting operations and inspection to prospective clients and employers. Completion of the Course, with the receipt of the Certificate of Completion, should place you among the most qualified for bolting inspection tasks.

### 4. How long do I have to complete the Course?

There is no time limit, but we encourage you to complete your work within six months.

### 5. If I choose not to take the quiz, is there any credit given?

There will be no formal confirmation given by SSTC that you have studied the Course material. There will be no refund given for the Course. You may keep the Course materials.

### 6. May I decide to have someone else study these materials and have that person take the quizzes instead?

Yes, you may turn over your study materials to another in your firm. The Course material and quizzes are copyrighted, however, and copying, posting on a company website, or reproduction in any form is not permitted. Should you decide not to take the quizzes, you are free to provide your blank quizzes to someone else. However, only they will receive credit for Course completion.

### 7. May a group of us study the material, and each send in the quizzes for credit?

We use several different quizzes for each Course. Each individual seeking credit must apply separately and submit the quiz provided to him or her. If several people in the same organization wish to take a Course as a group, we can arrange to register all individuals in the group. Email us for further information on a group plan.

### 8. What type of questions are on the quizzes, and how many are there?

Questions are multiple choice type questions, with some simply asking true or false. There are 25 questions for each section except Bolting Inspection, which has 50 questions. None will require the use of a calculator. The Course material is not to be used during the quiz. The RCSC *Specification for Structural Joints Using High Strength Bolts* is essential and is to be used during the quiz.

### 9. May I get help in completing the quiz?

This is a self-study course, and you may seek help in understanding the material prior to taking the quiz. However, you must not seek help during the quiz itself. We believe that you alone will take your quiz, practicing professional ethics.

#### **10. How will you know I took the quiz, and not someone else?**

You will be signing each quiz sheet, stating that you took the quiz without assistance. In an effort to control your quiz costs, the quizzes are not proctored by SSTC. We rely upon your professional ethics.

#### **11. How many quiz questions do I have to get right to pass?**

For each individual section, a passing grade is 70% or higher. For the Certificate of Completion to be issued for the entire 7-section Course, an overall rate of 80% or higher is needed, with no individual section falling below 70%.

#### **12. What do I get upon successful completion of the Course?**

Course participants will receive a confirmation letter for their records stating that they passed the Course. The letter also lists the contents of the Course, and the amount of CEU / PDH credit given.

#### **13. If I take the Course and achieve the 80% overall rate, what do I get?**

You will receive a formal Certificate of Completion of the Course, suitable for framing, as well as your letter confirming your successful completion of the Course, as described above.

#### **14. What if I fail to pass a section's quiz with 70%?**

You will be emailed a second quiz form. You are expected to re-study the Course materials a second time prior to retaking the quiz. There is no extra charge for the second quiz. A third quiz on the section is not offered.

#### **15. Where do I get the RCSC Specification?**

It can be downloaded for free at [www.boltcouncil.org](http://www.boltcouncil.org), or may be purchased in booklet form from the AISC at [www.aisc.org](http://www.aisc.org) or by calling AISC at (312) 670-2400. It is also contained in the AISC Steel Construction Manual.

#### **16. Where do I get the AISC Specification?**

The *Specification for Structural Steel Buildings* (AISC 360-10) can be downloaded for free at [www.aisc.org](http://www.aisc.org), or may be purchased in booklet form from the AISC at [www.aisc.org](http://www.aisc.org) or by calling AISC at (312) 670-2400. It is also included in the AISC Steel Construction Manual.

#### **17. Where do I get the *Guide*, listed as Recommended Reading for some of the sections?**

We reference certain chapters of the Guide. You can download for free the entire *Guide to Design Criteria for Bolted and Riveted Joints* at [www.boltcouncil.org](http://www.boltcouncil.org). The Guide may also be purchased from the AISC at [www.aisc.org](http://www.aisc.org) or by calling AISC at (312) 670-2400.

#### **18. Is there any overlap between section content?**

Yes, because some information applies to all subjects, such as the need for washers, the importance of lubrication, the level of pretension, etc., these subjects are repeated in two or more of the individual sections. This is to make each section self-contained. As you study, you may find specific variations between requirements, such as different rules for twist-off bolt lubrication when compared to the other installation methods.

#### **19. Is this Course approved by states requiring CEUs or PDHs for PE license renewal?**

Check with the state organization responsible for PE licensing. Most states accept self-study courses of this type, but a few do not.

#### **20. How are the CEU / PDH credit hours calculated?**

For self-study courses, the average time for an individual to complete a course is used as the basis for setting CEU / PDH credit hours. It is not permitted to "log" your own time spent in study and use that time instead. This Course is estimated to take a total of eight hours for reading and study, plus quiz completion, therefore it has been assigned 0.8 CEUs or 8 PDHs.

## SSTC Self-Study Course on High Strength Bolting Order Form

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**Michigan businesses and residents, add 6% sales tax on Publications Total amount plus Shipping and Handling amount.**

**Prepayment by check, Visa, MasterCard, Discover or American Express required. Checks must be drawn on a US bank. No foreign checks accepted.**

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**Steel Structures Technology Center, Inc.**  
 5277 Leelanau Ct.  
 Howell, MI 48843-5437  
 phone (734) 878-9560      fax (734) 878-9571  
[www.steelstructures.com](http://www.steelstructures.com)      [info@steelstructures.com](mailto:info@steelstructures.com)

## Delivery/Shipping Method and Policies

Standard Shipping & Handling charges are listed below.

Sales Amount (USD)	USA	Canada and Mexico	Other International
Up to 100.00	5.00	15.00	30.00
100.01 – 250.00	10.00	25.00	50.00
250.01 and over	15.00	40.00	70.00

Within the USA and Canada, Standard Shipping of most products is done using United States Postal Service (USPS), most commonly using Priority Mail. Small orders may be shipped First Class Mail. Our alternative method of shipping is FedEx Ground. We do not use United Parcel Service (UPS).

Orders are typically shipped within five business days after receipt of order. However, longer shipping times may occur during holiday periods, office vacation shutdown, and extended international business activities. Such closed dates are posted and updated in this section, as follows:

December 1 – December 18, 2014

Express shipping can be provided only when arranged via email to [info@steelstructures.com](mailto:info@steelstructures.com) and agreed to by SSTC, or when arranged by telephone to (734) 878-9560 and agreed to by SSTC. Additional charges for express shipping will be quoted in advance upon request.

For most shipments, when a PO Box is to be used for your receipt of your mail delivery, please supply your PO Box address and zip code / postal code. For shipments known to be shipped by FedEx, please supply a physical address, including the zip code / postal code for the physical address.

For information on delivery time outside the USA and Canada, to request alternate or express shipping, to get a shipping price quote, or for questions, contact SSTC at [info@steelstructures.com](mailto:info@steelstructures.com).

International Delivery (including Canada) may include additional fees such as duties and/or taxes imposed by your local Customs Office. These additional fees are not covered by SSTC's shipping and handling charge and you are responsible for these costs; as well as verifying that the product can lawfully be imported into the destination country. If you have any questions regarding these fees, please contact your local Customs Office, as they can provide you with all the necessary information regarding customs fees.

If you have any questions regarding these policies, please email SSTC at [info@steelstructures.com](mailto:info@steelstructures.com) or call (734) 878-9560.

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## Returns & Exchanges Policy

No refunds are made for self-study courses, whether in printed or in pdf form. For help with PDF files, email SSTC at [info@steelstructures.com](mailto:info@steelstructures.com).

Claims for shortages or damage must be made within 5 days of receipt of merchandise, and must be requested by email to [info@steelstructures.com](mailto:info@steelstructures.com).

### RETURN ADDRESS/CONTACT:

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Attn: Returns  
5277 Leelanau Ct.  
Howell, MI 48843-5437 USA  
[info@steelstructures.com](mailto:info@steelstructures.com)

If you have any questions on these policies, please email SSTC at [info@steelstructures.com](mailto:info@steelstructures.com).

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