



# CISC QUALITY GUIDELINE FOR STEEL BRIDGES

Canadian Institute of Steel Construction

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## PREFACE

The Canadian Institute of Steel Construction (CISC) is Canada's voice for the steel construction industry, providing leadership in design and construction efficiency, quality and innovation. The CISC promotes dialogue, collaboration and commerce between industry stakeholders – advancing the benefits of steel to the consulting community, builders and buyers, academia and government. The CISC represents a diverse community of steel manufacturers, fabricators and constructors, engineers and architects, owners and developers, and educators and students, offering a wide span of products and services to enhance capabilities and grow businesses.

The CISC has prepared this guideline in recognition of its interest in meeting the quality requirements of its customers. It is designed to assist Fabricators in developing a Quality System that will provide assurance that products will conform to contractual and regulatory requirements. This guideline addresses the special processes and specific requirements of steel fabrication for highway and railroad bridge structures.

The guideline is based on the belief that quality awareness is an integral part of all production processes. By promoting a "pride in workmanship" attitude in our employees, product quality will be maintained in the most economical manner.

This guideline shall be used by bridge Fabricators who wish to have their operations third-party audited and CISC Certified.

Note: CSA S6 Canadian Highway Bridge Design Code now requires bridge Fabricators to have a bridge-specific audited and certified quality management system. CISC Bridge Certification is recognized by CSA S6-14 as meeting this requirement.

### 1. SCOPE AND AIMS OF MANUAL

The Quality Systems Manual, to be developed by the Fabricator, shall define the scope of application with respect to departments or systems included, and production location, if more than one location is covered.

### 2. NORMATIVE REFERENCE

This guideline has been prepared using the most current published edition of the following codes and guidelines.

- i. CSA S6
- ii. CSA W59
- iii. CSA W47.1
- iv. CISC Code of Standard Practice
- v. CSA S16
- vi. CSA W178
- vii. SSPC for surface preparation and coatings
- viii. AREMA for Rail Bridges
- ix. AASHTO – Design LRFD Bridge Construction Specifications
- x. AASHTO/AWS D1.5
- xi. Appropriate Provincial Ministry Specifications
- xii. ISO 9001
- xiii. ASTM A6

### 3. TERMS AND DEFINITIONS

The following terms and definitions apply to this guideline or are commonly used in the industry. The fabricator may choose to include industry-specific or company-specific terms and definitions in this section.

**Corrective Action:** An action taken to eliminate the cause of a detected nonconformity or other undesirable situation.

**Defect:** The non-fulfillment of a requirement that is recognized and corrected while in current process. For example, a misplaced cleat detected at the fit checking stage may be directed back to the fitting station for proper relocation; it may be considered a defect and not a non-conformity.

**Document:** Information and its supporting medium used to define and/or establish quality requirements.

**Erection Diagrams:** General arrangement drawings showing the principal dimensions and elevations of the steel structure, sizes of the steel members, piece marks, size (diameter) and type of bolts, bolt installation requirements, elevations of column bases, all necessary dimensions and details for setting anchor rods, and all other information necessary for the assembly of the structure.

**Erection Procedure:** An engineered procedure outlining the construction methods, erection sequence, erection and temporary bracing requirements, and other engineering details necessary for shipping, handling, erecting, and maintaining the stability of the structural steelwork.

**FCM:** Fracture-Critical Material.

**LPT:** Liquid Penetrant Testing.

**Nonconformity:** The non-fulfillment of a requirement.

**Objective Evidence:** Data supporting the existence or verity of something.

**Preventive Action:** The elimination of the cause of a potential nonconformity or other undesirable potential situation.

**Quality Assurance:** The establishment of measures to prevent problems and to demonstrate that such measures are taken and are effective, providing confidence that the quality requirements will be fulfilled.

**Quality Control:** Activities aimed at determining whether results obtained through an activity conform to stated objectives for this activity. The results are measured and then compared with a pre-established objective for this activity.

**Quality Management System:** A system to establish the policy and objectives required to direct and control an organization with respect to quality and to achieve those objectives.

**Quality Objective:** An aim or goal related to improvement of the quality system.

**Quality Policy:** Overall intentions and direction of an organization related to quality as formally expressed by senior-level management.

**RT:** Radiographic Testing.

**Record:** Something stating results achieved or providing evidence of activities performed.

**Root Cause:** The initial and main reason why an event occurs. In corrective action, the removable factor leading to the elimination of a future nonconformity.

**UT:** Ultrasonic Testing.

## **4. QUALITY SYSTEM REQUIREMENTS**

### **4.1 General Requirements**

The Fabricator shall develop a Quality System that shall establish, document, implement, and maintain processes necessary to provide assurance that finished products conform to contract specifications in accordance with the requirements of this guideline.

While some of the work may be subcontracted, it is the Fabricator's responsibility to monitor all sub-contractor operations, methods and quality system to ensure they are in conformity with this guideline and all relevant Standards and Specifications.

### **4.2 Quality Manual and Work Procedures**

The written Quality System Manual shall be supported with applicable written work procedures and sample documents.

### **4.3 Control of Documents**

#### **4.3.1 General**

The Fabricator shall establish and maintain procedures for approval, issue, and maintenance of the documents and data required for the operation of the Quality System. Required documentation shall include, but may not be limited to, the following:

- a) Contract drawings, specifications, and amendments,
- b) Detail and Erection drawings,
- c) Welding documentation as required by CSA W47.1 and other relevant standards,
- d) Purchase orders,
- e) Quality control plans and quality records including inspection test plans and inspection records,
- f) Documented procedures and records required by this standard.

#### **4.3.2 Erection Diagrams and Shop Details**

##### **4.3.2.1**

The Fabricator, or his assigned representative, shall prepare shop details and erection diagrams from Certified-for-Construction contract documents. Preparation, use, and approval of these documents shall conform to the CISC Code of Standard Practice, and Provincial and Territorial Engineering Association guidelines, where applicable.

##### **4.3.2.2**

Revisions to detail drawings/data shall be dealt with in the same manner as the originals, or as agreed upon with the Customer. Revisions shall be clearly identified on drawings.

##### **4.3.2.3**

Current issues of appropriate documentation shall be available at all points of use. Provision must be made to ensure that obsolete drawings/data are removed from all points of use.

##### **4.3.2.4**

A shop drawing control system shall be maintained.

#### **4.3.3**

The Fabricator shall control the documentation required for procured and subcontracted items.

#### **4.3.4**

The Fabricator shall ensure that all required documentation is reviewed for adequacy prior to release.

#### **4.3.5**

The fabricator shall define the retention period for documentation, including consideration for requirements of specific contracts and governing legislation.

### **4.4 Control of Quality Records**

#### **4.4.1**

The Fabricator shall establish and maintain a system for the identification, collection, and storage of the records determined to demonstrate conformance to the requirements and effective operation of the Quality System. Required records shall include, but may not be limited to, the following:

- a) Contract drawings, specifications, and amendments,
- b) Mill test reports,
- c) Purchase orders,
- d) Applicable inspection and test records,
- e) Calibration records for measuring and inspection equipment,
- f) Shipping and receiving reports,
- g) Nonconformity, corrective action, and preventive action reports,
- h) Certified welding inspectors, welding operators and welders certifications.

#### **4.4.2**

All records required by the contract specifications shall be available for review by the customer or his representative.

#### **4.4.3**

The Fabricator shall control the records required for procured and subcontracted items.

#### **4.4.4**

The Fabricator shall define retention periods for records, including consideration for requirements of specific contracts and governing legislation.

## **5. MANAGEMENT RESPONSIBILITY**

### **5.1 Management Commitment**

Management is responsible for ensuring that:

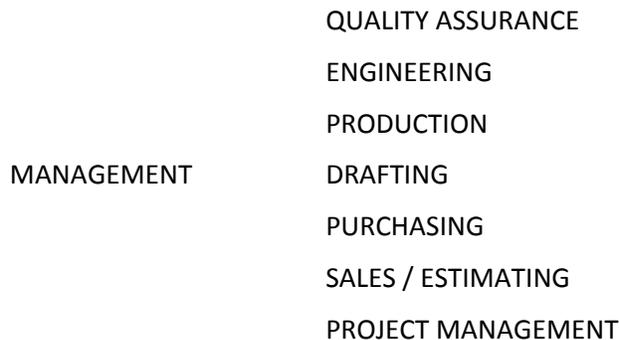
- a) A documented statement is in place that describes the Fabricator's Quality Policy with respect to commitment and quality objectives, signed by the most senior official in the organization.
- b) All employees are made fully aware of their authority and role in the Quality System as described in section 5.3.1.
- c) A Quality System that conforms to the requirements of this guideline is implemented.
- d) A senior-level management representative is appointed to ensure that the requirements of the Quality System are maintained and reported.
- e) A quality system internal audit by the Fabricator is carried out at a maximum interval of one year.

- f) The Quality System is reviewed at a senior management level at a maximum interval of one year, or more frequently, to ensure its continuing suitability and effectiveness.
- g) Adequate resources are provided to carry out the Quality System, including performance and verification of work.
- h) Employees performing the work are competent.
- i) Necessary changes are implemented to ensure a compliant and safe product.

## 5.2 Organization

### 5.2.1

The Fabricator shall define an organizational structure, which includes the following functions as applicable:



### 5.2.2

This chart represents a typical organizational structure. Departments may vary from company to company, and more than one function may be held by one person. Any of the functions noted may be subcontracted.

## 5.3 Responsibility and Authority

### 5.3.1

Each employee is responsible for the quality of his or her own work and carries an equally important share in the effectiveness of the quality assurance process.

#### 5.3.1.1

All employees are responsible to ensure that the work performed by them conforms to a standard of workmanship required by the company in accordance with the applicable contract requirements.

### 5.3.2

Management is responsible for ensuring that responsibility and authority is defined for carrying out the following:

- a) Ensuring that all product quality verifications are carried out on a continuous basis.
- b) Dealing with nonconformities and ensuring that the specified dispositions are carried out on a continuing basis.
- c) Communicating with the customer's appointed inspection representative(s).
- d) Carrying out the work in accordance with the applicable codes and standards.
- e) All welding and welding inspection in accordance with the latest requirements of CSA Standards S6, W47.1, W59, CGSB, ISO 9712 and AWS D1.5 as applicable.

- f) Dealing with nonconformities of a technical nature in accordance with the applicable codes and standards.
- g) Ensuring that all production personnel understand the contract requirements pertinent to their assignment.
- h) Providing sufficient notice and making proper arrangements for required inspection.
- i) Ensuring that all contract requirements, including revisions, are conveyed to the relevant departments and incorporated into the detail drawings and other fabrication data.
- j) Purchasing all items in accordance with the contract requirements, including revisions, and for obtaining the required documentation.

## **6. RESOURCE MANAGEMENT**

The Fabricator shall identify the personnel and the corresponding level of education, training, skills, and experience required in order to ensure that work affecting product quality is carried out in the required manner, and such records are kept on file and updated as required.

### **6.1 Personnel**

#### **6.1.1**

Welders, welding operators, tack welders, welding supervisors, and welding engineers shall be qualified to the requirements of the latest issue of CSA standard W47.1.

#### **6.1.2**

The Fabricator shall employ or retain a professional engineer with experience in CSA S6, AASHTO, or AWS D1.5 as applicable.

#### **6.1.3**

The fabricator shall have personnel specifically trained to evaluate and coordinate design according to CSA S6, AASHTO, or AWS D1.5 as applicable.

#### **6.1.4**

The fabricator shall have personnel specifically trained to purchase material to the requirements of CSA S6, AASHTO, or AWS D1.5 as applicable.

#### **6.1.5**

The Fabricator shall employ or retain personnel qualified to inspect to the contract specifications of CSA S6, AASHTO, AWS D1.5, W178.2, CGSB, and ISO 9712 as applicable.

#### **6.1.6**

The Fabricator shall employ or retain personnel certified as a Level III NDE administrator in accordance with CGSB as applicable.

#### **6.1.7**

The Fabricator shall employ or retain personnel certified as a Level II visual inspector as applicable.

#### **6.1.8**

The Fabricator shall employ or retain personnel certified to a Level II in MPI, UT, and/or RT as applicable.

#### **6.1.9**

The Fabricator shall verify the certification of all NDE personnel retained or employed.

## **6.2 Infrastructure and Equipment**

### **6.2.1**

The Fabricator shall determine, provide, and maintain the infrastructure and equipment needed to achieve conformity to product requirements. Infrastructure and equipment includes, as applicable:

- a) Buildings, workspace and associated utilities,
- b) Process equipment (both hardware and software),
- c) Supporting services (such as transport or communication).

### **6.2.2**

The fabricator shall have adequate facilities to perform assembly work under conditions.

### **6.2.3**

The fabricator shall have process equipment that is adequate to meet the customer's requirements, which shall include, as applicable:

- a) Cutting and drilling equipment,
- b) Material handling equipment,
- c) Inspection equipment made available for RT, UT, and LPT inspection, and
- d) Welding equipment.

## **6.3 Reference Material**

The fabricator shall have the most current published edition of the following reference materials made available and refer to the edition specified in contract documents. In addition, other versions or documents that may be specified in contract specifications shall be available:

- i. CSA S6
- ii. CSA W59
- iii. CSA W47.1
- iv. CISC Code of Standard Practice
- v. CSA S16
- vi. CSA W178
- vii. SSPC Volumes I & II (for paint)
- viii. AREMA for Rail Bridges (as required by contract documents)
- ix. AASHTO – LRFD Bridge Construction Specifications
- x. AASHTO/AWS D1.5
- xi. Appropriate Provincial Ministry Specifications (as required by contract documents)
- xii. Others as applicable by the project Specifications and other Standards

## **7. PROCESS MANAGEMENT**

### **7.1 QC Planning**

#### **7.1.1**

The Fabricator shall determine the procedures, documentation, records and resources required to ensure that products meet the contract specifications.

### **7.1.2**

The subcontract Fabricator shall demonstrate the ability to supply welded plate girders to the contract specifications – (See appendix for girder mock-up requirements).

### **7.1.3**

The Fabricator shall have a documented fracture control procedure and training complying with CSA S6, AASHTO, or AWS D1.5 as applicable.

### **7.1.4**

The Fabricator shall have welding procedures for SAW process, and any other process, that are required by the contract specifications and the requirements of W47.1, W59, and AWS D1.5 as applicable.

## **7.2 Contract Review**

### **7.2.1**

The Fabricator shall have a system in place to ensure that contract requirements are reviewed, incorporated into the work and communicated to the appropriate personnel responsible for production and quality control.

### **7.2.2**

The Fabricator shall ensure that the necessary expertise, personnel, equipment, and plant resources are available to meet the contract requirements.

### **7.2.3**

The Fabricator shall ensure that all additions and revisions to contract requirements are duly communicated to the necessary personnel, and incorporated into the work.

## **7.3 Purchasing**

### **7.3.1**

Purchase orders shall clearly describe the goods and services being ordered. The descriptions shall include the following information as applicable to the product being purchased:

- a) Quantity
- b) Unit of Measure
- c) Product Name
- d) Manufacturers Description
- e) Size and Length
- f) Material Specification
- g) Special Properties (e.g. Impact Category, FCM requirements)
- h) Finish
- i) Inspection Instructions
- j) Special Packaging or Shipping Instructions
- k) Applicable standards
- l) Scope of work
- m) Attachments to the purchase order
- n) Tolerances

### **7.3.2**

For subcontracted work, the Fabricator is responsible to ensure that the final product meets the contract specifications.

### **7.3.3**

Specifications, drawings, process requirements, inspection instructions and other relevant technical data shall accompany the purchase order if applicable.

### **7.3.4**

Purchase orders shall clearly specify the written documentation that shall be provided to verify conformance with purchase orders.

### **7.3.5**

Fracture-critical material and specifications shall be specifically identified on purchase orders.

## **7.4 Drafting**

### **7.4.1**

All fabricator drawings shall be approved prior to use, unless stated otherwise in contract documents.

### **7.4.2**

Drafting procedures shall be adequate to meet the requirements of CSA S6, AASHTO, and AWS D1.5 as applicable.

### **7.4.3**

Fracture-critical material shall be identified on all advance bills and shop details.

### **7.4.4**

Fracture-critical welds shall be identified in detail drawings.

## **7.5 Receiving**

### **7.5.1**

Incoming materials shall be matched against receiving slips and purchase orders.

### **7.5.2**

Nonconformities that are identified at the receiving stage shall be dealt with in accordance with Section 8.1, Control of Nonconformity.

### **7.5.3**

Material shall not be used or processed until it has been inspected and approved for use.

## **7.6 Material Verification**

### **7.6.1**

The Fabricator shall be able to verify, by Mill Certificate and Heat Number, the material specification of all items in stock and incorporated into the work (i.e. 100% traceable).

### **7.6.2**

Where individual pieces, lots, and batches are restocked, a traceable identification system shall be implemented and maintained.

### **7.6.3**

The Fabricator shall ensure that all bolts, washers, nuts, and assemblies purchased and received meet the material specifications identified in CSA S6 and AASHTO as applicable. The Fabricator shall ensure that all bolts are 100% traceable by batch number and have corresponding Test Certificates from the producer.

## **7.7 Control of Workmanship**

### **7.7.1**

All employees shall be made aware of their responsibilities under Section 5.3.1 of this guideline as they apply to workmanship.

### **7.7.2**

Workmanship and tolerances shall conform to the applicable clauses in the latest editions of CSA Standards S6, W59, S16, AASHTO, AWS D1.5, and to the CISC Code of Standard Practice as applicable.

### **7.7.3**

Fabricators performing welding shall be certified in accordance with the requirements of CSA Standard W47.1 and AWS D1.5 as applicable.

### **7.7.4**

The Fabricator shall ensure that manufacturing operations are carried out under controlled shop conditions. Controlled shop conditions shall include all conditions that affect product quality and the achievement of contract specifications.

### **7.7.5**

All tools and equipment used shall be suitable to perform the work and shall be in proper working order.

### **7.7.6**

The Fabricator shall provide adequate procedures to ensure proper fit-up in the field meeting the contract specifications, CSA S6, AASHTO and AWS D1.5 as applicable.

### **7.7.7**

The Fabricator shall provide adequate procedures to ensure that bolting meets the requirements of S6 and contract documents.

## **7.8 Product Verification**

The Fabricator shall verify conformance to the contract requirements.

### **7.8.1**

The Fabricator shall define inspection points and inspection record requirements to verify conformance to the contract requirements, including the following:

- a) Examination of material for size, conformance to dimensional tolerances, and surface condition or defects,
- b) Examination of assemblies for overall dimensions, and location and orientation of holes and detail components,
- c) Verification that welding is carried out and inspected as per contract requirement and in accordance with the company's welding standards. This includes visual examination of completed weldments,
- d) Examination of surface preparation and finish.

### **7.8.2**

Any additional inspection requirements noted in the contract documents shall be identified and implemented.

### **7.8.3**

The Fabricator shall provide access to and cooperation with the customers' designated representative for inspection of the work as required. Unless specific provisions are included in the contract documents, such inspections shall be scheduled so as not to impede the progress of production.

### **7.8.4**

The Fabricator shall ensure that all verification has been performed in conformance with contract requirements and this guideline.

### **7.8.5**

All test records specified above are maintained in accordance with Section 4.4.

### **7.8.6**

The Fabricator shall trace welds to the welders who produce them.

## **7.9 Customer-Supplied Products**

### **7.9.1**

Upon receipt, the Fabricator shall examine all items for compliance with the customer-supplied documentation and to detect nonconformities.

### **7.9.2**

The Fabricator shall promptly report to the customer any item found to be damaged, incomplete, or otherwise unsuitable.

### **7.9.3**

Unless otherwise specified, it is the responsibility of the customer to ensure that items supplied by the customer conform to the contract requirements.

## **7.10 Storage, Loading, and Shipping**

### **7.10.1**

The Fabricator shall maintain procedures to ensure that all items are properly prepared, handled, and/or packaged for storage and shipping to prevent damage to product.

### **7.10.2**

The Fabricator shall ensure that items loaded correspond to the shipping bill.

### **7.10.3**

The Fabricator shall maintain records of all items that have been shipped.

## **7.11 Control of Measuring and Inspection Equipment**

### **7.11.1**

The Fabricator shall maintain documented procedures to define the frequency and methods of checking, testing, and/or calibration of measuring and inspection equipment in accordance with standards.

### **7.11.2**

The Fabricator shall ensure that the equipment is suitable for the work and capable of measuring within the required tolerances.

### **7.11.3**

The Fabricator shall ensure that new equipment, stored equipment, and repaired equipment are checked before use.

### **7.11.4**

The Fabricator shall ensure that the calibration status is controlled by physical marking or other means.

### **7.11.5**

The Fabricator shall ensure that calibration records for measuring and inspection equipment are maintained.

### **7.11.6**

The Fabricator shall calibrate welding machines every three months for FCM work or every twelve months otherwise and record the results of the calibration.

## **8. MEASUREMENT, ANALYSIS, AND IMPROVEMENT**

### **8.1 Control of Nonconformity**

#### **8.1.1**

The Fabricator shall establish a written documented procedure to deal with nonconformities in order to ensure that only products that meet the contract requirements are released.

#### **8.1.2**

The Fabricator shall define the:

- a) Authority for disposition of nonconformities;
- b) Need for nonconformity reporting;
- c) Method of identifying nonconformities to prevent unintended use.

#### **8.1.3**

The Fabricator shall ensure that all nonconformities are dispositioned in one of the followings ways:

- a) In consultation with the customer, the item may be judged to be acceptable for its intended use "as is".
- b) The item may be reworked or repaired by an acceptable procedure that conforms to the contract requirements. In this instance, items must be re-inspected prior to release.
- c) The item may be rejected and/or returned to stock for re-use as allowable, or to the subcontractor/supplier as applicable.
- d) The item may be scrapped.

#### **8.1.4**

Records of the results and disposition of nonconformities shall be maintained in accordance with the requirements of Section 4.4.

## **8.2 Corrective Action**

### **8.2.1**

The Fabricator shall maintain a system for implementation of corrective action. Procedures for corrective action shall include directives for investigation of the cause, recommendations to prevent recurrence, and follow up.

### **8.2.2**

The Fabricator shall determine the level of corrective actions required considering the magnitude of the problems and the associated risks.

## **8.3 Preventive Action**

### **8.3.1**

The Fabricator shall maintain a system for the implementation of preventive action and establish a procedure to deal with preventive action initiatives.

### **8.3.2**

The Fabricator shall determine the level of preventive action required, considering the magnitude of the problems and the associated risks.

## **8.4 Analysis of Data**

### **8.4.1**

In accordance with Section 7.8, the fabricator shall define inspection points and inspection record requirements to verify conformance to the contract requirements.

### **8.4.2**

The Fabricator shall define critical inspection points and collect and analyze relevant data pertaining to those critical inspection points, employing suitable and defined statistical techniques. This will be completed at suitably defined intervals.

### **8.4.3**

The Fabricator shall establish improvement objectives, where necessary, in accordance with the analyzed data and other defined sources of data. Other sources of data may include, but are not limited to, Nonconformance Reports and Corrective Actions at a minimum.

## APPENDIX

### Mock-up or In-Production Bridge Girder Instructions

A fabricator seeking Initial Certification for Steel Bridges shall be required to prove competency capability to fabricate a three-plate girder by either completing a mock-up bridge girder as prescribed below or by having a similar girder in production inspected. Regardless of past experience, a bridge girder mock-up and third-party inspection are required for Fabricators seeking initial CISC Certification and for those CISC-Certified Bridge Fabricators that have not fabricated a bridge and a three-plate welded bridge girder within the last four years.

The fabricator shall create a general note sheet, girder detail, and shop assembly drawings and then build a mock-up bridge girder. Shop and assembly drawings shall be prepared and submitted to the assigned inspector and auditor for the documentation audit prior to the scheduling of an on-site inspection and audit. Representative Mill Test Reports, Certificates of Compliance, and other applicable documentation specific to the mock-up bridge girder will be required at the time of the on-site audit. The personnel responsible for and performing the work will demonstrate an understanding necessary for effective implementation of the requirements of codes and standards. All aspects of this exercise shall be performed in accordance with CSA S6 and CSA W59. Note: the inspection of the mock-up girder or girder in production may be scheduled at a different time than that of the QMS audit.

The applicability of an in-production girder shall be the decision of the third-party inspector and auditor. The Fabricator shall coordinate the timing of girder fabrication with the inspector.

### Instructions for the Mock-up Bridge Girder Exercise

The exercise will include producing drawings of a typical bridge girder and the actual fabrication of a mock-up bridge girder to demonstrate fabrication knowledge and skills. The exercise will include the following features:

1. Create a shop assembly drawing of a two-span bridge. The length of each span is 27 m. The elevation of the left abutment is set at 0 mm. The elevation of the pier is + 900 mm, and the elevation of the right abutment is + 600 mm. The bridge is five girders long, consisting of two end girders, one girder over the pier and an additional girder in each span between the end girder and the pier girder. The assembly drawing shall include information normally used by a drilling crew to lay out the girders to check for proper positioning prior to drilling the splices or checking the fit of the splices for field welding. The assembly drawing will be submitted to the auditor for review prior to fabrication of the mock-up bridge girder.
2. Create a detailed shop fabrication drawing and a general note sheet for the girder at the left abutment. This will be the mock-up bridge girder. It shall be at least 3.0 m in length. The web shall be a minimum of 1000 mm in height. The detailed shop fabrication drawing and general note sheet will be submitted to the auditor for review prior to fabrication. Fabrication drawings shall conform to CSA S6, Annex A10.1.2.3.
3. For this exercise, the mock-up bridge girder will be detailed and fabricated in accordance with the general notes and hold points included below:
  - 3.1 Material: The assembly and detail drawing will show all flanges, webs and splice plate materials conforming to CSA G40.21 Grade 350AT, Category 2 or 3. Stiffeners shall conform to CSA G40.21 Grade 350A. The actual material used for the fabrication exercise is the fabricator's choice (i.e. any available weldable grade material may be used for the fabrication of the mock-up bridge girder).

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- 3.2 Weld symbols on the fabrication drawings shall reference CWB-approved weld procedures. Procedures shall specify matching electrodes compatible with the base metal. The deposited weld metal shall meet the requirements of Table 10.14 in CSA S6.
  - 3.3 The bottom flange and lower half of the web are considered to be in tension. Regardless of the actual camber detailed on the assembly drawing, the mock-up bridge girder detail shall include a camber of at least 12 mm.
  - 3.4 The bottom and top flange will be detailed from material not less than 25 mm thick and 300 mm in width.
  - 3.5 The bottom flange will include a full-penetration butt weld splice that meets the requirements of CSA W59. Plate material may be the same thickness on each side of the bottom flange splice. The detail drawing will identify the joint design specified in the WPDS.
  - 3.6 The top flange will include a full-penetration butt weld splice with a thickness transition of at least 12 mm meeting the transition requirements of CSA W59, Clause 12.
  - 3.7 The web material thickness shall be no less than 9 mm. The web will include a full-penetration butt weld splice, where the material is the same thickness and meets the requirements of CSA W59.
  - 3.8 Web-to-top flange welds will be detailed as 8 mm fillet welds. Web-to-bottom flange welds will be detailed as 10 mm fillet welds, meeting the requirements of CSA W59.
  - 3.9 Two full-length intermediate stiffeners at least 9 mm in thickness will be detailed. The stiffeners shall be placed at approximately the mid-point of the girder, one on each side of the web. One stiffener shall be 90 degrees to the web and the other shall be 60 degrees to the web. One stiffener shall have a mill-to-bear condition at the bottom flange. All stiffener welds shall meet the minimum size requirements of CSA W59 and shall have a minimum 6 mm fillet weld.
  - 3.10 At one end of the mock girder, a bolted field splice shall be prepared for either the top or bottom flange with a minimum of 12 holes in the flange for 7/8 inch diameter, ASTM A325 bolts. The splice plates shall have a minimum thickness of 12 mm and include both top and bottom plates with a 5 mm shim.
  - 3.11 Quality control and NDT shall be performed in accordance with Annex A10.1 of CSA S6 and CSA W59, Clause 12.

#### **General Notes:**

1. The submerged arc process (except tacking) shall be used for flange-to-web welds. The welds shall be continuous, using mechanized or automatic equipment.
2. Welding (except tacking) of the stiffeners will be performed using the FCAW, MCAW or SAW process in accordance with CSA W59.
3. All welds shall be in accordance with the applicant's CWB approved procedures.
4. The applicant will perform intermediate and final inspection at the time of the audit and present visual inspection reports and NDE reports.
5. The auditor will not perform any inspections, direct work or provide instruction. The auditor may request alternate sequences, in agreement with the applicant to meet unforeseen on-site conditions. The auditor will be present to observe the process and the application of requirements by the applicant.

Knowledge and Skill Demonstrated (Mock-up Feature)	Fabrication and Inspection Instructions	S	U	Hold Points
Full-penetration butt splice RT NDE (Bottom flange)	The bottom flange splice shall be welded prior to the on-site inspection. The bottom flange weld shall be 100% RT. Radiographic test results shall be available at the beginning of the on-site inspection.			None
Full-penetration butt splice with transition UT NDE VT NDE (Top flange)	The top flange weld preparation and tacking shall be completed prior to the start of the on-site inspection. The top flange full-penetration butt weld shall be 100% UT.			The on-site inspector will observe the joint preparation and fit-up and make observations of the root pass and at other points throughout the welding process, as determined during the on-site audit/inspection. The on-site inspector will witness the UT.
Full-penetration butt splice UT NDE (Web)	The web splice weld and UT shall be completed prior to the on-site inspection. The accompanying UT results shall be available during the on-site audit.			None
Fillet weld (Flange-to-web)	The flange-to-web welds shall be 100% MT for the length of the girder.			The fit-up, tacking and welding of the web to the top and bottom flange fillet welds will be witnessed by the inspector. The on-site inspector will witness the MT.
Mill-to-bear fitting Fillet welding (Stiffeners)	The stiffeners shall not be welded prior to the on-site audit. Use SAW or FCAW to weld the stiffeners.			The fit-up, tacking and welding of the stiffeners shall be witnessed by the on-site inspector.
Match marking (Splice plates)	Fabricate splice plates for a flange. Assure that the splice plates are tied to their specific location in the assembly by the use of a match marking procedure.			The bolting operation shall be witnessed by the on-site inspector.
Fastener assembly validation Pretension joint bolt installation (Bolted field splice)	Fabricate splice plates for a flange. Assure that the splice plates are tied to their specific location in the assembly by the use of a match marking procedure.			The on-site inspector will witness the installation of ASTM A325 bolts using the Turn-of-Nut method.
Camber and lay-down assembly procedure	QA/QC and shop fitters plus supervision shall demonstrate an understanding of the measurements required and have a recording form created to record camber readings.			The inspector will witness personnel making a camber measurement on the girder. The inspector will verify that the applicant has the space for the lay-down to occur for typical size bridge girders.
Final inspection	A final Quality Control inspection will be performed by the fabricator at the time of the audit. All inspection and NDE reports will be required at that time.			Final Quality Control inspection will be witnessed by the inspector and auditor if requested.

## NOTES