

## **Boron in Structural Steel**

### **Background**

In November 2016, the Canadian Institute for Steel Construction (CISC) (<https://www.cisc-icca.ca>) followed by the Canadian Welding Bureau (CWB) in April 2017 (<https://www.cwbgroup.org/document/22713>) issued bulletins highlighting that some global steel producers (primarily Chinese) were adding boron (B) as part of their steel manufacturing processes. The bulletins cautioned that weld integrity could be adversely affected for steels with boron content exceeding 0.0008%.

In the 2017 Standard Specifications for Bridge Construction (SSBC), the Department included a maximum 0.0008% boron content limit provision for all structural steel bridge components. Structural steel originating from sources outside North America is also required to be re-tested and mill test report verified in Canada.

Furthermore, current North American structural steel standards (CSA/ASTM) do not require that the boron content be stated on mill test reports. Therefore structural steel supplied for Contracts utilizing the 2017 SSBC requires additional testing for boron in cases where the content is not stated on the mill test reports.

Since the implementation of the 2017 SSBC boron content provision, the Department has been working closely with industry to manage the potential impacts of boron being introduced into structural steel supply chains. This construction bulletin provides further guidance for Consultants but may also prove informative for contractors, fabricators, material suppliers and other stakeholders.

### **Non-welded Structural Steel Bridge Components**

Elevated boron in structural steel only has the potential to affect weldability and therefore boron provisions may be waived for bridge components that will not be welded (e.g. bolted cross-bracing members, some longitudinal barrier rails, single full length H-piles).

### **Welded Primary Structural Steel Bridge Components**

Primary structural steel bridge components include:

- Bridge girders;
- Abutment and pier diaphragms;
- Intermediate diaphragm cross bracing in skewed or horizontally curved bridges;
- Abutment and pier caps;
- Traffic barrier rails and posts;
- Overhead sign structures;

For any welded primary structural steel bridge components or where any components are welded to a primary structural steel bridge component, the boron content for all materials must not exceed 0.0008%. The boron content must be reported for all material.

No proposed variances to the Contract requirements will be considered by the Department.

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### Welded Non-Primary Structural Steel Bridge Components

Non-Primary structural steel bridge components include:

- Steel piles;
- Deck joints;
- Pedestrian barriers; and
- Bearings

If the boron content of non-primary welded structural steel bridge components is greater than 0.0008% two options may be considered:

1. The Contractor may source different material that has a boron content less than or equal 0.0008%; or
2. The Contractor may submit a request for information (RFI) to the Consultant proposing the use of material that has a boron content greater than 0.0008% (actual Boron content to be reported) along with the following information for review and acceptance:
  - a. Development of a re-qualification report that includes a Procedure Qualification Record (PQR) of a CWB accepted weld procedure using the proposed steel at the supplied boron content. The PQR must be completed in accordance with CSA W47.1 and include the following procedure qualification testing as identified in Table 10 of CSA W47.1:
    - i. Visual examination;
    - ii. Two macro etch test specimens;
    - iii. Four side (transverse) bend test specimens;
    - iv. Two reduced section tension test specimens;
    - v. Five subsurface weld metal CVN tests at -30 degree Celsius;
    - vi. Five subsurface HAZ CVN tests at -30 degree Celsius;
    - vii. Five base metal CVN tests at -30 degree Celsius (unless the MTR for the base metal provides CVN values); and
    - viii. Hardness test traverse across the base metal, HAV, weld metal, HAV and back across the base metal.

Or:

- b. Development of a qualification report that includes a Procedure Qualification Record (PQR) and weld procedure data sheet (WPDS) of a new CWB accepted weld procedure developed using the proposed steel at the supplied boron content. Procedure qualification testing shall be in accordance with CSA W47.1 and shall include the tests as listed in sub-bullets i) through viii) above.

The re-qualification or qualification report from the Contractor shall very clearly indicate whether the test results identified in sub-bullets i) through viii) above meet the requirements of CSA W47.1. The Consultant shall review the weld procedure and the report and then make a recommendation to the Department's Fabrication Specialist as to whether the proposed request should be accepted. The Department's Fabrication Specialist will then provide recommendation to the Department's Project Administrator.

For projects incorporating multiple steel heats for a given steel component, testing of each individual weld procedure need only be completed using the steel heat with the

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highest boron content. The results of testing on the highest boron content heat will be considered applicable to the remaining heats containing lower boron content.

### North American Steel

The CISC has indicated that North American steel mills are not adding boron to their steel. In cases where the mill test report for a steel heat melted and rolled in North America does not report boron content, a certified letter from the mill stating the measured boron content for the corresponding heat will be considered acceptable in lieu of issuing a revised mill test report that includes the boron content. The letter shall be signed by the mill's metallurgist.

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