

TENDER DOCUMENTS

SUBSECTION 6.43 ALUMINUM WORK

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SUBSECTION 6.43 ALUMINUM WORK

6.43.1 GENERAL

- 6.43.1.1 This subsection sets out the requirements related to aluminum work provided for in this Contract.
- 6.43.1.2 As needed, specific requirements related to aluminum work provided for in this Contract are set out in Section 4 *Special Technical Conditions*.

6.43.2 REFERENCE STANDARDS

- 6.43.2.1 The **Contractor** shall carry out all aluminum work in accordance with the requirements set out in the following standards and documents in addition to the terms and conditions of the Contract:

6.43.2.1.1 (ASTM) ASTM International

- ASTM B108/B108M-08 *Standard Specification for Aluminum-Alloy Permanent Mold Castings*;
- ASTM B209M-07 *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)*;
- ASTM B221M-07 *Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes (Metric)*;
- ASTM F593-02 (2008) *Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs*;
- ASTM F594-08 *Standard Specification for Stainless Steel Nuts*.

6.43.2.1.2 (CAN/CSA) Canadian Standards Association

- CAN3-Z299.3-85 (R2006) *Quality Assurance Program - Category 3*.
- CAN/CSA S6-06 *Canadian Highway Bridge Design Code*.
- CAN/CSA S157-05 *Strength Design in Aluminum*;
- CAN/CSA W47.2-M1987 (R2008) *Certification of Companies for Fusion Welding of Aluminum*;
- CAN/CSA W59.2-M1991 (R2003) *Welded Aluminum Construction*;
- CAN/CSA W178.1-08 *Certification of Welding Inspection Organizations*;
- CAN/CSA W178.2-08 *Certification of Welding Inspectors*.

6.43.2.1.3 (MTQ) Ministère des Transports du Québec

- MTQ – *Cahier des charges et devis généraux (CCDG)*;
- MTQ – *Normes – Ouvrages routiers – Tome VII Matériaux, Chapitre 6 Pièces métalliques, Norme 6401 Aluminium*.

6.43.3 MATERIALS

6.43.3.1 GENERAL

6.43.3.1.1 Aluminum shall meet the requirements set out in standards ASTM B108/B108M, ASTM B209M and ASTM B221M.

6.43.3.1.2 All aluminum components shall be new and free of warping, corrosion and such defects as cracks, nicks, sharp edges, ruts and welding splatters.

6.43.3.1.3 The fabrication tolerances for aluminum components shall meet the requirements set out in standard CAN/CSA S157.

6.43.3.2 BOLTS

6.43.3.2.1 All bolts used to assemble aluminum components shall be stainless steel in accordance with standards ASTM F593 and ASTM F594.

6.43.3.3 WELDING ELECTRODES

6.43.3.3.1 Welding electrodes shall have a basic coating and shall conform to standard CAN/CSA W59.2.

6.43.3.3.2 Electrodes shall be stored and prepared in accordance with standard CAN/CSA W59.2.

6.43.4 SOURCE OF ALUMINUM

6.43.4.1 CERTIFICATION OF CONFORMITY

6.43.4.1.1 Every time aluminum is delivered, and at least fourteen (14) days before it is used, the **Contractor** shall provide the Engineer with a certificate of conformity.

6.43.4.1.2 The certificate of conformity for every production batch of aluminum shall contain the following information:

- manufacturer's name;
- date and place of manufacture;
- type and condition of alloy;
- heat treatment record;
- nominal dimensions;
- casting number;
- analysis and test results;
- production batch number.

- 6.43.4.1.3 A production batch consists of aluminum components from the same cast that have undergone the same treatment.
- 6.43.4.1.4 The samples used for physical tests shall be available from the manufacturer for inspection by the Engineer.
- 6.43.4.2 STOCK ALUMINUM
- 6.43.4.2.1 Where stock aluminum is used, the **Contractor** shall confirm the quality of the materials by providing the Engineer with the manufacturer's stamps and certificates guaranteeing that the aluminum meets the prescribed requirements.
- 6.43.4.2.2 The **Owner** may, independently and at its own expense, conduct additional testing on components of its choosing. In the event of a defect or nonconformity, the **Contractor** shall cover the cost of all modifications and additional testing required to correct the defect or nonconformity.
- 6.43.4.2.3 If test certificates cannot be obtained from the manufacturer for all of the stock aluminum, the **Contractor** shall provide the Engineer with a certificate from an independent laboratory stating that the aluminum meets the prescribed requirements.
- 6.43.4.3 IMPORTED ALUMINUM
- 6.43.4.3.1 The **Contractor** shall provide the Engineer with a statement of compliance with the prescribed requirements signed by the Canadian aluminum supplier for any aluminum imported from countries other than the United States of America.
- 6.43.4.4 DELIVERY CONTROL
- 6.43.4.4.1 The **Owner** reserves the right to check the quality of aluminum components at the time of delivery in accordance with the requirements set out in standards ASTM B108/B108M, ASTM B209M and ASTM B221M.
- 6.43.4.4.2 Plates and hollow sections shall be big enough to allow 200 mm by 75 mm samples to be taken; the 200 mm dimension shall be in the direction of rolling.
- 6.43.4.5 LABELLING OF ALUMINUM
- 6.43.4.5.1 As prescribed by MTQ standard 6401, aluminum components shall be labelled in accordance with standards ASTM B108/B108M, ASTM B209M and ASTM B221M.
- 6.43.4.6 ALUMINUM TESTING METHODS
- 6.43.4.6.1 Aluminum shall be tested using the methods prescribed in the current ASTM standards.

6.43.4.7 DELIVERY, HANDLING AND STORAGE

- 6.43.4.7.1 All necessary precautions shall be taken to ensure that the aluminum components are not damaged during fabrication, transport and assembly. Specifically, the **Contractor** shall ensure that:
- 6.43.4.7.1.1 the edges of components are not nicked;
 - 6.43.4.7.1.2 the components are not unduly stressed;
 - 6.43.4.7.1.3 protective spacers required during transportation, lifting and storage of components are supplied and installed;
 - 6.43.4.7.1.4 no part of an aluminum component touches the ground;
 - 6.43.4.7.1.5 the components and their protective coating, as the case may be, are not altered in any way.
- 6.43.4.7.2 Aluminum structures and their components shall be protected during transport. The tubes shall be covered with adhesive tape at the contact points.

6.43.5 SHOP DRAWINGS

- 6.43.5.1 At least fourteen (14) days before any materials are ordered or any components are fabricated, the **Contractor** shall submit to the Engineer for review shop drawings and detailed design briefs for new aluminum components and structures. The drawings and design briefs shall be signed and sealed by an engineer who is a member of the Ordre des ingénieurs du Québec and has at least five (5) years of experience in aluminum structure analysis.
- 6.43.5.2 At minimum, shop drawings shall include but not be limited to, the following information:
- 6.43.5.2.1 a description of the work methods, of the type of equipment the **Contractor** plans to use for transport, of the steps for assembly and of the aluminum components;
 - 6.43.5.2.2 the main dimensions, the location of the various components and their identifying marks;
 - 6.43.5.2.3 fabrication and assembly details, including shop joints, cuts, counter-profiles, assemblies, holes, bearing plates, threaded anchors, rivets and bolts;
 - 6.43.5.2.4 aluminum components design loads;
 - 6.43.5.2.5 calculations and drawings of the supports, shoring and temporary braces proposed in accordance with clause 6.43.6.2 *Supports, Shoring and Temporary Braces*;

- 6.43.5.2.6 number of the welding procedure and the type of non-destructive weld testing indicated in the tail of the welding symbol for each welded assembly;
- 6.43.5.2.7 details and layout of the bolts.
- 6.43.5.3 The documents outlining the welding procedures and the data sheets shall be approved and bear the seal of the Canadian Welding Bureau and shall be signed and sealed by an engineer who is a member of the Ordre des ingénieurs du Québec and has the qualifications described in paragraph 6.43.5.1.
- 6.43.5.4 All values and dimensions indicated on the Contract drawings shall be considered approximate.
- 6.43.5.5 Before preparing its shop drawings, the **Contractor** shall conduct a detailed site survey of all existing components in order to determine their exact dimensions and validate the values and position of the assembly holes shown on the drawings. The **Contractor** shall conduct such a survey wherever the same detail applies.
- 6.43.5.6 The **Contractor** shall note that the dimensions of the aluminum components and the layout of the bolts can vary from place to place for each new structure where the same detail is shown on the drawings.
- 6.43.5.7 If, following the detailed survey of components, the dimensions obtained differ substantially from those indicated on the drawings, or if the site conditions do not allow the work to be performed as indicated on the drawings and in the specifications, the **Contractor** shall notify the Engineer and follow the Engineer's instructions.
- 6.43.5.8 The **Contractor** may not make any changes to the materials or construction details indicated on the shop drawings reviewed by the Engineer without prior written authorization from the Engineer.

6.43.6 EXECUTION OF WORK

6.43.6.1 GENERAL

- 6.43.6.1.1 Shop-made aluminum components shall not be modified on site. Any component that is modified on site shall be removed and replaced with a new shop-made component.
- 6.43.6.1.2 The **Contractor** shall not damage or soil components adjacent to work areas and shall repair, restore and clean to the Engineer's satisfaction any component affected by the work.

6.43.6.2 SUPPORTS, SHORING AND TEMPORARY BRACES

6.43.6.2.1 The **Contractor** shall ensure that the work methods used to dismantle aluminum components do not compromise the strength and/or stability of the components or the overall integrity of the structure.

6.43.6.2.2 Before removing the bolts holding together the components to be replaced or disassembled, the **Contractor** shall supply and install any temporary supports, falsework and braces needed to maintain the strength and stability of the structure and to ensure that loads are properly transferred to the bearing components and foundations.

6.43.6.2.3 The **Contractor** is entirely responsible for the design, supply, maintenance and removal of all temporary supports and devices.

6.43.6.2.4 Temporary supports and devices shall be designed in accordance with the requirements of standard CAN/CSA S6. Temporary supports shall be designed so as to bear the weight of the supported components and any other existing load or that may be applied to the structure.

6.43.6.3 CUTTING, DRILLING AND SURFACE PREPARATION

6.43.6.3.1 Shear cutting is permitted only on sheet metal not more than 12 mm thick.

6.43.6.3.2 Cutting or drilling with a blowtorch is not permitted.

6.43.6.3.3 At least 1 mm of material shall be milled off the entire edge of components cut by an arc cutting machine unless the edge needs to be welded.

6.43.6.3.4 Where an access opening is cut and formed, at least 1.5 mm of material shall be milled off the entire formed edge.

6.43.6.3.5 All edges shall be prepared in accordance with the requirements set out in standard CAN/CSA W59.2.

6.43.6.3.6 The templates used to drill holes in similar parts of members shall be accurately positioned.

6.43.6.3.7 The methods that will be used to cut or drill aluminum on site shall be submitted to the Engineer for review before the work begins.

6.43.6.3.8 Drilling and cutting shall be carried out in accordance with standard CAN/CSA S157.

6.43.6.3.9 The tolerance for the distance between a hole and the free edge of a component is 0 mm to +2 mm.

6.43.6.3.10 Where a shop-made assembly has at most five (5) metal components, each component may be punched to the final diameter. The diameter of the matrix shall not exceed the diameter of the punch by more than 2 mm.

- 6.43.6.3.11 Shop-made assemblies with holes that cannot be punched to the final diameter shall be bit drilled to the final diameter using a metal template or drilled to a diameter 4 mm smaller than the diameter of the bolt, then reamed to the final diameter.
- 6.43.6.3.12 For assemblies produced on site, holes shall be bit drilled to the final diameter using a metal template.
- 6.43.6.3.13 Shop-made holes and holes made on site shall be cut perfectly perpendicular to the surface.
- 6.43.6.4 WELDING
- 6.43.6.4.1 Welding shall conform to standard CAN/CSA W59.2.
- 6.43.6.4.2 The **Contractor** or, as the case may be, its subcontractors shall, if they carry out welding work, be certified by the Canadian Welding Bureau in accordance with the requirements set out in standard CAN/CSA W47.2, Division 1 or Division 2.1.
- 6.43.6.4.3 The qualification certificate shall be obtained before fabrication begins, and certification shall be maintained throughout the fabrication period.
- 6.43.6.4.4 The engineer responsible for the welding design, procedures and execution of welding work shall report to the shop on request.
- 6.43.6.4.5 Welders shall have the proper competency cards for the welding position and the type of electrode and welding process used. Such competency cards must be issued by the Canadian Welding Bureau in accordance with the requirements set out in standard CAN/CSA W47.2.
- 6.43.6.4.6 Where welds are made in conditions where stress or torsion can weaken or cause deformation of the members, the **Contractor** shall submit to the Engineer for review the following methods: a method detailing the welding sequence and methods to control torsion, including, but not limited to, pre-heating, post-heating, heating between passes and specification of cords, in accordance with the requirements set out in standard CAN/CSA W59.2.
- 6.43.6.4.7 The **Contractor** shall provide details of specific preparation for welding along the edges of some plates in order to ensure compliance with the prescribed standards.
- 6.43.6.4.8 Corner welds shall comply with the minimum and maximum widths prescribed in standard CAN/CSA W59.2 and shall be detailed on the shop drawings submitted by the **Contractor**.
- 6.43.6.4.9 Unless otherwise indicated on the drawings or in the specifications, the **Contractor** shall not carry out welding of any kind on site without written authorization from the Engineer, and then only in the manner and in the locations designated in the authorization.

6.43.7 QUALITY CONTROL

- 6.43.7.1 At least fourteen (14) days before aluminum work begins, the **Contractor** shall submit to the Engineer for review and comments the quality control program it plans to implement for the aluminum work.
- 6.43.7.2 The **Contractor** shall implement a quality control program in accordance with the requirements set out in standard CAN/CSA3-Z299.3. The program shall identify all of the inspections that will be conducted at the following stages:
- 6.43.7.2.1 receipt of materials;
 - 6.43.7.2.2 fabrication and assembly of components;
 - 6.43.7.2.3 transport to site, receiving and unloading;
 - 6.43.7.2.4 installation of finished components.
- 6.43.7.3 The **Contractor** shall give the Engineer access to all parts of the work at any time and shall provide such information and assistance as may be required.
- 6.43.7.4 The Engineer's inspection does not relieve the **Contractor** of its obligations to perform the work according to the requirements of the specifications and drawings.
- 6.43.7.5 The **Contractor** shall ensure that all welds made on aluminum components undergo a complete (100%) visual inspection, before, during and after welding, in accordance with the requirements set out in standard CAN/CSA W59.2 by a welding supervisor certified in accordance with the requirements set out in standard CAN/CSA W47.2.
- 6.43.7.6 The Engineer shall be notified at least twelve (12) hours before non-destructive testing, including visual examinations, is carried out.
- 6.43.7.7 Non-destructive testing, the interpretation of results and X-rays done by the inspector or welding supervisor shall be recorded in a written report to be submitted to the Engineer at least 24 hours before the components are sent from the shop to the site.
- 6.43.7.8 Non-destructive weld testing shall be performed by a registered laboratory certified by the Canadian Welding Bureau in accordance with the requirements set out in standard CAN/CSA W178.1. This laboratory shall also interpret the results.
- 6.43.7.9 Unless otherwise indicated on drawings and specifications, non-destructive weld testing shall be carried out as follows:
- 6.43.7.9.1 in a partial inspection of a weld, the ends of the weld and critical points, such as a change in shape or material, shall be examined first;
 - 6.43.7.9.2 where a partial inspection reveals a defect requiring repair, the entire length (100%) of the weld shall be examined;

- 6.43.7.9.3 the entire repaired part (100%) of the weld shall be re-inspected using the same process used for the inspection of the initial weld.
- 6.43.7.10 The **Owner** may, independently and at its own expense, conduct additional destructive or non-destructive weld testing. In the event of welding defects, the **Contractor** shall cover the cost of any weld inspections carried out before and after the defects are corrected.
- 6.43.7.11 The **Contractor** shall move and support the components to be inspected. Unless otherwise indicated by the Engineer, the inspection shall be carried out flat with vertical clearance of at least 1.25 m.
- 6.43.7.12 The Engineer shall be informed of any defects found in the work. The **Contractor** shall not make any repairs before obtaining authorization from the Engineer. The **Contractor** shall submit in writing, for the Engineer for review the methods it plans to use to correct the defects. The corrective methods shall include drawings, sketches and appropriate welding procedures.
- 6.43.7.13 Each repaired component shall be inspected by the Engineer before being shipped from the shop to the site.
- 6.43.7.14 No new or repaired component may be shipped from the shop before the Engineer has completed its final inspection and given written authorization to the **Contractor**.

END OF SUBSECTION