

# **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 describes the requirements relating to the aluminum work covered by this Contract.
- 6.43.1.2 Any specific requirements pertaining to the aluminum work covered by this Contract are set out on the plans and in Section 4 *Special Technical Conditions*.

### 6.43.2 MEASUREMENT UNIT

- 6.43.2.1 The measurement unit and symbol thereof used in this subsection are the following:

Measurement Unit	Designation	Symbol
length	millimeter	mm

### 6.43.3 REFERENCE STANDARDS

- 6.43.3.1 The Contractor shall carry out all aluminum work in accordance with the requirements of the following standards and documents, to which the provisions of this Contract are added:

6.43.3.1.1 (CAN/CSA) Canadian Standards Association:

- CAN/CSA S6 *Canadian Highway Bridge Design Code*;
- CAN/CSA S157 *Strength Design in Aluminum*;
- CAN/CSA W47.2 *Certification of Companies for Fusion Welding of Aluminum*;
- CAN/CSA W59.2 *Welded Aluminum Construction*;
- CAN/CSA W178.1 *Certification of Welding Inspection Organizations*;
- CAN/CSA W178.2 *Certification of Welding Inspectors*.

6.43.3.1.2 (ASTM) ASTM International:

- ASTM B85/B85M *Standard Specification for Aluminum-Alloy Die Castings*;
- ASTM B108/B108M *Standard Specification for Aluminum-Alloy Permanent Mold Castings*;
- ASTM B209M *Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)*;
- ASTM B221M *Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes (Metric)*;
- ASTM F593 *Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs*;
- ASTM F594 *Standard Specification for Stainless Steel Nuts*;

- ASTM F3125/F3125M *Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830MPa) and 150 ksi (1040 MPA) Minimum Tensile Strength, Inch and Metric Dimensions.*

6.43.3.1.3 (MTQ) Ministère des Transports du Québec:

- MTQ – *Cahier des charges et devis généraux (CCDG) – Construction et réparation;*
- MTQ – *Normes – Ouvrages routiers – Tome VII – Matériaux*
  - *Norme 6401 Aluminium.*

6.43.3.1.4 (ISO) International Organization for Standardization:

- *ISO 9001 Quality Management.*

## 6.43.4 MATERIALS

### 6.43.4.1 GENERAL

6.43.4.1.1 The aluminum parts shall comply with the following standards:

6.43.4.1.1.1 Aluminum die cast

6.43.4.1.1.1.1 ASTM B85/B85M:

6.43.4.1.1.1.1.1 360 and A360 alloys: injected aluminum die cast for luminaires with three thousand (3,000) hour salt spray resistance. Other alloys may be accepted when the specified salt spray resistance is one thousand (1,000) hours.

6.43.4.1.1.1.2 ASTM B108/B108M

6.43.4.1.1.1.2.1 356-T6 alloy: aluminum die cast for permanent mold casting parts for safety cabinets, electrical service cabinets and coupling flanges.

6.43.4.1.1.2 Aluminum sheet and plate

6.43.4.1.1.2.1 ASTM B209

6.43.4.1.1.2.1.1 5052H32 or 6061-T6 alloys: aluminum sheet for boxes used in electrical engineering;

6.43.4.1.1.2.1.2 5050H36 or 5052H38 alloys: aluminum sheet for signage panels;

6.43.4.1.1.2.1.3 6061-T6 alloy: aluminum sheet for variable message signs (VMS), plates for coupling flanges and other plates for lighting and signage structures.

- 6.43.4.1.1.3 Aluminum tube
  - 6.43.4.1.1.3.1 ASTM B221
    - 6.43.4.1.1.3.1.1 6061-T6 alloy: tubes for lighting and signage structure stringers and secondary members;
    - 6.43.4.1.1.3.1.2 6063-T6 alloy: tubes for lighting and signage structure posts, poles and primary members.
  - 6.43.4.1.2 All aluminum components shall be new and free of warps, corrosion and defects such as cracks, nicks, notches, sharp edges, ruts and welding splatters.
  - 6.43.4.1.3 The fabrication tolerances for aluminum components shall comply with standard CAN/CSA S157.
  - 6.43.4.1.4 The aluminum elements' surface finish shall be uniform and have an 80 grit clean shine, or as indicated on the plans.
- 6.43.4.2 BOLTS
  - 6.43.4.2.1 All bolts used to assemble aluminum parts shall be made of stainless steel and comply with standards ASTM F593 and ASTM F594.
- 6.43.4.3 WELDING ELECTRODES
  - 6.43.4.3.1 The welding electrodes shall have a basic coating and comply with standard CAN/CSA W59.2.
  - 6.43.4.3.2 The storage and preparation of the electrodes shall be done in accordance with standard CAN/CSA W59.2.

## **6.43.5 SOURCE OF ALUMINUM**

- 6.43.5.1 CERTIFICATE OF CONFORMITY
  - 6.43.5.1.1 For each delivery of aluminum at the manufacturer's plant and at least fourteen (14) days prior to use thereof, the Contractor shall provide the Engineer with a certificate of conformity.
  - 6.43.5.1.2 The certificate of conformity shall, for every aluminum production batch, contain the following information:
    - 6.43.5.1.2.1 aluminum manufacturer's name;
    - 6.43.5.1.2.2 date and place of manufacture;
    - 6.43.5.1.2.3 type and condition of alloy;
    - 6.43.5.1.2.4 heat treatment charter;

- 6.43.5.1.2.5 nominal dimensions;
- 6.43.5.1.2.6 casting number;
- 6.43.5.1.2.7 analysis and test results;
- 6.43.5.1.2.8 production batch number.
- 6.43.5.1.3 A production batch consists of aluminum parts from a same casting that have undergone the same transformation.
- 6.43.5.1.4 The samples used for the physical tests shall be available from the manufacturer for inspection thereof by the Engineer.
- 6.43.5.2 STOCK ALUMINUM
  - 6.43.5.2.1 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.
  - 6.43.5.2.2 The Owner may, independently and at its own expense, conduct additional tests on parts thereby selected. In case of defect or non-compliance, the Contractor shall pay for the costs of all modifications and additional tests required for correcting the defect or non-compliance.
  - 6.43.5.2.3 If test certificates cannot be obtained from the manufacturer for all the stock aluminum, the Contractor shall provide the Engineer with a certificate from a laboratory, member of the *Association des firmes de genie-conseil - Québec* (AFG), attesting that the aluminum complies with the indications on the plans.
- 6.43.5.3 IMPORTED ALUMINUM
  - 6.43.5.3.1 The Contractor shall provide the Engineer with a certificate of conformity to the prescribed requirements signed by the Canadian aluminum supplier for any aluminum imported from countries other than the United States of America.
- 6.43.5.4 DELIVERY CONTROL
  - 6.43.5.4.1 The Owner reserves the right to carry out a delivery control of the aluminum components in accordance with standards ASTM B108/B108M, ASTM B209M and ASTM B221M.
  - 6.43.5.4.2 The plates and profiles shall be big enough to allow the collection of 200 mm by 75 mm samples; the 200 mm dimension shall be in the direction of the rolling.
- 6.43.5.5 LABELLING OF ALUMINUM
  - 6.43.5.5.1 The aluminum parts shall be labelled in accordance with the requirements of standards ASTM B85/B85M, ASTM B108/B108M, ASTM B209M and ASTM B221M.

6.43.5.6 ALUMINUM TESTING METHODS

6.43.5.6.1 The aluminum shall be tested in accordance with the methods prescribed in the current applicable ASTM standards.

6.43.5.7 DELIVERY, HANDLING AND STORAGE

6.43.5.7.1 All necessary precautions shall be taken to ensure that the aluminum components are not damaged during shaping, transportation and assembly. Specifically, the Contractor shall ensure that:

6.43.5.7.1.1 the component edges are not nicked;

6.43.5.7.1.2 the components are not subjected to excessive stresses;

6.43.5.7.1.3 all the protective wedges required during transportation, lifting and storage of the components are supplied and installed;

6.43.5.7.1.4 no part of any aluminum component comes into contact with the ground;

6.43.5.7.1.5 the components and protective coating, if any, are not tampered in any way.

6.43.5.7.2 The aluminum structures and elements thereof shall be protected during transportation. The tubes shall be covered with adhesive tape at the contact points.

6.43.5.7.3 The aluminum structures shall be cleaned of all dust or grease before they leave the factory.

**6.43.6 SHOP DRAWINGS**

6.43.6.1 At least fourteen (14) days before any materials are ordered and any parts are fabricated, the Contractor shall submit to the Engineer, for review, the shop drawings and detailed design notes for the new aluminum elements and structures. The shop drawings and design notes shall be signed and sealed by an engineer member of the *Ordre des ingénieurs du Québec* (OIQ) and has at least five (5) years of relevant experience in aluminum structures calculations.

6.43.6.2 The shop drawings shall include, without being limited to, the following information:

6.43.6.2.1 the description of the working methods, the type of equipment the Contractor proposes to use for transportation, the assembly steps and of the aluminum elements;

6.43.6.2.2 the main dimensions, as well as the location of the different parts and identification mark thereof;

6.43.6.2.3 all shaping and assembly details, including the joints made in the workshop, the cuts, the counter-profiles, the assemblies, the holes, the bearing plates, the threaded anchors, the rivets and the bolts;

- 6.43.6.2.4 the aluminum elements' design loads;
- 6.43.6.2.5 the calculations and drawings of the temporary supports, shoring and reinforcements proposed in accordance with Article 6.43.7.2 *Temporary Supports, Shoring and Reinforcements*;
- 6.43.6.2.6 the number of the welding procedure and the type of non-destructive weld control indicated in the tail of the welding symbol for each welded assembly;
- 6.43.6.2.7 the detail and layout of the bolts.
- 6.43.6.3 The documents outlining the welding procedures and the data sheets shall be approved and bear the seal of the Canadian Welding Bureau (CWB) and shall be signed and sealed by an engineer member of the OIQ and has the qualifications described in paragraph 6.43.6.1.
- 6.43.6.4 All the values and dimensions indicated on the plans shall be considered approximate.
- 6.43.6.5 Before preparing its shop drawings, the Contractor shall conduct a detailed worksite survey of all existing components in order to determine the exact dimensions thereof and validate the values and position of the assembly holes indicated on the plans. The Contractor shall conduct such a survey in all the locations where a same detail applies.
- 6.43.6.6 The Contractor shall note that the dimensions of the aluminum elements and layout of the bolts may vary from one location to another for each new construction where the same detail is indicated on the plans.
- 6.43.6.7 If, following the detailed survey of the parts, the dimensions obtained differ from those indicated on the plans, or if the actual conditions do not allow for the work to be carried out as indicated on the plans, the Contractor shall notify the Engineer thereof and follow his instructions.
- 6.43.6.8 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.

## **6.43.7 EXECUTION OF WORK**

### **6.43.7.1 GENERAL**

- 6.43.7.1.1 Modifying shop-made aluminum elements on worksite is prohibited. Any part that is modified on worksite shall be dismantled and replaced with a new shop-made part.
- 6.43.7.1.2 The Contractor shall not damage or soil the elements adjacent to the work areas and shall repair, straighten and clean, to the satisfaction of the Engineer, any elements affected by the work.



- 6.43.7.1.3 The Contractor shall provide all the labor and supply all the machinery, equipment, tools and temporary structures for the assembly and worksite installation of the aluminum elements in accordance with the plans, and as directed by the Engineer.
- 6.43.7.1.4 The checks, inspections and acceptances by the Engineer shall be completed at each milestone of fabrication. The compliance of the elements shall be established before proceeding to the next step.
- 6.43.7.2 TEMPORARY SUPPORTS, SHORING AND REINFORCEMENTS
- 6.43.7.2.1 The Contractor shall ensure that the working methods used to dismantle the aluminum elements do not compromise the strength and/or stability of the parts or the overall integrity of the structure.
- 6.43.7.2.2 Before removing the bolts holding together the parts to be replaced or disassembled, the Contractor shall supply and install all temporary supports, shoring and reinforcements needed to ensure that the strength and stability of the structure are not affected and to ensure that the loads are properly transferred to the bearing components and foundations.
- 6.43.7.2.3 The Contractor is entirely responsible for the design, supply, maintenance and removal of all temporary supports and devices.
- 6.43.7.2.4 The temporary supports and devices shall be designed in accordance with standard CAN/CSA S6. The temporary supports shall be designed to bear the dead load of the supported parts as well as any other load that is present on, or likely to be applied to the structure.
- 6.43.7.2.5 The reinforcing elements required to temporarily compensate for the absence of, or to allow for the disassembly of the bracing members and other members likely to take over the compressive or tensile loads shall be designed so as to offer the same compressive or tensile capacity than the replaced or temporarily disassembled member.
- 6.43.7.2.6 After the temporary reinforcements have been installed and before the aluminum parts of the structure for which the temporary reinforcement was installed have been removed, the Contractor's design engineer shall issue an inspection report certifying that the temporary reinforcements comply with the falsework plans. The inspection of the temporary structures shall be conducted in the presence of the Engineer.
- 6.43.7.3 CUTTING, DRILLING AND SURFACE PREPARATION
- 6.43.7.3.1 Shear cutting is allowed only on plates of a thickness of 12 mm and less.
- 6.43.7.3.2 Cutting and drilling with a blowtorch are prohibited.
- 6.43.7.3.3 At least 1 mm of material shall be removed by grinding over the entire edge of the parts cut by an arc cutting machine unless the edge needs to be welded.

- 6.43.7.3.4 The cut edges of the aluminum plates and members shall be smooth and free of cracks, pits and breaks. The burrs and warps shall be removed by grinding. For parts to be painted or metallized, the sharp edges shall be rounded to a radius of at least 1.5 mm.
- 6.43.7.3.5 Where an access opening is cut and deep-drawn, at least 1.5 mm of material shall be removed by grinding over the entire deep-drawn edge.
- 6.43.7.3.6 In all cases, all edges shall be prepared in accordance with standard CAN/CSA W59.2.
- 6.43.7.3.7 The templates used to drill holes in similar parts of members shall be accurately positioned.
- 6.43.7.3.8 The sharp edges shall be rounded and the surfaces coated with silicone wax.
- 6.43.7.3.9 The methods that will be used to cut or drill the aluminum on worksite shall be submitted to the Engineer, for review, prior to the start of the work.
- 6.43.7.3.10 The aluminum drilling and cutting work shall comply with standard CAN/CSA S157.
- 6.43.7.3.11 The tolerance for the distance between a hole and the free edge of a part is 0 to +2 mm.
- 6.43.7.3.12 Where factory-made assemblies have less than five (5) metal parts, each part may be punched to the final diameter. The matrix diameter shall not extend beyond the punch diameter by more than 2 mm.
- 6.43.7.3.13 The factory-made assemblies, where holes cannot be punched to their final diameter, shall be drilled with a bit to the final diameter using a metal template, or drilled to a diameter 4 mm smaller than the bolt diameter, then reamed to the final diameter.
- 6.43.7.3.14 For the assemblies produced on worksite, the holes shall be drilled with a bit to the final diameter using a metal template.
- 6.43.7.3.15 All factory-made holes or holes made on worksite shall be drilled with accuracy perpendicularly to the surface. For factory-made holes, the parts shall meet the following requirements, failing which they will be rejected:
- 6.43.7.3.15.1 before any reaming, 75 % of the holes located in the same plane shall allow the free passage of a cylindrical joining pin of a diameter that is 3 mm smaller than the hole diameter;
- 6.43.7.3.15.2 before any reaming, 100 % of the holes located in the same plane shall allow the free passage of a cylindrical joining pin of a diameter that is 5 mm smaller than the hole diameter;
- 6.43.7.3.15.3 the cylindrical joining pin shall be inserted perpendicularly into the face of the member;

- 6.43.7.3.15.4 at least 85 % of the holes reamed or drilled to their full size, contiguous and located in the same plane shall not be decentered by more than 1 mm relative to the holes of adjacent parts.
- 6.43.7.3.16 All nicks and other warps on the periphery of the drilling holes shall be removed in order to ensure perfect contact between the parts to be assembled. The sections already assembled shall be disassembled to allow for this work.
- 6.43.7.4 WELDING
- 6.43.7.4.1 The welds shall comply with standard CAN/CSA W59.2.
- 6.43.7.4.2 The Contractor or subcontractors thereof, if any, that carry out welding work shall be certified by the CWB in accordance with standard CAN/CSA W47.2, Division 1 or Division 2.1.
- 6.43.7.4.3 The qualification certificate shall be obtained before the start of fabrication and the certification shall be maintained throughout the fabrication period.
- 6.43.7.4.4 The welders shall hold the competency cards that are appropriate on the basis of the welding position and the type of electrode and welding process used. Such competency cards shall be issued by the CWB in accordance with standard CAN/CSA W47.2.
- 6.43.7.4.5 The engineer responsible for the welding design, procedures and execution of the welding work shall, upon request, be present at the factory.
- 6.43.7.4.6 Where welds are made under conditions in which tensile forces or distortion stresses may weaken members or cause warping thereto, the Contractor shall submit to the Engineer, for review, the method detailing the welding sequence and the methods used for controlling distortion, including, without limitation, the pre-heating, post-heating, heating between passes and specification of the beads, in accordance with the requirements of standard CAN/CSA W59.2.
- 6.43.7.4.7 The Contractor shall provide the detail of the specific preparations for welding along the edges of certain plates in order to ensure compliance with the CAN/CSA standards specified in this subsection.
- 6.43.7.4.8 The fillet welds shall comply with the minimum and maximum sizes prescribed in standard CAN/CSA W59.2 and shall be indicated on the shop drawings submitted by the Contractor.
- 6.43.7.4.9 Unless otherwise indicated on the plans, the Contractor shall not carry out welding of any kind on worksite without having obtained the written authorization from the Engineer, and then only in the manner and in the locations designated in the authorization.
- 6.43.7.4.10 Welding on existing aluminum elements is prohibited.
- 6.43.7.4.11 Destructive tests may be required to determine the tensile strength or bending limits of the welded assemblies.

- 6.43.7.4.12 The Contractor shall ensure that all welds made on aluminum parts are fully (100 %) inspected visually, before, during and after the welding, in accordance with standard CAN/CSA W59.2 and by a welding supervisor, certified in accordance with standard CAN/CSA W47.2.
- 6.43.7.4.13 The non-destructive examinations shall include the visual inspection.
- 6.43.7.4.14 The non-destructive examinations conducted by the inspector or by the welding supervisor shall be recorded in a written report. This report, including the X-rays, shall be submitted to the Engineer at least twenty-four (24) hours before the parts leave the factory.
- 6.43.7.4.15 The non-destructive examinations of the welds shall be conducted by a laboratory, member of the AFG, that is certified by the Canadian Welding Bureau, in accordance with standard CSA W178.1, which shall also interpret the results.
- 6.43.7.4.16 The Engineer shall be notified at least twelve (12) hours before the conduct of the non-destructive examinations. The aluminum elements subject to the verifications cannot leave the factory before the reception of a written authorization by the Engineer.
- 6.43.7.4.17 Unless otherwise indicated on the plans, the non-destructive examinations of the welds shall be conducted as follows:
- 6.43.7.4.17.1 in a partial weld control, the check shall focus primarily on the weld ends and critical points, such as a change in the geometry and material;
- 6.43.7.4.17.2 when a partial control reveals a defect requiring repair, the entire (100 %) length of the weld shall be checked;
- 6.43.7.4.17.3 the repaired portion of the weld shall be fully (100 %) re-checked, using the same process as that used for checking the original weld.
- 6.43.7.5 BOLTED ASSEMBLY
- 6.43.7.5.1 All bolts used to assemble the aluminum elements shall be made of stainless steel.
- 6.43.7.5.2 For an aluminum structure, all bolts shall be installed with a washer at each end.
- 6.43.7.5.3 The slip-critical assemblies in the aluminum structure shall be made using bolts in accordance with standard ASTM F3135.

## **6.43.8 QUALITY CONTROL**

- 6.43.8.1 At least fourteen (14) days prior to the start of the aluminum work, the Contractor shall submit to the Engineer, for review, the quality control program it intends to implement for the execution of the aluminum work.

- 6.43.8.2 The Contractor shall implement a quality control program in accordance with standard ISO 9001. The program shall identify all the checkpoints that will be conducted at the following stages:
- 6.43.8.2.1 reception of materials;
  - 6.43.8.2.2 shaping and assembly of the parts;
  - 6.43.8.2.3 transportation, reception and unloading at the worksite;
  - 6.43.8.2.4 installation of the finished parts.
- 6.43.8.3 The Contractor shall give the Engineer access to all parts of the work at all times and shall provide all the information and assistance as may be required.
- 6.43.8.4 The Engineer's inspection does not relieve the Contractor of its obligations to carry out the work in accordance with the plans and specifications.
- 6.43.8.5 The Owner may, independently and at its expense, conduct additional destructive or non-destructive examinations on the welds. In the event of a welding defect, the Contractor shall pay the costs of all weld inspections that will be carried out before and after the defects are corrected.
- 6.43.8.6 The Contractor shall move and support the parts to be inspected. Unless otherwise indicated by the Engineer, the inspection shall be carried out flat with a minimum vertical clearance of 1.25 m.
- 6.43.8.7 The Engineer shall be informed of any defects found in the work. The Contractor shall not make any repairs before having obtained authorization from the Engineer to proceed. The Contractor shall submit in writing, for review by the Engineer, the methods thereby proposed to correct the defects. The corrective methods shall include the appropriate plans, sketches and welding procedures.
- 6.43.8.8 Each repaired part shall be inspected by the Engineer before being shipped from the factory to the worksite.
- 6.43.8.9 A new or repaired aluminum element may not leave the factory before the inspection report relating to the non-destructive examinations of the welds has been submitted to the Engineer and the latter has completed its final inspection and given written authorization to the Contractor.
- 6.43.8.10 Where the assembly of lighting or signage structure parts is carried out, in whole or in part, in a factory other than that of the manufacturer, the non-destructive examinations of the welds shall be conducted at the factory of the manufacturer of these structures. The X-rays and report of the non-destructive examinations of these welds shall be added to the inspection report described in paragraph 6.43.7.14.
- 6.43.8.11 The Contractor shall not ship any aluminum element from the factory before having obtained written authorization from the Engineer to proceed.

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**END OF SUBSECTION**