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**S157-17/S157.1-17**

**Strength design in aluminum/  
Commentary on CSA S157-17, *Strength  
design in aluminum***

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# Preface

This is the fifth edition of CSA S157, *Strength design in aluminum*. It supersedes the previous editions published in 2005, 1983, 1969, and 1962.

This Standard is for building applications but it is written in a form that may be used for all types of aluminum load-bearing components or assemblies. Expressions for the strength of structural components are based on the concept of limit states design.

Requirements to satisfy the ultimate limit state form the core of the Standard. As a document referenced by the *National Building Code of Canada*, the load factors and resistance factors specified by that Code are given. However, because the design expressions predict the nominal resistance of components and connections, this Standard is useful in any field of engineering in which known applied loads are to be supported.

Serviceability limit states depend on the desired behaviour under service loads for each particular application and are not specified in this Standard. For components used in buildings, reference is made to Commentary A of the *National Building Code of Canada*.

CSA S157.1, *Commentary on CSA S157-17*, Strength design in aluminum (hereinafter referred to as the Commentary), is provided which, while not a mandatory part of the Standard, is essential to the implementation of this Standard's requirements. In this Standard, cross-references to the Commentary are identified by the prefix "C" before the clause, table, or figure number.

This edition of CSA S157 contains significant changes from the previous edition and follows, wherever possible, the same order of presentation as CSA S16, in order to facilitate the use of these two Standards:

- a) A more comprehensive list of symbols is provided in Clause 3.
- b) Clause 4 contains a new set of requirements on structural documents.
- c) A significantly longer list of wrought aluminum products conforming to the ASTM specifications is presented in Table 1. Time-temperature limits are provided for T5 and T6 tempers and nominal strengths of aluminum filler metals are given in a new table.
- d) In Clause 8, elastic analyses of structures now include second order effects and the effects of geometric imperfections. This has significant implications on the design of members subject to flexure and axial forces (Clause 14).
- e) The design of built-up compression members is moved to a mandatory Annex.
- f) Clause 11 presents generalized design equations for members subject to lateral-torsional buckling.
- g) The extent of the heat-affected-zone (HAZ) in welded connections is redefined in Clause 15. It is now similar to the provisions of Eurocode 9 and Section 17 of CSA S6.
- h) A new set of recommendations for the design of screws is included in Clause 16.7.
- i) Clauses 18, 20, 21, and 22 on fabrication, erection, inspection and testing, respectively, are new clauses. They are adapted from CSA S16.
- j) The specifications on the fatigue of aluminum presented in Clause 23 have been revised by incorporating the detail category and S-N curve definitions from Section 17 of CSA S6. The detail category definitions are similar to the steel definitions in Section 10 of CSA S6. The S-N curve definitions are consistent with the *Aluminum Design Manual*.
- k) Clause 24 presents a new set of provisions for the design of composite beams (concrete slab on aluminum girders). This is an adaptation of the provisions of CSA S16 to aluminum.

CSA Group acknowledges that the development of this Standard was made possible, in part, by the financial support of the Aluminum Association of Canada, Alubec, and the Centre québécois de recherche et de développement de l'aluminium.

This Standard was prepared by the Technical Committee on Strength Design in Aluminum, under the jurisdiction of the Strategic Steering Committee on Construction and Civil Infrastructure, and has been formally approved by the Technical Committee.

**Notes:**

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- 3) *This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*
- 4) *To submit a request for interpretation of this Standard, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Request for interpretation” in the subject line:*
  - a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*
  - b) *provide an explanation of circumstances surrounding the actual field condition; and*
  - c) *where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.*

*Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at [standardsactivities.csa.ca](http://standardsactivities.csa.ca).*
- 5) *This Standard is subject to review within five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Proposal for change” in the subject line:*
  - a) *Standard designation (number);*
  - b) *relevant clause, table, and/or figure number;*
  - c) *wording of the proposed change; and*
  - d) *rationale for the change.*

*S157-17*  
***Strength design in aluminum***



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# S157-17

## Strength design in aluminum

### 1 Scope

#### 1.1 Applicability

This Standard applies to limit state design, fabrication, erection, and inspection of aluminum alloy members and assemblies

- a) intended to comply with building codes such as the *National Building Code of Canada (NBCC)*; or
- b) not addressed by another CSA Group standard.

When this Standard is referenced by other CSA Group standards (e.g., product standards), the requirements of this Standard apply as so specified in the referencing CSA Group standard.

**Note:** Annex A lists some applications to which other standards apply.

#### 1.2 Other standards

The use of other standards for the design, fabrication, erection, and/or inspection of members or parts of aluminum structures is neither warranted nor acceptable except where specifically directed in this Standard. The substitution of other standards or criteria for design, fabrication, erection, and/or inspection is expressly prohibited unless specifically directed in this Standard.

#### 1.3 Rational design

Where this Standard does not provide requirements for a specific situation, a rational design is to be used, based on appropriate theories, tests, analyses, or engineering experience. The design formulas provided in this Standard may be supplemented by such a rational design, provided that nominal margins (or factors) of safety are at least equal to those intended in the provisions of this Standard.

#### 1.4 Terminology

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the Standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

#### 1.5 Units of measure

The expressions contained herein are dimensionally uniform, and any consistent system of units may be employed. Where dimensions are identified, SI units are used, typically newtons (N) for force, millimetres (mm) for length, and megapascals (MPa = N/mm<sup>2</sup>) for stress.

## 2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below.

### CSA Group

B51-14

*Boiler, Pressure Vessel, and Pressure Piping Code*

CAN/CSA-B311-02 (R2012)

*Safety Code for Manlifts*

CAN/CSA-B354.2-01 (R2013)

*Self-propelled elevating work platforms*

B602-16

*Mechanical couplings for drain, waste, and vent pipe and sewer pipe*

CAN/CSA-C225-10 (R2015)

*Vehicle-mounted aerial devices*

S6-14

*Canadian Highway Bridge Design Code*

S16-14

*Design of steel structures*

S37-13

*Antennas, towers and antenna-supporting structures*

S269.1-16

*Falsework and formwork*

S269.2-16

*Access scaffolding for construction purposes*

S408-11

*Guidelines for the development of limit states design*

W47.2-11 (R2015)

*Certification of companies for fusion welding of aluminum*

W59.2-M1991 (R2013)

*Welded aluminum construction*

W178.1-14

*Certification of welding inspection organizations*

W178.2-14

*Certification of welding inspectors*