

PD 6702-1:2009+A1:2019



BSI Standards Publication

Structural use of aluminium

Part 1: Recommendations for the design of aluminium structures to BS EN 1999

Publishing and copyright information

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2019

Published by BSI Standards Limited 2019

ISBN 978 0 539 02282 7

ICS 91.080.10

The following BSI references relate to the work on this document:

Committee reference B/525/9

Drafts for comment 18/30382954 DC

Amendments/corrigenda issued since publication

| Date | Text affected |
|-------------|------------------|
| 31 May 2019 | A1: see Foreword |

Contents

| | Page |
|---|------------|
| Foreword | iii |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions | 1 |
| 4 Recommendations for the use of BS EN 1999-1-1 | 2 |
| 4.1 Reliability differentiation [see BS EN 1999-1-1:2007, 2.1.2(3) and Annex A] | 2 |
| <i>Table 1 — Restrictions on construction features for use with EXC1 where the consequences of failure are known to be low</i> | 3 |
| <i>Table 2 — Performance criteria for designation of quantified service category</i> | 5 |
| <i>Figure 1 — Method of designation of quantified service category F12 on drawings</i> | 6 |
| <i>Figure 2 — Method of designation of quantified service categories F25 and above on drawings^{A)}</i> | 6 |
| 4.2 Use of other wrought alloys [see BS EN 1999-1-1:2007, 3.2.1(1)] | 6 |
| <i>Table 3 — Mechanical properties of original British Standard heat-treatable alloys</i> | 7 |
| <i>Table 4 — Mechanical properties of original British Standard non-heat-treatable alloys</i> | 9 |
| 4.3 Application of electrical welded tubes [see BS EN 1999-1-1:2007, 3.2.2(1)] | 10 |
| 4.4 Mechanical fasteners [see BS EN 1999-1-1:2007, 3.3.2.2(1)] | 10 |
| 4.5 Plastic redistribution [see BS EN 1999-1-1:2007, 7.1(4)] | 10 |
| 4.6 Serviceability limits for deflections in buildings — vertical and horizontal deflections [see BS EN 1999-1-1:2007, 7.2.1(1) and 7.2.2(1)] | 10 |
| 4.7 Serviceability limits for vibrations in buildings [see BS EN 1999-1-1:2007, 7.2.3] | 11 |
| <i>Table 5 — Limiting deflections</i> | 11 |
| 4.8 Other joining methods [see BS EN 1999-1-1:2007, 8.9] | 11 |
| 4.9 Use of castings [see BS EN 1999-1-1:2007, 3.2.3(1), C.3.4.2(2), C.3.4.2(3) and C.3.4.2(4)] | 13 |
| 5 Recommendations for the use of BS EN 1999-1-3 | 13 |
| 5.1 Use of damage tolerant design [see BS EN 1999-1-3:2007, 2.1(1), 2.2.2 and A.3.1(1)] | 13 |
| 5.2 Fatigue damage value [see BS EN 1999-1-3:2007, 2.2.1(3)] | 14 |
| 5.3 Derivation of fatigue loading [see BS EN 1999-1-3:2007, 2.3.1(2)] | 14 |
| 5.4 Fatigue load factors [see BS EN 1999-1-3:2007, 2.3.2(6) and 2.4(1)] | 14 |
| 5.5 Fatigue strength data for low strength alloys [see BS EN 1999-1-3:2007, Clause 3(1)] | 14 |
| 5.6 Effect of aggressive exposure [see BS EN 1999-1-3:2007, 4(2)] | 14 |
| 5.7 Damage equivalent factors [see BS EN 1999-1-3:2007, 5.8.2(1)] | 14 |
| 5.8 Detail categories based on nominal stress [see BS EN 1999-1-3:2007, 6.1.3(1), 6.2.1(2) and 6.2.1(7)] | 14 |
| 5.9 Low stress cycles [see BS EN 1999-1-3:2007, 6.2.7(1) and Annex F] | 15 |
| 5.10 Effect of stress range gradient [see BS EN 1999-1-3:2007, 6.2.1(11)] | 15 |
| <i>Table 16 — Gradient adjustment factor, k_b (Case 1 to Case 5)</i> | 17 |
| <i>Table 17 — Values of k_b for Case 1, Case 3, Case 4 and Case 5</i> | 18 |
| <i>Table 18 — Values of k_b for Case 2 and Case 5</i> | 19 |
| 5.11 Hot spot strength method [see BS EN 1999-1-3:2007, 6.2.4(1)] | 19 |
| <i>Figure 3 — Example of hot spot stresses in a tubular lattice joint</i> | 21 |
| <i>Table 19 — Values of $\Delta\sigma_c$-m_1 for hot spot stress assessment</i> | 22 |
| 5.12 Fatigue strength of casting details [see BS EN 1999-1-3:2007, I.2.2(1) and I.2.3.2(1)] | 22 |
| 5.13 Fatigue strength of adhesively bonded joints [see BS EN 1999-1-3:2007, I.2.4(1)] | 22 |
| <i>Table 6 — Detail categories for plain material</i> | 23 |
| <i>Figure 4 — Fatigue strength curves for plain material [see Table 6]</i> | 25 |
| <i>Table 7 — $\Delta\sigma$ (N/mm²) for plain material (see Figure 4)</i> | 25 |
| <i>Table 8 — Members with welded attachments — transverse weld toe</i> | 26 |

| | |
|--|-----------|
| <i>Figure 5 — Fatigue strength curves for members with welded attachments — transverse weld toe (see Table 8)</i> | 28 |
| <i>Table 9 — $\Delta\sigma$ (N/mm²) for members with welded attachments — transverse weld toe (see Figure 5)</i> | 28 |
| <i>Table 10 — Detail categories for members with welded attachments — longitudinal welds</i> | 29 |
| <i>Figure 6 — Fatigue strength curves for members with welded attachments — longitudinal welds (see)</i> | 31 |
| <i>Table 11 — Numerical values of $\Delta\sigma$ (N/mm²) for members with welded attachments — longitudinal welds (see Figure 6)</i> | 31 |
| <i>Table 12 — Detail categories for welded joints between members</i> | 32 |
| <i>Figure 7 — Fatigue strength curves for welded joints between members (see Table 12)</i> | 34 |
| <i>Table 13 — Numerical values of $\Delta\sigma$ (N/mm²) for welded joints between members (see Figure 7)</i> | 34 |
| <i>Table 14 — Detail categories for mechanically fastened joints</i> | 35 |
| <i>Figure 8 — (see Table 14)</i> | 37 |
| <i>Table 15 — Numerical values for $\Delta\sigma$ (N/mm²) for mechanically fastened joints (see Figure 8)</i> | 37 |
| Bibliography | 38 |

Summary of pages

This document comprises a front cover, and inside front cover, pages i to iv, pages 1 to 38, an inside back cover and a back cover.

Foreword

Publishing information

This part of PD 6702 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 December 2009. It was prepared by Subcommittee B/525/9, *Structural use of aluminium*, under the authority of Technical Committee B/525, Building and civil engineering structures. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

PD 6702-1:2009+A1:2019 supersedes PD 6702-1:2009, which is withdrawn.

Relationship with other publications

This Published Document gives guidance on the use of BS EN 1999-1-1 and BS EN 1999-1-3, for the design of aluminium structures in the UK.

Information about this document

BS EN 1999, Parts 1-1, 1-2, 1-3, 1-4 and 1-5 replaced BS 8118-1 after a period of coexistence. The replacement of BS 8118-1 represents substantial change in design practice in the UK. This Published Document aims to ensure that aluminium structures are designed with the same level of assurance of reliability as that implicit in BS 8118-1.

The guidance given in this Published Document consists of non-contradictory complementary information (NCCI) to enable the user to apply BS EN 1999 in a safe and cost-effective manner, with particular reference to the following:

- a) provision in the National Annexes for nationally determined parameters where supporting information is required;
- b) alternative information where options are permitted in BS EN 1999.

This Published Document is likely to be subject to amendment following an update of BS EN 1999-1¹.

The start and finish of text introduced or altered by Amendment No. 1 is indicated in the text by tags **A1** **A1**. Minor editorial changes are not tagged.

This publication is not to be regarded as a British Standard.

Presentational conventions

The provisions of this Published Document are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

¹ Currently anticipated to be published in 2020 or 2021.

1 Scope

This part of PD 6702 gives guidance on the use of the following parts of BS EN 1999, *Design of aluminium structures*:

- Part 1-1, *General structural rules*;
- Part 1-3, *Structures susceptible to fatigue*.

It is applicable to the same scope of application as BS EN 1999 unless otherwise stated.

The design information included in this document is applicable only when the recommendations in PD 6705-3 are followed for the execution of the structure.

NOTE This document covers those items identified in the UK National Annexes to BS EN 1999-1-1 and BS EN 1999-1-3 as requiring additional guidance. Further material, not necessarily identified in the relevant National Annex, is also given for information.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 4395-1, *Specification for high strength friction grip bolts and associated nuts and washers for structural engineering – Part 1: General grade*² **A1**

BS EN 1090-3, *Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures*

BS EN 1990:2002+A1:2005, *Eurocode – Basis of structural design*

BS EN 1999-1-1:2007, *Eurocode 9: Design of aluminium structures – Part 1-1: General structural rules*

BS EN 1999-1-3:2007, *Eurocode 9: Design of aluminium structures – Part 1-3: Structures susceptible to fatigue*

PD 6705-3, *Structural use of steel and aluminium – Part 3: Recommendations for the execution of aluminium structures to BS EN 1090-3*

3 Terms and definitions

For the purposes of this part of PD 6702, the terms and definitions given in BS EN 1999-1-1 and BS EN 1999-1-3 and the following apply.

3.1 quantified service category

category that characterizes a component or structure (or part thereof), in terms of the circumstances of its use within specified limits of static and cyclic stressing

NOTE See [4.1.1.2](#), [4.1.2](#), [4.1.4](#) and [4.1.5](#).

² BS 4395-1 has been withdrawn.