

BRITISH STANDARD

**BS 8118 :
Part 2 : 1991**

*Incorporating
Amendment No. 1*

Structural use of aluminium

Part 2. Specification for materials, workmanship and protection

ICS 91.080.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Civil Engineering and Building Structures Standards Policy Committee (CSB/-) to Technical Committee CSB/36, upon which the following bodies were represented:

Aluminium Federation
Association of Consulting Engineers
Institution of Civil Engineers
Institution of Structural Engineers
London Regional Transport
Ministry of Defence
Royal Institute of British Architects
Royal Institution of Chartered Surveyors
The Welding Institute

This British Standard, having been prepared under the direction of the Civil Engineering and Building Structures Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 31 March 1992

© BSI 07-1999

Amendments issued since publication

Amd. No.	Date	Comments
10486	July 1999	Indicated by a sideline

The following BSI references relate to the work on this standard:
Committee reference CSB/36
Draft for comment 85/12254 DC

ISBN 0 580 19210 5

Contents

	Page
Committees responsible	Inside front cover
Foreword	3
Specification	
Section 1. General	
1.1 Scope	4
Section 2. Materials	
2.1 Wrought materials	5
2.2 Castings	5
2.3 Bolts, nuts, washers and rivets	5
2.4 Welding consumables	5
Section 3. Workmanship	
3.1 General	6
3.2 Storage and transportation	6
3.3 Fabrication erection and assembly tolerances	6
3.4 Marking out	6
3.5 Cutting	6
3.6 Drilling, punching reaming	6
3.7 Bending and forming	6
3.8 Bolting and riveting	7
3.9 Welding	8
3.10 Structural adhesives	11
3.11 Inspection and safety	11
Section 4. Protection	
4.1 General	12
4.2 Painting	12
4.3 Protection of metal-to-metal contact surfaces and at bolted and riveted joints	13
4.4 High strength friction grip bolted joints	13
4.5 Pinned joints	13
4.6 Welded joints	13
4.7 Bonded joints	13
4.8 Contact between aluminium and non-metallic materials	13

	Page
Appendices	
A Tolerances	14
B Methods, extent and acceptance levels for production welds	18
Tables	
2.1 Performance requirements for structural aluminium	5
3.1 Hole clearances for bolts, rivets and special fasteners	7
3.2 Minimum metallic path separation between simultaneous welds	9
A.1 Tolerance on external dimensions of rolled and formed sections	14
A.2 Tolerances on roll formed profiled sheet	14
A.3 Tolerances on bend radii	15
A.4 Maximum distortion of webs	15
B.1 Recommended methods and extent of inspection for welded joints	19
B.2 Recommended acceptance levels for production welds	21
Figures	
A.1 Flange out of square	16
A.2 Flatness of web plates	16
A.3 Deviation from verticality	17

Foreword

This Part of BS 8118 has been prepared under the direction of the Civil Engineering and Building Structures Standards Policy Committee. BS 8118 combining a code of practice to cover the design and testing of aluminium structures (Part 1) and a specification for materials, fabrication and protection (Part 2).

Part 2 specifies requirements for the materials, workmanship and protection of aluminium and aluminium alloy construction and structures.

Although BS 8118 is a revision of CP 118, it is written with a different design philosophy. Because of this, CP 118 will not be withdrawn immediately so that a period of overlap in design procedures can be allowed.

The full list of organizations who have taken part in the work of the Technical Committee is given on the inside front cover.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages 1 to 24, an inside back cover and a back cover.

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

Section 1. General

1.1 Scope

This Part of BS 8118 specifies requirements for the materials, workmanship and protection of aluminium and aluminium alloy construction and structures.

The requirements of this Part apply to the fabrication, protection, assembly and erection of aluminium and aluminium alloy construction, but the engineer undertaking the design needs to be aware of those items which will effect the design.

Guidance on fabrication tolerances, erection tolerances and assembly tolerances is given in appendix A, and on weld inspection acceptance levels in appendix B. Any reference to drawings is to be taken as those drawings prepared by or approved by the designer.

For definitions used in this standard refer to BS 8118 : Part 1.

NOTE. The titles of the publications referred to in this standard are listed after appendix B.

Section 2. Materials

2.1 Wrought materials

2.1.1 Unless otherwise specified by the designer wrought materials shall comply with BS 1470 to BS 1475 and BS 4300 : Parts 1, 12, 14 and 15.

2.1.2 Where aluminium alloys are offered in place of those that comply with **2.1.1**, or the designer specifies such alternative alloys, the performance aspects listed in table 2.1 shall be tested to the satisfaction of the designer, using expert advice as necessary.

Table 2.1 Performance requirements for structural aluminium	
Performance requirement	Specified by
0.2 % proof stress	0.2 % proof stress
Minimum tensile strength	Minimum tensile strength
Ductility	Elongation in a specified gauge length
Durability	Durability rating
Weldability	Weldability
Weld strength	Reduction factor for heat-affected zone
Density	Density
Expansion	Coefficient of linear expansion

2.1.3 Standard structural sections shall comply with BS 1161.

2.1.4 Other structural sections shall comply with the relevant British Standard given in **2.1.1** and with the dimensional requirements as specified by the designer.

2.2 Castings

Castings shall comply with BS 1490. Dimensional requirements, inspection and quality control shall be as specified by the designer.

2.3 Bolts, nuts, washers and rivets

2.3.1 Materials

The material for bolts, nuts, washers and rivets shall be as specified by the designer. Rivets shall be formed by the process specified by the designer.

2.3.2 Form

Unless otherwise specified by the designer the form of bolts, nuts, washers and rivets shall comply with the relevant British Standards.

2.3.3 High strength friction grip bolts, nuts and washers

Unless otherwise specified by the designer, high strength friction grip (HSFG) bolts, nuts and washers shall comply with BS 4395 : Part 1 or BS 6105.

2.4 Welding consumables

2.4.1 Filler wire for welding

Filler metal for welding shall comply with BS 2901 : Part 4.

2.4.2 Gas-shielding

Argon shielding gas, helium and argon/helium mixtures shall be of 99.5 % (V/V) minimum purity.

Section 3. Workmanship

3.1 General

Fabrication and assembly operations for aluminium shall be similar to those for steel, but are affected by the lower mass of the structures and assemblies, by the greater flexibility of members, by the larger dimensional changes due to temperature and by the ease with which aluminium can be machined.

During erection the structure shall be securely bolted or fastened. Temporary bracing shall be used if necessary to ensure stability under all erection loads and conditions, including those due to erection equipment and its operation.

NOTE. Guidance may be sought from BS 5531.

3.2 Storage and transportation

Aluminium shall be stored in dry places, clear of the ground. Contact with other metals and with materials such as cement and damp timber shall be avoided.

NOTE. This is to avoid the possibility of superficial corrosion which may cause unsightly staining or marking. Sheet and plate are particularly susceptible.

Care shall be taken of material for architectural use, particularly if the material is anodized; surfaces shall be protected with strippable tapes, waxes or lacquers while danger of damage exists.

Sheet and plate shall be stacked, if possible on end in racks, to avoid distortion.

For land or air transport, aluminium shall be packed to avoid mechanical damage, abrasion and contact by agents liable to cause surface corrosion and staining. For transport by sea, aluminium shall be packed in moisture-proof packages and adequately crated to prevent damage to the waterproofing paper.

3.3 Fabrication, erection and assembly tolerances

Tolerances on the fabrication, the site erection and the assembly of structures and components (see appendix A for guidance) shall be as specified by the designer.

3.4 Marking out

Marking out techniques, including the use of fine scribing-lines, are similar to those for steelwork. Fine scribing-lines shall not be used on critically stressed areas of thin materials, and where subsequent welding is involved, paint, chalk, graphite or other marking materials likely to contaminate shall not be used.

Due attention shall be given to the effects of the relatively high coefficient of expansion of aluminium in measuring, marking out and assembly, particularly when temperature variations are large.

3.5 Cutting

Cutting shall be by machining, shearing or arc-cutting. Bandsaws and circular saws shall have a tooth form and pitch to suit the thickness of the material to be cut. Cut edges shall be smooth and free from burrs, distortions and other irregularities. Care shall be taken to avoid the use of tools contaminated by other metals, particularly copper or brass. Shearing shall normally be limited to material 6.4 mm thick or less. Arc-cutting shall be by a process shown by test, to the satisfaction of the designer, to have no deleterious effect on the material. Flame-cutting shall not be used.

Sheared or arc-cut edges shall be subsequently machined or filed smooth if used as edge preparations for welds in strength members. For 7*** series alloys, sheared edges shall be machined back to remove areas of residual stress.

3.6 Drilling, punching and reaming

Holes shall be made either drilling, drilling and reaming or, except in 2*** and 7*** series alloys, by punching. Undersize punching shall be permitted for all alloys provided that all burrs, edge defects, local distortions, and in the case of 2*** and 7*** series alloys areas of residual stress, are removed by subsequent reaming.

Holes for bolts and rivets shall, unless otherwise specified by the designer, be of the sizes specified in table 3.1. Where holes for bolts and rivets in certain members are required by the designer to be drilled with parts assembled and tightly clamped together, the parts shall be subsequently separated to remove burrs.

The depth of countersinking shall not exceed the thickness of the countersunk part less 4 mm unless specified by the designer. In no case shall the depth exceed the thickness of the countersunk part less 1 mm.

3.7 Bending and forming

Where bending or forming is required the fabricator shall consult the manufacturer's recommendations regarding the bend radius, alloy and temper appropriate to the operation and any subsequent heat treatment required. When doubt exists about the formability of a member, tests shall be carried out to the approval of the designer before fabrication commences.

Heat treatment and hot forming shall be carried out only under competent metallurgical direction and supervision. The 7*** series alloys shall not be bent or cold formed in the fully heat-treated condition, nor shall correction of weld distortion be performed, because of the risk of stress corrosion cracking.

Any piece of component that cracks or fractures because of forming shall be rejected.

Table 3.1 Hole clearance for bolts, rivets and special fasteners			
Type	Material	Diameter	Clearance on diameter
Bolts close fitting	—	mm Any	mm ≤ 0.13 ¹⁾
Bolts not close fitting	—	< 13 ≥ 13	≤ 0.4 ¹⁾ ≤ 0.8 ¹⁾
Solid rivets	Aluminium	< 13 ≥ 13	≤ 0.4 ≤ 0.8
	Steel or corrosion resisting steels	< 13 ≥ 13	≤ 0.8 ≤ 1.6
HSFG bolts (all plies up to three, or outer two plies for greater than three plies)	Steel or corrosion resisting steels	≤ 24 > 24	≥ 2 ≥ 3
HSFG bolts (above three plies, inner plies)	Steel or corrosion resisting steels	Any	≤ 3
Special rivets and fasteners	As recommended by the manufacturer		
¹⁾ From measurements of actual bolt and hole diameters; the clearance should not be increased on account of irregular or excess zinc coating on the bolts. For metal-sprayed parts the clearance before spraying may at the discretion of the designer, be increased by 0.13 mm except where the hole is deep and spraying is non-uniform.			

3.8 Bolting and riveting

3.8.1 Bolting

Where either the full area of the shank of the bolt, or the full bearing area of the shank of the bolt, is to be developed, the threaded portion of the bolt shall not extend within the thicknesses of the connected parts. In addition, the length of the bolt shall be such that at least one clear thread shows above the nut after tightening, and at least one thread plus the thread runout is clear between the nut and the un-threaded shank of the bolt.

Washers shall be provided under all the bolt heads and nuts. Galvanized steel washers shall be used with steel bolts. Washers of pure aluminium, or of the same material as the bolt or the member, shall be used with corrosion resisting steel bolts.

Nuts shall be fully, but not excessively, tightened. Locking devices shall be used as required.

The threads of aluminium bolts shall be lubricated before assembly, particularly if the joint will subsequently be dismantled.

NOTE. Lanolin sealing is recommended for the threads of anodized bolts.

Where slotted holes are provided for movement connections, the joint shall be free to move.

3.8.2 Friction grip bolting

3.8.2.1 Surfaces in contact

For joints between aluminium members, at the time of assembly, the contact surfaces shall be clean, free from burrs and defects which would prevent solid seating of the parts, and of substances that would interfere with

the development of friction between them.

When the aluminium surfaces are treated by grit blasting, using aluminium oxide grit G39 complying with BS 2451, so that a slip coefficient of $\mu = 0.3$ can be assumed without testing, the blasting treatment shall be sufficient to give a visually uniform coverage of the surfaces.

NOTE 1. When it is required to ensure consistent friction properties to conform with test results, careful quality control of the process is required by such methods as the use of test strips. Grit quality shall be controlled, particularly where grit is re-used.

NOTE 2. With aluminium to steel joints it will be advantageous to increase the friction value of the interface by roughing the steel surface.

3.8.2.2 Holes in members

Holes in members shall comply with 3.3 and table 6 of BS 4604 : Part 1 : 1970.

3.8.2.3 Minimum ply thickness

The minimum ply thicknesses shall be in accordance with 3.4 of BS 4604 : Part 1 : 1970.

3.8.2.4 Assembly

When bolts complying with BS 4395 : Part 1 are used the assembly shall comply with 4.1, 4.2 and 4.3 of BS 4604 : Part 1 : 1970. When other bolts are used the procedure for achieving the required shank tension shall be agreed with the designer.

If a joint has been dismantled it shall not be re-assembled unless the surface treatment of the interface has been re-applied.

3.8.2.5 Inspection

Inspection of friction grip bolted joints shall be in accordance with 5.1 of BS 4604 : Part 1 : 1970.