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PUBLISHED DOCUMENT

Structural use of steel and aluminium

Part 3: Recommendations for the execution
of aluminium structures to BS EN 1090-3

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Summary of pages

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Foreword

Publishing information

This part of PD 6705 is published by BSI and came into effect on 31 December 2009. It was prepared by Subcommittee B/525/9, *Structural use of aluminium*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

This Published Document gives guidance on the use of BS EN 1090-3 for the execution of aluminium structures in the UK.

Information about this document

BS EN 1090-3 will replace BS 8118-2 after a period of coexistence. The replacement of BS 8118-2 will represent a substantial change in design practice in the UK. The purpose of this Published Document is to ensure that aluminium structures will be executed with the same level of assurance of reliability as that implicit in BS 8118-2.

The guidance given in this Published Document consists of non-contradictory complementary information (NCCI) to enable the user to apply BS EN 1090-3 in a safe and cost-effective manner, with particular reference to the following:

- a) selection of options where they are defined in BS EN 1090-3;
- b) alternative information where permitted in BS EN 1090-3.

Presentational conventions

The provisions in this Published Document are presented in roman (i.e. upright) type. Its recommendations 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 Published Document cannot confer immunity from legal obligations.

1 Scope

This part of PD 6705 gives guidance on the use of BS EN 1090-3 for the execution of aluminium structures designed to BS EN 1999.

It is applicable to the same scope of application as in BS EN 1090-3, unless otherwise stated.

The specification information included in this document is applicable only when the design guidance in PD 6702-1 has been followed.

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 EN 1011-4:2000, *Welding – Recommendations for welding of metallic materials – Part 4: Arc welding of aluminium and aluminium alloys*

BS EN 1011-6, *Welding – Recommendation for welding of metallic materials – Part 6: Laser beam welding*

BS EN 1011-7, *Welding – Recommendation for welding of metallic materials – Part 7: Electron beam welding*

BS EN 1090-3:2008, *Execution of steel structures and aluminium structures – Part 3: Technical requirements for aluminium structures*

BS EN 1289:1998, *Non-destructive testing of welds – Penetrant testing of welds – Acceptance levels*

BS EN 1435:1997+A2:2004, *Non-destructive testing of welds – Radiographic testing of welded joints*

BS EN 1714:1998+A2:2004, *Non-destructive testing of welds – Ultrasonic testing of welded joints*

BS EN 1999, *Eurocode 9: Design of aluminium structures*

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*

BS EN 14399-3:2005, *High-strength structural bolting assemblies for preloading – Part 3: System HR Hexagon bolt and nut assemblies*

BS EN ISO 6520-1:2007, *Welding and allied processes – Classification of geometric imperfections in metallic materials – Part 1: Fusion welding*

BS EN ISO 7093-1:2000, *Plain washers – Large series – Part 1: Product grade A*

BS EN ISO 10042:2005, *Welding – Arc-welded joints in aluminium and its alloys – Quality levels for imperfections*

BS EN ISO 13919-2:2001+A1:2004, *Welding – Electron and laser beam welded joints – Guidance on quality levels for imperfections – Part 2: Aluminium and its weldable alloys*

BS EN ISO 15612, *Specification and qualification of welding procedures for metallic materials – Qualification by adoption of a standard welding procedure*

BS EN ISO 15614-11, *Specification and qualification of welding procedures for metallic materials – Welding procedure test – Part 11: Electron and laser beam welding*

BS EN ISO 25239-3, *Friction stir welding – Aluminium – Part 3: Qualification of welding operators*¹⁾

BS EN ISO 25239-4, *Friction stir welding – Aluminium – Part 4: Specification and qualification of welding procedures*¹⁾

BS EN ISO 25239-5, *Friction stir welding – Aluminium – Part 5: Quality and inspection requirements*¹⁾

PD 6702-1, *Structural use of aluminium – Part 1: Recommendations for the design of aluminium structures to BS EN 1999*

3 Terms and definitions

For the purposes of this part of PD 6705, the terms and definitions given in BS EN 1090-3 and PD 6702-1 apply.

4 Recommendations for the use of BS EN 1090-3

4.1 General

The recommendations in this part of PD 6705 are based on the National Annexes to BS EN 1999 and the design recommendations in PD 6702-1, which provides non-contradictory complementary information on the design rules in BS EN 1999.

Guidance is given in PD 6702-1 on the selection of execution class, which is one of the means of providing different levels of reliability of structural performance. This is achieved in BS EN 1090-3 by varying the level of assurance that the quality standards assumed in deriving the BS EN 1999 resistance data have been met in construction.

A major factor in the determination of the quality requirements is the degree of cyclic loading which the structural components need to resist. BS EN 1999-1-3 does not provide normative fatigue design data and the informative fatigue data in BS EN 1999-1-3:2007, Annex J, have not been accepted by the UK. Alternative fatigue rules are instead given in PD 6702-1. These latter rules are consistent with a set of quality levels, based on fitness for purpose, which are different from those given in BS EN 1999-1-3:2007, Annex J, and BS EN 1090-3. Furthermore, the quality levels assumed in PD 6702-1 are based on specific methods and extents of inspection unlike those given in the European Standards.

The quality levels and extents of inspection in BS EN 1090-3 are differentiated on the basis of two service categories depending on whether the structure/component is classified as “predominantly static” or “significant fatigue”. There is no further definition in BS EN 1090-3 as to how these two conditions are to be differentiated in a quantitative way.

¹⁾ In preparation.

In order to overcome these impediments to safe use, PD 6702-1 has adapted the principle of the service category to provide a set of fully quantified service categories which are used to define in this document the extents of inspection and acceptance levels that are compatible with the recommended design rules in PD 6702-1 (see 4.2).

For these reasons it is essential that the recommendations of this document are followed for execution when the recommendations in PD 6702-1 have been used for the design.

Additional information has been given in accordance with BS EN 1090-3:2008, Table A.1 and Table A.2, except where it relates to matters which might be dependent on a specific project.

4.2 Service category (see BS EN 1090-3:2008, 3.13)

These recommendations make use of the following quantified service category designations in increasing order of performance requirement: F12, F20, F25, F31, F40, F50, F63 (see 4.1).

If no quantified service category is specified for a structure, component or part of a component, it should be assumed that F20 applies.

NOTE 1 The background to the quantified service category designations can be found in PD 6702-1.

NOTE 2 The following subclauses of this document contain recommendations which are differentiated on the basis of quantified service category: 4.5.1, 4.5.2, 4.6.1, 4.6.3, 4.7.4, 4.8.1, 4.10.1.2, 4.10.2, 4.10.3, 4.10.4 and 4.10.5.

4.3 Execution classes (see BS EN 1090-3:2008, 3.8 and 4.1.2)

It should be noted that the execution class (EXC) provides a measure of the degree of assurance that the work has or will be carried out to the required quality. This is primarily differentiated by the extent of documented records as well as procedure and product testing. It does not define the quality requirement itself, which is dependent on the service category (see 4.2).

NOTE The following subclauses of this document contain additional recommendations relating to those requirements in BS EN 1090-3 which are differentiated on the basis of execution class: 4.4.1, 4.4.2, 4.7.2, 4.7.3, 4.7.5, 4.7.6, 4.8.2 and 4.10.3.

4.4 Specification and documentation

4.4.1 Quality documentation (see BS EN 1090-3:2008, 4.2.1 and Annex B)

It is recommended that BS EN 1090-3:2008, 4.2.1, items a) to f) are documented for EXC2, regardless of whether this documentation has been specified.

4.4.2 Quality plan (see BS EN 1090-3:2008, 4.2.2 and Annex B)

It is recommended that a quality plan appropriate to the work and based on BS EN 1090-3:2008, Annex B, is prepared wherever EXC2, EXC3 or EXC4 is specified.

4.5 Constituent products

4.5.1 Wrought products (see BS EN 1090-3:2008, 5.3 and Table 1)

Where hollow extrusions formed by a porthole or bridge die are used to carry tension transverse to the direction of extrusion, special precautions should be taken during the extrusion process to verify that the die seam welds are structurally sound. These precautions are as follows.

- a) The start, finish and intermediate billet-to-billet joint positions in each extruded length should be identified.
- b) Sample sections from the extrusion should be cut out from the locations identified in item a). Where more than one cell exists in the cross-section, two adjacent sections should be cut out.
- c) Alternate cells in the first cross-section should be subjected to expansion by forcing a tapered mandrel or "drift" into the cell until tearing occurs. This process should be repeated on the adjacent cells in the second section.
- d) The tear fracture faces should be examined for evidence of poor bonding and low ductility of the extrusion weld.
- e) If evidence of poor bonding is found, further sections should be taken from the extrusion and retested as in items c) and d) until sound lengths of extrusion are revealed.
- f) Where it is practicable to conduct transverse tensile tests from samples taken from seam weld locations, the mechanical properties should be shown to conform to the relevant product standard.
- g) In critical cases where a high transverse tensile utilization grade is required or where the quantified service category exceeds F20 in the transverse direction, it is recommended that the billet is subjected to non-destructive testing (NDT) to prove that it is free from internal flaws.

4.5.2 Castings (see BS EN 1090-3:2008, 5.3 and Table 3)

It is recommended that the guidance given in BS EN 1999-1-1:2007, C.3.4.2, is followed with the exception that the maximum diameter of pores given in BS EN 1999-1-1:2007, C.3.4.2(2), item b) should not be used. The maximum diameter of pores should instead conform to Table 1.

Table 1 Maximum diameter of pores

Quantified service category	Maximum pore size
	mm
F12	4,0
F20	3,0
F25	2,2
F31	1,5
F40	0,9
F50	0,5
F63	0,3

If castings require subsequent machining, the machined surfaces should be subject to further surface inspection prior to incorporation into the structure.

4.5.3 Welding consumables (see BS EN 1090-3:2008, 5.5)

The combination of parent material and consumable should conform to BS EN 1011-4:2000, Table B.2, unless otherwise specified. Where there is a choice of consumable type in this table, the criteria for selection should be agreed with the project specifier.

In all cases, the consumable should be of the same type used to qualify the weld procedures used for the project.

4.6 Preparation

4.6.1 Identification (see BS EN 1090-3:2008, 6.2)

Hard stamps should not be used in the following circumstances:

- a) on 7000 alloy material;
- b) where quantified service categories above F20 are required;
- c) on thin material where denting might occur;
- d) where otherwise forbidden by the specifier.

The same restrictions apply to soft or low stress stamps except that they should not be used where quantified service categories above F31 are required.

4.6.2 Holing for fasteners (see BS EN 1090-3:2008, 6.6)

Where holes are drilled in parts assembled and tightly clamped together, burrs on faying surfaces only need to be removed if the parts are subsequently separated prior to final assembly.

4.6.3 Assemblies (see BS EN 1090-3:2008, 6.9)

Complete or staged assemblies of structures should be used in the following circumstances:

- a) where close dimensional tolerances are necessary in the final structure for functional reasons;
- b) where the fit-up of butting pre-loaded bolted joints is critical to the ductility or fatigue performance of the joint. In the latter case, quantified service categories above F20 should be considered.

4.7 Welding

4.7.1 Welding processes (see BS EN 1090-3:2008, 7.3)

Welding may be carried out by the following processes subject to the recommendations in 4.7.2, 4.7.3, 4.7.4, 4.7.5, 4.10.3.2, 4.10.4.2, 4.10.5.2 and 4.10.5.3:

- a) laser beam welding;
- b) electron beam welding;
- c) friction stir welding.