BRITISH STANDARD

Industrial type flooring and stair treads –

Part 5: Solid plates in metal and glass reinforced plastics (GRP) – Specification

ICS 91.060.30

Confirmed
December 2011

BSI
British Standards

Publishing and copyright information

ISBN 0 580 48258 8

The following BSI references relate to the work on this standard:
Committee reference B/208
Draft for comment 06/30094368 DC

Publication history

First published July 1995

Second (present) December 2006

Amendments issued since publication

Amd. no.	Date	Text affected

Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 12, an inside back cover and a back cover.

This page deliberately left blank

Foreword

Publishing information

This part of BS 4592 was published by BSI and came into effect on 29 December 2006. It was prepared by Subcommittee B/208/1, *Stairs and walkways – Industrial*, under the authority of Technical Committee B/208, *Stairs and walkways*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 4592, together with Part 0, supersedes BS 4592-5:1995, which is withdrawn.

Information about this document

BS 4592 is published in seven parts, as follows:

- *Part 0: Common design requirements and recommendations for installation;*
- *Part 1: Metal open bar gratings – Specification;*
- *Part 2: Expanded metal sections – Specification;*
- *Part 3: Cold formed metal planks – Specification;*
- *Part 4: Glass reinforced plastics (GRP) open bar gratings – Specification;*
- *Part 5: Solid plates in metal and glass reinforced plastics (GRP) – Specification;*
- *Part 6: Glass reinforced plastics (GRP) moulded open mesh gratings – Specification*[1)].

The requirements in this part cover areas that are not addressed by BS EN ISO 14122, *Safety of machinery – Permanent means of access to machinery*, which is published in the following parts:

- *Part 1: Choice of fixed means of access between two levels;*
- *Part 2: Working platforms and walkways;*
- *Part 3: Stairways, stepladders and guard-rails;*
- *Part 4: Fixed ladders.*

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

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

1) In preparation.

Requirements in this standard are drafted in accordance with *The BSI guide to standardization – Section 2: Rules for the structure, drafting and presentation of British Standards*, subclause **11.3.1**, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall ...'". This means that only those products that are capable of passing the specified test will be deemed to conform to this standard.

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 Scope

This part of BS 4592 specifies requirements for the design, manufacture, supply and installation of solid plates in metal, aluminium and glass reinforced plastics (GRP) intended for use in industrial flooring and stair treads

It is not applicable where access to machinery is required, in which case the requirements of BS EN ISO 14122 apply.

NOTE 1 This standard does not cover agricultural uses (see BS 5502).

NOTE 2 For the more common requirements for industrial flooring and stair treads, see BS 4592-0.

NOTE 3 The method of test for strength and deflection is given in BS 4592-0:2006, Annex A and information to be supplied at the time of enquiry or order is given in BS 4592-0:2006, Clause **4**.

In addition to the definitive requirements, this standard also requires the items detailed in BS 4592-0:2006, Clause **4** to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

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 4592-0, *Industrial type flooring and stair treads – Part 0: Common design requirements and recommendations for installation*

BS 4872-1, *Specification for approval testing of welders when welding procedure approval is not required – Part 1: Fusion welding of steel*

BS 8118-2, *Structural use of aluminium – Part 2: Specification for materials, workmanship and protection*

BS EN 10025, *Hot rolled products of non-alloy structural steels – Technical delivery conditions*

BS EN 1011-1, *Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding*

BS EN 10258, *Cold-rolled stainless steel narrow strip and cut lengths – Tolerances on dimensions and shape*

BS EN 12020, *Water quality – Determination of aluminium – Atomic absorption spectrometric methods*

3 Terms and definitions

For the purposes of this part of BS 4592, the terms and definitions given in BS 4592-0, BS 4592-1 and the following apply.

NOTE Definitions of some of the common terms are illustrated in Figure 1.

3.1 Types of plate

3.1.1 plain
flat plate with a gritted top surface, having no perforations or raised portions

3.1.2 chequer
flat, solid plate with a raised pattern on the top surface

NOTE Examples of different chequer plates are shown in Figure 1.

3.2 Dimensions of rectangular plates

3.2.1 plate width
overall size of plate measured from one side to the other where the plate is supported by secondary supports, independent stiffeners or butt straps

3.2.2 plate length
longest side of the plate, regardless of whether it is the span or the width

3.2.3 plate depth
overall distance from the top of a floor to the underside of a floor, avoiding any raised pattern

3.2.4 plate thickness
overall distance from the top surface of a plate to the underside of a plate, avoiding any raised pattern

3.3 Supports

3.3.1 simply supported
supported but not fixed on all four edges even though two edges are able to be supported by stiffeners or joint covers

3.3.2 butt strap
strip of plate welded, bonded and/or bolted to the underside of a plate to support, stiffen the edge and cover the gap between adjacent plates

3.3.3 encastré
plate that is securely bolted, welded or bonded to the supporting system on all four sides

3.3.4 shelf angle
support fixed to concrete or steelwork (vertical leg down) around perimeter of flooring

Figure 1 **Plating terms**

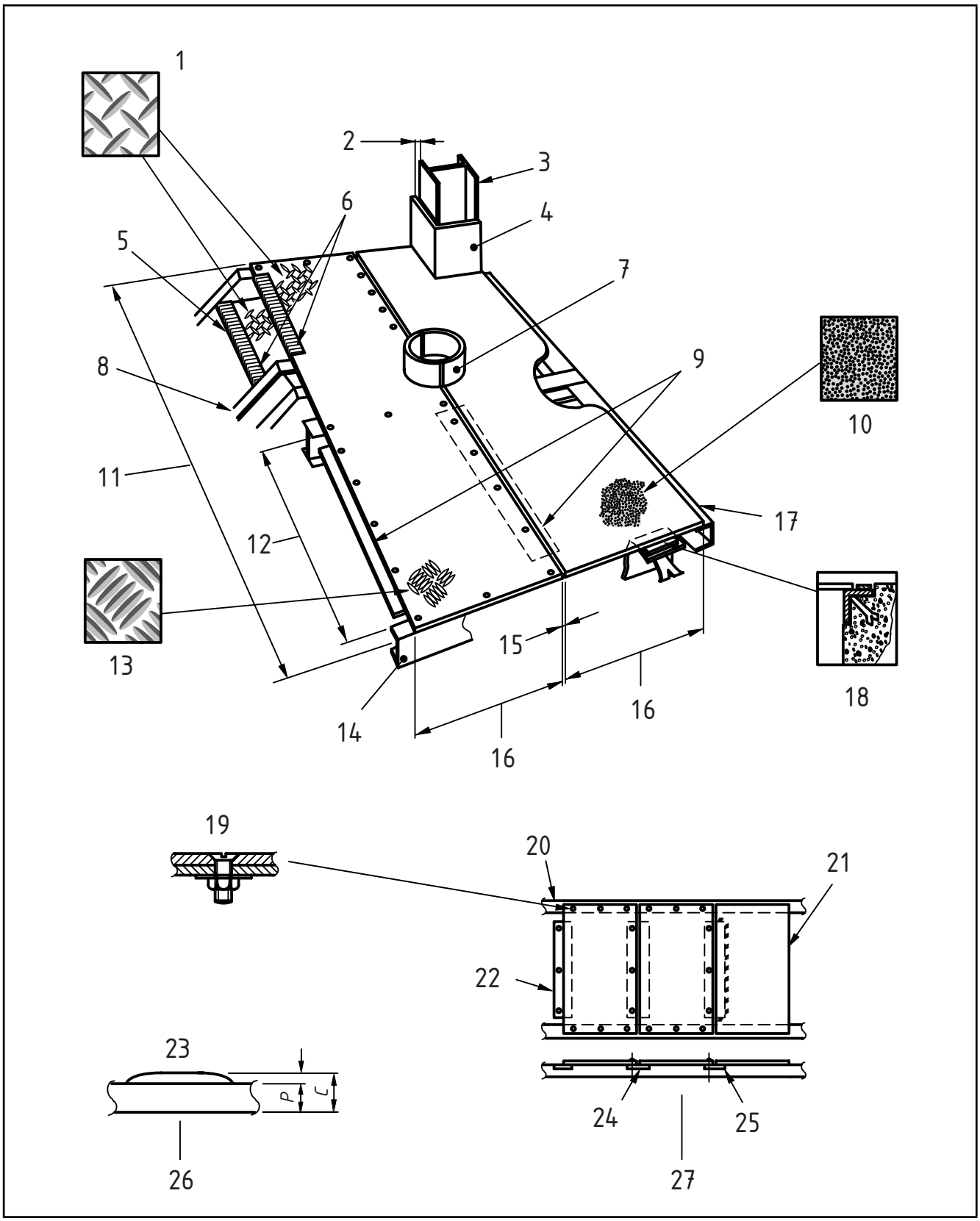


Figure 1 **Plating terms** (*continued*)

Key

1	Durbur pattern chequer plate	17	Secondary support
2	Erection clearance	18	Shelf angle (with grouting tangs)
3	Wall or column	19	Slotted M12 countersunk screws with washer and hexagonal nut (slotted M10 countersunk screws GRP only)
4	Cut-out with straight shaping and toe plate	20	Primary support
5	Stair tread	21	Support required
6	Nosing	22	Support for adjacent panels
7	Cut-out with curved shaping and toe plate	23	Minimum stud height of 1.2 mm
8	Cranked stair stringer	24	Butt strap out of 80 × 6 flat
9	Butt strap	25	Securely fixed to adjacent panels
10	Bonded abrasive grit on plain plate	26	Raise pattern, 'teardrop' or 5-bar treadplate pattern (metal), or diamond pattern (GRP)
11	Overall span	27	Layout of panels either encastré or simply supported
12	Clear span	28	Dimension over plate
13	5-bar treadplate pattern	29	Dimension over chequer
14	Primary support		
15	Erection clearance		
16	Width[A)]		

[A)] The longest side is always referred to as length (l) and the shortest side is referred to as width (w)

4 Information to be supplied

The following items to be agreed between the contracting parties are specified in the clauses referred to and shall be fully documented. For compliance with the standard both the definitive requirements specified throughout this part of BS 4592 and those specified in BS 4592-0:2006, Clause **4** and the following documented item shall be satisfied.

a) Requirements for protection against corrosion shall be agreed between the manufacturer and the purchaser.

5 Material requirements

5.1 Steel

Low carbon steel shall conform to BS EN 10025.

Stainless steel shall, as a minimum, conform to the requirements of austenitic steel specified in BS EN 10258.

5.2 Aluminium

Aluminium shall conform to BS EN 12020.

5.3 Glass reinforced plastics (GRP)

5.3.1 Glass reinforced plastic shall consist of a fully cured composite of a thermoset resin, the necessary additives such as fillers, stabilizers, etc., together with the appropriate quantity of glass fibre reinforcements and core materials (if required) to achieve the specified design requirements.

NOTE A post-manufacture protective surface coat can be applied to enhance ultraviolet degradation resistance, if required.

5.3.2 All cut ends and holes shall be sealed with polyurethane resin after cutting and drilling.

5.4 Protection against corrosion

Floor plates shall be free draining.

Requirements for protection against corrosion shall be agreed between the supplier and purchaser.

NOTE 1 Requirements might vary according to the end use.

NOTE 2 For the external protection of low carbon steel, hot dip galvanizing in accordance with BS EN ISO 1461 is recommended.

6 Size requirements

Plates shall be supplied to suit, or shall be cut from, the manufacturer's standard nominal plate widths, plate lengths, plate depths and plate thicknesses as specified by the manufacturer or the supplier subject to permissible tolerances (see Table 1).

NOTE Nominal plate thicknesses are exclusive of raised patterns, i.e. over plain (o/p).

The minimum height of raised patterns shall be 1.2 mm.

Table 1 **Thicknesses and widths of plate**

Nominal thickness mm		**Nominal width** mm	
>	=	= 1 200	>1 200 = 1 500
2.0	2.5	0.19	0.29
2.5	3.0	0.23	0.28
3.0	4.0	0.28	0.30
4.0	5.0	0.30	0.33
5.0	6.0	0.33	0.35
6.0	8.0	0.36	0.38
8.0	10.0	0.40	0.41
10.0	13.0	0.44	0.45

7 Tolerance requirements

The maximum permissible tolerances on work sizes of plates shall be as follows:

a) plate length, +0 mm to –3 mm;

b) plate width, +0 mm to –3 mm;

c) difference between diagonals, ±5 mm (out of squareness of plate);

d) height of raised pattern, +1 mm to –0 mm.

8 Construction and fixing requirements

8.1 Supports for plates

Plates shall be supported on all sides, with a minimum extension over their supports of 25 mm.

NOTE For an increased load-carrying capacity with a considerably reduced deflection, plates should be encastré. Plates can be welded down, bonded, bolted or bolted and bonded using countersunk screws.

8.2 Secondary supports

Secondary supports shall be used to provide support for sides of plates not supported by primary supports.

NOTE Secondary supports can be supplied either permanently fixed to the primary supports or as an independent stiffener or joint cover in the form of a suitable section or a butt strap attached to the joining side of an adjacent plate (see Figure 1).

8.3 Encastré plates

Encastré plates that are bolted to supports shall be bolted down near the corners, approximately 100 mm from corners and at centres not exceeding 500 mm. In these cases plates shall be drilled and countersunk before being bolted to the supporting structure.

8.4 Toe plates

Toe plates specifically required around cut-outs in plates shall be formed from flat sections or angle sections before being fixed securely to the plate by welding, bonding, or bonding and bolting.

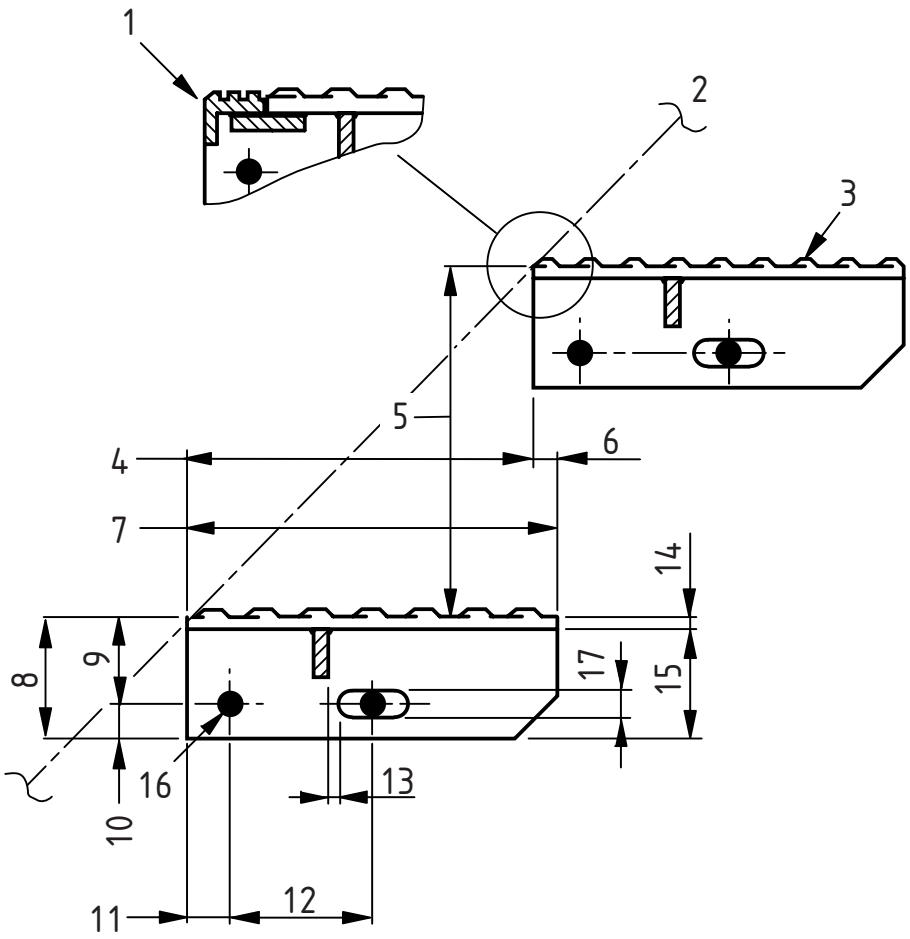
8.5 Supports for stair treads

End plates for metal treads shall be fillet welded to the tread for their full length at each end unless the load is transferred (as in the case of GRP treads) to a ledge support at each end. The tread shall be securely fixed by one of the above methods before the support is bolted to the staircase stringers.

NOTE 1 The fixing dimensions for bolting the end plates or ledge supports to the stringers should be as shown in Figure 2.

NOTE 2 For imposed loads on treads, see BS 4592-0.

Figure 2 **Fixing dimensions for bolted end supports – Metal plate treads**[A)]



Key

1 Leading edge of stair tread fitted with anti-slip nosing
2 Pitch line
3 1.2 mm (min.) height of raised pattern
4 Going
5 Riser
6 Overlap (= 16 mm)
7 Tread width
8 Overall tread depth (78 mm)
9 Distance from top of tread to centre of bolts (58 mm)
10 Distance from bottom of tread to centre of bolts (20 mm)
11 Distance from end of tread to first bolt (30 mm)
12 Centres of bolts (see Notes 1 and 2)
13 Distance from slotted hole to stiffener (9.5 mm)
14 Chequer plate depth over plain (8mm)
15 Depth of tread end plate (70 mm)
16 Diameter of first bolt holes (stair treads 14 mm, ladder treads 12 mm)
17 Width of slotted hole (stair treads 14 mm, ladder treads 12 mm)

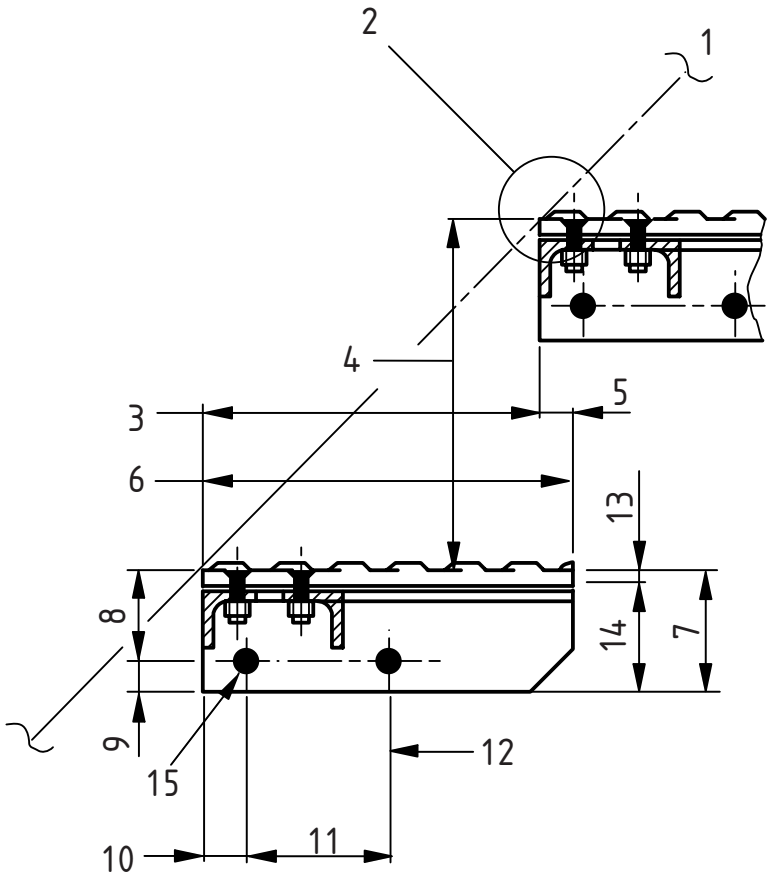
A) 5 mm thick flat metal end plates with 30 × 5 mm (minimum) stiffening flat welded to underside of plate between end plates

NOTE 1 For tread widths of 250 mm up to and including 290 mm, the dimension (x) is 125 mm.

NOTE 2 For tread widths of 291 mm or more, the dimension (x) is 175 mm.

NOTE 3 The rear hole can be slotted as shown except for ladder treads.

Figure 3 **Fixing dimensions for bolted end supports – GRP plate treads**[A)]



Key

1 Pitch line
2 30 mm wide strip at leading edge of tread to have quartz or similar grit bonded on to top of plate to provide anti-slip nosing
3 Going
4 Riser
5 Overlap (= 16 mm)
6 Tread width
7 Overall tread depth (80 mm)
8 Distance from top of tread to centre of bolts (55 mm)
9 Distance from bottom of tread to centre of bolts (25 mm)
10 Distance from end of tread to first bolt (30 mm
11 Centres of bolts (see Notes 1 and 2)
12 Distance from edge of rear hole to stiffener (16 mm)
13 Chequer plate depth over plain (10 mm)
14 Depth over tread end plate (70 mm)
15 Diameter of bolt holes (stair treads 13 mm, ladder treads 10 mm)

A) 70 × 70 × 6 mm (minimum) GRP support angles with 38 × 38 × 6 mm (minimum) GRP stiffening angles screwed to underside of GRP plate between support angles.

NOTE 1 For tread widths of 250 mm up to and including 290 mm, the dimension (x) is 125 mm.

NOTE 2 For tread widths of 291 mm or more, the dimension (x) is 175 mm.

8.6 Bonding of toe plates

Toe plates shall be bonded using a suitable resin adhesive.

8.7 Low carbon steel

Low carbon steel shall be arc welded in accordance with BS EN 1011-1.

8.8 Stainless steel

Stainless steel shall be welded in accordance with BS 4872-1.

8.9 Aluminium

Aluminium shall be welded in accordance with BS 8118-2.

9 Performance requirements

9.1 General

When tested in accordance with **9.2** or **9.3**, as applicable, plate flooring shall withstand the appropriate unfactored loads given in Table 2. Where a cut-out is required, the remaining area of plate shall be made capable of carrying the appropriate unfactored design load. The relevant deflection criteria [see **9.3**b)], within the limit of the allowable stress of the material used, shall be maintained.

Table 2 **Load factors and combinations**

Loading	**Factor, γ_f**
Dead load	1.4
Dead load restraining uplift or overturning	1.0
Imposed load	1.6

NOTE The values given above are taken from BS 5950-1. For further information see BS 5950-1:2000 ***2.4****, and for recommendations on use of permissible stress, see BS 449-2.*

The positions of concentrated loads during testing shall be either those that produce the maximum stresses or, where deflection is the design criterion, those that produce maximum deflection.

NOTE The unfactored safe working loads or characteristic loads for a range of effective plate spans and plate widths is usually stated in trade literature.

9.2 Flooring and walkways

When tested in accordance with Annex A of BS 4592-0:2006, the flooring or walkway plate shall conform to the following requirements.

a) It shall have a load safety factor for dead and imposed loads of at least that given in Table 2 for metal, or a minimum of 4.0 for GRP when subjected to the unfactored imposed load given in Table 1 of BS 4592-0:2006.

b) The limits for deflection shall be in accordance with BS 4592-0:2006, **5.2.2**.

NOTE 1 The method recommended for determining values for plates, either simply supported on all sides or fixed on all sides, is that using equations developed by C.C. Pounder. In such calculations, it is important that the appropriate flexular modulus for each material is taken into account.

NOTE 2 Standard structural design theory can be used for calculations at the preliminary design stage. (See manufacturer's literature for the appropriate mechanical properties for each composite.)

9.3 Treads

Where a tread is tested in accordance with Annex A of BS 4592-0:2006, the tread shall conform to the following requirements:

a) for limit state design with imposed loads, it shall have a load factor of not less than 1.6 (see Table 2) for metal and not less than 4.0 for GRP (see BS 4592-0:2006, **A.4.1**);

b) it shall deflect elastically by not more than 1/300 times the effective span, or 6 mm, whichever is the lesser.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 449-2, *The use of structural steel in building – Part 2: Metric units.*

BS 4592-1, *Metal open bar gratings – Specification.*

BS 4592-2, *Expanded metal sections – Specification.*

BS 4592-3, *Cold formed metal planks – Specification.*

BS 4592-4, *Glass reinforced plastics (GRP) open bar gratings – Specification.*

BS 5502, *Buildings and structures for agriculture.*

BS 5950-1, *Structural use of steelworks in building – Part 1: Code of practice for design in simple and continuous construction – Hot rolled sections.*

BS EN ISO 14122, *Safety of machinery – Permanent means of access to machinery.*

BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods.*

This page deliberately left blank

BSI – British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.
Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001.
Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111.
Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002.
Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

389 Chiswick High Road
London
W4 4AL