

Specification for

Steel single tier bolted shelving (angle upright type)

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Business Equipment Trade Association	Storage Equipment Manufacturers' Association
Department of the Environment (PSA)	
Institute of Materials Handling	

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Foreword

This British Standard, having been prepared under the direction of the Mechanical Engineering Standards Committee, is a revision of the 1955 edition and takes account of metric dimensions.

The committee in revising the standard has made such constructional modifications as experience has shown desirable.

It is possible to use the component specified in this standard to build double or multiple tiers of shelving, but it is strongly urged that prior consultation should be held with the manufacturers in all cases when it is intended to carry out this operation.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard relates to single tier bolted steel shelving not more than 3 075 mm high prepared as open type or closed type and installed in the form of bays or runs. The rigidity of the shelving depends on bracing or sheeting.

It specifies the materials from which the shelving is to be manufactured, the finish, the method of construction for assembly purposes and those dimensions necessary for interchangeability.

The nomenclature used is defined and the safety of the finished assemblies is ensured by the provision of tests for safe working loads on the uprights.

Notes on erecting technique are contained in Appendix A.

2 References

The titles of the publications referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the following definitions apply.

3.1 bay

the unit of steel shelving, either single or double sided, open type or closed type (See Figure 1, Figure 2 and Figure 3)

3.2 single sided bay

a number of shelves placed as required and supported by uprights the whole being accessible from the front only (See Figure 1, Figure 2 and Figure 3.)

3.3 double sided bay

two single sided bays joined back to back having a common back sheet or cross braces. The assembly thus provides two sets of shelving each of which is accessible from its front only (See Figure 17 and Figure 18.)

3.4 run

a number of bays joined side to side, either single or double sided (See Figure 17 and Figure 18.)

3.5 level

the vertical space between any two adjacent shelves in the same bay (See Figure 3.)

3.6 bin

a level fitted with a bin front (retaining lip) (See Figure 3.)

3.7 subdivision

the spaces resulting from the subdivision of a level by the insertion of shelf dividers (See Figure 3.)

3.8 plain shelves

shelves without reinforcement (See Figure 6.)

3.9 single reinforced shelves

shelves reinforced front and back (See Figure 17 and Figure 18.)

3.10 double reinforced shelves

shelves reinforced front, back, sides and centre (See Figure 17 and Figure 18.)

3.11 ledge shelving

shelving the upper shelves of which are of less depth than the lower (See Figure 4.)

4 Dimensions of assemblies

4.1 Single sided bays. The overall dimensions of single sided bays shall be in accordance with the values given in the following ranges.

- a) *Range of nominal heights:* 975, 1 875, 2 175, 2 475, 2 775 and 3 075 mm.
- b) *Range of nominal lengths:* 600, 900 and 1 200 mm.
- c) *Range of nominal depth from front to back:* 250, 300, 400, 500, 600 and 750 mm.

4.2 Double sided bays. The range of dimensions for double sided bays shall be identical with those for single sided bays except that the depths are combined.

4.3 Runs. The range of heights and depths for runs shall be identical with those given for bays.

The length of a run is the sum of the lengths of the individual bays of which it is composed.

NOTE The length of the openings between the front flanges of the angle uprights of a bay is the length of the bay less 80 mm.

The access height at the front of a level is the centre to centre dimension of the shelves less 30 mm.

When bin fronts are fitted the height dimension is further reduced.

Access to subdivisions will be further restricted by the thickness of the divider.

5 Components

5.1 Dimensions and tolerances of components.

The detailed dimensions of the individual components from which the bays are assembled shall be those shown in Figure 5 to Figure 16 inclusive and the alphabetically indexed panels given on the same figures according to the list below. In all cases the limits of tolerance on the dimensions shall be those also given on the figures.

Angle uprights	Figure 5	Dividers	Figure 12
Shelves	Figure 6	Bin fronts	Figure 13
Cross braces	Figure 7	Base plinths	Figure 14
Shelf reinforcers and shelf side supports	Figure 8	Shelf drawers	Figure 15
	Figure 8	Doors	Figure 16
Side sheets	Figure 9	Screws	5.2
Back sheets	Figure 10	Nuts	5.3
Card holders	Figure 11		

5.2 Screws. The screws used for assembly of the shelving shall have mushroom heads, and shall have either metric threads of 6 mm diameter to BS 3643-1 or UNC threads of ¼ in diameter to BS 1580-1 and BS 1580-2.

5.3 Nuts

5.3.1 General. The thickness of the nuts shall be that given for the pressed-type M6 nuts in BS 4183 or ¼ in nuts in BS 1981.

5.3.2 Position of screws and nuts as shown in Figure 17

- a) 6 mm × 8 mm long mushroom head. For fixing two shelf reinforcing channels together.
- b) 6 mm × 12 mm long mushroom head. For fixing shelf, through flange of one angle upright (including, when used, through the shelf reinforcing channels or card holders).
For fixing shelf side support, through flange of one angle upright.
For fixing braces, through flange of one angle upright.
For fixing centres of braces together.
- c) 6 mm × 20 mm long mushroom head. For fixing shelves, through flanges of two angle upright (including, when used, through the shelf reinforcing channels).
For fixing braces, through flanges of two angle uprights.

5.3.3 Position of screws and nuts as shown in Figure 18

- a) 6 mm × 8 mm long mushroom head. For fixing dividers to shelves, and two centre shelf reinforcing channels together.
- b) 6 mm × 12 mm long mushroom head. For fixing shelf through flange of one angle upright (including, when used, through the sheet sides, sheet backs, shelf reinforcing channels or card holders).
For fixing base plinth to angle upright.
For fixing shelf side support, through flange of one angle post (including through sheet side).
- c) 6 mm × 20 mm long mushroom head. For fixing shelves through flanges of two angle uprights (including, when used, through the sheet sides, sheet backs or shelf reinforcing channels).
For fixing shelf side supports through flanges of two angle uprights (including through sheet side).
- d) 6 mm × 25 mm long mushroom head. For fixing bin fronts to angle uprights.

6 Materials and finish

6.1 Commercial grade carbon steel. All the components of the shelving shall be fabricated from commercial grade carbon steel to BS 1449-1 having a minimum lower yield stress of 170 N/mm².

Where grade 15 material is used in manufacture, the minimum thickness of material shall be as follows:

Angle upright strength designation mark	Commercial grade 15 material thickness mm
A	2.0
B	2.5
C	3.0

With the thickness tolerance variation ± 0.05 mm and where a thinner, stronger material is used in accordance with 6.2 the outer face of each leg of the angle upright shall be incised with a minimum of two marks indicating its strength designation A, B or C.

6.2 Stronger materials for steel angle uprights. Steel having a minimum lower yield stress (or 0.2 % proof stress) in excess of 170 N/mm² may be used (with the thickness appropriately reduced) provided that the load factor of 3 against failure is maintained for each magnitude of loading contained in Table 3.

For suitable stronger steels to BS 1449-1 or BS 4360, where the minimum yield stress (or 0.2 % proof stress) is guaranteed by the manufacturer to the shelving supplier, no additional steel strength tests are required.

For suitable stronger steels to BS 1449-1 where the yield stress (or 0.2 % proof stress) is not guaranteed by the manufacturer and the shelving supplier wishes to take advantage of the increase in strength of material through cold rolling, the consistent quality of processed material shall be stabilized and monitored in accordance with Appendix B. See also Appendix D for compression tests.

6.3 Straightness of steel angles. The angle section shall be straight with an offset not more than 1/600 of the length, and the twist of section shall not exceed 40 min of angle per metre.

6.4 Enamelling. All sheet steel and angle components shall be stove enamelled. Colours shall be chosen from BS 5252.

6.5 Preparation before enamelling. Before enamelling treatment is commenced, all burrs and sharp edges shall be removed from the various components, and they shall be free from grease, rust, scale or similar surface imperfections.

6.6 Test of enamel film. An enamel film on a section cut from a sheet metal component shall not show signs of cracking or loss of adhesion when bent round a mandrel of diameter 12.5 mm. When a 24 mm square is etched through the enamel with cuts at 3 mm centres in both directions, and a piece of transparent adhesive tape is firmly fixed over the whole area and then sharply removed, all 3 mm square areas shall remain perfectly adhered to the steel.

6.7 Screws and nuts. Screws and nuts shall be coated with cadmium or zinc. The coatings shall comply with the requirements of BS 3382-1 or BS 3382-2.

7 Construction

7.1 Single sided bays

7.1.1 Standard bay. A standard bay shall consist of four vertical angle uprights supporting the required number of shelves.

The shelves shall be secured to the angle uprights at eight points by means of the screws and nuts specified in clause 6, each corner of a shelf being fastened to both flanges of the angle upright.

7.1.2 Open type bay with cross bracing. In order to impart the necessary rigidity open type bays shall be fitted with cross braces bolted to the angle uprights in positions at the sides and rear of the bay, in accordance with the details given in 7.5 and Figure 17 and Figure 19.

7.1.3 Closed type bay with side and back sheets.

A closed type bay shall be fitted with side sheets (Figure 9) and back sheets (Figure 10) which, in addition to enclosing the bay at the sides and back, also ensure the necessary rigidity. They shall be fastened by the shelf attachment screws and nuts. Where shelves are more than 600 mm apart, a further intermediate screw and nut shall be fitted. Single side and back sheets of the full height shall be fitted to closed type bays up to 1 875 mm in height. For bays of greater height the sides and backs shall be formed from upper and lower sheets which conform to the dimensions given in Figure 9 and Figure 10 respectively and which shall be bolted to the overlap.

7.2 Double sided bays

7.2.1 Open type bay. Back cross braces shall be common to the two single sided bays which are linked back to back to form a double sided bay.

7.2.2 Closed type bay. Each sheet shall be common to the two linked closed type bays.

7.2.3 Fastenings. Where shelves on each side are at a corresponding level, they shall be fastened by common screws and nuts.

7.3 Runs

7.3.1 Open type runs. When single faced or double sided open type bays are linked to form runs the cross braces shall be fitted in the positions specified in 7.5 and shown in Figure 17 and Figure 19 according to the number of bays comprising the runs. Adjacent shelves and angle uprights shall be fastened by common screws and nuts.

7.3.2 Closed type stacks. When single sided or double sided closed type bays are linked to form runs, side sheets shall be common to the linked bays.

7.3.3 Ledge shelving. Where the components described in this British Standard are used to form ledge shelving in excess of 2 475 mm high overall, or loaded in excess of 800 kg in the upper portion of the bay, the user shall consult the manufacturer for the adequate reinforcing of the shelf at ledge level.

7.4 Fastening. Shelves of adjacent bays which are at the same level shall be fastened by common screws and nuts.

7.5 Arrangement of cross bracing. The methods of cross bracing detailed below shall apply to all runs of standard height, unless otherwise agreed between the purchaser and the manufacturer. The positions of bracing for different bay arrangements shall be as shown in Figure 19.

The number of pairs of cross braces in the vertical plane at each of the positions shown in Figure 19 shall be in accordance with Table 1.

Table 1 — Arrangement of cross bracing

Height of run mm	Cross braces
975	1 pair
1 875 2 175 2 475 2 775	2 pairs
3 075	3 pairs

7.6 Reinforcement. In order to accommodate the requirements for varying types of load, three forms of shelves shall be available as follows:

- plain shelves
- single reinforced shelves
- double reinforced shelves

Single reinforced shelves shall be fitted with shelf reinforcers (see Figure 8, Figure 17 and Figure 18) inside both the front and back flanges. These shall be held in position by the front and back shelf attachment screws.

Double reinforced shelves shall be fitted with similar reinforcers and, in addition, with two shelf reinforcers bolted back to back, freely located under the centre of the shelf, and resting on its side return flanges.

Shelf side supports (see Figure 8, Figure 17 and Figure 18) shall be used to support double reinforced shelves. They shall be placed immediately under each shelf side flange and shall be attached by the screws and nuts to the angle posts at four points.

7.7 Card holders (see Figure 11). When card holders are required they shall be fitted along the front flanges of the shelves and bolted inside the angle uprights by the front attachment screws.

7.8 Dividers (see Figure 12). When dividers are used they shall be fitted between adjacent shelves of a bay to form subdivisions. Dividers shall be secured with screws or with other types of fastener.

7.9 Bin fronts (see Figure 13). When bin fronts are used they shall be fitted along the front of the levels to form a retaining lip, and shall be bolted at each end to the angle uprights.

7.10 Base plinths (see Figure 14). Base plinths may be fitted to the front of closed type bays for the purpose of enclosing the space between the bottom shelf and the floor. They may be fitted as an optional extra to an open type bay. When base plinths are used, they shall be bolted at each end to the front flanges of the angle uprights.

7.11 Shelf drawers (see Figure 15). Shelf drawers may be placed on the shelves for the storage of small parts. Drawers are designed so that six drawers, 133 mm wide, will fit on a 900 mm shelf and six drawers, 150 mm wide, will fit on a 1 000 mm shelf. Different combinations of drawers will not fit exactly on to the other standard shelves.

The drawers are specifically suitable for 300 mm and 500 mm deep shelving. Shelves shall be fitted at 100 mm or 150 mm centres, depending on the depth of drawer used.

7.12 Doors. Hinged doors may be provided suitable for use with shelving of heights 975 mm, 1 875 mm and 2 175 mm. Where supplied they shall be complementary to the standard shelving and shall be capable of being fitted either during erection or at a later date. Locking facilities may be provided. Espagnolette bolts are preferred. Figure 16 shows two alternative arrangements.

Sliding doors may also be provided.

7.13 Foot plates (sole plates). Foot plates (sole plates), and or any packs used to level and plumb the shelving, shall be steel plates and shall be fixed to the uprights to prevent them being dislodged and causing instability.

NOTE Foot plates (sole plates) are recommended in order to spread loads or provide uniform bearing for the uprights. They should be provided by arrangement between the purchaser and the manufacturer. (See Appendix A.)

8 Loading of shelves

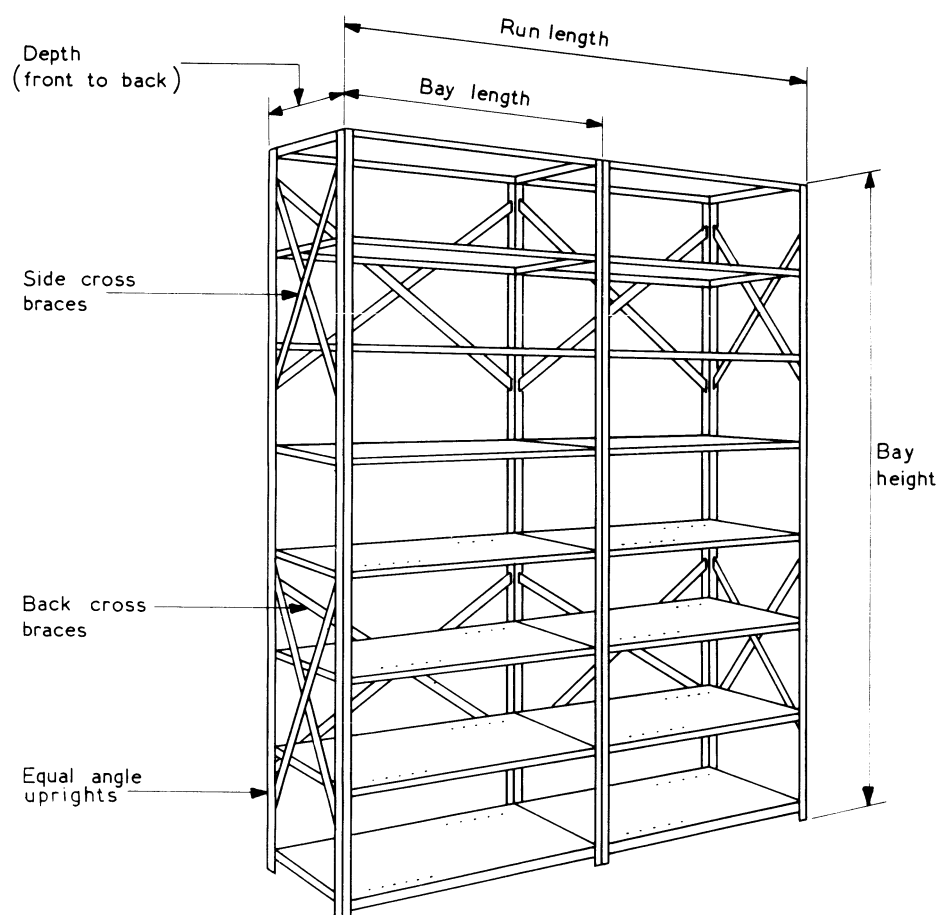
The maximum uniformly distributed static loads applicable on the plain, single reinforced and double reinforced shelves shall be those given in Table 2.

NOTE The loads in Table 2 are derived from tests, and are the lower values of either:

- a) half the crippling load, or
- b) the load causing a vertical deflection of the longest flange of 0.6 % of the length of that flange.

Table 2 — Maximum safe distributed loads for shelves (minimum factor of safety, 1.8)

Width	Depth	Plain shelf	Shelf with front and rear reinforcement	Shelf with front, rear, centre and side reinforcement
mm	mm	kg	kg	kg
600	250, 300, 400, 500, 600	205	500	795
900	250, 300, 400, 500, 600, 750	170	340	545
1 000	300, 400, 500, 600	140	320	545
1 200	600	110	305	545

**Figure 1 — Typical arrangement of a single sided two bay run, open type**

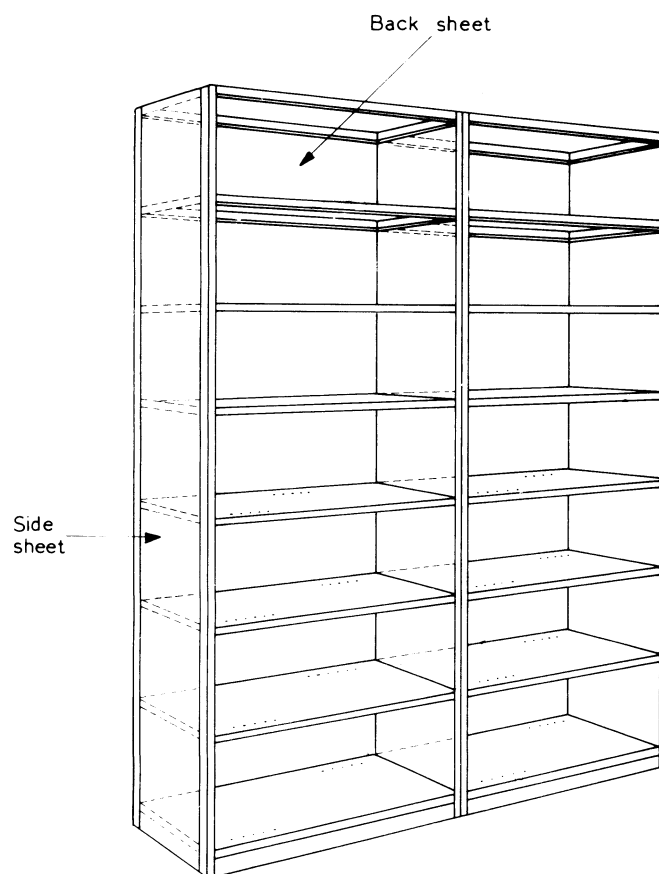


Figure 2 — Typical arrangement of a single sided two bay run, closed type