

Educational furniture

Part 4. Specification for strength and stability of storage furniture for educational institutions

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- British Furniture Manufacturers' Federation
- British Office Systems and Stationery Federation
- Castor Manufacturers (UK) Association
- Chartered Society of Designers
- Clasp Development Group
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Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
Specification	
1 Scope	1
2 References	1
3 Definitions	1
4 Strength and stability tests	1
5 Strength requirements	2
6 Stability requirements	6
7 Glass	6
8 Marking	6
Annexes	
A (normative) Tests on shelves, horizontal surfaces and clothes hanging rails	7
B (normative) Tests on pivoted doors	10
C (normative) Tests on sliding doors	11
D (normative) Tests on flaps	12
E (normative) Tests on roll fronts	13
F (normative) Tests on drawers	13
G (normative) Strength tests for trays	15
H (normative) Tests on carcass and underframe	17
J (normative) Strength of trolleys	18
K (normative) Tests for strength of coat hooks	19
L (normative) Stability tests	19
M (normative) Calibration of drawer slamming machine	22
Tables	
1 Summary of test procedures	3
2 Order of tests for ranges of furniture	4
A.1 Steel impact plates	7
A.2 Average loads applied to parts other than the part being tested	7
A.3 Maximum loads applied to parts undergoing test	7
L.1 Loads to be applied	20
Figures	
A.1 Test for strength of shelf supports	8
A.2 Test for deflection of shelves	8
A.3 Test for strength of clothes hanging rail supports	9
A.4 Test for deflection of clothes hanging rails	9
B.1 Test for strength of pivoted doors	10
C.1 Arrangement for slam open/shut test of sliding doors	11
D.1 Test for strength of flaps	12
E.1 Slam shut test of roll front	13
F.1 Test for strength of runners	13
F.2 Test for slamming shut of drawers	14
F.3 Test for displacement of bottom surface of drawers	14
F.4 Test for wear and fatigue of drawers and runners	15
G.1 Tray operation attachment device	16
H.1 Test for strength of carcass and underframe	17
K.1 Strength of hooks	19
L.1 Overturning test on an unloaded carcass: doors and drawers	20
L.2 Horizontal impact device	21
L.3 Overturning test on a loaded article: doors and drawers	21
L.4 Overturning test on a loaded article: drawer slamming	22
L.5 Overturning test on loaded article: flaps	22
List of references	Inside back cover

Foreword

This Part of BS 5873 has been prepared by Technical Committee FW/4. It supersedes BS 5873 : Part 4 : 1991 which is withdrawn. This revision includes additional requirements and test methods for trolleys and trays.

Individual purchasers may well be able to judge the general suitability of storage furniture by inspection but, if they are non-technical, they may not be able to assess its strength and suitability in use. It is for this reason that this standard specifies objective criteria for strength and stability of storage furniture which are based on the simulation of conditions of use.

The strength tests described in this standard reproduce normal use and common types of misuse to which storage furniture for educational institutions may be subjected. The tests are designed to be applied to an article that is fully assembled and ready for use and are intended only to determine strength of the structure. Two test levels are given for the tests: general and heavy. The general grade applies to furniture for normal use. The heavy grade applies only to bulk storage or storage of extremely heavy items such as large books.

The stability tests described in this standard determine the ability of the furniture to remain stable in normal use.

Tests carried out in accordance with this standard are intended to demonstrate the ability of the item to give satisfactory service in its intended environment. It should be understood that such tests do not ensure that structural failure will not eventually occur as a result of habitual misuse or after an excessively long period of service.

Attention is drawn to BS 4875 : Part 7, which describes methods of test for domestic and contract furniture that are very similar to those in this standard.

The other Parts of BS 5873 are as follows:

- Part 1. *Specification for functional dimensions, identification and finish of chairs and tables for educational institutions*
- Part 2. *Specification for strength and stability of chairs for educational institutions*
- Part 3. *Specification for strength and stability of tables for educational institutions*
- Part 5. *Specification for security of fixed secure storage units for educational institutions*

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 22, an inside back cover and a back cover.

Specification

1 Scope

This Part of BS 5873 specifies strength and stability requirements for storage furniture for educational institutions, including lockers, secure storage and trolleys. This standard applies specifically to school furniture and is not applicable to office furniture used by the administrative staff. Two test levels, general and heavy, are specified.

This Part of BS 5873 does not cover requirements and test methods for the security of fixed secure storage furniture which are dealt with in BS 5873 : Part 5.

2 References

2.1 Normative references

This Part of BS 5873 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 5873 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This British Standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 5873 the following definition applies.

3.1 stability

Ability of an item of furniture to withstand forces that tend to cause it to tip over.

4 Strength and stability testing

4.1 Inspection before and after testing

4.1.1 Inspection before testing

Immediately before testing, each article shall be thoroughly inspected. Any defects in the members, joints or attachments of such components as flaps and extensions shall be noted so that they are not attributed to the effect of the tests when the tests have been completed.

Fittings in self-assembly furniture shall be tightened before testing.

4.1.2 Inspection after testing

Immediately after completion of the tests, the article shall again be thoroughly inspected. Any apparent defects shall be noted and a determination shall be made of any changes that have taken place since the initial inspection.

4.2 Moisture content and conditioning

Before the tests are commenced the article shall be sufficiently old to ensure that all component materials have developed their full strength. At least 4 weeks in normal conditions shall elapse from manufacture in the case of glued joints in timber, plastics moulded parts, etc.

Parts made of timber products shall have a moisture content of between 8 % and 12 %. If the moisture content is above 12 % the article shall be allowed to dry out in a warm ventilated room until the moisture content is between 8 % and 12 %.

If a standard atmosphere is required for conditioning or testing, that atmosphere shall be at a temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and a relative humidity of $50\% \pm 5\%$.

If there is not time for furniture to be aged or to reach equilibrium the moisture content shall be measured where applicable at the beginning and at the end of the testing sequence, and these measurements shall be included in the test report if they are outside the limits specified, together with the age of the article when testing commenced.

4.3 Setting up of furniture

The articles shall be tested as delivered.

Self-assembly furniture shall be assembled according to the instructions supplied with the article. If the article can be combined in different ways the most adverse combination shall be used for each test.

This requirement shall also apply to furniture that can be combined with other articles. Articles intended for wall attachment shall be mounted on a wall so that secure attachment is achieved in every mounting position specified by the manufacturer.

Articles intended to be floor standing shall be placed on a flat and level floor.

4.4 Rate of carrying out tests

The test forces shall be applied at a sufficiently slow rate to ensure that negligible dynamic load is applied and also to ensure that kinetic heating does not occur.

NOTE. It is recommended that the tests are carried out at a maximum rate of 6 cycles/min.

4.5 Test loading and measurements

4.5.1 Classification of loadings

Loadings are classified as follows.

- a) *Functional loadings.* Test loadings applied to storage furniture to cause stresses to simulate those caused by use of the furniture for storage purposes.
- b) *Static loading.* Steady and gradual application (up to the maximum that the storage furniture may be required to withstand) of a test loading, repeated a sufficient number of times to make sure of the static strength of the furniture.
- c) *Fatigue loading.* Repeated application to storage furniture, in a steady and gradual manner, of the load which is likely to occur most frequently.

4.5.2 Measurements

Unless otherwise stated for a particular test, measurements shall be made within the following tolerances.

- a) All loads and forces shall be measured to an accuracy of $\pm 5\%$.
- b) All masses shall be measured to an accuracy of $\pm 0.5\%$.
- c) All dimensions shall be measured to an accuracy of ± 1.0 mm.
- d) All angles shall be measured to an accuracy of $\pm 2^\circ$.

NOTE. The tests may in certain cases be carried out by means of loads or forces. For practical purposes a force of 10 N may be taken to be equal to the downward force due to a mass of 1 kg.

4.6 Combinations of tests

The strength tests shall be carried out on the same article of furniture. The forces to be applied and the number of cycles of application shall be as given in table 1.

Tests on a particular component shall be carried out in the order given in table 1.

NOTE 1. The different component parts of an item may be tested in any order and not necessarily in the order given in table 1.

Components that have a dual function shall be subjected to the relevant tests for each function, e.g. a shelf that can be pulled out on runners shall be subjected to the tests for shelves and additionally to the wear and fatigue tests for drawers and runners.

For an article fitted with a number of flaps, drawers or doors that are identical in every respect (apart from the direction of opening and closing), it shall be permissible to test only one of the relevant flaps, doors or drawers. Other flaps, drawers or doors fitted to the article shall each be tested separately.

NOTE 2. If tests are intended to prove a range of equipment, this may be achieved by testing the most highly stressed units or parts of units. It is possible, therefore, at the discretion of the test authority, to cover the testing of the whole range by carrying out the test programme given in table 2.

NOTE 3. The tests can be considered to cover only items or components which are manufactured of precisely the same material and are similar in construction and design.

5 Strength requirements

5.1 Shelves, horizontal surfaces and clothes hanging rails

5.1.1 Strength of shelf supports

After testing in accordance with A.1, the shelf supports shall conform to 5.11.

5.1.2 Deflection of shelves

After testing in accordance with A.2, the deflection of the shelves shall not exceed the following values:

- particle board: span/200;
- wood: span/150;
- other materials: span/100.

5.1.3 Strength of top and bottom surfaces

After testing in accordance with A.3, the top and bottom surfaces shall conform to 5.11.

5.1.4 Strength of clothes hanging rails supports

After testing in accordance with A.4, the clothes hanging rail supports shall conform to 5.11.

5.1.5 Deflection of clothes hanging rails

After testing in accordance with A.5, the increase in the deflection of the clothes hanging rail after 1 week shall be less than the span/100.

5.2 Pivoted doors

5.2.1 Strength of pivoted doors

After testing in accordance with B.1, the pivoted doors shall conform to 5.11.

5.2.2 Wear and fatigue of pivoted doors

After testing in accordance with B.2, the pivoted doors shall conform to 5.11.

5.2.3 Slamming open and shut of pivoted doors

After testing in accordance with B.3, the pivoted doors shall conform to 5.11.

5.3 Sliding doors

5.3.1 Wear and fatigue of sliding doors

After testing in accordance with C.1, the sliding doors shall conform to 5.11.

5.3.2 Slamming open and shut of sliding doors

After testing in accordance with C.2, the sliding doors shall conform to 5.11.

5.4 Flaps

5.4.1 Strength of flaps

After testing in accordance with D.1, the flaps shall conform to 5.11.

5.4.2 Wear and fatigue of flaps

After testing in accordance with D.2, the flaps shall conform to 5.11.

Table 1. Summary of test procedures

Test	Test level	
	General	Heavy
	Number of applications and test forces	Number of applications and test forces
Strength of top and bottom surfaces (A.3):		
Top surface		
Height above the floor:		
– Less than 1050 mm	1250 N	2 × 900 N
– 1050 mm and above	450 N	700 N
Bottom surface		
Wall units	1000 N	1250 N
Floor units, unrestricted headroom	1000 N	1250 N
Floor units, headroom less than 1050 mm	450 N	700 N
Strength of pivoted doors (B.1)	30 kg 10 cycles	45 kg 10 cycles
Wear and fatigue of pivoted doors (B.2)	80 000 cycles	80 000 cycles
Slam open of pivoted doors (opening force) (B.3)	2 kg 10 cycles	3 kg 10 cycles
Slam shut of pivoted doors (closing force) (B.3)	2.5 kg 20 000 cycles	3 kg 20 000 cycles
Wear and fatigue of sliding doors (C.1)	80 000 cycles	80 000 cycles
Slam open/shut of sliding doors (C.2)	4.0 kg 10 cycles	6.0 kg 10 cycles
Strength of flaps (D.1)	300 N	500 N
Wear and fatigue of flaps (D.2)	40 000 cycles	40 000 cycles
Slam shut of roll fronts (E.1)	40 cycles	40 cycles
Wear and fatigue of roll fronts (E.2)	40 000 cycles	40 000 cycles
Strength of drawer runners (F.1)	375 N 10 cycles	450 N 10 cycles
Slam open/slam shut of drawers (F.2)		
slam open/slam shut 5 kg	Velocity at calibration points 1.85 m/s	Velocity at calibration points 2.05 m/s
slam open/slam shut 35 kg	1.25 m/s	1.40 m/s
Displacement of bottom surface of drawers (F.3)	70 N	70 N
Wear and fatigue of drawers and runners (F.4)	80 000 cycles	80 000 cycles
Strength of trays:		
Sustained load (G.1)	0.1 kg/mm of internal depth	0.1 kg/mm of internal depth
Vertical downward static load (G.2)	up to 35 kg 10 cycles	up to 35 kg 10 cycles
Wear and fatigue of trays and runners (G.3)	0.05 kg/mm of internal depth 40 000 cycles	0.05 kg/mm of internal depth 40 000 cycles
Drop test (G.4)	10 drops from 350 mm	10 drops from 700 mm
Strength of carcass and underframe (H.1)	450 N 10 cycles	600 N 10 cycles

Table 1. Summary of test procedures (*continued*)

Test	Test level	
	General	Heavy
	Number of applications and test forces	Number of applications and test forces
Strength of trolleys:		
Sustained load (J.1)	3 × working load for each load bearing component	3 × working load for each load bearing component
Castor/wheel pin retention (J.2)	5 kg suspended from castor/wheel for 2 min	5 kg suspended from castor/wheel for 2 min
Hazard fatigue (J.3)	5 mm step, 2 mm step 2000 cycles	5 mm step, 2 mm step 5000 cycles
Obstruction impact (J.5)	not required	20 kg per castor/wheel 3 cycles
Horizontal fatigue (J.6)	20 N 30 000 cycles	25 N 50 000 cycles
Long distance running (J.4)	not required	20 kg per castor/wheel Speed 3.22 km/h (2 mph) for a distance of 150 km
Strength of coat hooks (annex K)	460 N	460 N

Table 2. Order of tests for ranges of furniture

Item	Order of tests
The largest floor unit and the largest hanging unit (if this does not include the longest shelf span unit then the unit containing this item is also tested)	Strength of shelf supports Deflection of shelves Strength of top and bottom surfaces Strength of carcass and underframe Strength of wall attachment devices
The relevant door whose geometry creates the greatest bending moment on the hinge	Strength of pivoted doors Slam open of pivoted doors Slam shut of pivoted doors Wear and fatigue of pivoted doors
The largest sliding door	Slam shut/open of sliding doors Wear and fatigue of sliding doors
The largest hinged flap	Strength of flaps Wear and fatigue of flaps
The largest roll front (vertical)	Slam shut of roll front Wear and fatigue of roll front
The largest drawer	Strength of runners Slam open of drawers Slam shut of drawers Displacement of drawer bottoms Wear and fatigue of drawers and runners
The longest clothes hanging rail	Strength of clothes hanging rail supports Deflection of clothes hanging rails
The largest tray	Sustained load Vertical downward static load Wear and fatigue of tray and runners Drop test
The most heavily loaded castor/wheel	Sustained load Pin pull out Hazard fatigue Horizontal fatigue Long distance running Obstruction impact

5.5 Roll fronts

5.5.1 Slamming shut of roll fronts

After testing in accordance with E.1, the roll front shall conform to 5.11.

5.5.2 Wear and fatigue of roll fronts

After testing in accordance with E.2, the roll front shall conform to 5.11.

5.6 Drawers

5.6.1 Strength of runners

After testing in accordance with F.1, the runners shall conform to 5.11.

5.6.2 Slamming open and shut of drawers

After testing in accordance with F.2, the drawers shall conform to 5.11.

The force required to move the drawers during the test shall not exceed 70 N and the force to maintain movement shall not exceed 45 N.

5.6.3 Displacement of bottom surface of drawers

After testing in accordance with F.3, the drawers shall conform to 5.11.

5.6.4 Wear and fatigue of drawers and runners

After testing in accordance with F.4, the drawers and runners shall conform to 5.11.

The force required to move the drawers during the test shall not exceed 70 N and the force maintain the movement shall not exceed 45 N.

5.7 Trays

5.7.1 Sustained load

After testing in accordance with G.1, the tray shall conform to 5.11.

5.7.2 Vertical downward static load

After testing in accordance with G.2, the tray shall conform to 5.11.

5.7.3 Wear and fatigue of tray and runners

After testing in accordance with G.3, the tray and runners shall conform to 5.11.

After testing in accordance with G.3, the force required to operate the loaded tray at the end of the test shall be not more than 20 % greater than that required at the beginning of the test.

5.7.4 Tray drop

After testing in accordance with G.4, the tray shall conform to 5.11.

5.8 Carcase and underframe

5.8.1 Strength of carcase and underframe

After testing in accordance with H.1, the carcase and underframe shall conform to 5.11.

5.8.2 Strength of wall attachment devices

After testing in accordance with H.2, the wall attachment devices shall conform to 5.11.

5.9 Strength of trolleys

5.9.1 Sustained load

After testing in accordance with J.1, the trolley shall conform to 5.11.

5.9.2 Castor/wheel pin retention

During the castor/wheel pin retention test as described in J.2, the castor/wheel shall not separate from the item to which it is fitted.

5.9.3 Hazard fatigue

After testing in accordance with J.3, the trolley shall conform to 5.11.

5.9.4 Long distance running

After testing in accordance with J.4, the trolley shall conform to 5.11.

5.9.5 Obstruction impact

After testing in accordance with J.5, the trolley shall conform to 5.11.

5.9.6 Horizontal fatigue

After testing in accordance with J.6, the trolley shall conform to 5.11.

5.10 Strength of coat hooks

After testing in accordance with annex K, the coat hooks shall conform to 5.11.

5.11 Acceptance criteria

NOTE. The test results are valid only for the article tested.

If the test results are intended to be applied to other similar articles, the test specimen should be representative of the production model.

After testing in accordance with annexes A to K, as applicable, the article shall be examined and shall conform to the following criteria.

- a) There shall be no fracture of any member, joint or component.

NOTE. Stress whitening is not considered to be a failure;

- b) There shall be no loosening, shown to be permanent by hand pressure applied to suitable members, of joints intended to be rigid.
- c) There shall be no deformation or wear of any component that might essentially affect its function.
- d) There shall be no loosening of any means of fixing components to the article.
- e) Moveable parts shall open and close freely and catches shall operate smoothly.