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मानक

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IS 12674-1 (1989): Methods of test for strength and stability of settees and benches, Part 1: Strength [CED 35: Furniture]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

**METHODS OF TEST
FOR STRENGTH AND STABILITY OF
SETTEES AND BENCHES**

PART 1 STRENGTH

भारतीय मानक

सेटी की सामर्थ्य और स्थिरता की परीक्षण पद्धति

भाग 1 सामर्थ्य ज्ञात करना

UDC 684·433·3 + 684·436·2 : 620·17

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards on 24 February 1989, after the draft finalized by the Furniture Sectional Committee had been approved by the Civil Engineering Division Council.

This standard is being issued in two parts. This Part (Part 1) describes the method of test to determine the strength of settees and benches by simulating the various forces that occur in use. The tests described in this standard reproduce normal use and common types of misuse to which seating may be subjected. As a result, the methods are applicable to nearly all seatings. Four test levels are given for the tests to cover the variations in severity of end use that arise from the use of delicate styles, short life furniture, robust serviceability styles, etc. Whilst the tests reproduce normal use and common types of misuse, they do not reproduce any abuse to which the article may be subjected. The tests are designed to be applied to an article, that is, fully assembled and ready for use and are only intended to determine the strength of the structure; they do not assess durability of filling materials, upholstery fabrics or foam cushions. The tests also do not reproduce the effects caused by degradation of structural materials by sunlight or chemical attack.

In the formulation of this standard, considerable assistance has been derived from BS 4875 (Part 3) : 1985 'Strength and stability of furniture : Part 3 Methods for determination of strength of settees', issued by the British Standards Institution, U.K.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'.

Indian Standard

METHODS OF TEST FOR STRENGTH AND STABILITY OF SETTEES AND BENCHES

PART 1 STRENGTH

1 SCOPE

1.1 This standard (Part 1) describes methods for determination of strength of the structure of all types of settees and other articles, such as, benches with seats for two to four persons.

1.2 This standard does not apply to chairs which are covered by IS 5416 (Part 1) : 1988 'Methods of test for strength and stability of chairs and stools : Part 1 Strength of chairs and stools'. It does not apply to multiple seating units for stadium seating as the loads applied are not representative of this type of use.

NOTE — Tests carried out according to the requirements of 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.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
IS 287 : 1973	Recommendations for maximum permissible moisture content of timber used for different purposes (<i>second revision</i>)
IS 809 : 1970	Specification for rubber flooring materials for general purposes

3 PRINCIPLE

3.1 General

The principle is to determine the strength of the structure of an article of furniture by applying to various parts, loads or forces simulating normal functional use as well as acceptable misuse, according to a graded scale of severity (*see Annex A*).

3.1.1 The inter-relation of the tests is shown in Table 1 and a summary is given in Table 2.

3.1.2 The sequence as a whole determines the following:

- a) Static strength and initial damage,
- b) fatigue strength and damage propagation, and

- c) Ability to withstand acceptable misuse and demonstration of sufficient residual strength.

3.1.3 The severity of loading is graded by varying the number of application or the magnitude of forces applied.

3.2 Static Tests

The principle of static tests is to assess the static strength of the article under high levels of loading that only occasionally occur.

3.3 Fatigue Tests

The principle of fatigue tests is to assess the strength of the component parts of the article under repeated operations, movement, or applications of loads occurring during daily use.

3.4 Impact Tests

The principle of impact tests is to assess the impact strength of the article under rapid rates of loading that only occasionally occur.

4 GENERAL REQUIREMENTS FOR TESTS

4.1 Test Loading

All loads and forces shall be measured to an accuracy of ± 5 percent.

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. The apparatus used to apply seat loading shall not restrain the article from overturning nor hinder horizontal movement of the article when the back force is applied.

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 condition shall elapse from the manufacture in the case of glued joints in timber, plastics, moulded parts, etc. Parts made of timber products shall be checked with an electric moisture meter to ensure that the moisture content conforms to the limits specified in IS 287 : 1973.

If a standard atmosphere is required for conditioning or testing, that atmosphere shall be at a temperature of $27 \pm 3^\circ\text{C}$ and a relative humidity of 50 ± 5 percent.

Table 1 Test Data (Purposes of Each Test)
(Clause 3.1.1)

Number	Title	Primary Purpose	Secondary Purpose	Type
1	a) Seat static load test b) Back static load test			
2	Arm and wing sideways static load test	Basic strength	Damage initiation	Functional
3	Arm downwards static load test			
4	a) Seat fatigue test b) Back fatigue test	Service durability	Damage propagation	
5	a) Leg forwards and sideways test b) Static load test c) Diagonal base test	Handling strength		
6	Seat impact test		Residual strength	Acceptable misuse
7	a) Back impact test b) Arm impact test	Impact strength		
8	Drop test			

Table 2 Summary of Test Procedure
(Clauses 3.1.1, 8.1.1, 8.1.2, 8.2, 8.3, 8.4.1, 8.5.2, 8.5.3, 8.5.4, 8.6, 8.7.1 and 8.8)

Number	Title	Description	Test Level (See Annex A)			
			1	2	3	4
1	a) Seat static load test	Seat force, N	1 100	1 300	1 600	2 000
	b) Back static load test	Back force at each pad, N	410	560	760	760
		Balancing seat force at each pad, N	1 100	1 300	1 600	2 000
2	Arm sideways static load test	Force applied, N	300	400	600	900
	Wing sideways static load test	Force applied, N	200	300	400	500
3	Arm downwards static load test	Force applied, N	700	800	900	1 000
4	a) Seat fatigue test	Number of cycles, 950 N seat force	25 000	50 000	100 000	200 000
	b) Back fatigue test	Number of cycles, 400 N back force	25 000	50 000	100 000	200 000
5	a) Leg forwards static load test	Maximum forward force, N	375	500	620	760
	b) Leg sideways static load test	Maximum forward force, N	300	390	490	760
		Balancing seat force, N	780	1 000	1 250	1 800
	c) Diagonal base force test	Force applied, N	250	375	500	620
6	Seat impact test	Drop height, mm	140	180	240	300
7	a) Back impact test	Drop height, mm	120	210	330	620
	b) Arm impact test	Angle, degrees	28	38	48	68
8	Drop test	Drop height, mm	75	100	150	200

4.3 Rate of Carrying Out the Tests

The 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.

During the static load tests described in 8.1 to 8.3 the forces shall be maintained for at least 10 s during each cycle.

NOTE — It is recommended that the tests are carried out at maximum rate of six cycles per minute.

4.4 Setting Up of Furniture

The articles shall be tested as delivered. Self assembly furniture shall be assembled according to instructions supplied with the article. If the article can be combined in different ways, the most adverse combination shall be used for each test.

5 INSPECTION BEFORE AND AFTER TESTING

5.1 Immediately before commencement of testing, each article shall be thoroughly inspected. Any defects in the members, joints or attachments shall be noted so that they are not attributed to the effect of the tests when the tests have been completed. A complete dimensional check shall be carried out on all articles that may suffer permanent deformation as a result of testing.

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

5.1.2 Fittings in self assembly furniture shall be tightened before testing, and after each test level if testing is carried out at more than one test level.

NOTE — Fittings in self assembly furniture that become loose during the tests do not constitute a test failure. Manufacturers of self-assembly furniture should be recommended to issue instructions with the furniture that fittings should be tightened occasionally.

5.1.3 Each article shall be subjected to each of the tests at the same test level in the order specified and the occurrence of any of the following shall be recorded as defects affecting the strength of the article:

- a) Fracture of any member, joint or component, including seat suspensions and castors;
- b) Fracture or cracking through the thickness of any part of structural shell;
- c) Loosening, shown to be permanent by hand pressure applied to suitable members, of joints intended to be rigid;

- d) Loosening of the underframe or base inserts moulded into a structural shell relative to the shell surface, shown to be permanent by means of hand pressure applied to the underframe or the base;
- e) Free movement in the back, arms, legs or other components of the article greater than that noted in the initial inspection;
- f) Deformation of any part of the article or any cracks that will adversely affect its appearance or strength;
- g) Impairment of the operation of any mechanical part.

6 APPARATUS

6.1 Means of Applying Required Loads or Forces

6.2 Means of Measuring Dimensions to an Accuracy of ± 0.2 mm

6.3 Loading Point Template (see Fig. 1, 2 and 3)

It shall consist of two shaped members fastened together by a pivot at one end. The contours of the shaped surfaces are so devised as to sink into the upholstery for a representative distance under moderate loads. For this purpose, the seat loading arm shall have a total mass of 20 kg, applied through the seat loading point. The apparatus is marked as shown in Fig. 1 so that the template can be positioned easily with two members at an angle of 90° to each other.

6.4 Stops

These shall prevent the article from sliding but not from overturning. Stops shall be not higher than 12 mm except in cases where the design of the article necessitates the use of higher stops, where the lowest stop which will prevent the article from moving, shall be used.

6.5 Seat Loading Pad

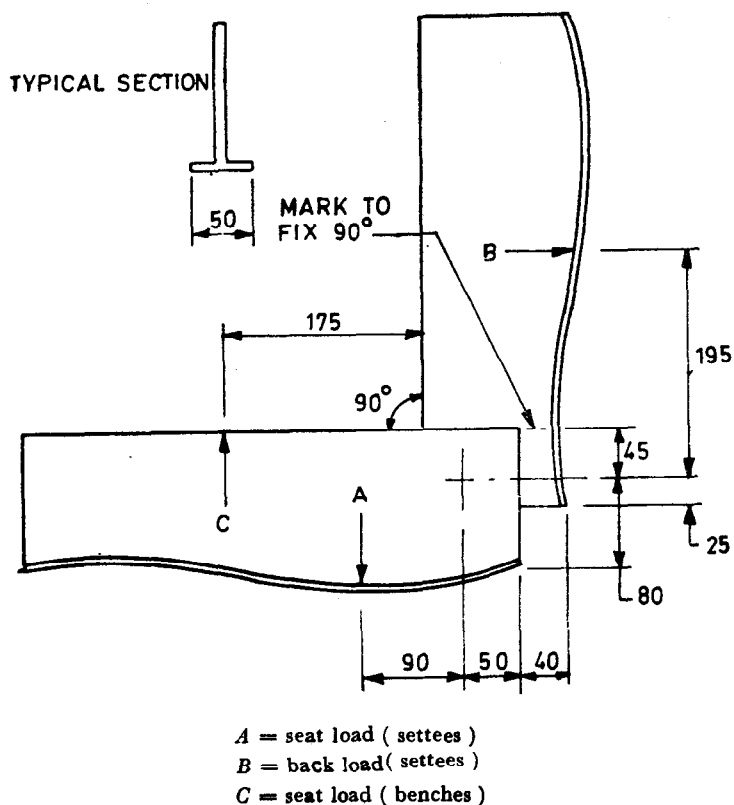
A naturalistically shaped indenter as illustrated in Fig. 4, consisting of a rigid shaped surface.

6.6 Smaller Seat Loading Pad

A rigid circular object 200 mm in diameter having a face with a convex spherical curvature of 300 mm radius and a 12 mm front edge radius (see Fig. 5).

6.7 Back Loading Pad

A rigid rectangular object 200 mm high and 250 mm wide having a face curved across the width of the pad with a convex cylindrical curvature of 450 mm radius and with a 12 mm radius on all the front edges (see Fig. 6).



All dimensions in millimetres.

FIG. 1 LOADING POINT TEMPLATE

6.8 Foam for Facing Pads

The seat and back loading pads (see 6.5, 6.6 and 6.7) are faced with a 25 mm thick layer of polyether foam. Alternatively, a layer of the polyether foam described above may be positioned between the loading pad and the test structure.

6.9 Local Loading Pad

A rigid cylindrical object 100 mm in diameter having a flat face with a 12 mm radius on the front edge.

6.10 Impactor

A mass, that is, free to move in relation to the rest of the assembly approximately 200 mm in diameter separated from the striking surface by means of springs. The moving parts, less the springs have a mass of not less than 17 kg, and the whole apparatus has a mass of 25.0 ± 0.1 kg. The springs are 400 ± 5 mm long with a closed length of 124 ± 5 mm, a spring rate of 0.69 ± 0.1 kg/mm and are set to a working length of 253.0 ± 0.5 mm (see Fig. 7). The striking surface is an approximately flat leather pad containing fine dry sand.

6.11 Impact Hammer

A striker in the form of a cylinder having a mass of 6.5 kg, supported from a pivot by a steel tube 38 mm in diameter with a wall thickness of 1.6 mm and having a mass of 2.00 ± 0.02 kg. The distance between the pivot and the centre of gravity of the striker is 1 m. The pendulum arm is pivoted by a low friction bearing (see Fig. 8).

6.12 Floor

Comprising a rubber mat 2 mm thick having a hardness of 97 IRHD when measured in accordance with IS 809 : 1970, resting on a concrete floor.

NOTE — This floor is specified only for the drop test (see 8.8).

6.13 Double Back Loading Pad

A pad consisting of two rigid rectangular objects 200 mm high and 250 mm wide whose faces are curved across the width of the pad with a convex cylindrical curvature of 450 mm radius and with a 12 mm radius on all front edges. The distance between the pads shall be adjustable so that the centres can be sited over the back loading positions on each seat.

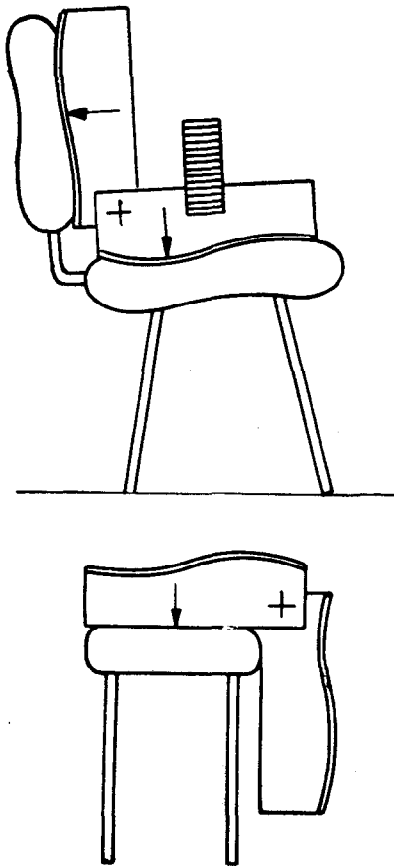


FIG. 2 POSITION OF LOADING POINT TEMPLATE

7 DETERMINATION OF SEAT AND BACK LOADING POINTS

7.1 General

If the number of seats in the article is not obvious, divide the total seat length (in mm) by 600 mm and round to the nearest whole number to determine the number of seats. Divide the total seat length into seats of equal length. Mark the position of each of the seat(s).

7.2 Settees

Position the template (6.3) with its load applied at the seat loading point on the centreline of the seat as far towards the rear as possible. Adjust its position by pushing the back loading portion into the back, so levering the seat portion forward until the shape of the template correlates with that of the seat (see Fig. 3). Mark the required loading points from the template. Repeat the procedure on the other seats.

7.3 Benches

Set up the template (6.3) at an angle of 90° with the aid of the mark as shown in Fig. 3.

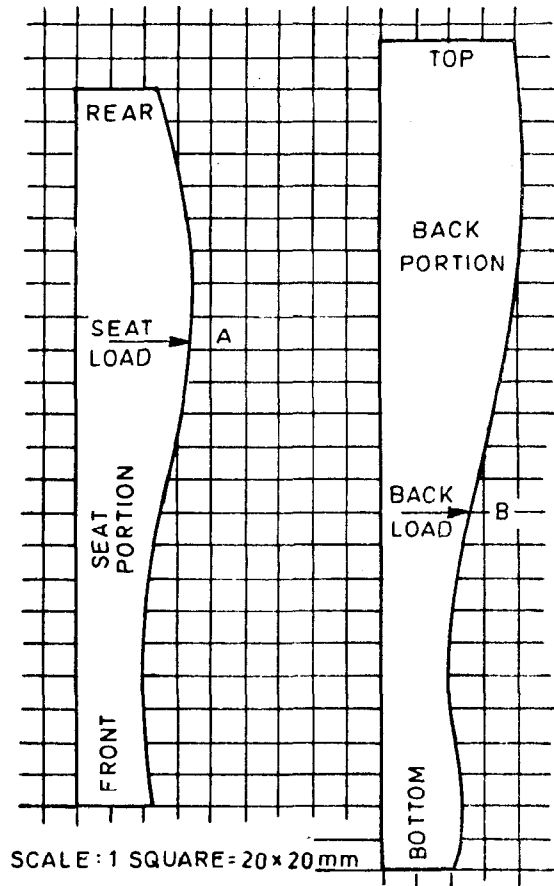


FIG. 3 LOADING SURFACE CURVES FOR CHAIR SEAT AND BACK LOADING TEMPLATE

Place on the bench as shown in Fig. 2. Mark the required loading point from the template.

8 PROCEDURE

8.1 Test 1 : Seat and Back Static Load Tests

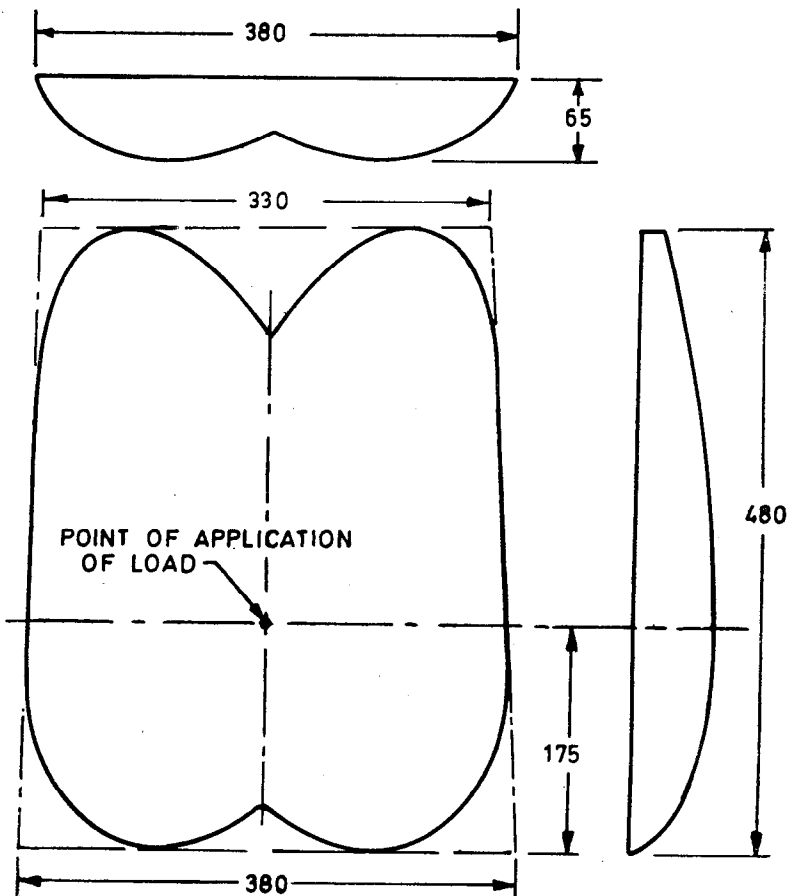
8.1.1 Test 1a : Seat Static Load Test

Carry out the test at the following positions (see Fig. 9):

- On each seat for articles with two seats,
- On one end seat and the centre seat for articles with three seats, and
- On one end seat and one of the centre seats for articles with four seats.

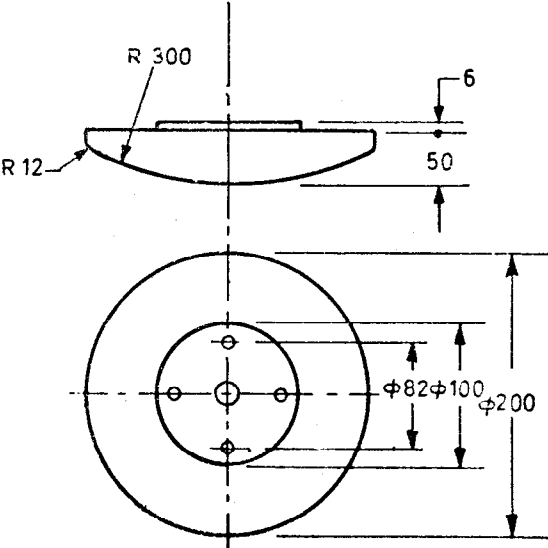
During the test load, the other seat(s), that is, not being tested with a force of 750 N applied through the smaller seat loading pad (6.6).

Mount the seat loading pad (6.5) to conform to the seat plane first at the seat loading point (see 7), and subsequently on the front edge of the seat. Apply the appropriate downward force, V specified in Table 2 for a total of 10 times. Repeat the procedure on the remaining positions as specified above.



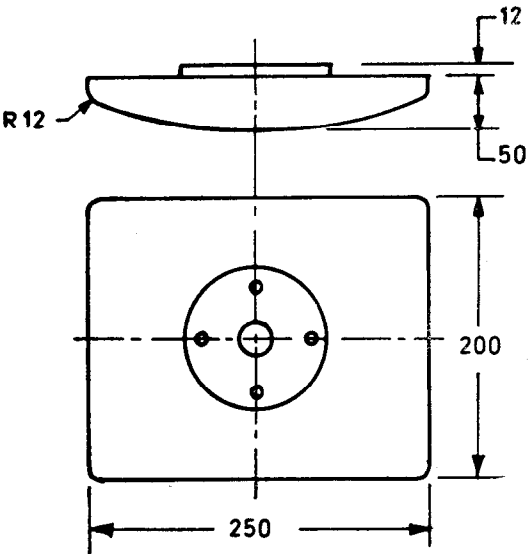
All dimensions in millimetres.

FIG. 4 SEAT LOADING PAD
(PLAN AND SIDE ELEVATION)



All dimensions in millimetres.

FIG. 5 SMALLER SEAT LOADING PAD



All dimensions in millimetres.

FIG. 6 BACK LOADING PAD

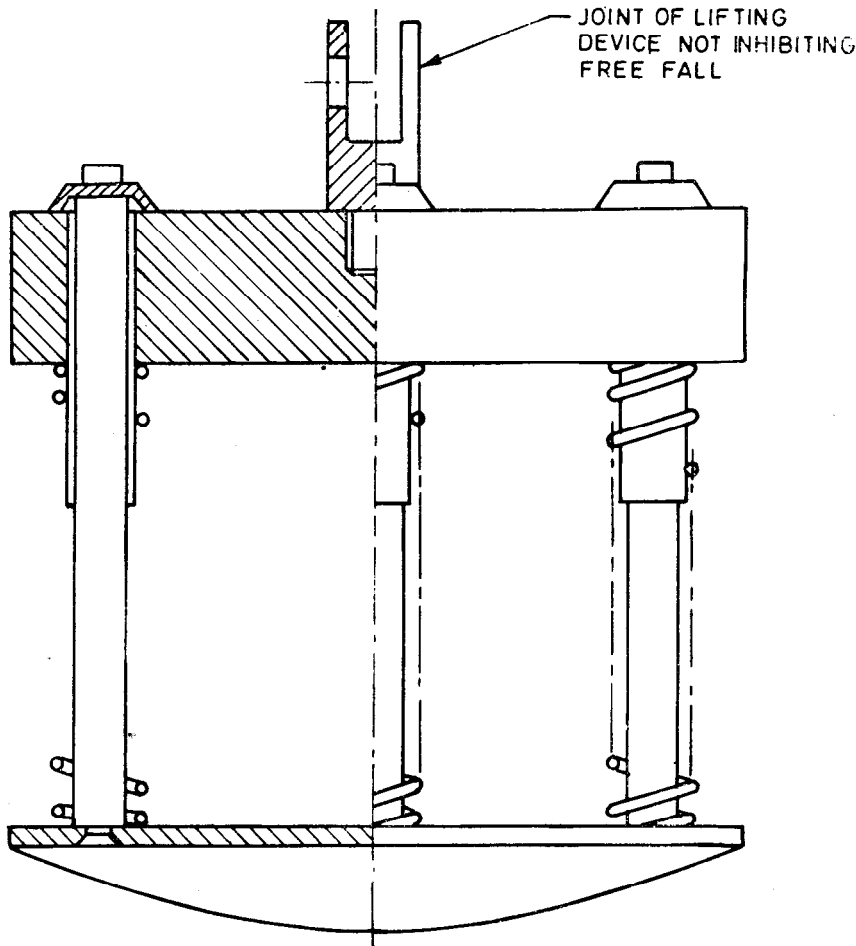


FIG. 7 IMPACTOR

8.1.2 Test 1b : Back Static Load Test

Position the centre of the double back loading pad (6.13) at the back loading point (see 7) or at 100 mm below the top of the back, whichever is the lower. Prevent the article from rearwards movement by placing stops behind the rear feet or castors.

During the test, load both seats beneath the back positions being tested with the force specified in 8.1.1 at the seat loading point (see Fig 10).

Apply the appropriate test force, H_a , specified in Table 2 perpendicular to the back when under load a total of 10 times with the balancing seat force specified in Table 2 applied at the seat loading point (see 7).

For units with three seats (1, 2, 3) carry out the test at positions 1 and 2. For units with four seats (1, 2, 3, 4) carry out the test at positions 1, 2 and 2, 3.

If the article tends to overturn, reduce the back force to a magnitude that just prevents rearwards overturning and report the actual force used.

NOTE — Since one position of the seat loading pad in the seat static load test is the same as that specified for the back static load test, it is convenient to perform these two tests as a combined seat and back static load test (Test 1).

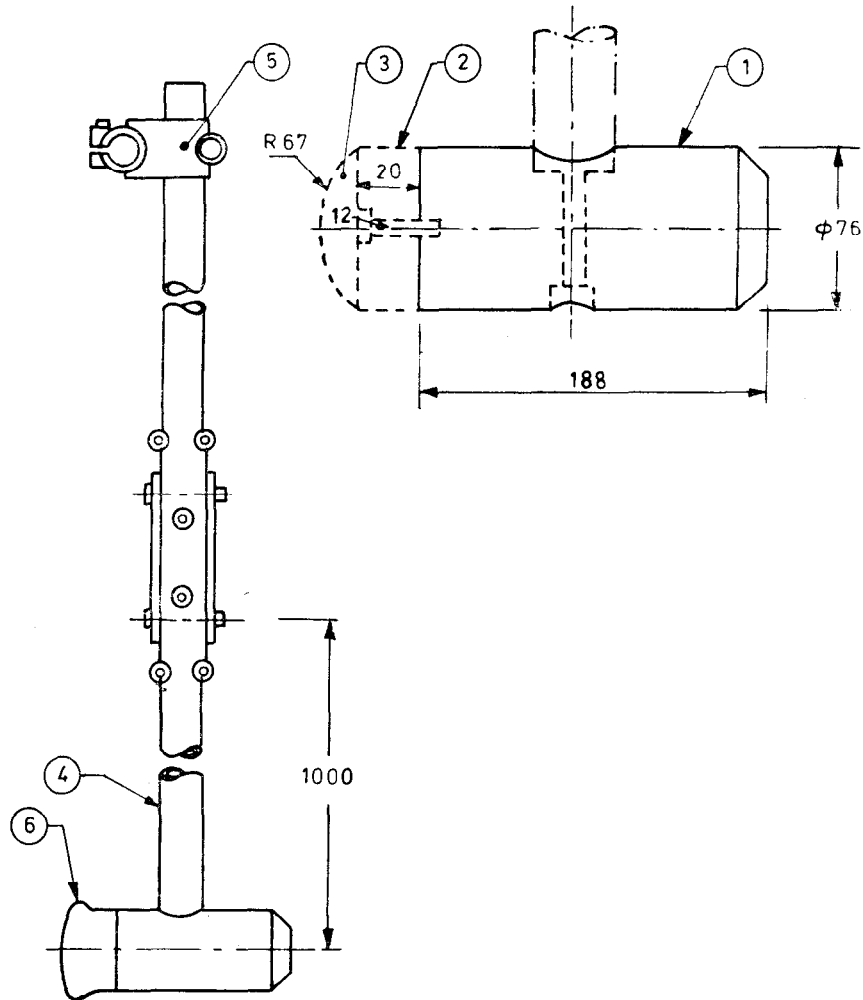
8.2 Test 2 : Arm and Wing Sideways Static Load Test

Apply two outward forces, H_a , of the appropriate magnitude specified in Table 2 between the arms of the article at the point along the arms most likely to cause failure. Apply the forces 10 times, using the local loading pad (6.9) (see Fig. 11).

If a settee has wings, that is, two side pieces at the top of a settee against which the head may be rested, repeat the test by applying the appropriate forces specified in Table 2 outwards from the wings.

8.3 Test 3 : Arm Downwards Static Load Test

Apply a vertical force, V_a , of the appropriate magnitude specified in Table 2, using the smaller seat loading pad (6.6), at the point along the arms most likely to cause a failure. Apply the force 10 times (see Fig. 12).



LEGENDS —

1. Pendulum head — mild steel mass approximately 6.4 kg
2. Beech
3. Rubber 50° shore
4. Pendulum arm — length 950 cold drawn seamless steel tube
5. Height adjustment
6. Hammer head as shown in detail

Mass of assembly 1 + 2 + 3 = 6.5 ± 0.07 kg

NOTE — Pendulum head is drawn turned 90° of working position

All dimensions in millimetres.

FIG. 8 IMPACT HAMMER

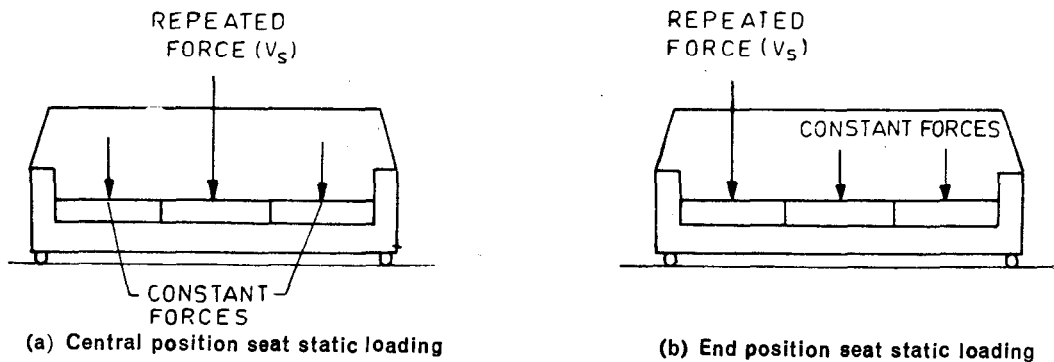
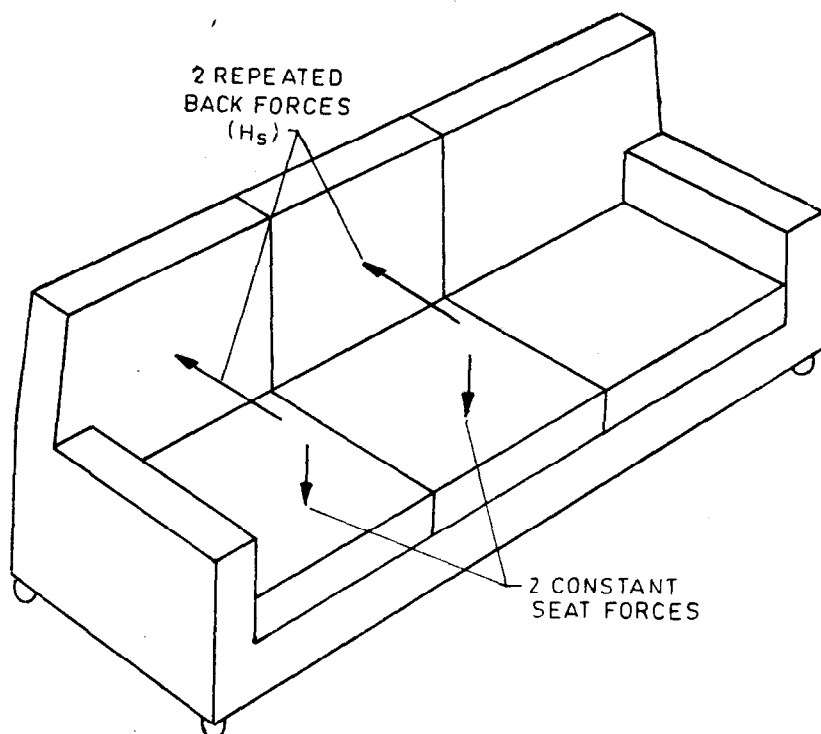


FIG. 9 SEAT STATIC LOAD TEST



Double Back Loading

FIG. 10 BACK STATIC LOAD TEST

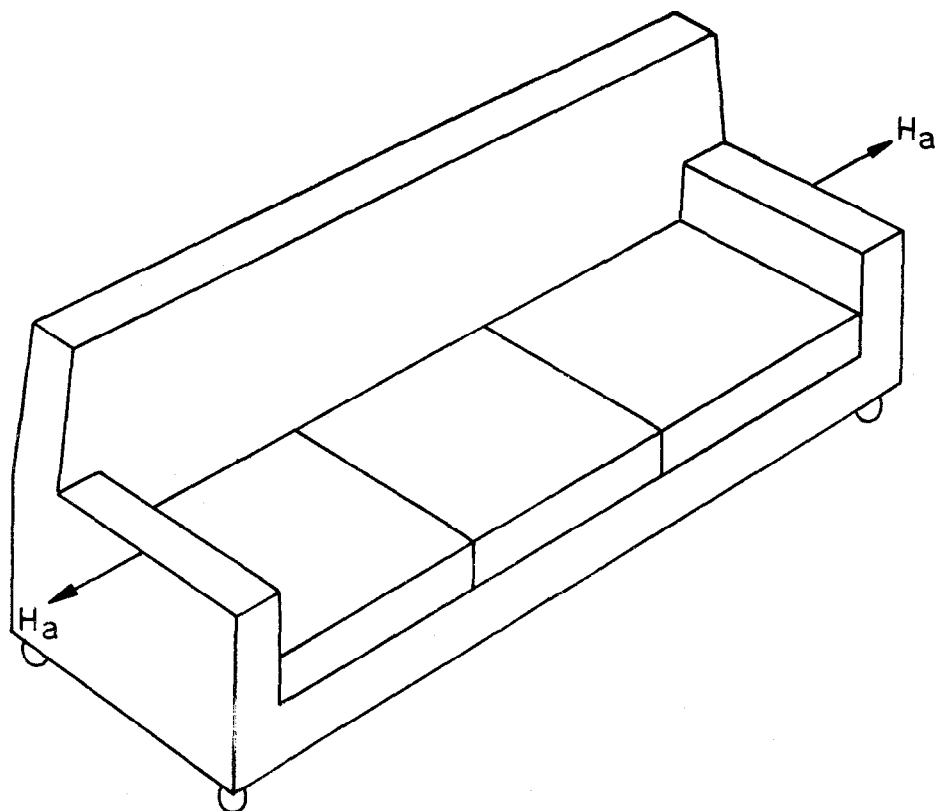


FIG. 11 ARM AND WING SIDEWAYS STATIC LOAD TESTS

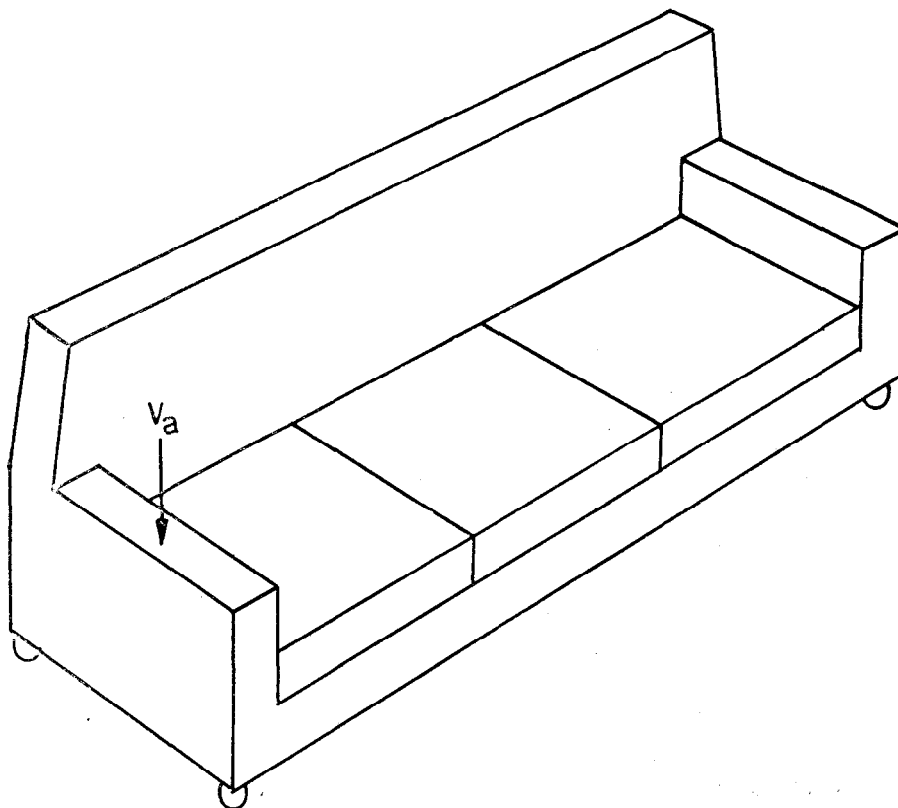


FIG. 12 ARM DOWNWARDS STATIC LOAD TEST

If the article tends to overturn, apply a balancing load large enough to prevent the article from overturning when the full force is applied, on the side of the seat opposite to that on which the full force is applied.

8.4 Test 4 : Seat and Back Fatigue Tests

NOTE — Because the number of cycles and the seat load are common to both the seat and back fatigue tests, it is normally convenient to perform these two tests together as a combined seat and back fatigue test (Test 4).

8.4.1 Test 4a : Seat Fatigue Test

Apply the test force of 950 N for appropriate number of cycles, (see Table 2) by means of the seat loading pad (6.5) positioned at the seat loading point (see 7 and Fig. 13). Carry out the test at the positions given in 8.1.1.

8.4.2 Test 4b : Back Fatigue Test

Position the centre of the back loading pad (6.7) either at the back loading point (see 7), or at 100 mm below the top of the back, whichever is the lower. Prevent the article from rearwards movement by placing stops behind the rear feet or castors. Conduct the test by the repeated application of a force of 330 N, or if the article tends to overturn, of such lesser force to just prevent rearwards overturning. Record the magnitude of any reduced force used. Conduct the test using the back loading pad (6.7).

During each cycle, apply a force of 950 N to the seat. Carry out the test at the positions specified in 8.1.1 (see Fig. 14).

8.5 Test 5 : Leg Static Load Test

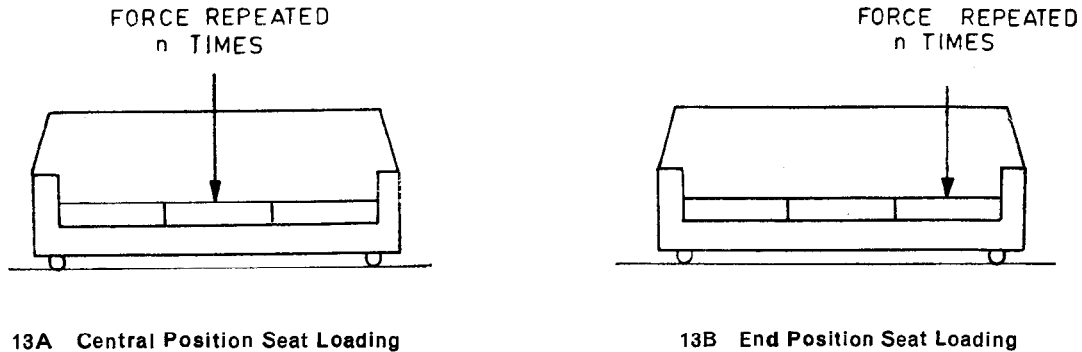
8.5.1 General

Leg tests are applicable to articles with legs or pedestals. There are no rearward leg loading tests because assessment of durability when subjected to them will have been demonstrated in the back static strength test.

Articles without legs or pedestals shall be subjected to the diagonal base test (8.5.4) instead of the tests in 8.5.2 and 8.5.3.

8.5.2 Test 5a : Leg Forward Static Load Test

Restrain the front feet of the article from movement. Apply the appropriate force specified in Table 2 at the seat loading point (see 7) by means of the loading pads (6.5 or 6.6). Apply a horizontal force centrally to the rear of the article at seat level in a forward direction using the local loading pad (6.9). The horizontal force used shall have the appropriate magnitude specified in Table 2 but if the article tends to overturn, reduce the forward leg force until forward overturning is prevented. Record the magnitude of any reduced force used. Apply the forward leg force 10 times.



n = Specified number of applications of seat fatigue force

FIG. 13 SEAT FATIGUE TEST

8.5.3 Test 5b : Leg Sideways Static Load Test

Perform the test in the same manner as the leg forwards static loading test except that a pair of front and rear test feet shall be restrained from movement whilst a horizontal force is applied centrally to the side of the article at seat level in a sideways direction towards the restrained feet. Apply appropriate force specified in Table 2.

Apply the appropriate balancing force specified in Table 2 at a suitable position across the seat but not more than 150 mm from the unloaded edge of the seat. If the article tends to overturn with the vertical seat force in its furthestmost position from the unloaded edge, reduce the horizontal seat force to a magnitude that just prevents sideways overbalancing, and record the actual force used.

8.5.4 Test 5c : Diagonal Base Test

Apply simultaneously two opposing forces of the appropriate magnitude specified in Table 2 to one pair of diagonally opposite corners of the article. Apply the forces 10 times in an inward direction as near as possible to the lowest point of the article (see Fig. 15).

8.6 Test 6 : Seat Impact Test

Allow the impactor (6.10) to fall freely onto the seat at the seat loading point (see 7) from the appropriate height specified in Table 2. Repeat the procedure 10 times. Repeat the test at any other position considered likely to cause failure, and in particular as near to the front edge as is possible at its most vulnerable point.

When testing an unupholstered article, place a piece of foam (6.8) approximately 30 mm thick on the seat. In cases of soft upholstery where it is difficult to measure the drop height accurately, first place a 2 kg mass having a diameter of 200 mm on the article and determine the drop height from the underside of the mass.

8.7 Test 7 : Back and Arm Impact Tests

8.7.1 Test 7a : Back Impact Test

Place the article with its front feet prevented by stops from moving forward. Strike the centre of the top outside of the back, or when there is no back, the centre of the seat front edge with the impact hammer (6.11) horizontally. Drop the impact hammer through the appropriate vertical height (or angle) given in Table 2 at the following back positions:

- At both positions for articles with two seats,
- At one end position and one centre position for articles with three seats, and
- At one end position and one centre position for articles with four seats.

Repeat the procedure 10 times.

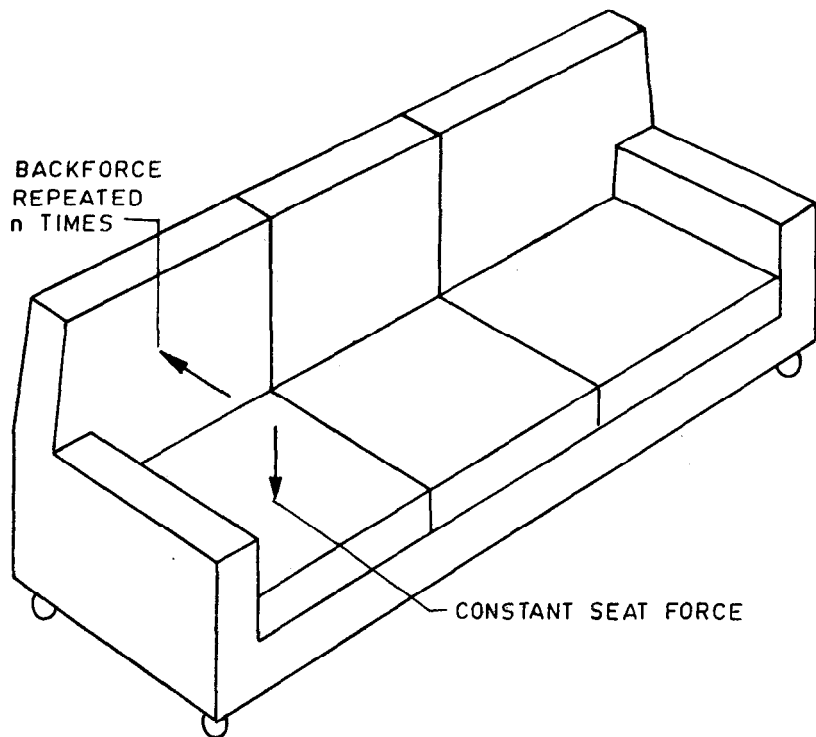
If the article has wings, rearrange the position of the article and repeat the test with the impact hammer hitting the outside of the top of one wing at right angles to the surface and in the position most likely to cause failure.

8.7.2 Test 7b : Arm Impact Test

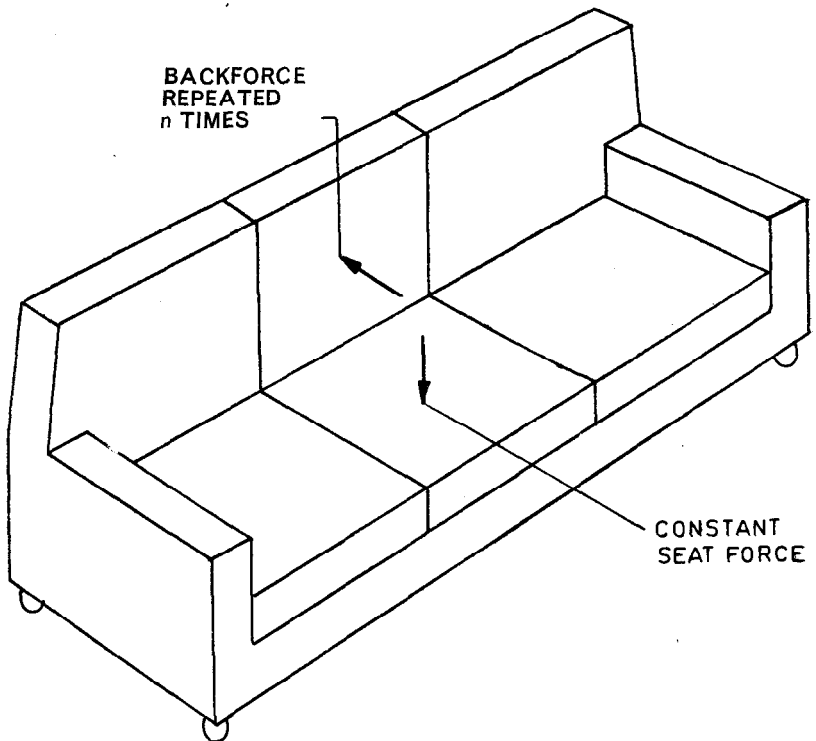
Carry out this test in the same manner as for the back impact test except to apply the impact in an inward direction to the outside face of one arm at the position most likely to cause failure (see Fig. 16). Place the stops against the feet on the opposite side of the article to the arm being tested.

8.8 Test 8 : Drop Test

Lift up the article at one end and then allow to fall freely from the appropriate height specified in Table 2 so that the impacting feet or castors strike the floor (6.12) (see Fig. 17).



14A End Position Back Fatigue Loading



14B Central Position Back Fatigue Loading

FIG. 14 BACK FATIGUE TEST

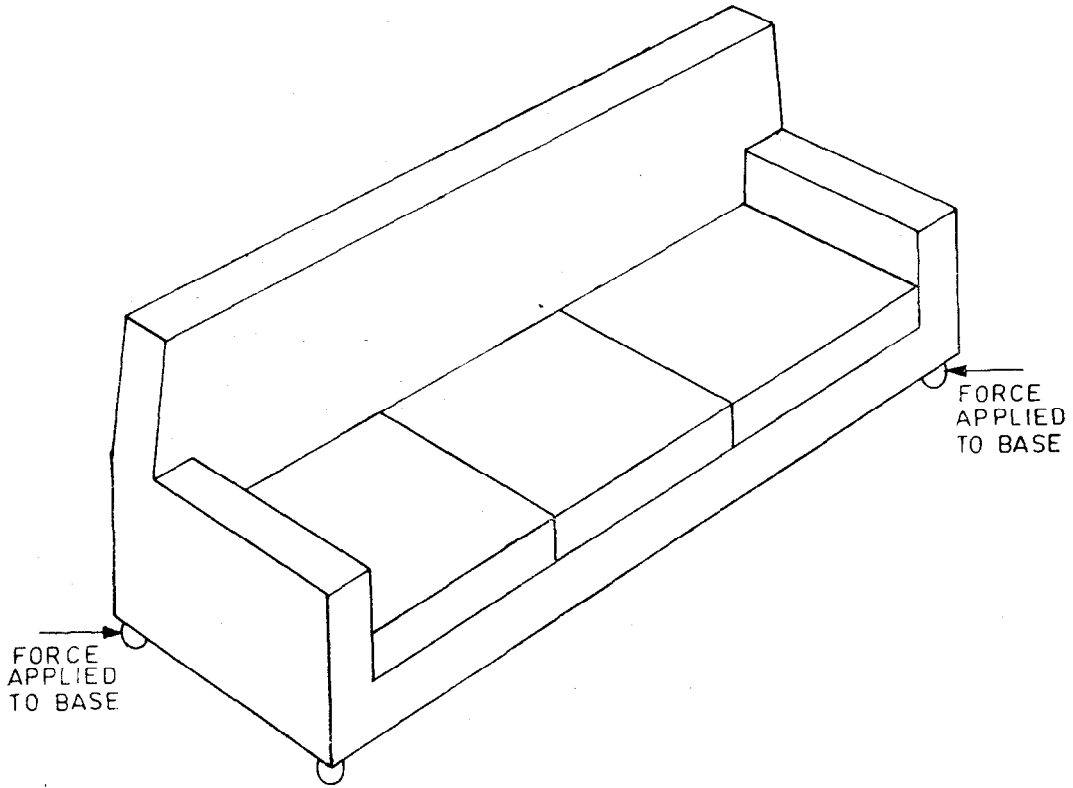


FIG. 15 DIAGONAL BASE TEST

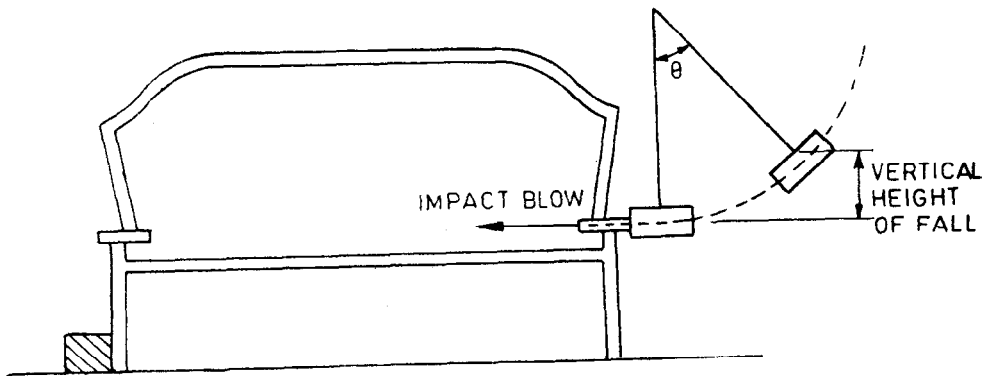


FIG. 16 ARM IMPACT TEST

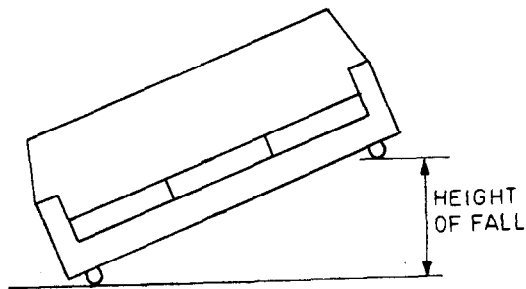


FIG. 17 DROP TEST

9 INTERPRETATION OF RESULTS

9.1 Each article shall be considered to have passed the tests at the appropriate test level if no defects are observed (see 5), if a backforce of not less than 410 N was used in 8.1.2 and if the requirements of the appropriate product specification are met.

10. TEST REPORT

10.1 The test report shall include the following particulars:

- a) Details of the article of seating tested;
- b) Test level that the article has been tested against;

- c) Details of any defects observed before the tests;
- d) Details of any defects observed after the tests;
- e) If required;
 - 1) any damage which does not impair the function of the article, and
 - 2) the magnitude of any non-standard forces used (see 8.1, 8.4 and 8.5);
- g) The test result, pass or fail; and
- h) Details of any deviation from the test procedures.

ANNEX A
(Clause 3.1 and Table 2)

TEST LEVELS OF SETTEES

A-1 EXPLANATION OF FURNITURE TEST LEVELS

A-1.1 Table 3 gives the type of use that might be expected from each furniture test level.

Table 3 Relationship of Test Levels to Use of Furniture

Test Level	Description of Performance	Example
1	Careful domestic	Domestic bedroom
2	General domestic	Domestic living/dining room or hotel bedroom
3	Severe domestic	Settees where rough treatment and careless handling occur, for example, college study, hotel reception
4	Severe	Settees intended for exceptionally severe use, for example, termini, student common room and barrack room.

A-1.2 Specific application of furniture in relation to test level is given in Table 4.

Table 4 Specific Application of Furniture in Relation to Test Level

Type of Use	Strength of Frame (Test Level)			
	1	2	3	4
Folding garden and camping	×	×		
Domestic	×	×	×	
Office		×	×	×
Educational			×	×
Institutional				×
Hotel		×	×	
Hospital		×	×	×
Military				×
Police station			×	×
Recreation room				×
Common room				×
Public hall			×	×

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Doc : No. BDC 35 (4580)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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