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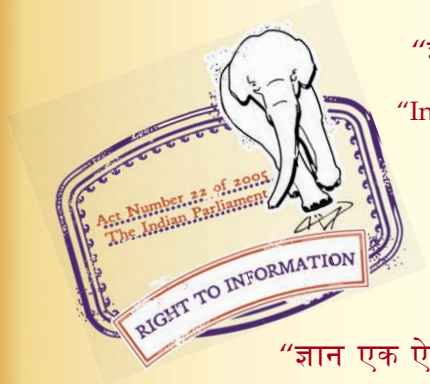
IS 5416-1 (1988): Methods of test for strength and stability of chairs and stools, Part 1: Strength [CED 35: Furniture]



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"Knowledge is such a treasure which cannot be stolen"

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IS : 5416 (Part 1) - 1988
(Reaffirmed 2002)

Indian Standard

METHODS OF TEST FOR STRENGTH AND STABILITY OF CHAIRS AND STOOLS

PART 1 STRENGTH

(First Revision)

UDC 684·435 : 620·17

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 7

August 1989

Indian Standard

METHODS OF TEST FOR STRENGTH AND STABILITY OF CHAIRS AND STOOLS

PART 1 STRENGTH

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 1) (First Revision) was adopted by the Bureau of Indian Standards on 15 December 1988, after the draft finalized by the Furniture Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard was first published in 1969 covering the methods of test for general purpose erect wooden chairs for evaluation of their sturdiness. In this revision, the standard is being issued in two parts. Part 1 of this standard covers method of test for determination of strength of chairs and stools. Part 2 will cover methods of test for determination of stability of chairs and stools. The major changes made in this revision are that the realignment of the test has been improved by specifying the use of realistic apparatus. The scope of the standard has been enlarged to cover the chairs of other materials and tests for stools have been included.

0.3 In the formulation of this standard, considerable assistance has been derived from BS 4875: Part 1 : 1985 'Strength and stability of furniture: Part 1 Methods for determination of strength of chairs and stools', issued by the British Standards Institution.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 1) gives test methods for determination of strength of the structure of all types of chairs and stools.

2. TERMINOLOGY

2.1 For the purpose of this standard, definitions given in IS : 4415-1967* shall apply.

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 function.

3.2 The interrelation of the tests is shown in Table 1 and the test loads are given in Table 2.

*Glossary of terms for wooden furniture and fixtures (*first revision*).

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.

The severity of loading is graded by varying the number of applications or the magnitude of forces applied (*see* Table 3).

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

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

TABLE 1 PURPOSE OF EACH TEST

(*Clause* 3.2)

SEQUENCE	NUMBER	TITLE	PRIMARY PURPOSE	SECONDARY PURPOSE	TYPE
1	1a 1b	Seat static load test Back static load test	Basic strength	Damage initiation	Functional
2	2	Arm and wing sideways static load test			
3	3	Arm downwards static load test			
4	4a 4b	Seat fatigue test Back fatigue test	Service durability	Damage propagation	
5	5a 5b 5c	Leg forwards and sideways test Static load test Diagonal base test	Handling strength	Residual strength	Acceptable misuse
6	6	Seat impact test	Impact strength		
7	7a 7b	Back impact test Arm impact test			
8	8	Drop test			
9	9	Chair swivelling wear test	Service	No secondary purpose	Functional
10	10	Seat height adjustment wear test	Wear		

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

4. TEST SAMPLES

4.1 Tests shall be carried out on chairs and stools before final polishing.

4.2 Before each test, the chair or stool shall be carefully examined for any visible defects. Such defects shall be noted, so that they are not attributed to subsequent tests.

4.3 In order to assess whether a lot submitted for inspection and test conforms to the relevant requirement of this specification, the following procedure shall be adopted:

The samples shall be drawn at random from a lot in accordance with Table 4.

4.4 All tests shall be done on the same chair and stool in order in which they are mentioned in **3.**

5. REQUIREMENTS FOR TESTS

5.1 Test Loads — All loads and forces shall be measured to an accuracy of ± 5 percent.

5.2 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 the manufacture in the case of glued joints in timber, plastics, mould parts, etc.

TABLE 2 TEST LOADS

(*Clause* 3.2)

Number	Title	Description	Test Level (*See* Appendix A)				
			1	2	3	4	5
1a	Seat static load test	Seat force (in N)	—	1 100	1 300	1 600	2 000
1b	Back static load test	Back force (in N) at each pad	—	410	560	760	760
		Balancing seat force (in N)	—	1 100	1 300	1 600	2 000
2	Arm sideways static load test	Force applied (in N)	—	300	400	600	900
	Wing sideways static load test	Force applied (in N)	—	200	300	400	500
3	Arm downwards static load test	Force applied (in N)	—	700	800	900	1 000
4a	Seat fatigue test	Number of cycles: 950 N seat force	12 500	25 000	50 000	100 000	200 000
4b	Back fatigue test	Number of cycles: 330 N back force	12 500	25 000	50 000	100 000	200 000
5a	Leg forwards static load test	Maximum forward force (in N)	300	375	500	620	760
5b	Leg sideways static load test	Maximum sideways force (in N)	250	300	390	490	760
		Balancing seat force (in N)	760	780	1 000	1 250	1 800
5c	Diagonal base force test	Force applied (in N)	125	250	375	500	620
6	Seat impact test	Drop height (in mm)	—	140	180	240	300
7a	Back impact test	Drop height (in mm)	—	120	210	330	620
7b	Arm impact test	Angle (in degrees)	—	28	38	48	68
7c	Wing impact test	Drop height (in mm)	—	120	210	330	620
		Angle (in degrees)	—	28	38	48	68
8	Drop test	Drop height (in mm)					
		a) Stacking chairs and stools with legs or pedestals longer than 200 mm	150	300	450	600	900
		b) Non-stacking chairs with legs or pedestals longer than 200 mm	—	150	200	300	450
		c) Chairs and stools with legs or pedestals shorter than 200 mm	—	75	100	150	250
9	Chair swivelling wear test	Number of cycles	—	25 000	50 000	100 000	200 000
10	Seat height adjustment wear test	Number of cycles	—	—	10 000	15 000	25 000

Note — The absence of a value for certain tests at some test levels indicates that the test is not appropriate at that level.

TABLE 3 SPECIFIC APPLICATIONS FOR FURNITURE IN RELATION TO TEST LEVELS

(*Clause* 3.2)

Types of Use	Strength of Frame (Test Level)				
	1	2	3	4	5
Folding garden and camping		×	×		
Domestic	×	×	×	×	
Office			×	×	×
Educational				×	×
Institutional					×
Hotel			×	×	
Non-specialized hospital			×	×	×
Military				×	×
Police station				×	×
Recreation room					×
Common room					×
Public hall				×	×

TABLE 4 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

(*Clause* 4.3)

Lot Size (No. of Samples in the Lot)	Sample Size (No. of Samples) to be Selected	Permissible No. of Defective Chairs or Stools
(1)	(2)	(3)
Up to 50	3	0
51 ,, 150	5	0
151 ,, 300	8	0
301 ,, 500	13	0
501 ,, 1 000	20	1
1 001 ,, 3 000	32	2
3 001 and above	50	3

Parts made of timber products shall be checked with an electric moisture meter to ensure that the moisture content is between 12 and 15 percent. If the moisture content is too high, the article shall be allowed to dry out in a warm ventilated room until the moisture content is between 12 and 15 percent.

If a standard atmosphere is required for conditioning or testing, that atmosphere shall be a temperature of 27 ± 3°C and a relative humidity of 50 ± 5 percent.

5.3 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 **9.1** to **9.3** 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.

6. INSPECTION BEFORE AND AFTER TESTING

6.1 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.

6.2 Immediately after the 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.

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

NOTE — Fittings in self-assembly furniture that come 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.

6.4 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) Any fracture of any member, joint or component, including seat suspensions and castors;

b) Any fracture or cracking through the thickness of any part of structural shell;

c) Any loosening, shown to be permanent by hand pressure applied to suitable members, of joints intended to be rigid;

d) Any 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 base;

e) Any free movement in the back, arms, legs or other components of the article greater than that noted in the initial inspection;

f) Any deformation of any part of the article or any cracks that will adversely affect its appearance or strength;

g) Any impairment of the operation of any mechanical part (including any significant change in the seat height during any phase of the seat height adjustment tests); and

h) Any clearly audible noise developed during testing.

7. APPARATUS

7.1 Means of applying required loads or forces.

7.2 Means of measuring dimensions to an accuracy of ± 0·2 mm.

7.3 Loading Point Template (*see* Fig. 1, 2 and 3) — consisting 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 is positioned easily with the two members at an angle of 90° to each other.

7.4 Stops — to 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.

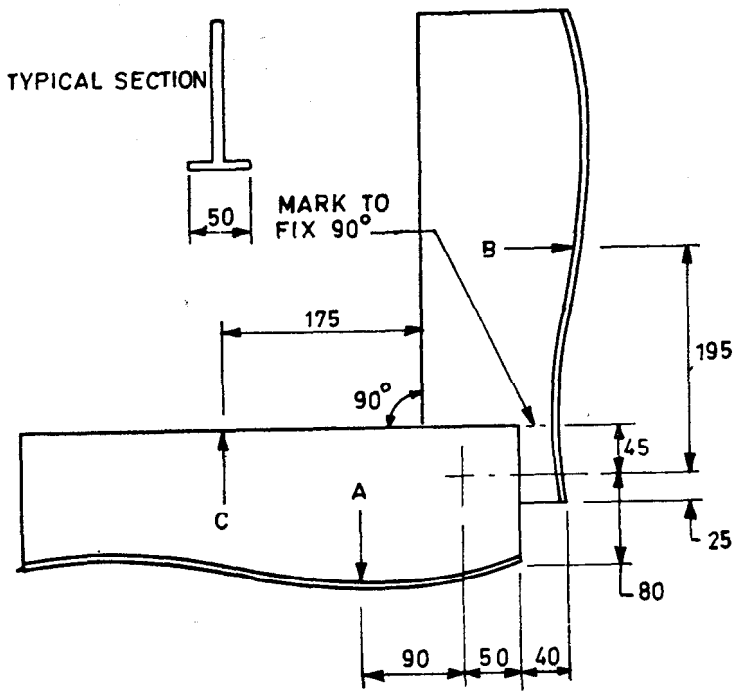
7.5 All loading pads should be capable of pivoting at least in the vertical plane and if design constrictions allow it, also in the horizontal plane.

7.6 Seat Loading Pad—a naturalistically shaped indentor as illustrated in Fig. 4, consisting of a rigid shaped surface.

NOTE — The shape, being complex, is defined not in a drawing but in existing moulds.

7.7 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).

7.8 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 front edges (*see* Fig. 6).



A = seat load (chairs)
B = back load (chairs)
C = seat load (stools)

All dimensions in millimetres.

FIG. 1 LOADING POINT TEMPLATE

7.9 Foam for Facing Pads — the seat and back loading pads (**7.6, 7.7** and **7.8**) are faced with a 25 mm thick layer of polyether foam with a hardness index, when measured of 135/660 N at a density of 27 to 30 kg/m^3. Alternatively, a layer of the polyether foam described above may be positioned between the loading pad and the test structure.

7.10 Local Loading Pad — a rigid cylindrical object 100 mm in diameter having a flat face with a 12 mm radius on the front edge.

7.11 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.

7.12 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).

8. DETERMINATION OF SEAT AND BACK LOADING POINTS

8.1 For Chairs — Position the template (*see* **7.3**) with its load applied at the seat loading point on the centreline of the chair 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 chair (*see* Fig. 2). Mark the required loading points from the template.

8.2 For Stools — Set up the template (*see* **7.3**) at an angle of 90° with the aid of the mark as shown in Fig. 3. Place the template on the stool as shown in Fig. 2. Mark the required loading point from the template.

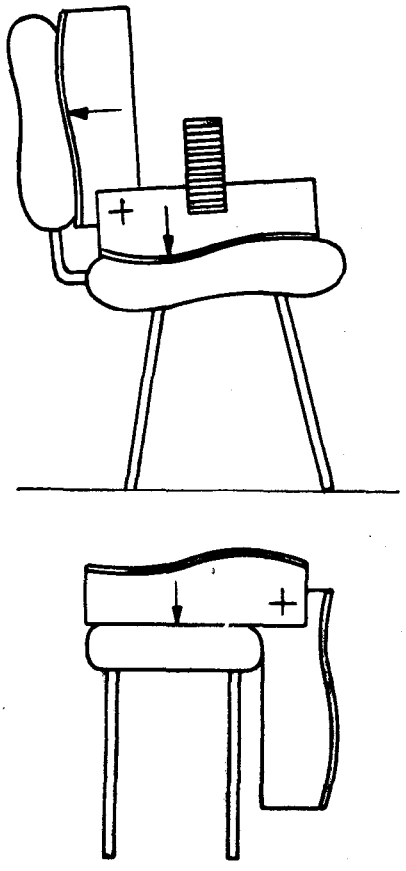


FIG. 2 POSITION OF LOADING POINT TEMPLATE

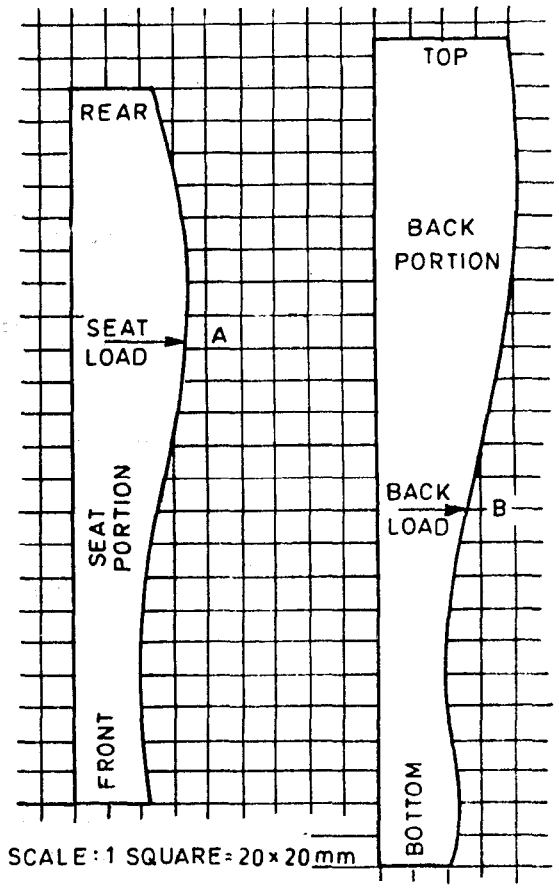


FIG. 3 LOADING SURFACE CURVES FOR CHAIR SEAT AND BACK LOADING TEMPLATE

9. TEST PROCEDURE

9.1 Test 1 : Seat and Back Static Load Tests

9.1.1 *Test 1a : Seat Static Load Test* — Mount the seat loading pad (*see* **7.6**) to conform to the seat plane, first at the seat loading point (*see* **8**), and subsequently 100 mm back from the front edge of the seat. Apply the appropriate downward force, V_s (*see* Fig. 9), specified in Table 2 for a total of 10 times.

In cases such as pedestal and cantilever chairs when it is not clear which of several positions of the seat loading pad is likely to cause failure, subject each of the positions to 10 applications of the force specified above, using, if appropriate, the smaller seat loading pad (**7.7**).

For stools, apply the force along the fore and aft centreline of the seat at the seat loading point (*see* **8**).

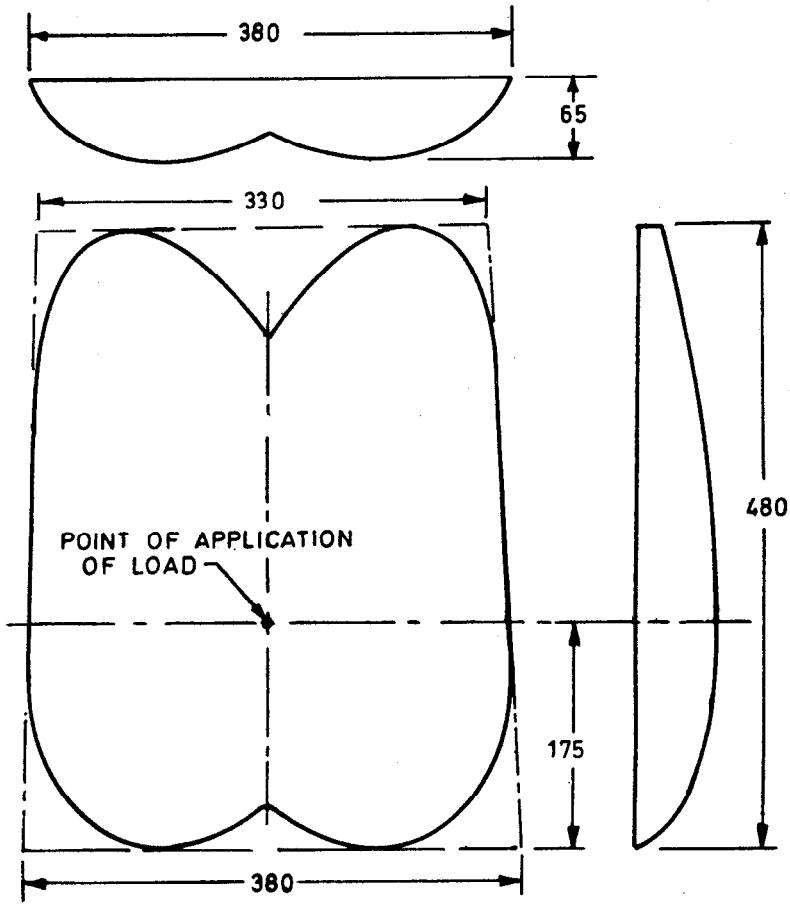
Apply the force at the specified distance from any point on the circumference using, if necessary, the smaller seat loading pad (*see* **7.7**).

Additionally, for reclining chairs with footrests, repeat the test at the same test level on the footrest using the smaller seat loading pad (*see* **7.7**) with the force applied at the centre of the footrest.

9.1.2 *Test 1b : Back Static Load Test with Flexibility Assessment* — Position the centre of the back loading pad (*see* **7.8**) either at the back loading point (*see* **8**), or at 100 mm below the top of the back, whichever is the lower. Prevent the chair from rearwards movement by placing stops behind the rear feet or castors.

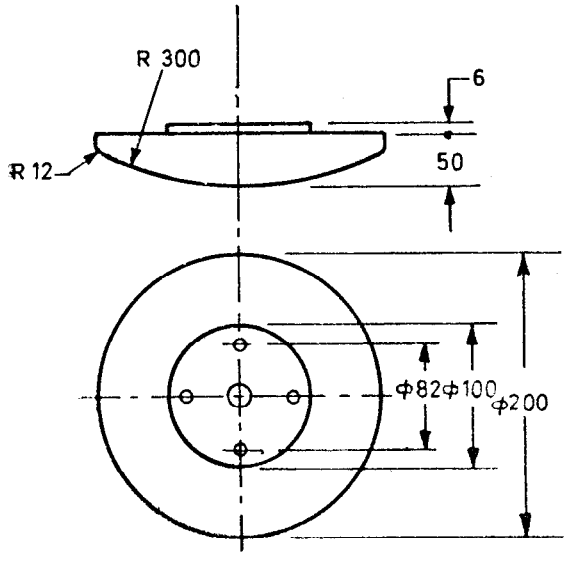
Apply the appropriate test force, H_s, specified in Table 2 (*see* Fig. 10), perpendicular to the back when under load for a total of 10 times with the balancing seat force specified in Table 2 applied at the seat loading point (*see* **8**).

If the article tends to overturn, reduce the back force to a magnitude that just prevents rearwards overturning. Report the actual force used [*see* **11.1**(b)].



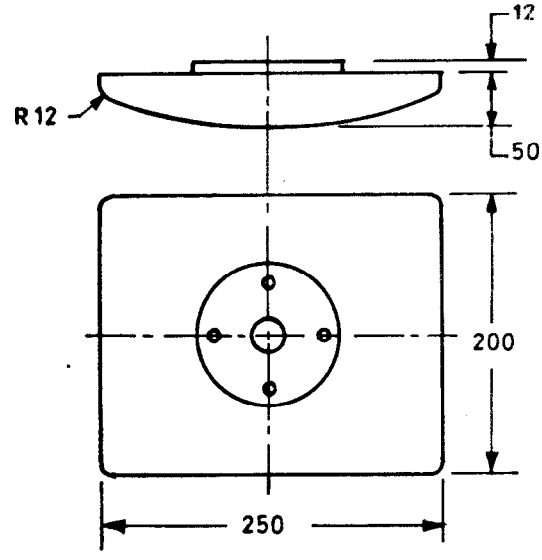
All dimensions in millimetres.

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

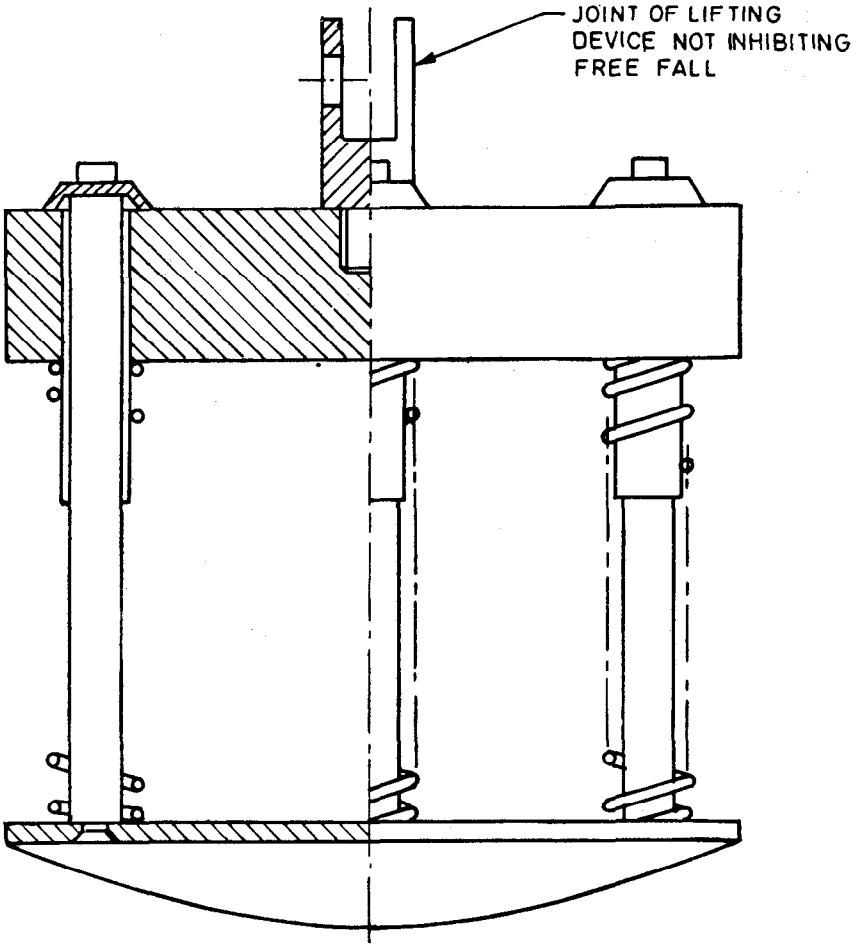


FIG. 7 IMPACTOR

When this test is applied to an article fitted with a spring rocking action base that has a tension adjustment, increase the tension so that the least possible rocking movement is obtained during the test.

If it is not possible to apply the back force at the back loading point due to the construction of the article, for example, if the back is constructed of cross-members positioned above and/or below the back loading point, use a suitable panel to spread the load over the back cross-members, ensuring that the panel used does not overlap the side upright members of the article.

When this test is applied to a stool, apply the backward force horizontally to the front edge of the seat. Regardless of the shape of the seat, for stools with rectangular underframes apply the force perpendicular to each of the two adjacent sides in turn, half the number of applications being applied to each side. For stools with triangular underframes apply the force along each of the two median lines in turn.

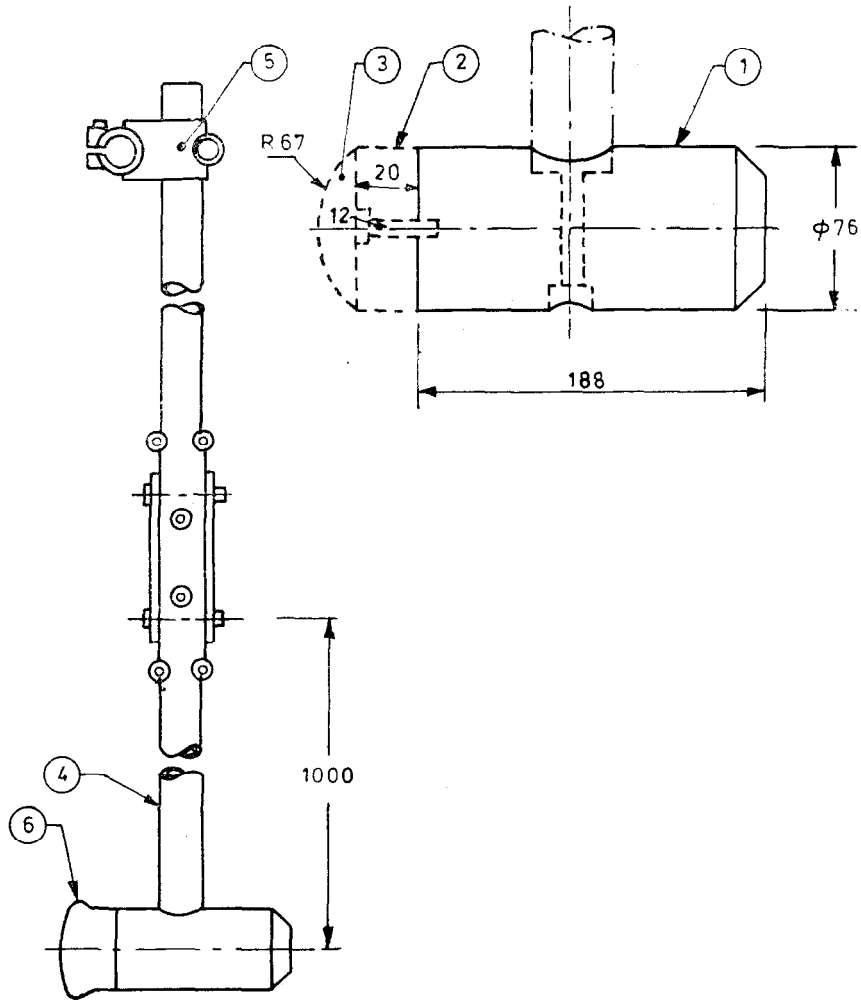
Incline chairs fitted with tilting mechanisms at $15 \pm 5°$ back from the vertical.

On the tenth application of the back force, measure the relative deflection of the back, D (*see* Fig. 10). Calculate the flexibility quotient D/H as illustrated in Fig. 10, where H is the distance from the seat surface to the top of the back and D is the deflection of the top of the back.

Additionally, for all foam chairs, maintain the back load for 5 min or until creep movement has stopped, whichever is the longer. After this, measure the distance in millimetres between the face of the indentor whilst the load is applied and the surface of the back when unloaded (measured before the test).

NOTE 1 — The deflection is measured during the back static strength test so that any plasticization of plastics components has been taken into account.

NOTE 2 — 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.



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

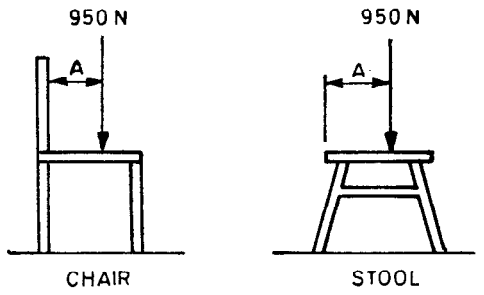
All dimensions in millimetres.

FIG. 8 IMPACT HAMMER

NOTE 3 — All foam chairs are seating units composed essentially of flexible cellular material. Internal or external reinforcement or stiffening may be incorporated but this does not function as a frame, that is, loads applied in use are transmitted to the floor or base platform by the flexible foam, and not by structural components or other material. All foam chairs are subject to creep, that is, the phenomenon of slow distortion under sustained load. Therefore, while support may be adequate immediately on sitting down, after a period of sitting, it may gradually deform.

9.2 Test 2 : Arm and Wing Sideways Static Load Tests — Apply two outward forces, H_a, of the appropriate magnitude specified in Table 2 between the arms of the chair at the point along the arms most likely to cause failure. Apply the forces 10 times using the local loading pad (*see* **7.10** and Fig. 11).

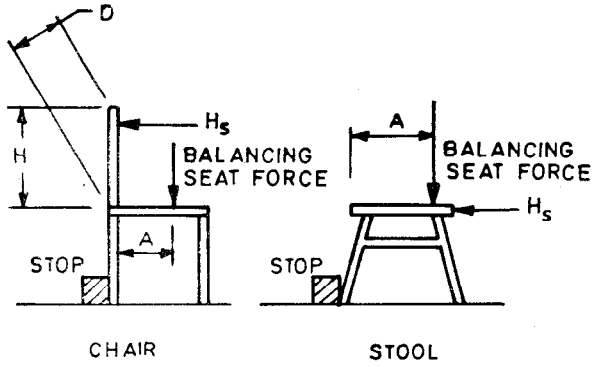
If the chair has wings, that is, two side pieces at the top of the chair against which the head may be rested, repeat the test by applying the appropriate forces specified in Table 2 outwards from the wings.



NOTE — Distance '*A*' is as determined in accordance with clause **8**.

FIG. 9 SEAT STATIC LOAD TEST

9.3 Test 3 : Arm Downwards Static Load Test — Apply a vertical force, V_a, of the appropriate magnitude specified in Table 2, using the smaller test loading pad (*see* **7.7**) at the point along the arms most likely to cause a failure. Apply the force 10 times.



NOTE — Distance '*A*' is as determined in accordance with clause **8**.

FIG. 10 BACK STATIC LOAD TEST WITH FLEXIBILITY ASSESSMENT

If the chair tends to overturn, apply a balancing load large enough to prevent the chair from overturning when the full force is applied, on the side of the seat opposite to that on which the full force is applied (*see* Fig. 12).

9.4 Test 4 : Seat and Back Fatigue Tests

9.4.1 *Test 4a : Seat Fatigue Test* — Apply the test force of 950 N by means of the seat loading pad (*see* **7.6**) with the centre of the loading pad positioned at the seat loading point (*see* **8** and Fig. 13). Apply the force for the appropriate number of times specified in Table 2.

If required, repeat the test on footrails or footrests at the appropriate test level.

9.4.2 *Test 4b : Back Fatigue Test* — Position the centre of the back loading pad (*see* **7.8**) either at the back loading point (*see* **8**), or at 100 mm below the top of the back, whichever is the lower (*see* Fig. 14). 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 reduce of force used. Conduct the test using the back loading pad (*see* **7.8**) for the appropriate number of applications specified in Table 2. During each cycle, apply a force of 950 N to the seat.

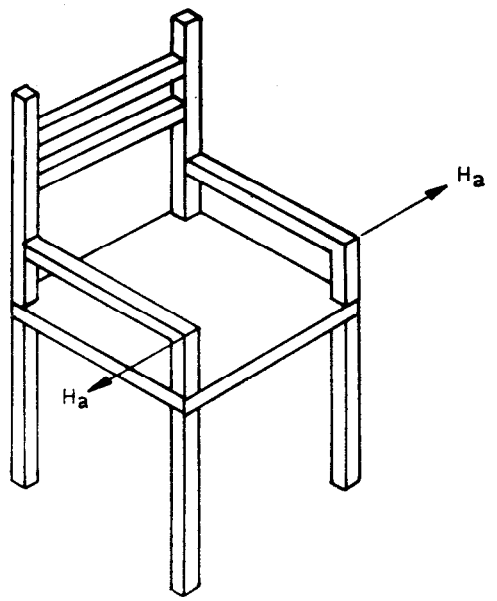
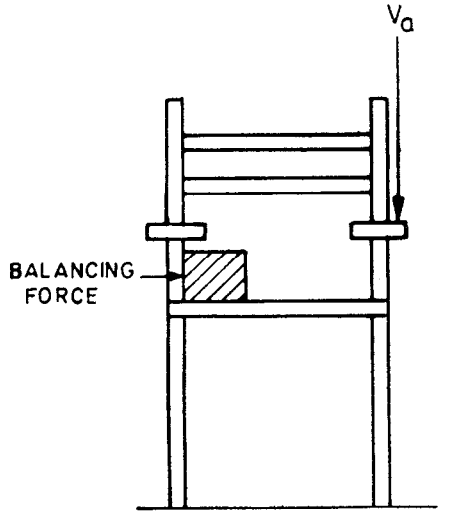


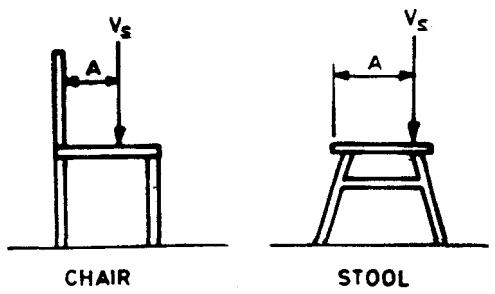
FIG. 11 ARM AND WING SIDEWAYS STATIC LOAD TEST

When this test is applied to a chair fitted with a spring rocking action base that has a tension adjustment, adjust the tension to the middle of its range of adjustment.



NOTE — Chain stable under initial load.

FIG. 12 ARMS DOWNWARDS STATIC LOAD TEST

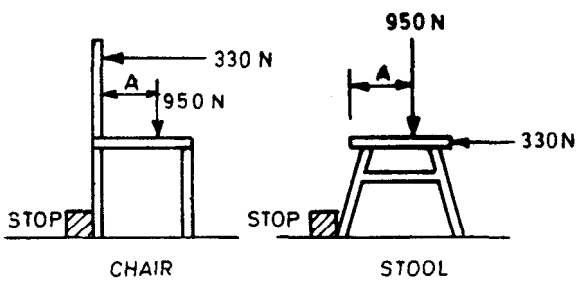


NOTE — Distance '*A*' is as determined in accordance with clause **8.**

FIG. 13 SEAT FATIGUE TEST

When this test is applied to a stool, apply the backward force horizontally to a front edge of the seat. Test stools with four legs on which the seat surface is not symmetrical both with the seat major dimensions sideways, and with the major dimensions fore and aft for half the number of applications of the force in each of the two directions. Test circular stools with three legs along two of the principal axes of the three legs.

NOTE — Because the number of cycles and the seat load are common to both the seat and back fatigue test it is normally convenient to perform these two tests (**9.4.1** and **9.4.2**) together as a considered seat and back fatigue test.



NOTE — Distance '*A*' is as determined in accordance with clause **8.**

FIG. 14 BACK FATIGUE TEST

9.5 Test 5 : Leg Static Load Test

9.5.1 *General* — Leg tests are applicable to chairs and stools with legs or pedestals except those articles with swivel actions. 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.

Similarly, the leg tests need not be applied to stools without backrests and without an obvious front or rear because proof of the performance of the stool when subjected to leg tests will have been demonstrated in the back static load test.

For stools with backrests and those with a shaped seat so that the front and rear of the stool are obvious, the leg tests shall be applied as for chairs. Where such a stool has only three legs, the foot on the stool fore and aft of the centreline and one other foot shall be provided with stops in the sideways static load test (*see* **9.5.3**).

In the forward static load test, the foot of the single front leg or the feet of the two front legs shall be provided with stops as appropriate.

Chairs without legs or pedestals shall be subjected to the diagonal base test (*see* **9.5.4**) instead of the tests in **9.5.2** and **9.5.3.**

9.5.2 *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* **8**) by means of the loading pads (*see* **7.6** or **7.7**). Apply a horizontal force centrally to the rear of the article at seat level in a forward direction using the local loading pad (**7.10**). 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 forwards overturning is prevented. Record the magnitude of any reduced force used. Apply the forward leg force 10 times.

9.5.3 *Test 5b : Leg Sideways Static Load Test* — Perform the test in the same manner as the leg forward 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 the force 10 times. The maximum force shall be the appropriate force specified in Table 2 (*see* Fig. 15).

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 furthermost position from the unloaded edge, reduce the horizontal seat force to a magnitude that just prevents sideways overturning and record the actual force used (*see* Fig. 15).

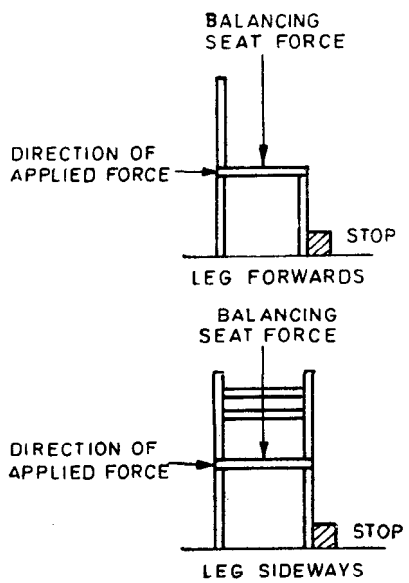


FIG. 15 LEG STATIC LOAD TEST

9.5.4 *Test 5c* : *Diagonal Base Test* (*see* **7.5.1**) — Apply simultaneously two opposing forces of 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. 16).

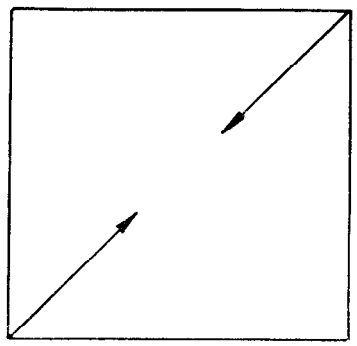
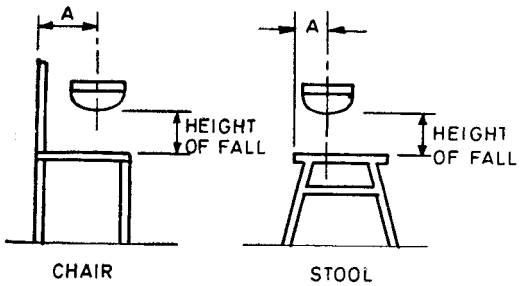


FIG. 16 DIAGONAL BASE TEST

9.6 Test 6 : Seat Impact Test — Allow the impactor (*see* **7.11**) to fall freely onto the seat at the seat loading point (*see* **8**) from the appropriate height specified in Table 2 (*see* Fig. 17). 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.



NOTE — Distance '*A*' is as determined in accordance with clause **8.**

FIG. 17 SEAT IMPACT TEST

When testing an unupholstered article, place a piece of foam (*see* **7.9**) 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.

9.7 Test 7 : Back and Arm Impact Tests

9.7.1 *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 (*see* **7.12**) horizontally (*see* Fig. 18). Drop the impact hammer through the appropriate vertical height (or angle) given in Table 2. Repeat the procedure 10 times. If a stool has no easily determined front edge, apply the test in the direction most likely to cause the stool to overturn.

If the chair or stool is provided with a swivel base, the direction of the impact shall pass through the vertical axis of the swivel.

If the chair has wings, rearrange the position of the chair 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.

9.7.2 *Test 7b* : *Arm Impact Test* — Carry out this test as for the back impact test except apply the impact in an inward direction to the outside face of one arm at the position most likely to cause failure. Place the stops against the feet on the opposite side of the article to the arm being tested (*see* Fig. 19). If the article is provided with a swivel base, the direction of impact shall pass through the vertical axis of the swivel.

9.8 Test 8 : Drop Test — Support the article so that at impact on one foot, the line joining that foot to the foot diagonally opposite is inclined at 10° to the horizontal whilst the line joining the remaining feet is horizontal (*see* Fig. 20). In the case of three-legged stools, support the stool so that

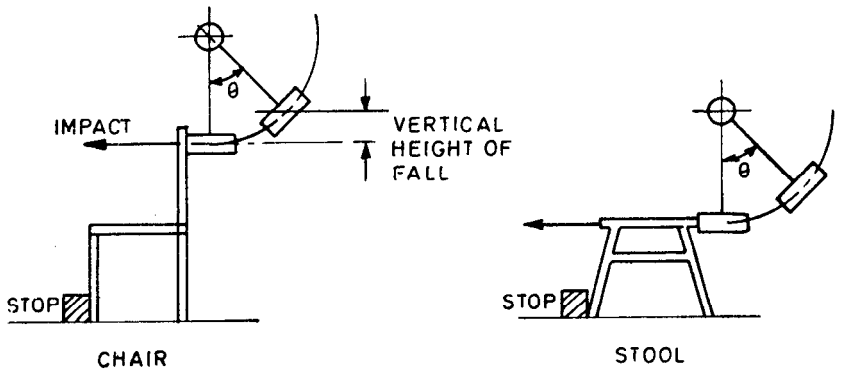


FIG. 18 BACK IMPACT TEST

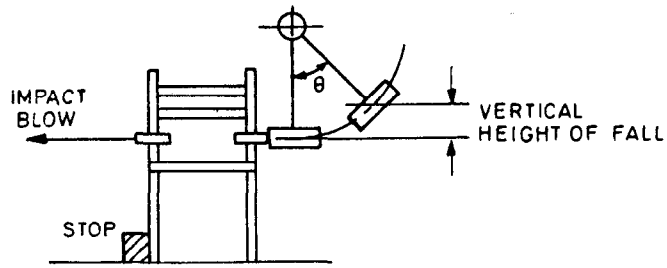


FIG. 19 ARM IMPACT TEST

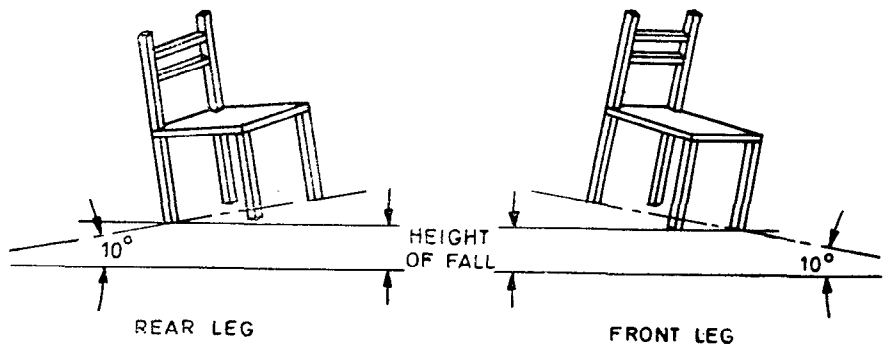


FIG. 20 DROP TEST

the line joining two feet is horizontal and the line from the third foot, that is, the one receiving the impact to the mid-point of the line is inclined at 10° to the horizontal. For chairs having 5 star bases, use the nearest diagonally opposite foot.

Lift up the article to the appropriate height specified in Table 2 for the type of leg or pedestal fitted to the article. Drop the article 10 times on to a front leg and 10 times on to a rear leg, or in the case of three-legged articles, on to two legs in turn, on to the floor.

NOTE 1 — This test may be carried out by lifting the article by three cords that are adjusted in length with the article standing in the correct orientation on a plane inclined at 10° from the horizontal.

NOTE 2 — Stacking chairs and stools are more likely to be dropped than other articles of seating. Chairs should be subjected to drop tests at whichever one of the heights specified in Table 2 is applicable.

9.9 Test 9 : Chair Swivelling Wear Test — Apply a vertical downward force of 950 N to the seat using the seat loading pad (*see* **7.6**) at the seat loading point (*see* **8**). Rotate the seat of the chair through an angle of 45° relative to the base for the appropriate number of cycles specified in Table 2.

NOTE — This test may not be carried out as the same chair used for tests given in **9.1** to **9.8.**

9.10 Test 10 : Seat Height Adjustment Wear Test — Set the seat of the chair at its maximum height and apply a vertical downward force of 950 N to the seat using the seat loading pad (*see* **7.6**) at the seat loading point (*see* **8**).

Maintain the force for at least 3 s. Lower the seat until it rests just above the lowest position of its height adjustment. Apply the force of 950 N as previously specified and maintain for at least 3 s, and then remove. Return the seat to the maximum height. Repeat the loading cycle for the appropriate number of cycles specified in Table 2. At the end of the test, maintain the seat loading force of 950 N for 1 h with the seat at its maximum height.

NOTE 1 — This test assesses semi-automatic mechanisms designed to lower the seat under the mass of a sitting person and to raise the seat when unloaded.

NOTE 2 — Some variation in the detail of the procedure may be required for different seat height adjustment mechanisms. The required number of seat height adjustment and loading cycles should be maintained.

NOTE 3 — When this test is carried out on the same chair previously used for tests given in **9.1** to **9.8**, any fatigue failures consequent on the effective repetition of the seat fatigue test need not be reported.

10. INTERPRETATION OF RESULTS

10.1 Each article shall be considered to have passed the tests at the appropriate test level if no defects are observed (*see* **6**) and if:

a) the flexibility quotient (*see* **9.1.2**) did not exceed 0·000 8 × H_s (*see* Fig. 10);

b) for all-foam chairs, the back deflection (*see* **9.1.2**) did not exceed 100 mm;

c) a back force of not less than 410 N was used in **9.1.2**; and

d) the requirements of the appropriate product specification are met.

11. TEST REPORT

11.1 The test report shall include the following particulars:

a) Details of the article tested;

b) The 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) the flexibility quotient (*see* **9.1.2**);

2) details of any damage which does not impair the function of the article;

3) the magnitude of any non-standard forces used (*see* **9.1.2**, **9.4.2**, **9.5.2** and **9.5.3**);

4) for all-foam chairs, the back deflection in mm; and

5) that the tests in **9.1.1** and **9.4.1** were additionally carried out on footrails and footrests; and

f) The test result, pass or fail.

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Printed at New India Printing Press, Khurja, India