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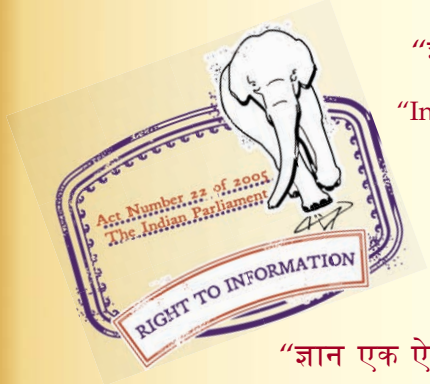
IS 5416-2 (1988): Methods of test for strength and stability of chairs and stools, Part 2: Determination of stability of chairs and stools [CED 35: Furniture]



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IS : 5416 (Part 2) - 1988
(Reaffirmed 2002)

Indian Standard

METHODS OF TEST FOR STRENGTH AND STABILITY OF CHAIRS AND STOOLS

PART 2 DETERMINATION OF STABILITY OF CHAIRS AND STOOLS

(First Revision)

UDC 684·435 : 620·17

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

Gr 4

July 1989

Indian Standard

METHODS OF TEST FOR STRENGTH AND STABILITY OF CHAIRS AND STOOLS

PART 2 DETERMINATION OF STABILITY OF CHAIRS AND STOOLS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part 2) (First Revision) was adopted by the Bureau of Indian Standards on 21 November 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 purposes of erect wooden chairs. Now this standard is being issued in two parts. Part 1 covers methods of test for determination of strength of chairs and stools of all types.

0.3 This part (Part 2) of the standard covers methods of test for determination of stability of chairs and stools.

0.4 In the formulation of this standard, considerable assistance has been derived from BS 4875 : Part 2 'Strength and stability of furniture Part 2 Methods for determination of stability of chairs and stools; issued by the British Standards Institution.

0.5 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, 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 2) prescribes the methods for determination of stability of all types of upright chairs and stools, easy chairs and tilting and reclining chairs.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Stability — The ability to withstand overturning.

3. PRINCIPLE

3.1 The principle is to determine the stability of an article by simulating the overturning forces that occur in use and determining whether the article overturns.

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.

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

5. APPARATUS

5.1 Means of Applying Required Loads or Forces

5.2 Means of Measuring Dimensions to an Accuracy of ± 0·2 mm

5.3 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 is positioned easily with the two members at an angle of 90° to each other.

5.4 Floor — It shall comprise a level horizontal surface.

5.5 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 that will prevent the article from moving shall be used.

5.6 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. It shall be constrained to remain in position without restricting the freedom of the article to overturn (*see* Fig. 4). The loading pad shall be attached to a force application device capable of applying forces with an accuracy of ± 1 N.

NOTE — A recommended linkage arrangement is shown in Fig. 5.

5.7 Discs — There shall be a total of 14 discs each having a radius of 175 mm, thickness of 40 mm and mass of 10 kg.

5.8 Support Apparatus — It shall be used for carrying out the tests in **7.6.2** to **7.6.4**, having a mass of not more than 2·5 kg.

6. DETERMINATION OF SEAT AND BACK LOADING POINTS

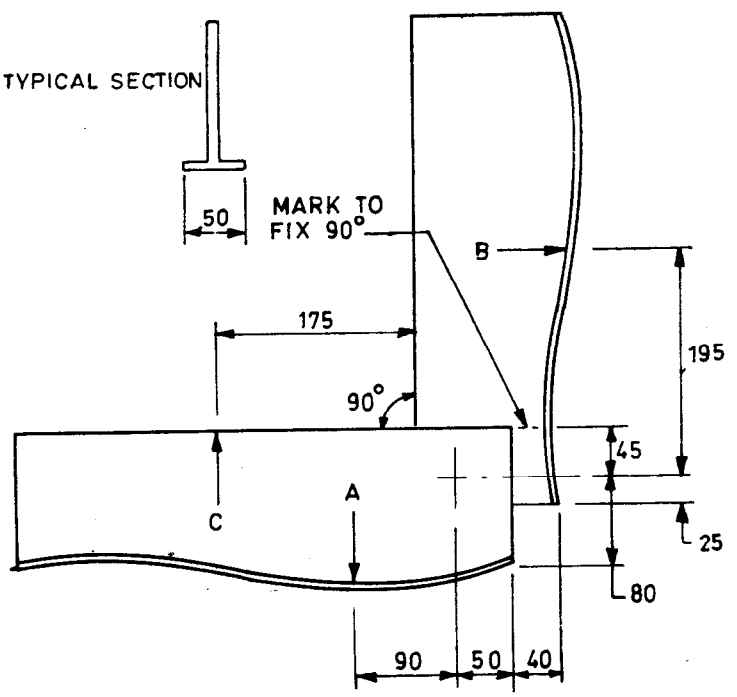
6.1 Chairs — Position the template (**5.3**) with its load applied at the seat loading point on the centre line of the chair as far towards the rear as possible. Adjust its position by pushing the back loading portion into the back, so levering the seat portion forward until the shape of the template correlates with that of the chair (*see* Fig. 3). Mark the required loading points from the template.

6.2 Stools — Set up the template (**5.3**) at an angle of 90° with the aid of the mark as shown in Fig. 3. Place the template on the steel as shown in Fig. 2. Mark the required loading point from the template.

7. PROCEDURE

7.1 General — Position the chair or stool on the floor (**5.4**) with the legs restrained by stops (**5.5**).

7.1.1 For tests on articles with swivelling bases, rotate the base to the position relative to the seat that is most likely to cause overturning and tighten



A = seat load (chairs)
B = back load (chairs)
C = seat load (stools)
All dimensions in millimetres.

FIG. 1 LOADING POINT TEMPLATE

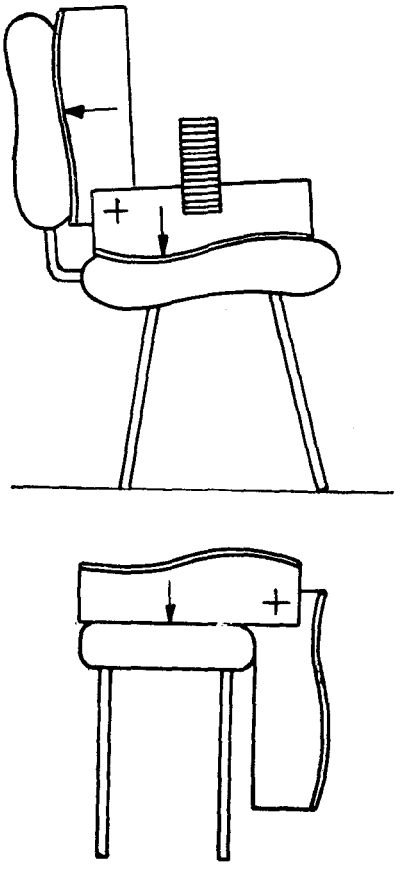


FIG. 2 POSITION OF LOADING POINT TEMPLATE

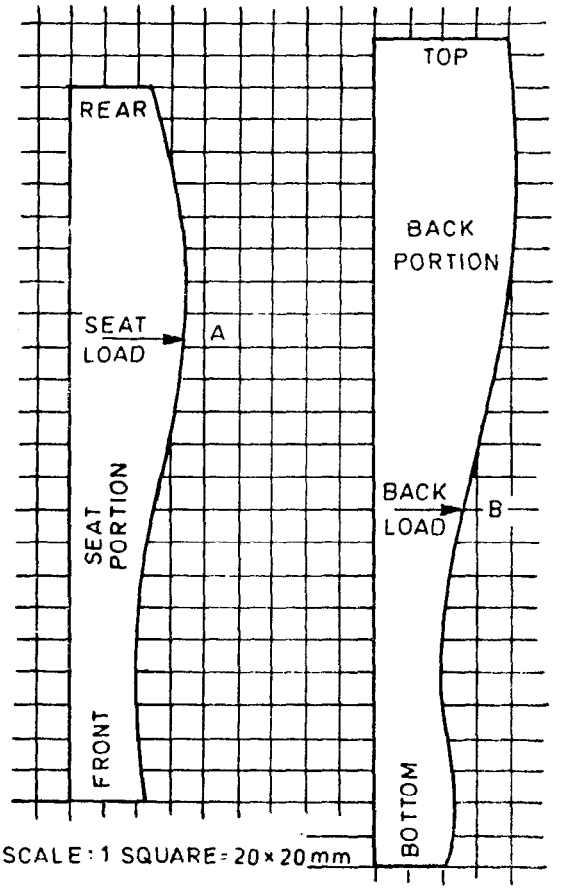
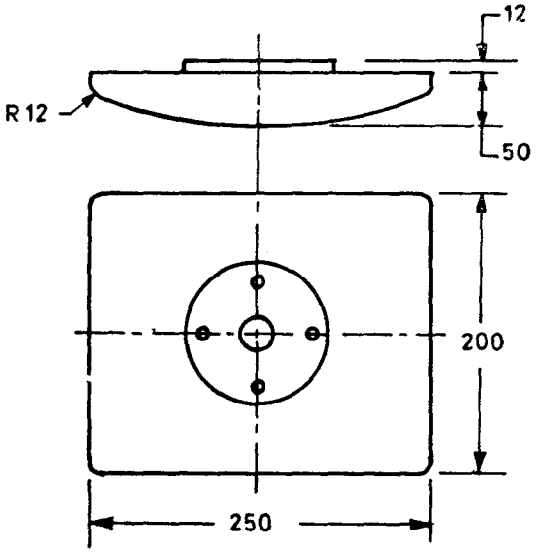


FIG. 3 LOADING SURFACE CURVES FOR CHAIR SEAT AND BACK LOADING TEMPLATE

any assembly fittings. Set adjustable height chairs at the height that is most likely to cause overturning. Place a chair or stool with a circular base with its edge against a stop in a position commensurate with that specified for four-legged chairs. Position three or five-star bases so that the two feet are against the stops (**5.5**).

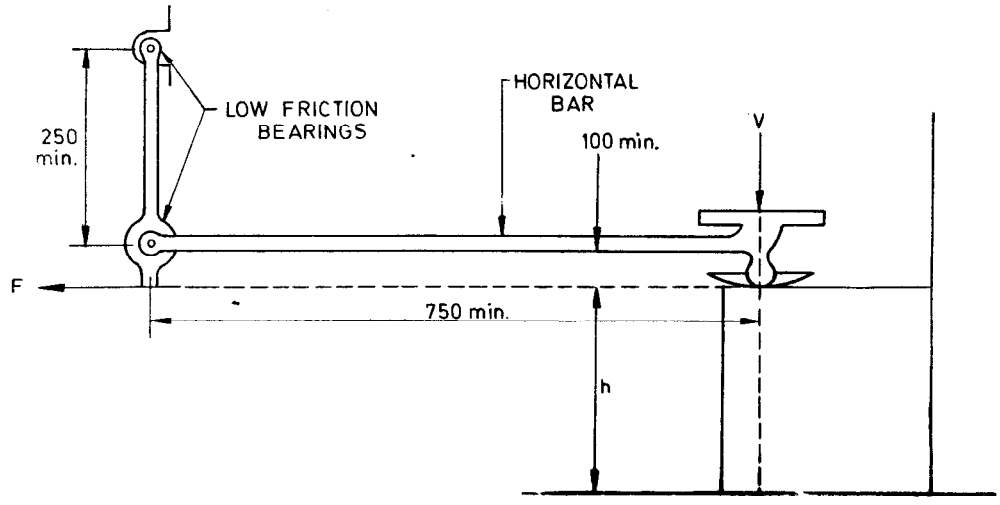
Record whether the article tends to overturn during each of the tests described in **7.2** to **7.6**.

7.2 Forward Overturning and Sideways Overturning for Chairs Without Arms — Position the chair with the stops against the front legs on one side (as appropriate). Apply a force of 600 N vertically by means of the loading pad (**5.6**) so as to act at a point 50 mm from the edge of the seat at those positions along its exposed periphery most likely to result in instability (usually tests on the centre line are sufficient). Apply a force, *F*, of 20 N horizontally along a horizontal line extended forwards from the point where the base of the loading pad meets the upper surface of the seat (*see* Fig. 6). Test chairs with adjustable backrests and reclining and tilting chairs, with their back assemblies locked or set so as to be inclined rearwards from the vertical by an angle of 15 $\pm$ 5°. Load free swivelling backrests on the axis of rotation even when this axis cannot be adjusted by an angle of 15 $\pm$ 5°.



All dimensions in millimetres.

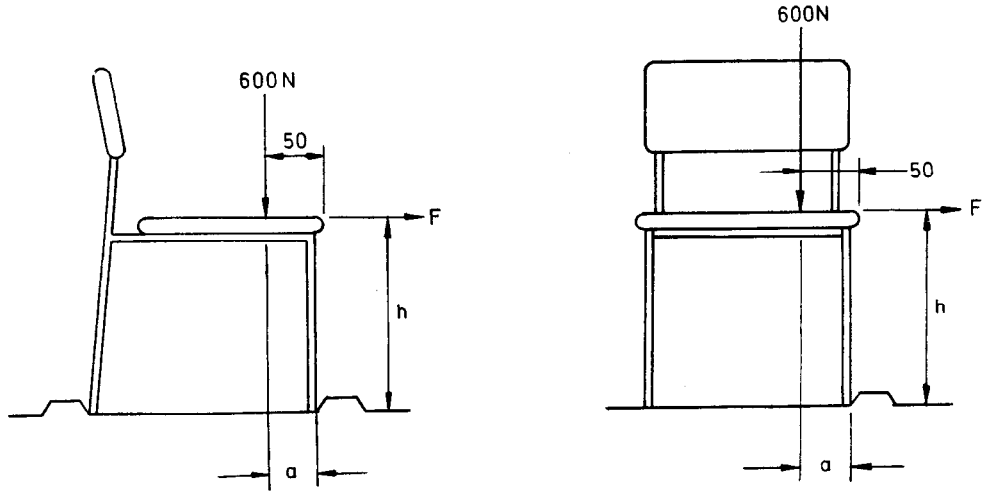
FIG. 4 BACK LOADING PAD



h = loaded seat height
V = vertical load
F = horizontal force

All dimensions in millimetres.

FIG. 5 SUGGESTED LINKAGE ARRANGEMENT CONSTRAINING LOADING PAD



All dimensions in millimetres.

FIG. 6 FORWARDS OVERTURNING AND SIDEWAYS OVERTURNING FOR CHAIRS WITHOUT ARMS

7.3 Rearward Overturning

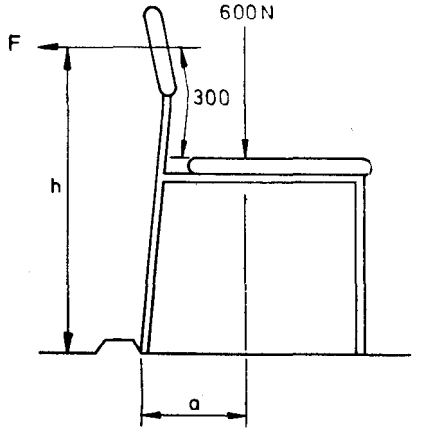
NOTE — The test applies only to chairs with backs extending 50 mm or more above the unloaded seat. This does not apply to tilting chairs or to chairs where the back reclines beyond those limits stated in **7.6.1.**

7.3.1 Position the chair with the stops against the rear legs. Apply a vertical force of 600 N to the seat by means of the loading pad (**5.6**) at the seat loading point (*see* **6** and Fig. 7). Determine the distance, h (in mm), between the loaded seat height and the floor by measuring the distance between the horizontal bar (*see* Fig. 5) and the base of the pad, and subtracting it from the distance between the horizontal bar and the floor. For chairs having a value of h greater than 720 mm, use an overturning force, F, of 80 N. For chairs having a value of h less than 720 mm, calculate the overturning force, F (in N), required from the following formula:

$$F = 285{\cdot}7 \left(1 - h/1\,000 \right)$$

Apply force F horizontally to the back of the chair at a height of 300 mm above the unloaded seat, or at the top edge of the backrest, whichever is the lower.

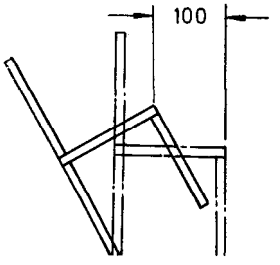
Set adjustable angle backrests (unless they adjust to such a degree that they are covered by **7.6.2** or **7.6.3**) at the rearmost point of their working range of adjustment. Load articles with free swivelling backrests on their axis of rotation even when this axis cannot be set at the rearmost point of their working range of adjustment.



All dimensions in millimetres.

FIG. 7 REARWARDS OVERTURNING UNDER LOADED CONDITION

7.3.2 Tilt the chair rearwards about its rear feet so that the front edge of the seat moves through a horizontal distance of 100 mm (*see* Fig. 8).

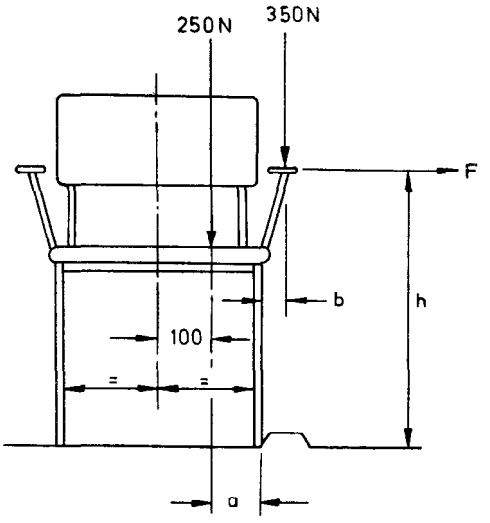


All dimensions in millimetres.

FIG. 8 REARWARDS OVERTURNING UNDER SELF WEIGHT

7.4 Sideways Overturning for Chairs with Arms — Position the chair with the stops (**5.5**) against the legs of one side. Apply a vertical force of 250 N at a point 100 mm to one side of the fore and aft centre line of the seat and between 175 and 250 mm forward of the rear edge of the seat (*see* Fig. 9). Apply a vertical force of 350 N by means of the loading pad (**5.6**) at a position 37·5 mm inside the outer edge of the arm at the most adverse position along its length. Apply a horizontal force, *F*, of 20 N outwards at the upper surface of the armrest and in line with the vertical arm force on the side with stopped feet (*see* **4**).

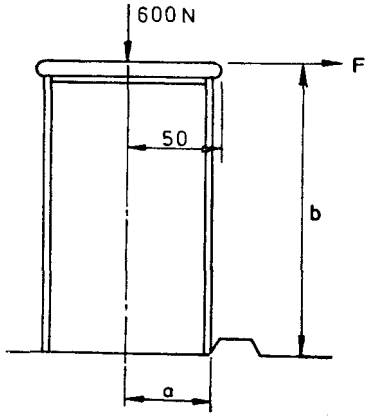
7.5 Stools — Position the feet of the stool so that the two feet are resting against the stops (**5.5**). Apply a vertical force of 600 N by means of the loading pad (**5.6**) at a point 50 mm from the



All dimensions in millimetres.

FIG. 9 SIDEWAYS OVERTURNING FOR CHAIRS WITH ARMS

edge of the seat nearest the stopped feet (*see* Fig. 10). Apply a horizontal force, *F*, of 20 N through the centre of the seat in a direction towards the stopped feet. Tilt the stool rearwards about two of its feet so that the front edge of the seat moves through a horizontal distance of 100 mm.



All dimensions in millimetres.

FIG. 10 OVERTURNING FOR STOOLS

7.6 Rearwards Overturning of Chairs with Tilting or Reclining Mechanisms

7.6.1 *General* — The tests in **7.6.2**, **7.6.3** and **7.6.4** are applicable to chairs that are fully reclined or tilted; they are not alternative methods to those for upright chairs. The test for tilting chairs is valid for all values of θ (*see* Fig. 11) and values of γ between $\gamma = 90$ and 120°. The test is not required when the minimum value of θ is greater than 55°.

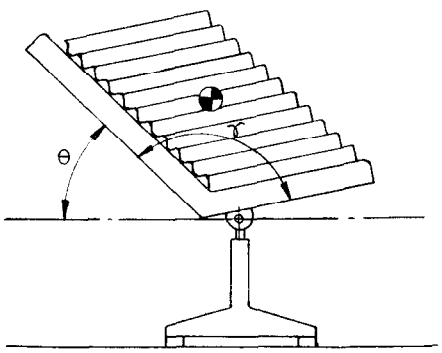
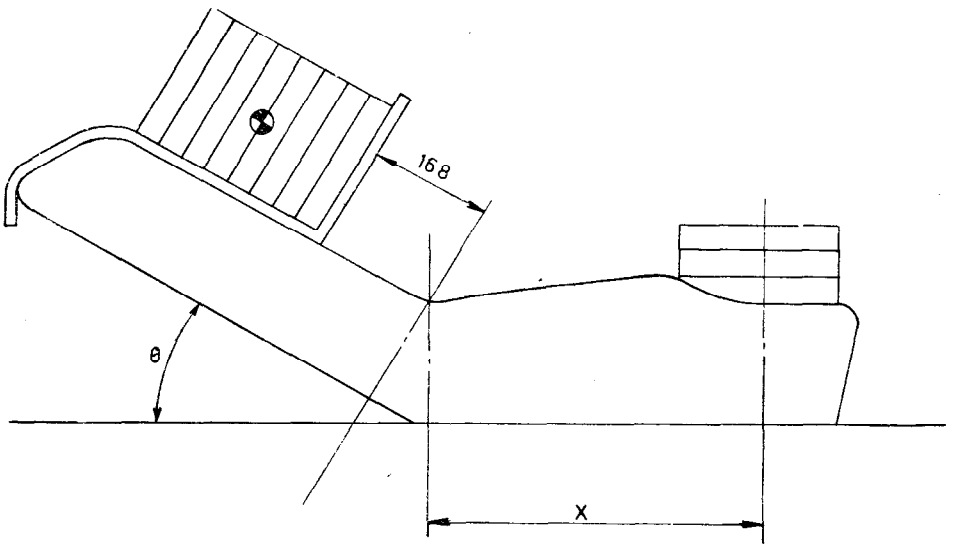


FIG. 11 TEST FOR TILTING CHAIRS

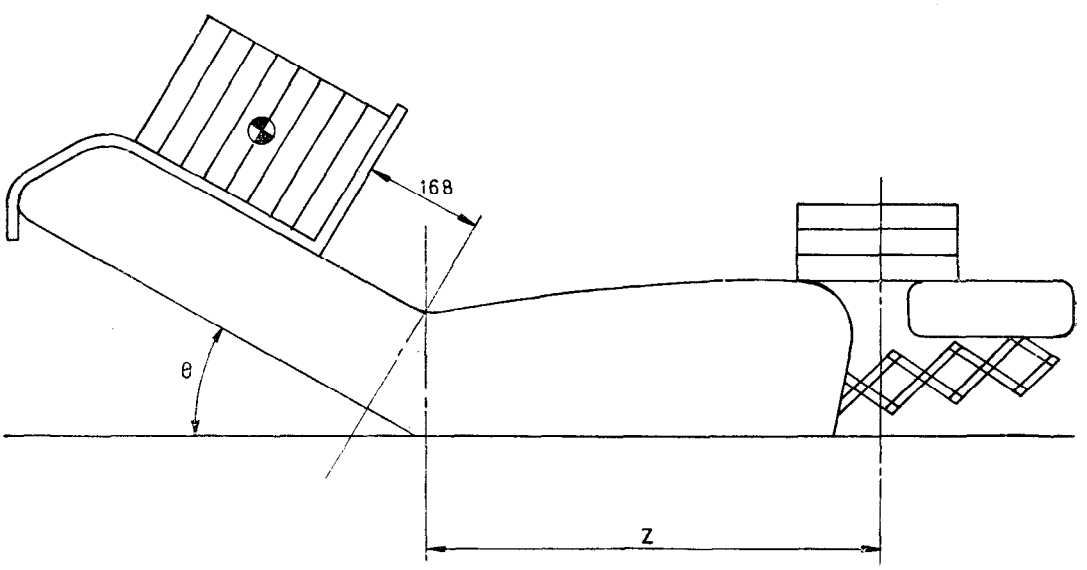
The test for reclining chairs without footrests (**7.6.3**) is valid for values of θ (*see* Fig. 12) less than or equal to 55° and the test for reclining chairs with footrests (**7.6.4**) is valid for values of θ (*see* Fig. 13) less than or equal to 45°.

7.6.2 *Tilting Chairs* — Place 11 discs (**5.7**) on the chair seat firmly settled against the contours of the back of the chair. If the discs, stacked on top of each other, exceed the height of the chair back, it is necessary to use a light stick, or other means of support, to stop the upper discs from sliding off. The apparatus of support is shown in Fig. 14.



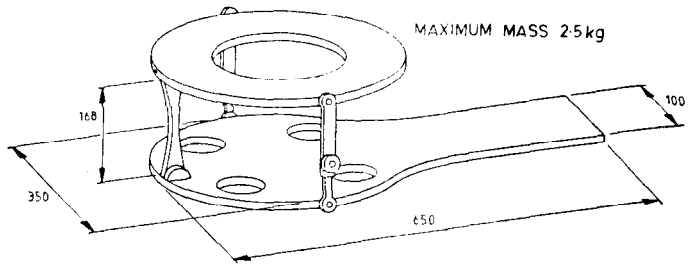
All dimensions in millimetres.

FIG. 12 TEST FOR RECLINING CHAIRS WITHOUT FOOTRESTS



All dimensions in millimetres.

FIG. 13 TEST FOR RECLINING CHAIRS WITH FOOTRESTS



All dimensions in millimetres.

FIG. 14 SUPPORT APPARATUS

7.6.3 *Reclining Chairs Without Footrests* — Set the chair in its fully reclined position. Determine the value of θ, the angle between the backrest and the floor, as illustrated in Fig. 12. Determine the value of X required by interpolation of the values in Table 1. Place eight discs (**5.7**) firmly settled against the contours of the back of the chair at a point 168 mm above the intersection point of the seat and back surfaces. Place a further three discs with their centre at a distance X mm from the intersection point of the seat and back surfaces as illustrated in Fig. 12.

7.6.4 *Reclining Chairs with Footrests* — Carry out the test described in **7.6.3** except that three discs shall be position Z mm from the intersection point of the seat and back surfaces (*see* Fig. 13 and Table 1).

8. INTERPRETATION OF RESULTS

8.1 Each article shall be considered to have passed the tests if the article did not overturn during the tests and if the requirements of the appropriate product specification are met.

9. TEST REPORT

9.1 The test report shall contain the following particulars:

a) Details of the article tested, and

b) Whether the article overturns during testing.

TABLE 1 VALUES OF *X* AND *Z*

(*Clauses* 7.6.3 *and* 7.6.4)

θ	X	Z
degrees	mm	mm
0	474	614
10	424	564
20	375	515
30	325	464
45	252	392
60	194	—

NOTE — Intermediate values can be obtained by plotting graph from the values given above.

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