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भारतीय मानक मसौदा

जिम्नास्टिक में प्रयुक्त असमान बार – विशिष्टि

(IS 4387 *का पहला पुनरीक्षण*)

Draft Indian Standard

Uneven Bars Used in Gymnastics — Specifications

(*First Revision of* IS 4387)

ICS 97.220.30

Sports Goods Sectional Committee, PGD 41	Last date for comments: 60 days from the date of circulation of the wide circulation draft.

FOREWORD

(*Formal clauses will be added later*)

Uneven bars, also referred to as asymmetric bars, are essential equipment in gymnastic events.

This standard was originally published in 1967. This first revision of this standard has been brought out to align it with the latest international rules of the game and to keep pace with the latest technological developments and international practices.

In this revision following major changes have been made:

a) Material specifications have been updated;
b) Performance parameters have been added; and
c) Manufacturing and workmanship clause have been updated.

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 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Draft Indian Standard

UNEVEN BARS USED IN GYMNASTICS — SPECIFICATION

(*First Revision of IS 4387*)

1 SCOPE

This standard covers the requirements of uneven bars, used in gymnastic competitions and training. It does not cover the specification for uneven bars used for learning.

2 TERMINOLOGY

2.1 Cable Tension — The pre-determined value of force (in N) exerted on the mounting cables of the completely-mounted unloaded uneven bars.

2.2 Static Tractive Force — The predetermined value of force (in N) exerted on the midpoint of the bar, pulling the bar vertically downwards.

2.3 Starting Position — The position of an unloaded bar from which the total deflection in vertical and horizontal direction is determined. The midpoint of the bar shall serve as the point of reference for the measurements.

2.4 Deflection — The measured distance (in mm) between the starting position and the maximum displacement of the midpoint of bar in vertical and horizontal direction respectively.

2.5 Definition of Spatial Dimensions and Test Directions — For the determination of the vertical and horizontal deflection of the midpoint of the bar or the bar linkage the spatial dimensions are defined as illustrated in Fig. 1.

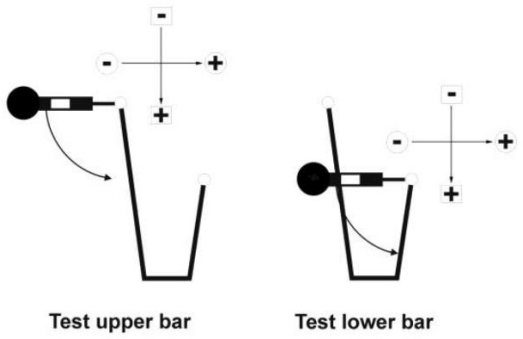


Fig. 1 SPATIAL DIMENSIONS (PENDULUM IN HORIZONTAL POSITION BEFORE RELEASE)

2.6 Pendulum — Tubular test body of given dimensions and mass with an additional low-friction falling weight inside. The test body is attached to a bar or a bar linkage with the help of two inflexible grasping arms, each of which is at the same distance from the midpoint of the bar or the bar linkage, guaranteeing a low-friction rotation of the test body about the longitudinal axis of the bar or the bar linkage.

2.7 Maximum Force (F_{max}) — The maximum value of the reaction force in the direction of the pendulum's centre of gravity measured as the sum of the forces exerted on both grasping arms during the pendulum swing, expressed in Newtons.

2.8 Hanging Position — Stable equilibrium position of the hanging pendulum under gravity conditions only.

2.9 Horizontal Position — Position of the attached pendulum rectangular to the hanging position.

2.10 Additional Falling Weight — Cylindrical test body of given dimensions and mass inside the pendulum producing an additional impact stress on the gymnastic apparatus during pendulum swing.

2.11 Internal Drop Height — Predetermined sliding distance of the additional falling weight inside the pendulum.

2.12 Initial Tension — Predetermined value of the force (in N) exerted on the bar or the bar linkage, composed of the gravity of the attached pendulum and an additional tractive force pulling the bar-pendulum system vertically downwards.

2.13 Frequency of Oscillation — Reciprocal of the value determined by the duration of the half amplitude interval divided by the number of oscillations of the bar-pendulum system within the half amplitude interval as illustrated in Fig. 2. The frequency is expressed in Hz.

2.14 Maximum Amplitude — Value of the amplitude (in mm) of the first oscillation of the bar-pendulum system after the release of the initial tension.

2.15 Half Amplitude — Value of the amplitude (in mm) of the first oscillation which is equal to or less than half the maximum amplitude.

2.16 Half Amplitude Interval — Duration of oscillation (in ms) between the passage of the maximum amplitude and the reaching of the half amplitude as illustrated in Fig. 2.

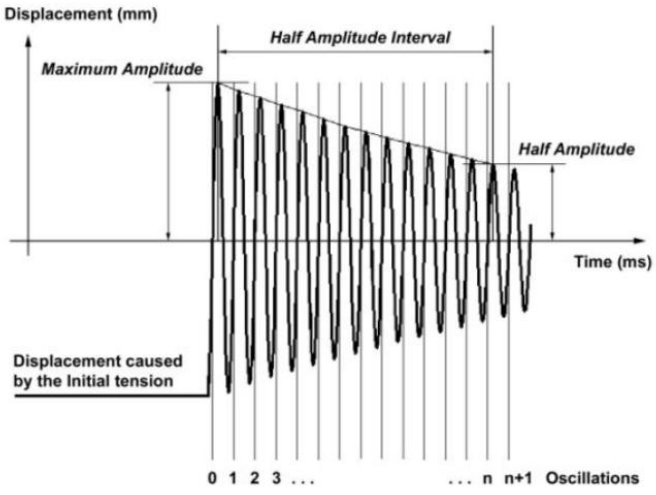


FIG. 2 OSCILLATION DAMPING PARAMETERS

3 CONSTRUCTION AND WORKMANSHIP

3.1 The apparatus shall consist of two circular-profile bars positioned parallel to each other at different heights, supported by a base structure. The support base shall include four uprights, secured by tension cables with a maximum diameter of 1 cm, anchored to the floor. Each bar is attached to two supports, with one positioned lower and the other higher. A floor-mounted mechanism allows for width adjustments between the bars.

3.2 The distance between the two bars can be adjusted from 130 cm to 180 cm, with changes made in small steps of up to 2 cm. A scale on the adjustment device indicates this distance. Additionally, both bars can be raised by 10 cm when needed, but the maximum diagonal distance between them shall not exceed 182 cm.

3.3 The entire apparatus must be stable. Incident vertical and transversal forces must not move the apparatus.

3.4 The upper surface of the bars shall be water absorbent and shall not be slippery. The surface of the bars shall be made of wood or of other material with similar behaviour.

3.5 There shall be no protruding nails, projecting wire rope terminations or pointed or sharp-edged components. Rough surfaces should not present any risk of injury. All welds shall be smooth. Protruding bolt threads within any accessible part of the equipment shall be permanently covered.

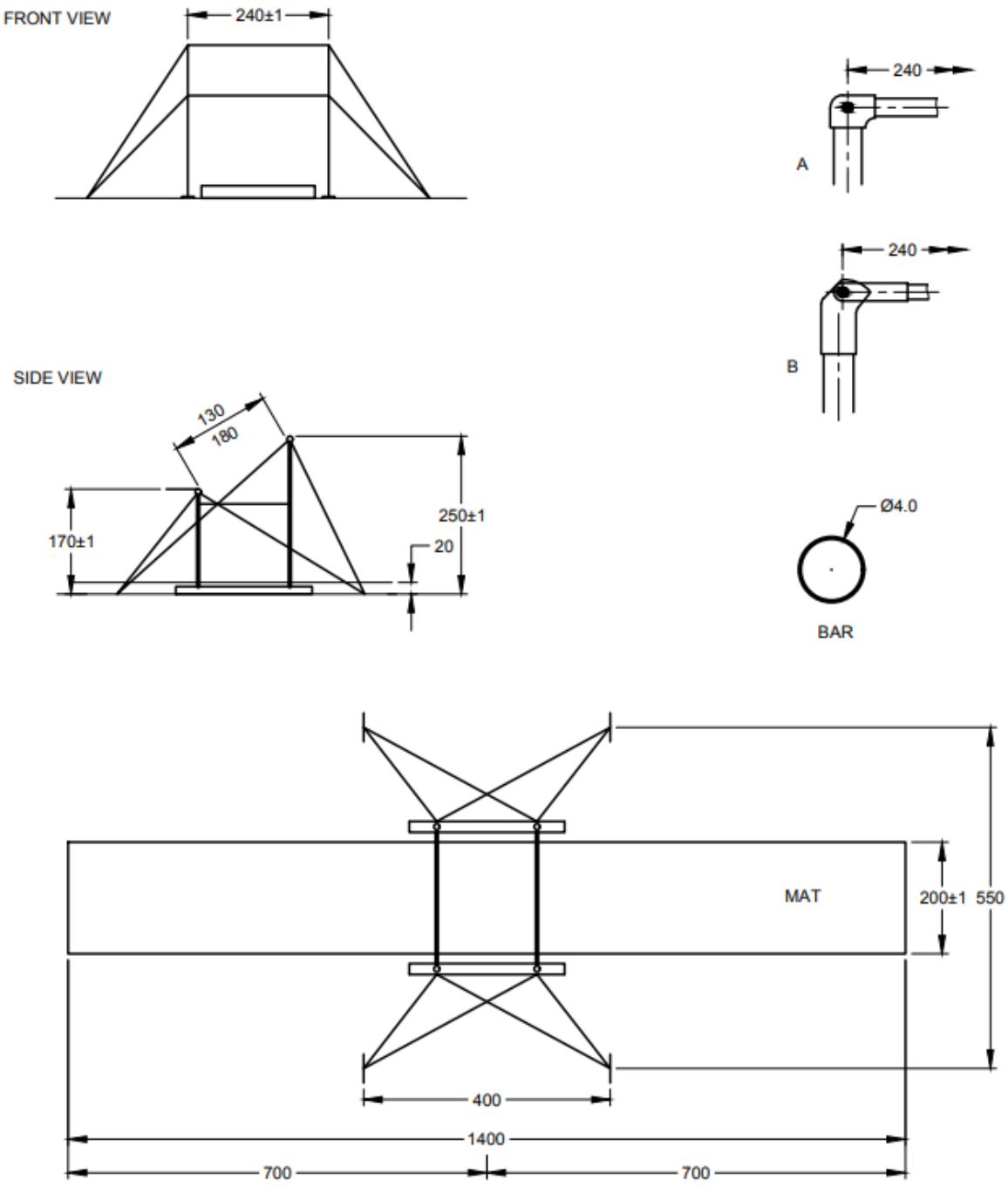
4 REQUIREMNETS

4.1 Material

The surface of the bars shall be made of wood or of other material with similar behaviour (hygroscopic plastic with the same functional characteristics as wood). If it is made of wood, it shall be free of errors like knots and fissure.

4.2 Shape and Dimensions

Shape and dimensions of uneven bar shall be as given in Fig. 3.



All dimension are in cm

FIG. 3 UNEVEN BAR

4.3 Colour

The bars shall maintain their natural wooden color and are not polished or coated, ensuring a reliable grip for gymnasts.

5 PERFORMANCE TEST REQUIREMENT

5.1 Static Traction Stress Test

The upper and lower bars of the apparatus shall be tested in accordance with the procedures outlined in Annex B. The recorded deflection values for both bars shall be within the range of 70 mm to 100 mm, inclusive.

5.2 Pendulum Swing Stress Test

The upper bar and the lower bar of the apparatus shall be tested in accordance with the procedures described in Annex C, the mean values of the measured variables for both the bars shall conform to the values given in Table 1.

Table 1 Requirements for Stress by Pendulum Swing
(*Clause* 5.2)

Sl No.	Requirements	Mean Values
(1)	(2)	(3)
i)	F_{max} (N)	$1500 \leq x \leq 1800$
ii)	Positive vertical deflection (mm)	$80 \leq x \leq 120$
iii)	Negative horizontal deflection (mm)	$-41 \leq x \leq -26$
iv)	Positive horizontal deflection (mm)	$46 \leq x \leq 71$

"x" represents the mean value of the measured variable

5.3 Oscillation Damping Test

The upper bar and the lower bar of the apparatus shall be tested according to the procedures described in Annex D, the mean values of the measured variables for both the bars shall conform to the values given in Table 2.

Table 2 Requirements for Oscillation Damping
(*Clause* 5.3)

Sl No.	Requirements	Mean Values
(1)	(2)	(3)
i)	Frequency of oscillation (Hz)	$2.50 \leq x \leq 3.50$
ii)	Half amplitude interval (ms)	$350 \leq x \leq 5700$

"x" represents the mean value of the measured variable

6 PACKGING AND MARKING

6.1 Packing

The uneven bar shall be packed as agreed to between the purchaser and the supplier.

6.2 Marking

6.2.1 The uneven bar shall be marked with the followings:

a) Manufacturer’s name and trade-mark
b) Month and year of manufacture.

7.2.2 *BIS Certification Marking*

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the standard mark.

ANNEX A

TEST SET-UP AND APPARATUS

(*Clause* B-3, C-4, and D-4)

A-1 TEST SET-UP FOR STATIC TRACTION STRESS TEST

Any type of test set-up is acceptable that is capable to stress the test specimen under prescribed conditions and monitoring and recording the displacement-time history of the midpoint of the bar.

A-2 TEST SET-UP FOR PENDULUM SWING STRESS TEST

Any type of test set-up is acceptable that is capable of stressing the test specimen with a pendulum swing under prescribed conditions and monitoring and recording the displacement-time history of the midpoint of the bar or the bar linkage and the reaction force-time history of the pendulum. It is optional, but desirable, that the pendulum is released from a magnet in the horizontal position.

A-3 TEST SET-UP FOR OSCILLATION DAMPING TEST

Any type of test set-up is acceptable that is capable of stressing a bar-pendulum system under prescribed conditions and monitoring and recording the displacement-time history of the midpoint of the bar or the bar linkage. It is optional, but desirable, that the bar-pendulum system is released from a magnet at the prescribed initial tension.

A-4 TEST SET-UP FOR LATERAL STABILITY TEST

Any type of test set-up is acceptable that is capable to stress the test specimen under prescribed conditions and monitoring and recording the tractive force-time history of the towing cable.

A-5 BAR LINKAGE

Any type of rigid mechanical linkage between the bars is acceptable which enables an attachment of the pendulum for all tests in transversal test direction. The bar linkage shall enable a distance between the bars of (52 ± 1) cm. The weight of the bar linkage shall be (3.0 ± 0.3) kg.

A-6 PENDULUM

The pendulum shall meet the following criteria:

A-6.1 Mass and Geometry

The tubular test body shall have a mass of (40.0 ± 1.2) kg (including load cells, grasping arms and appliances for additional weights) and a geometry as specified in Fig. 4. All the dimensions shall have tolerance of 3 percent. The load cells shall be located between the test body and the grasping arms. The weight of each grasping arm shall be (1.0 ± 0.03) kg.

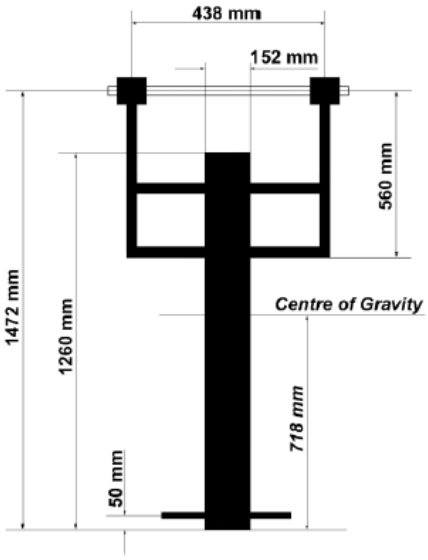


FIG. 4 PENDULUM DIMENSIONS

A-6.2 Pendulum Fixation

The pendulum fixation to the bar shall meet the following criteria

A-6.2.1 *Functional Properties*

The fixation shall allow an immediate transfer of forces between pendulum and bar and guarantee a low-friction rotation of the pendulum about the longitudinal axis of the bar (the use of roll bearings is recommended).

A-6.3 Additional Falling Weight

The additional falling weight shall meet the following criteria:

A-6.3.1 *Mass and Geometry*

The cylindrical falling weight shall have a mass of (20.0 ± 0.2) kg and a geometry as specified in Fig. 5. All the dimensions shall have tolerance of 3 percent.

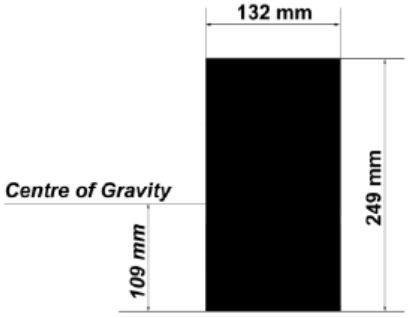


FIG. 5 GEOMETRY OF ADDITIONAL FALLING LOAD

A-6.3.2 Damping of the Additional Falling Weight at the Inside Bottom of the Tubular Test Body

The damping properties of the additional falling weight shall meet the following criteria: The additional falling weight of 20 kg shall produce an average peak force of (5800 ± 1500) N over 15 impact tests inside the tubular test body with a vertical drop height of (50 ± 1) mm. A chloroprene rubber at the bottom of the test body with a thickness of 8 mm, a density of 1.40 g/cm^3 and a tensile strength of 5.5 MPa is re-commended.

A-7 RECORDING EQUIPMENT

A-7.1 Displacement-Time

The selection of the specific displacement - time recording equipment, including transducers and recorders, is at the discretion of the test laboratory. However, the transducers shall provide linear signals proportional to the two-dimensional displacement of the midpoint of the bar. If displacement is recorded, the test equipment shall have means to determine and record the starting position of the bar from which the total deflections are determined. The total system, detection and recording, shall be capable of measuring displacements of up to 200 mm at frequencies from 2 Hz to 200 Hz to an accuracy of ± 1 percent. The minimum sampling rate of the data acquisition system shall be 500 Hz.

A-7.2 Reaction Force-Time

Any reaction force-time recording equipment, including load cells and recorders, which can monitor the reaction force exerted on the pendulum simultaneously with the displacement-time trace is acceptable. The total system, detection and recording, shall be capable of measuring reaction forces of up to 5 000 N at frequencies from 2 Hz to 200 Hz to an accuracy of ± 1 percent. The minimum sampling rate of the data acquisition system shall be 500 Hz.

A-7.3 Tractive Force

Any tractive force recording equipment, including load cells and recorders, which can monitor the tractive force exerted on the parallel bars is acceptable. The total system, detection and recording, shall be capable of measuring tractive forces of up to 5000 N to an accuracy of ± 1 percent.

ANNEX B
(*Clause* 5.1)

STATIC TRACTION STRESS TEST

B-1 TEST PRINCIPLE

A bar of a mounted apparatus is pulled vertically downwards with a predetermined static tractive force. A measuring device mounted on the bar monitors the displacement-time history of the midpoint of the bar caused by this force. The maximum deflection is recorded with the aid of a data acquisition system. After the release of the static tractive force the bar must return into the starting position.

B-2 TEST SPECIMEN

The test specimen submitted for testing shall consist of a complete uneven bar as it is intended to be used during training or competition.

B-3 CONDITIONING AND TEST TEMPERATURE

The uneven bars, mounted and assembled for use, shall be preconditioned at 50 percent ± 10 percent relative humidity and (27 ± 3) °C for a minimum of 24 h prior to the test. All testing shall be carried out under the same conditions.

B-4 TEST APPARATUS

Refer to Annex A.

B-5 TEST PROCEDURE

B-5.1 Mount the upper and lower bars to a height as given in Fig. 3.

B-5.2 The default cable tension shall be 2 750 ± 50 N provided that there is no other specific cable tension suggested by the manufacturer. If a specific cable tension is suggested by the manufacturer, then this suggested cable tension shall be used.

B-5.3 Install the displacement measuring device on the unloaded bars and record the initial positions.

B-5.4 Pull the midpoint of one bar vertically downwards with a static tractive force of 1 350 ± 20 N and capture, then record the resulting maximum deflection (mm) using recording equipment described in **A-7**.

B-5.5 After the release of the static tractive force verify whether the bar returns into the starting position.

ANNEX C
(*Clause* 5.2)

PENDULUM SWING STRESS TEST

C-1 TEST PRINCIPLE

A pendulum which is attached to a bar or a bar linkage of a mounted apparatus is rotated from hanging position into horizontal position and then released. While it swings down, an additional falling weight inside the tubular pendulum slides down from a predetermined internal drop height until the weight strikes against the inside bottom of the pendulum, producing an additional impact stress on the gymnastic apparatus. A measuring device monitors the displacement - time history of the midpoint of the bar or the bar linkage. Load cells inside both pendulum grasping arms monitor the reaction force - time history of the pendulum. Both are recorded with the aid of a data acquisition system. The test measures the maximum reaction force in the direction of the pendulum's centre of gravity and the positive deflection of the bar or the bar linkage in vertical direction and the positive and negative deflection of the bar in horizontal direction.

C-2 TEST SPECIMEN

Refer to **B-2**

C-3 CONDITIONING AND TEST TEMPERATURE

Refer to **B-3**

C-4 TEST APPARATUS

Refer to Annex A.

C-5 TEST PROCEDURE

C-5.1 Mount the upper and lower bars to a height as given in Fig. 3.

C-5.2 The default cable tension shall be 2 750 ± 50 N provided that there is no other specific cable tension suggested by the manufacturer. If a specific cable tension is suggested by the manufacturer, then this suggested cable tension shall be used.

C-5.3 Install the displacement measuring device on the unloaded bars and record the initial positions.

C-5.4 Attach the pendulum (50 kg, that is, 40 kg pendulum with additional 10 kg falling weight) to a bar in hanging position.

C-5.5 Move the pendulum from hanging position into horizontal position and move the additional falling weight inside the pendulum to the 50 ± 1 cm internal drop height position. For the direction of the pendulum swing at the different test positions *see* Fig. 1.

C-5.6 Release the pendulum and capture the displacement-time history of the midpoint of the bar or the bar linkage and the reaction force-time history of the pendulum, using recording equipment described in **A-7**.

C-5.7 Each bar shall be subjected to stress by performing the pendulum swing five times.

C-5.8 Immediately after each test, record the following parameters: maximum force (Fmax) in Newtons (N), positive vertical deflection (mm), and both positive and negative horizontal deflections (mm).

C-5.9 The arithmetic mean values of the measured variables for each bar shall be determined based on all five tests conducted per bar.

ANNEX D
(*Clause* 5.3*)*

OSCILLATION DAMPING TEST

D-1 TEST PRINCIPLE

A pendulum which is attached to a bar or a bar linkage of a mounted apparatus is pulled vertically downwards until a predetermined initial tension is reached. The abrupt release causes a damped oscillation of the bar-pendulum system. A measuring device monitors the displacement - time history of the midpoint of the bar or the bar linkage which is recorded with the aid of a data acquisition system. The test measures the frequency as well as the half amplitude interval of the oscillation.

D-2 TEST SPECIMEN

Refer to **B-2**

D-3 CONDITIONING AND TEST TEMPERATURE

Refer to **B-3**

D-4 TEST APPARATUS

Refer to Annex A.

D-5 TEST PROCEDURE

D-5.1 Mount the upper and lower bars to a height as given in Fig. 3.

D-5.2 The default cable tension shall be 2 750 ± 50 N provided that there is no other specific cable tension suggested by the manufacturer. If a specific cable tension is suggested by the manufacturer, then this suggested cable tension shall be used.

D-5.3 Install the displacement measuring device on the unloaded bars and record the initial positions.

D-5.4 Attach the pendulum (50 kg, that is, 40 kg pendulum with additional 10 kg falling weight at the inside bottom of the pendulum) to a bar (tests in lateral test direction) or the bar linkage (tests in transversal test direction) in hanging position.

D-5.5 Pull down the pendulum vertically until the initial tension of 1 000 ± 30 N is reached.

D-5.6 Release the pendulum and capture the displacement - time history of the midpoint of the bar or the bar linkage using recording equipment described in **A-7**.

D-5.7 Repeat the above procedure for each bar five times.

D-5.8 Immediately after each test, record the following parameters: frequency (Hz) and half-amplitude interval (ms) of the oscillation.

D-5.9 The arithmetic mean values of the measured variables for each bar shall be determined based on all five tests conducted per bar.

D-5.10 Calculate the values of all required variables as given in Table 2, rounded to the decimal places.