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ANSI E1.26 – 2006 (R2012) Entertainment Technology Recommended Testing Methods and Values for Shock Absorption of Floors Used in Live Performance Venues

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ANSI E1.26 – 2006 (R2012) Entertainment Technology Recommended Testing Methods and Values for Shock Absorption of Floors Used in Live Performance Venues

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The PLASA Technical Standards Program was created to serve the PLASA membership and the entertainment industry in technical standards related matters. The goal of the Program is to take a leading role regarding technology within the entertainment industry by creating recommended practices and standards, monitoring standards issues around the world on behalf of our members, and improving communications and safety within the industry. PLASA works closely with the technical standards efforts of other organizations within our industry, including USITT and VPLT, as well as representing the interests of PLASA members to ANSI, UL, and the NFPA. The Technical Standards Program is accredited by the American National Standards Institute.

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The Floors Working Group, which authored this Standard, consists of a cross section of entertainment industry professionals representing a diversity of interests. PLASA is committed to developing consensus-based standards and recommended practices in an open setting.

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Interest category codes:

CP = custom-market producer	DE = designer
DR = dealer rental company	G = general interest
MP = mass-market producer	U = user

Table of Contents

Acknowledgments....iv
Table of Contents.... v
1 Scope 1
2 Definitions - Types of Floors.... 1
3 Requirements 1
4 Test Methods 1
4.1 General.... 1
4.2 Shock Absorption Test 1
4.2.1 Test equipment 2
4.2.2 Standard Deformation 4
4.2.3 Implementation 5
4.2.4 Analysis 5
4.3 Deformation depression, W_x.... 6
4.3.1 General information 6
4.3.2 Test equipment 6
4.3.3 Measuring instrument.... 6
4.3.4 Implementation 6
5 Recommendations 8
5.1 Uniformity of properties 8
5.2 Environmental compatibility.... 8
5.3 Reporting values 8
Appendix A 9
A.1 Surface-elastic floors with elastic construction.... 9
A.1.1 Key.... 9
A.1.2 Location of the system measurement points.... 9
A.2 Surface-elastic floors with elastic construction.... 10
A.2.1 Key.... 10
A.2.2 Location of the system measurement points.... 11
A.3 Surface-elastic dance floors with an elastic layer.... 12
A.3.1 Key.... 12
A.3.2 Location of the system measurement points.... 12
Appendix B 14
Appendix C 15

1 Scope

This document sets out the energy absorption requirements for floors in venues used for live performances, and the methods for testing them. This document is to be used in conjunction with all applicable local building codes and requirements.

2 Definitions - Types of Floors

2.1 Surface elastic floors consist of an elastic layer, a rigid load distribution layer and a top surface. These floors generally have a harder surface and respond well to rolling loads.

2.2 Point elastic floors consist of an elastic layer and a top surface. The top surface is generally considered softer, and they do not respond well to rolling loads.

2.3 Area elastic floors combine the characteristics of both surface elastic and point elastic floor construction. These floors consist of an elastic layer, a load distribution layer and an elastic layer with a top surface. These floors provide point impact protection, yet respond well to rolling loads.

2.4 Rigid floors consist of a top layer with little or no elastic construction.

3 Requirements

The requirements are based on the following criteria. All of these requirements shall be taken into consideration in their entirety, with no one requirement outweighing any other:

a. Performance floors represent a significant functional component
b. Performance floors provide significant protection to performers
c. These floors may, by design, have a reduced load bearing capacity

4 Test Methods

4.1 General

Performance tests shall be conducted by the manufacturer and the results provided to the end user.

4.1.1 Test sections of the floor shall be a minimum of 2.5 m X 3.5 m (8' x 12'), with at least one joint between sections.

4.1.2 Tests shall be conducted on a floor with a slope of less than 1/4" per foot rise per foot of run.

4.1.3 All tested pieces shall be acclimated to the expected ambient conditions per the manufacturer's recommendations prior to testing. Temperature and humidity conditions at the time of testing shall be recorded.

4.1.4 A minimum of 5 points (as defined in Appendix A) shall be tested, the values recorded, and an average value computed. The high, low, and average values shall be reported. Additional points may be tested and used to compute the average value.

4.2 Shock Absorption Test

Shock absorption is determined by analyzing two measurements taken using the apparatus shown in Figure 1. These two measurements are taken at each designated test point. Each point shall be tested a minimum of five times without moving the apparatus. The recorded values shall be averaged and the average value shall be used as the value for that test point.

4.2.1 Test equipment

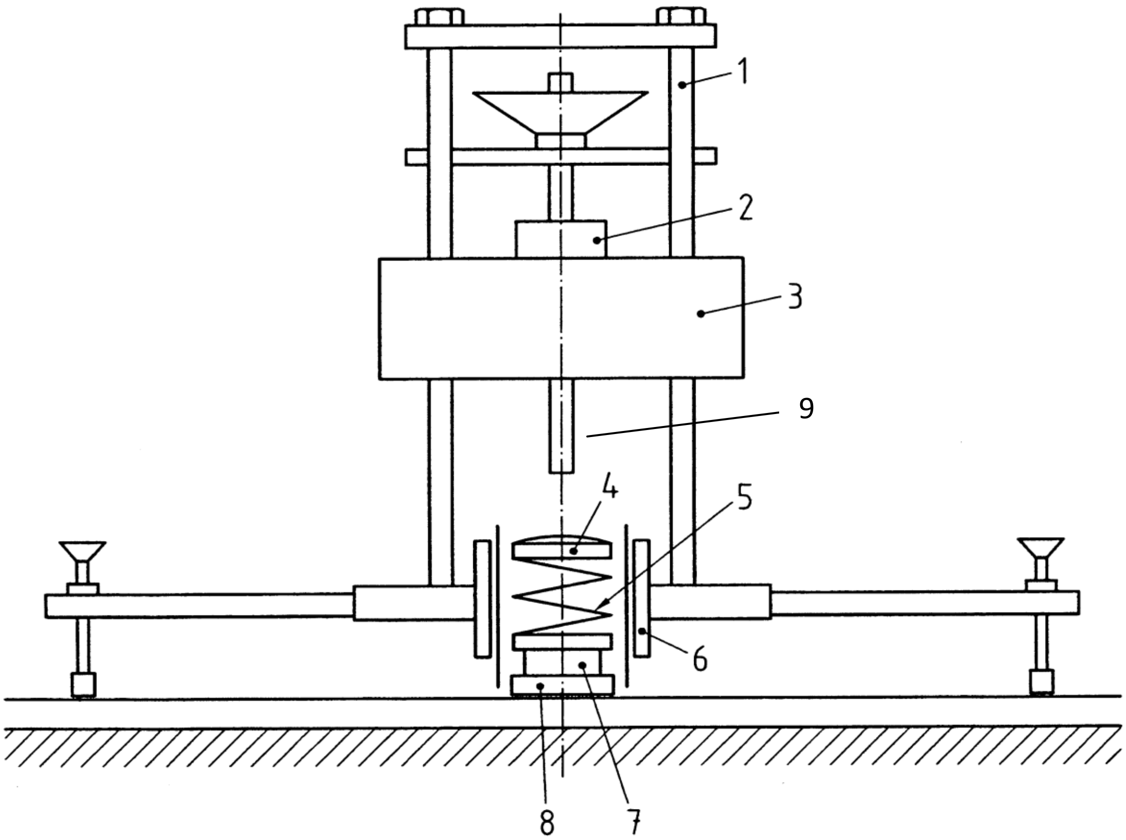


Figure 1 – Construction of the test equipment (example)

Key

1 Guide post
2 Electromagnet
3 Drop weight
4 Baffle
5 Spring(s)
6 Guide sleeve
7 Force detector
8 Test foot (foot plate)
9 Transfer bolt

The test apparatus shown in Figure 1 consists of a drop weight (3), which is held in place using an electromagnetic release mechanism (2). The weight is guided by two side posts (1) and shall have a transfer bolt (9) affixed to the bottom surface. The weight (3) shall drop onto a sub assembly consisting of a baffle (4), spring (5), force detector (7) and test foot (8) contained within a sleeve (6). This serves to transfer the force generated by the drop weight onto the subject test piece, as absorbed by the spring and detected by the force detector.

4.2.1.1 Technical requirements

The test apparatus shall have the following technical characteristics:

a. The drop weight (3) with transfer bolt (9) shall have a total mass of 20±0.1 kg. The transfer bolt (9) shall be of hardened steel, a minimum of 50 mm in diameter, have a length of 75 mm and have a smooth ground underside.

b. The baffle (4) shall act as an upper spring cover and shall be of hardened steel with a convex upper surface, radius 100 mm.

c. The spring (5) shall have a graphically verified elastic constant, c = 2000±60 N/mm, at any force in the range of 0 kN to 10 kN.

d. The test foot (8) shall be of hardened steel with a convex underside, radius 500 mm; 10 mm thick, edge radius 1 mm, and 70 mm diameter.

e. The sleeve (6) shall be metal with a diameter of 70 mm to match the test foot and contain the spring.

f. The total weight of the test foot (8), sleeve (6), spring (5), baffle (4), and force detector (7) shall not exceed 3 kg.

g. The axis of the stand feet supporting the apparatus shall be a minimum of 600 mm from the axis of the drop weight.

h. The trigger mechanism shall provide an adjustable drop height from 40 mm to 120 mm.

4.2.1.2 Measuring instrument

The measuring instrument shall consist of a force detector with an amplifier and recording unit. Force detectors that shall be allowed include strain gauge force transducers, and piezoelectric stress rings. These devices shall be accurate with 1% over a measurement range of 0 kN to 10 kN.

4.2.1.3 Calibration

A reference standard spring[1] is used for this. This consists of a defined arrangement of cup springs and gives the nominal force dispersal value as 53%. In order to carry out the calibration, the test apparatus is set up as shown. The average shock absorption, KA_{Ref} is worked out from five measurements, as follows:

$$KA_{Ref} = (1 - (F_{max1} / F_{max2})) \times 100\%$$

where:

KA_{Ref} is the measured shock absorption of the reference standard, as a percentage (%);
F_{max1} is the average maximum impact force of the reference standard, in Newtons (N);
F_{max2} is the average maximum impact force of the rigid floor, in Newtons (N).

The difference in the nominal shock absorption of the reference standard gives the correction value to be taken into account in equation 4.2.1.5.

The calibration correction value, ΔKA, may now be calculated as:

$$\Delta KA = 53\ \% - KA_{Ref}$$

where

ΔKA is the required calibration correction value;
KA_{Ref} is the measured shock absorption value of the reference standard as a percentage (%).

This calibration shall be carried out at least every three months.

4.2.1.4 Implementation

The test equipment shall be set up vertically (±1°) and its position shall not be changed between individual measurements of force dissipation at any one measurement point.

[1] The reference springs for the standard may be requested from the Federal Institute of Sporting Sciences, Carl-Diem-Weg 4, 50933 Cologne, Germany

The shock absorption of a measurement point shall be calculated from the average of two measurements. The individual measurements shall be taken one after the other at an interval of one minute.

Before each impact, the drop height h = (55.0 ± 0.25) mm shall be set by means of a gauge block. The measuring instrument shall then be tared, setting the zero point for the force with the weight raised.

Pressure shall be removed from the measurement point within 60 seconds after an individual measurement (drop test).

4.2.1.5 Analysis

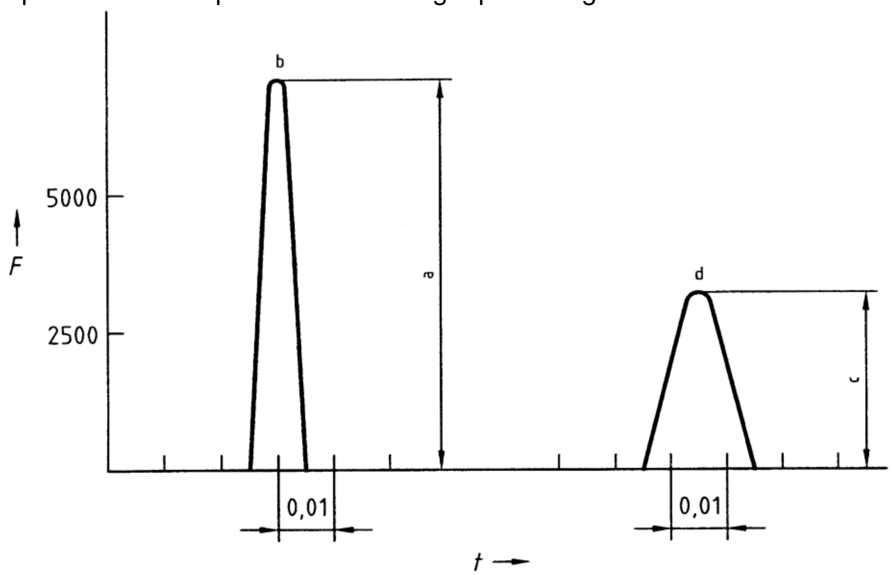
The shock absorption, *KA*, expressed as a percentage (%) shall be determined from the measured impact forces, $F_{maxrigidfloors}$ and $F_{maxdancefloor}$ (see Figure 2) as follows:

$$KA = (1 - (F_{maxdancefloor} / F_{maxrigidfloor})) \times 100\% + \Delta KA$$

where

KA	is the shock absorption, as a percentage (%);
$F_{maxdancefloor}$	is the measured maximum impact force of the dance floor, in Newtons (N);
$F_{maxrigidfloor}$	is the measured maximum impact force of the rigid floor, in Newtons (N).

The shock absorption shall be expressed as an integer percentage.



Key

F Force in N

t Time in seconds

[a] $F_{maxrigidfloors}$

[b] Measurement from rigid floor

[c] $F_{maxdancefloors}$

[d] Measurement from tested dance floor

Figure 2 – Test instrument – recording measurements

4.2.2 Standard Deformation

4.2.2.1 General

Standard deformation is determined by simultaneously measuring deformation of the test piece and the impact force exerted on the test piece in the area of the deformation.

The standard deformation is the deformation of the test piece subjected to an impact force of 1500 N.

The standard deformation is ascertained from four individual measurements taken using the test instrument at each system measurement point on the test piece.

When carrying out the performance test at each system measurement point, the average from the four individual measurements at each measurement point shall not exceed 4 mm.

4.2.2.2 Test equipment

A modified version of the test instrument shown in the schematic sketch in Figure 1 shall be used. Modifications shall be as follows:

a) Spring(s) (5) with a graphically verified elastic constant c = (40.0 ± 1.5) N/mm, at any force in the range 0 kN to 1.6 kN;
b) Lifting, holding and release devices for the drop weight (3), with an adjustable drop height of (120.0 ± 0.25) mm between the lower surface of the transfer bolt (9) and the upper surface of the baffle (4).

4.2.2.3 Measuring instrument

The force exerted on the test piece shall be recorded using at least two suitable displacement sensors (e.g. inductive displacement sensors with probes or similar) with boosters and displacement recording devices to determine the vertical deviation of the test piece. The sensors shall have a measuring range of ± 10 mm and limits of error no greater than 0.05 mm.

The displacement sensors shall be placed at a maximum distance of 125 mm from the test equipment's drop weight axis.

When detecting the measurement signals from the displacement sensors, the measuring amplifier must have a linear (+/- 1dB) passband from 0 Hz to 1000 Hz.

4.2.3 Implementation

The test equipment shall be set up vertically (±1°) and its position shall not be changed between individual measurements.

The displacement sensors are to be fixed to a stand that is isolated from the test instrument. The support points for this stand must be at least 1000 mm from the drop weight axis. The displacement sensors are to be deployed at a maximum distance of 125 mm from the drop weight axis in such a way that they are, as far as is possible, at the same distance from the drop weight axis. The connecting line between the measurement points must pass through the drop weight axis.

Before starting the test procedure, the displacement sensors' probes must be in contact with the test foot's touch areas. It must be ensured that the acceleration of the displacement sensors' probes is able to follow the deformation of the floor resulting from the impact. The recording system used for recording the measurement signal must be started before the drop weight is released.

The individual measurements shall follow at intervals of one minute. The standard deformation at a measurement point is taken as the average of the four individual measurements.

Before each impact, the drop height h = (120.0 ± 0.25) mm shall be set by means of a gauge block. The measuring instrument shall then be tared, setting the zero point for the force and displacement with the weight raised.

4.2.4 Analysis

Only the initial impact of any one drop test is used in the analysis.

Using these measured values, the standard deformation in millimeters is determined as follows:

$$StV_n = \left(\frac{1500\text{N}}{\text{F}_{\text{max,n}}} \right) f_{0,\,\text{max,n}}$$

$$StV = \left(\frac{1500}{\text{F}_{\text{max}}} \right) f_{0,\,\text{max}}$$

where

StV is the standard deformation, in millimetres;

$f_{0,\,max}$ is the maximum vertical deformation of the test piece's surface in the drop weight axis in millimetres (mm). This is calculated as the arithmetic average of the maximum vertical deformations recorded from the individual displacement sensors for each drop test;

F_{max} is the maximum force exerted on the force recorder, in Newtons (N).

The standard deformation at a measurement point is the arithmetic average of the four individual values obtained (to be given to the nearest 0.1 mm).

4.3 Deformation depression, W_x

4.3.1 General information

The deformation depression is obtained using the test instrument.

4.3.2 Test equipment

A modified version of the test instrument shown in the schematic sketch in Figure 1 is used.

4.3.3 Measuring instrument

The force exerted on the test piece is measured using the measuring equipment described in 4.2.2.3.

The vertical deformation of the test piece is determined using displacement sensors, signal amplifiers and a recording system as in 4.2.2.3.

4.3.4 Implementation

The test equipment shall be set up vertically (±1°) and the position of the drop weight axis shall not be changed between individual measurements.

In order to determine the vertical deformation of the test piece, displacement sensors are also deployed as in 4.2.3 at distances of 100 mm for W_{100} and 500 mm for W_{500} from the test instrument's drop weight axis on the surface of the test piece. These displacement sensors are used to measure the vertical deformation at these locations at the same time as the central vertical deformation is measured on the drop weight axis.

All central vertical deformation on the drop weight axis is determined as described in 4.2.3.

The displacement sensors shall be fixed to a support that is isolated from the test instrument. The support points for this stand must be at least 1000 mm from the drop weight axis.

The same instructions shall be adhered to for recording the displacement sensors' measured signals as are used when determining standard deformation.

Measurements are taken at each measurement point in four different quadrants. An example of how the measurement points might be arranged is shown in Figure 3.

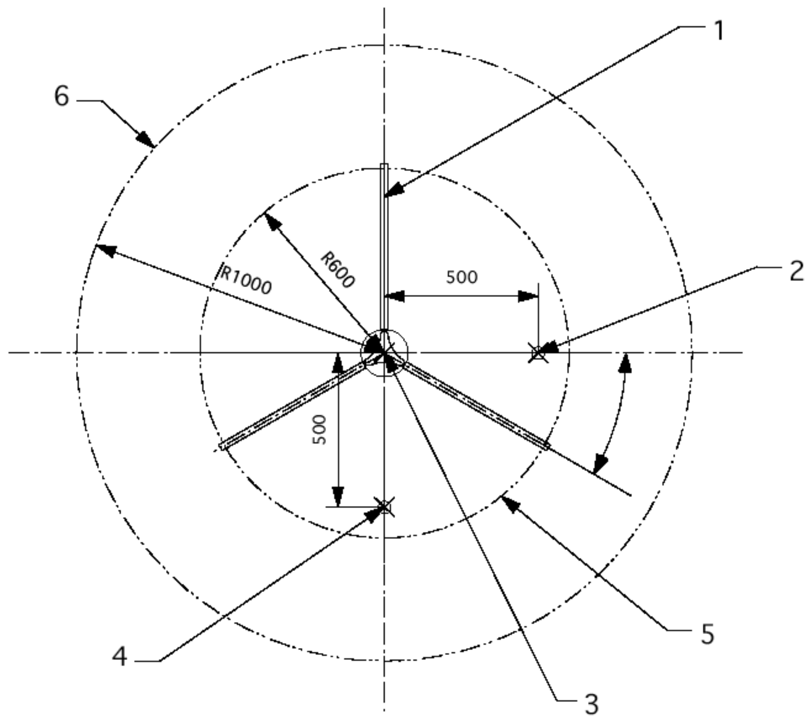


Figure 3 – Layout of the test instrument for determining the deformation depression W_{500} in quadrants.

Key

1 Test Apparatus
2 Measurement point W_{500}
3 Measurement point *StV*
4 Measurement point W_{500}
5 Deployment radius for the test instrument feet at a distance of 600mm from the drop weight axis
6 Deployment radius for the test probes support assembly feet at a distance of 1000mm from the drop weight axis. Test probe support assembly shall be positioned $30° \leq \alpha \leq 60°$ between the test instrument feet.

The same procedure shall be used to determine the size of the deformation depression W_{100}.

Two separate measurements shall be taken at each measurement point. These individual measurements are taken at intervals of one minute.

Before each impact, the drop height h = (120.0 ± 0.25) mm shall be set by means of a gauge block. The measuring instrument shall then be tared, setting the zero point for the force and displacement with the weight raised.

4.3.5 Analysis
Only the initial impact of a drop test shall be used in the analysis. Additional rebound impacts shall not be used.

Using these measured values, the deformation depression shall be determined as follows:

$$W_x = \frac{f_{x,\max}}{f_{o,\max}} \cdot 100\%$$

where:

Wx is the deformation depression expressed as a percentage

$f_{0,\ max}$ is the maximum central vertical deformation of the test piece's surface on the drop weight axis in millimeters (mm). This is calculated as the arithmetic average of the maximum vertical deformations recorded from the individual displacement sensors for each drop test;

$f_{x,\ max}$ is the maximum vertical deformation of the test piece's surface at a distance *x* mm from the drop weight axis in millimeters (mm). The index *x* is either 100 for W_{100} or 500 for W_{500}.

The deformation depression at a measurement point is the arithmetic average of the two individual values obtained in each quadrant.

The deformation shall be expressed as an integer percentage value.

5 Recommendations

5.1 Uniformity of properties
The tested properties of any point on the floor shall be within 5% of the average value.

5.2 Environmental compatibility
The floor shall be designed and constructed so as not to endanger the health and safety of its users as a consequence of the release of harmful gases or dangerous particles.

5.3 Reporting values
Values for shock absorption, standard deformation, and deformation depression shall be reported by the manufacturer.

5.3.1 Acceptable shock absorption, KA, shall be a minimum 40%, and shall not exceed 65%.

5.3.2 Acceptable standard deformation, StV, shall not exceed 5mm.

5.3.3 Acceptable deformation depression, W_{500}, shall not exceed 20%.

Appendix A
(normative)
Location of the system measuring points

A.1 Surface-elastic floors with elastic construction
(See figures A.1 to A.4)
(With one sprung beams layer and staggered supports)

A.1.1 Key
a Load-distribution board (wooden boards with top surface or parquet)
b Dead floor
c Sprung beam layer
d Support
◙ System measurement point

A.1.2 Location of the system measurement points

System measuring point 1:	Above a support
System measuring point 2:	Midway between two supports above the sprung board
System measuring point 3:	Above a join in the sprung beam layer
System measuring point 4:	Midway between two sprung beams in them panel (high support)
System measuring point 5:	Midway between two sprung beams in them panel (midway between two staggered supports)
System measuring point 6:	At a T-join in the load distribution boards (one measuring direction along a join and one along the centre of a panel)
System measuring point 7:	At a join in the load distribution boards (one measuring direction along a join and one along the centre of a panel)

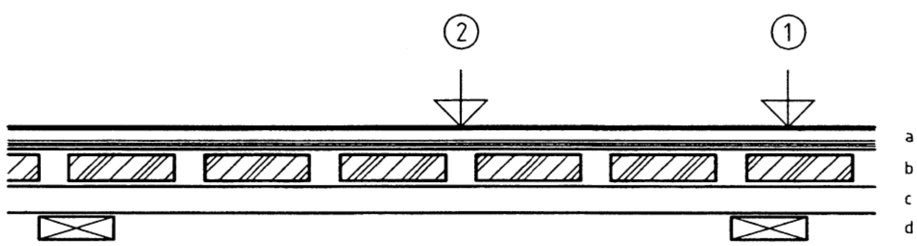


Figure A.1 – Surface-elastic floors with elastic construction (with one sprung beams layer and staggered supports)

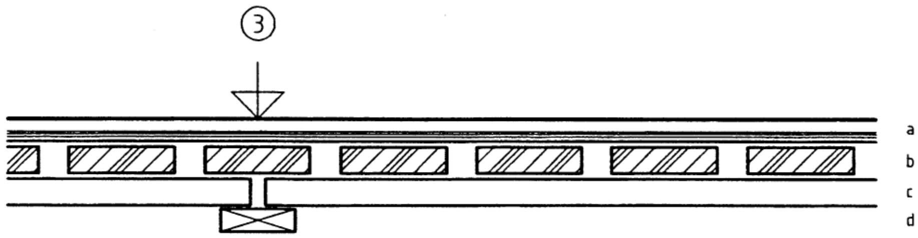


Figure A.2 – Surface-elastic floors with elastic construction (with one sprung beams layer and staggered supports)

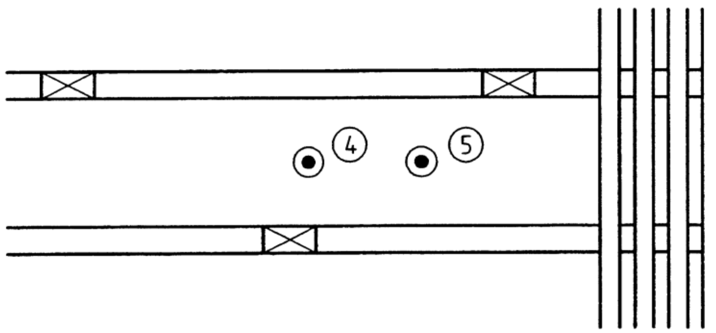


Figure A.3 – Surface-elastic floors with elastic construction (with one sprung beams layer and staggered supports)

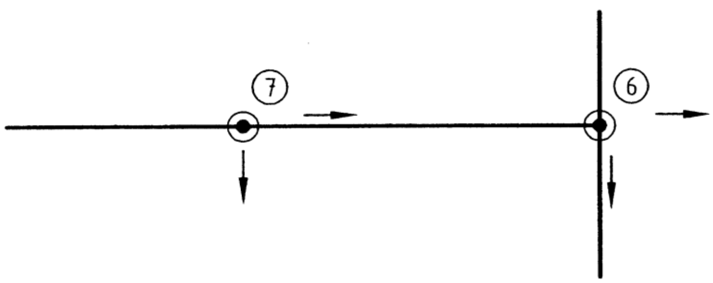


Figure A.4 – Substructure for surface-elastic floors with elastic construction (with one sprung beams layer and staggered supports)

A.2 Surface-elastic floors with elastic construction

(See figures A.5 to A.8)
(With one sprung beams layer and non-staggered supports)

A.2.1 Key

a Load-distribution board (wooden boards with top surface or parquet)
b Dead floor
c Sprung beam layer
d Support
◙ System measurement point

A.2.2 Location of the system measurement points

System measuring point 1:	Above a support
System measuring point 2:	Midway between two supports above the sprung board
System measuring point 3:	Above a join in the sprung beam layer
System measuring point 4:	Midway between two sprung beams in them panel (high support)
System measuring point 5:	Midway between two sprung beams in them panel
System measuring point 6:	At a T-join in the load distribution boards (one measuring direction along a join and one along the centre of a panel)
System measuring point 7:	At a join in the load distribution boards (one measuring direction along a join and one along the centre of a panel)

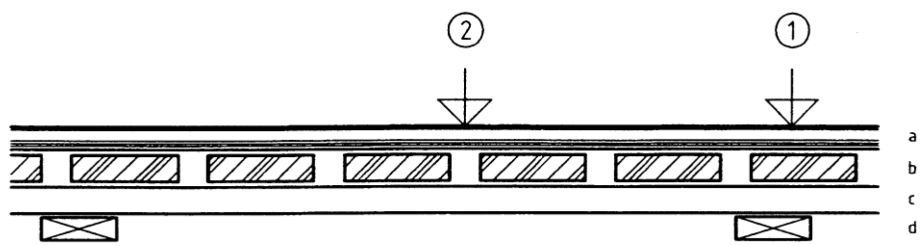


Figure A.5 – Surface-elastic floors with elastic construction (with one sprung beams layer and non-staggered supports)

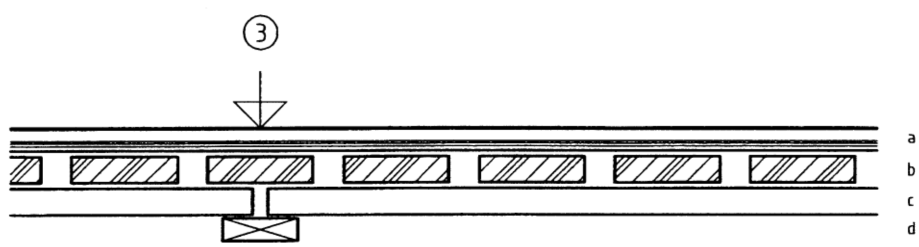


Figure A.6 – Surface-elastic floors with elastic construction (with one sprung beams layer and non-staggered supports)

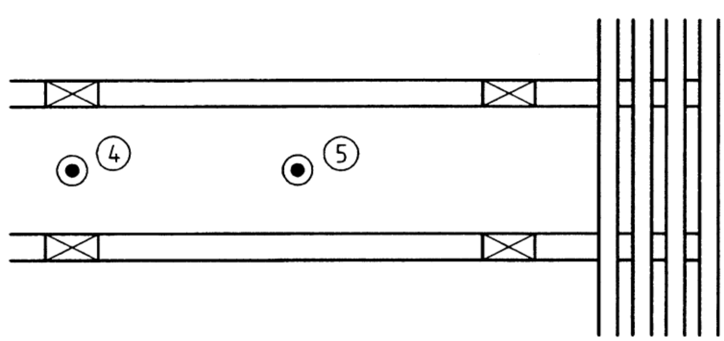


Figure A.7 – Surface-elastic floors with elastic construction (with one sprung beams layer and non-staggered supports)

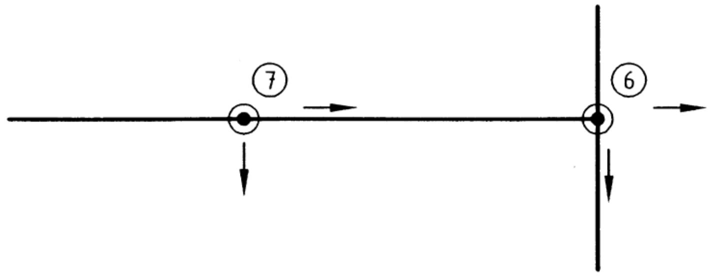


Figure A.8 – Surface-elastic floors with elastic construction (with one sprung beams layer and non-staggered supports)

A.3 Surface-elastic dance floors with an elastic layer

(See figures A.9 and A.10)

A.3.1 Key

______ Upper layer of the load-distribution board (wooden boards with top surface or parquet)
---------- Lower layer of the load-distribution board
◙ System measurement point

A.3.2 Location of the system measurement points

System measuring point 1:	At a T-join in the upper layer of the load-distribution board (one measuring direction along a join and one along the centre of a panel)
System measuring point 2:	At a join in the upper layer of the load-distribution board (one measuring direction along a join and one along the centre of a panel)
System measuring point 3:	At a T-join in the lower layer of the load-distribution board (one measuring direction along a join and one along the centre of a panel)
System measuring point 4:	At a join in the lower layer of the load-distribution board (one measuring direction along a join and one along the centre of a panel)
System measuring point 5:	At an intersection point (where a join in the upper layer of the load-distribution board crosses a join in the lower layer of the load-distribution board)
System measuring point 6:	In the panel (midway between joins)
System measuring point 7:	Above a pad
System measuring point 8:	Midway between two pads

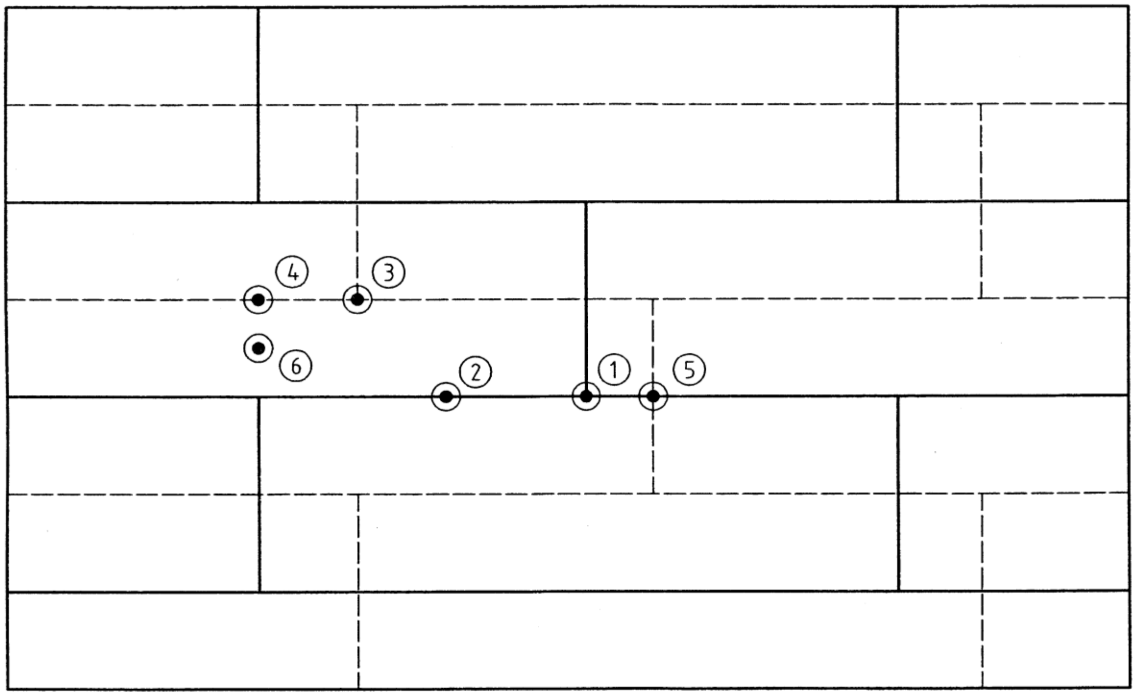


Figure A.9 – Dance floors with an elastic layer

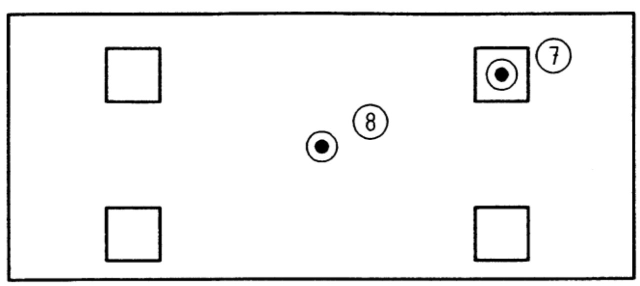


Figure A.10 – Dance floors with an elastic layer and with pads arranged in a grid pattern

Appendix B

(Not normative. Informational only.)

The results of testing several floors per DIN 18032, Part II, are published in Mark Foley's *Dance Floors: A Handbook for the Design of Floors for Dance (*London: Dance UK; 1991, updated 1998. 52 p.) DIN 18032, Part II is functionally equivalent to the test procedure described in this E1.26 standard. The data from Foley's book is reprinted here, with permission, for the information of users of this standard. *Dance Floors: A Handbook for the Design of Floors for Dance* is available from Dance UK [Battersea Arts Centre; Lavender Hill; London SW11 5TN; UK; 44-(0)20-7228-4990; www.danceuk.org] and other vendors.

This appendix contains no requirements, and compliance with no part of it is required to claim compliance with this standard. It is purely informational.

Floor type	**Shock absorption (*KA*)**	**Deflection (*StV*)**	**Deflective Indentation, W_{500}**	**Rolling load**
Junkers DIN Floor	63.7%	2.4 mm	12%	>1500 N
Junkers Modular DIN Sports Floor	59.1%	2.35 mm	14%	>1500 N
Junkers Single Layer Squash Floor	63.2%	2.52 mm	17%	>1500 N
Boen Sportsflor BoFlex Pl (Hewetson Hardwood Floors)	61%	2.8 mm	14.2%	>1500 N
Robbins Bio Cushion I (Hewetson Hardwood Floors)	57%	1.9 mm	20%	>1500 N
Robbins Bio Cushion II (Hewetson Hardwood Floors)	62%	2.4 mm	14%	>1500 N
Robbins Sportwood Plus (Hewetson Hardwood Floors)	46%	1.0 mm	5%	>1500 N
Robbins Sportwood Plus Ultra (Hewetson Hardwood Floors)	71%	3.3 mm	15%	>1500 N
Springbok Precision Air (Hewetson Hardwood Floors)	58%	2.2 mm	11.5%	>1500 N
Loctite (Hewetson Hardwood Floors)	24%	0.5 mm	1%	>1500 N
Robbins Spring Air (Hewetson Hardwood Floors)	55%	1.0 mm	33%	>1500 N
Hamberger Berlin 1 (Dynamik Sport Systems)	61%	2.5 mm	9%	>1500 N
Hamberger Berlin 2 (Dynamik Sport Systems)	60.9%	2.68 mm	9%	>1500 N
Hamberger Helsinki 10 (Dynamik Sport Systems)	60%	3.0 mm	3%	>1500 N
Hamberger Helsinki 20 (Dynamik Sport Systems)	58%	3.0 mm	2.5%	>1500 N
Hamberger Munchen 22 (Dynamik Sport Systems)	61.6%	2.72 mm	10.5%	>1500 N
Hamberger Montreal 20 (Dynamik Sport Systems)	56%	2.4 mm	7%	>1500 N
L'AIR Floor (measured centre panel) Kenneth Snipes Fabrications/Design	66.7%	3.4 mm	14.7%	Not tested
New Sadlers Wells stage floor (designed by Mark Foley)	64%	4.0 mm	10%	>1500 N

Appendix C

(Not normative. Informational only.)

Additional tests on floors were conducted in Cincinnati, Ohio on 11 September 2001 and were witnessed by Tim Hansen of Oasis Stage Werks, who is the chairman of the working group that authored E1.26. The tests were conducted per the procedure in DIN 18032, which is functionally the same as the procedure described in this standard. Some modifications were made to the test procedure in an attempt to account for the weight differences between male and female dancers. The modifications to the test procedure consisted of dropping the weight from three heights, rather than the one specified in the standard. It was later determined that this was statistically insignificant. The testing was commissioned by Fisher Dachs Associates, in collaboration with David Nash. (Some test results, previously published, have been redacted at the request of Fisher Dachs Associates.)

This appendix contains no requirements, and compliance with no part of it is required to claim compliance with this standard. It is purely informational.

Floor	Position	*KA*(x) values per DIN 18032-mod Drop height (mm)			DIN 18032 (mod.) Standard Deformation Vertical *StVv* (mm)	DIN 18032 (mod.) Deflective Indentation W_{500} (%)		
		45	55	65		1	2	Average
Harlequin (plain floor)	Max	63.2	63.4	63.5	5.63	18.7	37.9	28.3
	1	64.1	64.7	65.0	5.63	18.7	37.9	28.3
	2	65.0	65.5	65.9	5.43	19.4	39.3	29.4
	3	66.9	67.2	67.4	5.35	15.7	20.6	18.1
	4	66.9	66.8	67.6	4.84	19.2	31.6	25.4
	5	63.2	58.9	63.5	4.10	9.6	35.8	22.7
Harlequin w/Cascade Marley	Max.	65.0	65.2	65.3				
	1	65.2	65.4	65.9				
	2	65.9	66.1	67.1				
	3	66.8	67.6	67.4				
	4	66.3	66.3	66.5				
	5	65.0	65.2	65.3				
Harlequin w/ High-Density Marley	Max	64.5	64.7	64.9				
	1	65.0	65.5	65.8				
	2	65.9	67.0	66.8				
	3	66.4	67.0	67.6				
	4	65.9	66.2	66.7				
	5	64.5	64.7	64.9				
Cascade Marley on concrete	Max.	-0.35	-0.97	-0.30				
High-Density Marley on Concrete	Max.	-0.35	-0.97	-1.04				
F.D.A. (Bio Channel)	Max.	53.3	52.3	53.4	2.45	25.7	34.5	30.1
	1	53.3	52.3	53.7	1.95	32.4	43.5	37.9
	2	53.5	52.7	53.4	2.29	21.0	28.7	24.9
	3	54.0	54.9	54.0	2.45	18.9	24.5	21.7
Oasis (D'Ancer)	Max	34.3	33.8	33.3	3.63	38.6	35.8	37.2
	1	34.3	42.4	42.1	2.20	63.6	59.1	61.3
	2	34.8	33.8	33.3	1.44	97.2	81.9	89.5
	3	52.2	52.3	52.1	2.43	13.3	48.6	30.9
	4	57.5	57.4	58.0	3.63	16.5	26.9	21.7
	5	51.7	51.3	51.0	2.65	13.8	21.8	17.8

Floor	Position	*KA*(x) values per DIN 18032-mod Drop height (mm)			DIN 18032 (mod.) Standard Deformation Vertical *StVv* (mm)	DIN 18032 (mod.) Deflective Indentation W_{500} (%)		
		45	55	65		1	2	Average
Nash (Robbins) w/Permacushion Pads	Max.	63.9	63.9	64.4	5.10	19.8	25.6	22.7
	1	63.9	63.9	64.4	4.22	24.0	30.9	27.5
	2	69.3	69.6	69.2	5.10	18.6	24.6	21.6
	3	66.3	66.2	66.8	4.10	17.8	22.7	20.3
	4	64.8	65.2	65.5	3.63	16.7	29.5	23.1
Nash (Robbins) No Permacushion Pads	Max.				2.91	22.3	27.3	24.8
	1				1.85	24.7	42.8	38.7
	2				2.42	26.8	32.1	29.5
	3				2.71	24.0	16.1	20.1
	4				2.91	10.3	12.3	11.3

== END ==