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Textile floor coverings — Determination of mass loss using the Lisson test

Revêtements de sol textiles — Détermination de la perte de masse à l'aide de la machine Lisson

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12951 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 12, *Textile floor coverings*.

Annex A forms a normative part of this International Standard. Annex B is for information only.

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Textile floor coverings — Determination of mass loss using the Lisson test

1 Scope

This International Standard specifies a method of test to determine the mass loss of textile floor coverings using the Lisson Tretrad machine.

Experience with the method described shows that some countries regard the Lisson Tretrad test to be not suitable for wool and wool-rich textile floor coverings but many ISO members are using the method sucessfully.

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2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 139, *Textiles — Standard atmospheres for conditioning and testing.*

ISO 1765, *Machine-made textile floor coverings — Determination of thickness.*

ISO 1957, *Machine-made textile floor coverings — Sampling and cutting specimens for physical tests.*

ISO 2424, *Textile floor coverings — Vocabulary.*

ISO 8543, *Textile floor coverings — Method for determination of mass.*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions, in addition to those in ISO 2424, apply:

3.1
mass loss per unit area m_V
difference between the sample mass before and after the wear test, related to the tested area, (see clause 10)

3.2
relative mass loss m_{rV}**, for pile carpets**
ratio of the mass loss per unit area m_V as a percentage of the mass of pile per unit area above the substrate (in accordance with ISO 8543)

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3.3
I_{TR}
index calculated according to the following equation:

$$I_{TR} = 0,19\sqrt{m_{AP}} \times \left(\frac{100 - m_{rv}}{100} \right)$$

where

m_{AP} is the mass per unit area above the substrate in grams per square metre, determined in accordance with ISO 8543;

m_{rv} is the relative fibre loss expressed as a percentage.

4 Principle

The specimens of a textile floor-covering are exposed, at constant load and slippage and for a prescribed number of double passages, to the action of a four-footed wheel (Tretrad), the feet of which are fitted with interchangeable rubber soles.

5 Apparatus

5.1 Lisson Tretrad machine, comprising a bed plate, a vacuum cleaning system and two Tretrad assemblies (see Figure 1)

5.1.1 Bed plate

The bed plate faces are parallel to the track travelled by the Tretrad feet and the front edge of the plate is rounded with a 10 mm radius to simulate a stair nosing.

The test surface is formed by the width of the Tretrad feet and the length of the track over which the Tretrad runs. The track length shall be determined for each machine by measuring the distance between the front edge of the base plate and the perpendicular projection of the Tretrad axis at its furthermost point of reversal. The length of track shall be (800 ± 20) mm.

Two clamps mounted at each end of the bed plate are used to hold each specimen under tension. The tension is applied by means of a weighted third clamp, each specimen being subjected to a force of (200 ± 10) N.

5.1.1 Tretrad assemblies

The Lisson Tretrad apparatus has two Tretrad assemblies each of which comprises a Tretrad mounted in a frame that is free to rotate around an axis that is 135 mm to 140 mm above the upper surface of the bed plate.

Each Tretrad comprises four equally-spaced legs with rigidly attached feet platforms.

The surface of the foot platform has a radius of curvature of (112,5 ± 1) mm a circumferential length of (100 ± 1) mm and a width of (55 ± 0,5) mm. The ends of the contact surfaces of the platforms are rounded with a radius of (4,0 ± 0,5) mm.

The vertical force applied by the Tretrad feet, in the stationary state, shall be (150 ± 2) N measured without the soles in position (see Figure 2).

NOTE A ring dynamometer may be used to check this force.

The linear speed of the Tretrad is (0,28 ± 0,02) m/s and the peripheral speed of the Tretrad with sole coverings is (20 ± 1) % greater than the linear speed. This causes slippage of the feet on the test specimen in addition to the compressive action.

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At the front edge of the bed plate the Tretrad runs beyond the bed and is held horizontal by a height adjustable stopper in such a way that the lower edge of the foot (without sole material) can be adjusted between 5 mm below and 5 mm above the level of the surface of the bed plate (see Figure 2).

At the points of reversal the Tretrad remains stationary for approximately 1 s; during this stoppage at the forward point of reversal, the Tretrad is rotated through an angle (but not a right angle) to ensure that the feet walk evenly over the length of the test area.

5.1.2 Vacuum cleaning system

Suction nozzles follow the horizontal movement of the Tretrad assemblies. The nozzles are flexibly mounted and are equipped on their undersides with slides that rest on the edges of the test specimens thereby not imposing any wear on the specimens.

Each nozzle has the dimensions shown in Figure 2 and is connected to the vacuum cleaner in order to extract the abraded fibre.

The vacuum cleaner performance shall be such as to produce an airflow of at least 30 l/s measured at the connection point of the nozzles by an appropriate anemometer in order to remove loose fibre from the surface of the specimens.

5.2 Soles,[1] made from vulcanized styrene butadiene rubber (SBR) with silicic acid-based white filler additives

The soles have a wave profile on one face, and the slip resistance of the sole material is controlled to ensure standard behaviour in the Lisson Tretrad test (see annex A).

The sole material shall be stored in the dark and air exchange shall be avoided. After long times of storage of the soles (e.g. $>$ 2 years) they shall be validated by the calibration procedure (calibration carpet).

Size (mm)	:	minimum 190 ± 2 long by 55 ± 0,5 wide
Thickness (mm)	:	2,5 ± 0,3
Density (g/cm^3)	:	1,32 ± 0,03
Hardness (Shore A)	:	90 ± 3
Wavelength (mm)	:	13,0 ± 0,5
Amplitude (mm)	:	4,0 ± 0,3
Profile height (mm)	:	0,6 ± 0,1
Slip resistance (N)	:	2,8 ± 10 %

5.3 Balance, capable of weighing the test specimens to the nearest 0,01 g

5.4 External vacuum cleaner, equipped with a rotating brush, with or without beaters

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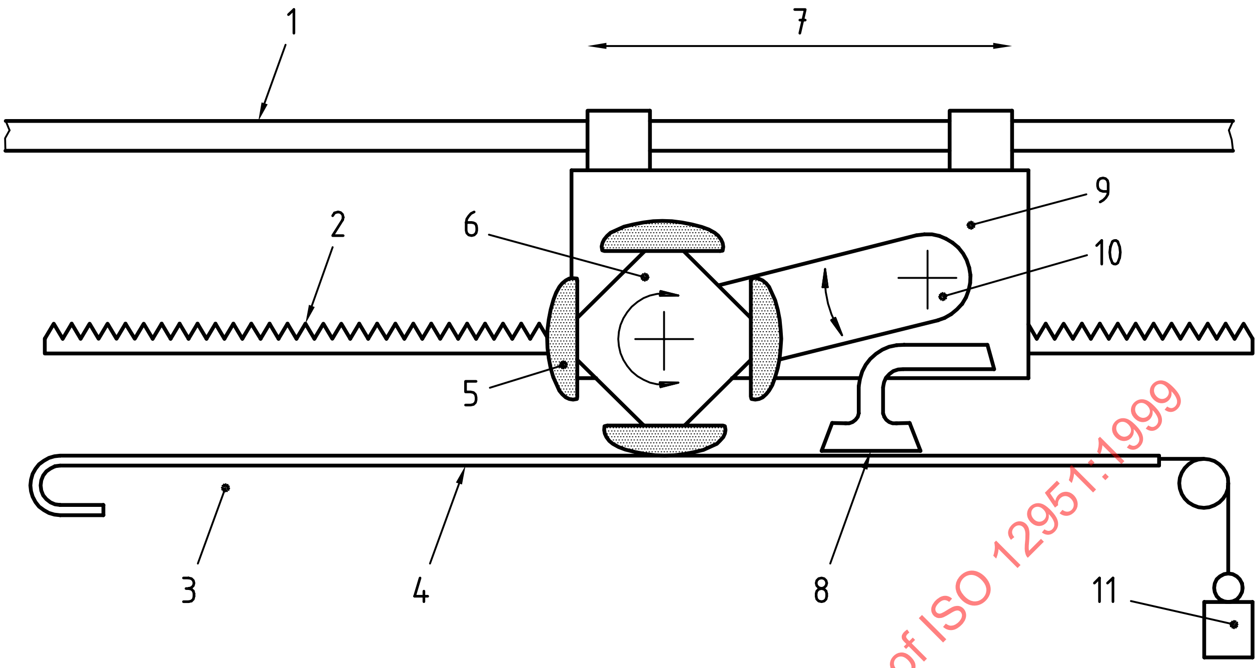
1) Certified soles are available from TFI, Deutsches Teppichforschungsinstitut, Charlottenburger Allee 41, 52068 Aachen, Germany.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product. Equivalent products may be used if they can be shown to lead to similar results.



Key

1 Support
2 Cogbar
3 Bed plate
4 Specimen
5 Foot
6 Tretrad wheel
7 Movement of the Tretrad
8 Dust section
9 Frame
10 Drive
11 Tension weight

Figure 1 — Lisson Tretrad testing machine

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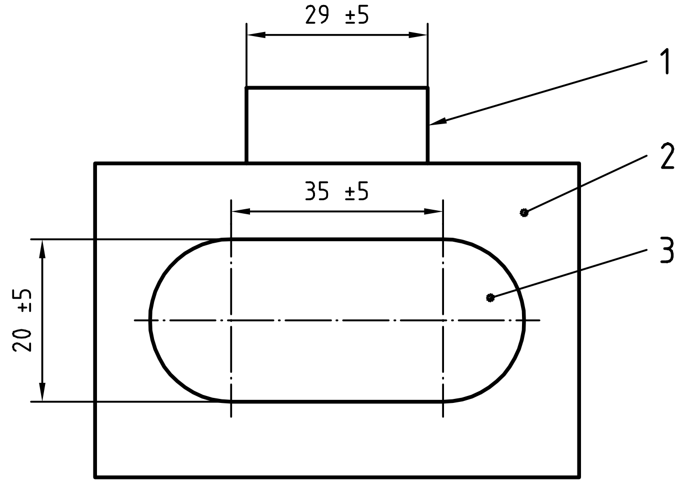
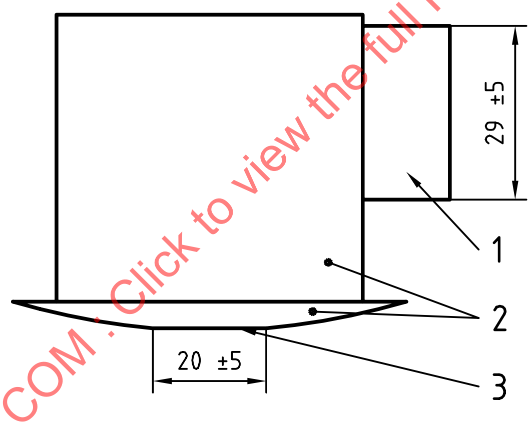
Dimensions in millimetres



Key

1 Conection to vacuum cleaner
2 Nozzle casing
3 Nozzle mouth

a) bottom view



Key

1 Connection: side view
2 Nozzle casing
3 Nozzle mouth

b) side view

Figure 2 — Vacuum inlet

6 Sampling and selection of test specimens

Select the specimens in accordance with ISO 1957. For each test prepare at least four specimens each 1 500 mm in the direction of manufacture (machine direction) by 100 mm in the cross-machine direction.

Tiles shall be cut and assembled into the appropriate dimensions of the required specimens.

Where appropriate, unsealed cut edges shall be sealed to prevent edge tuft loss during the test.

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7 Atmosphere for conditioning and testing

The specimens shall be conditioned for at least 48 h in the standard atmosphere for testing textiles specified in ISO 139, prior to testing in the same atmosphere. The specimens shall be laid out singly, use surface uppermost.

8 Calibration of the apparatus

The test apparatus shall be checked with a calibration carpet[2)] and calibrated by adjusting the set number of to and fro traverse cycles.

9 Procedure

Prior to testing clean the specimen with the vacuum cleaner (5.4) giving four passes in each direction with the final pass in the direction of pile lay.

Weigh the test specimens individually to determine m_1 (see 10.1) to the nearest 0,01 g and then mount them on the bed plate as described below.

Fit the test specimen over the leading 10 mm radius rounded edge of the Lisson Tretrad base plate (5.1.1) to the forward mount and clamp on the table under a tension of (200 ± 10) N.

Test specimens that may become distorted during the test shall be further stabilised by being adhered to the bed plate. To carry this out, initially fix single sided tape to the underside of the specimens then attach the specimens to the bed plate by means of double sided tape; this allows for removal of the specimens without weight change (in this case omit the pretensioning).

Specimens with a distinct pile lay shall be fitted to the bed plate with the pile lay in the direction of the stair nosing.

If the material is usually fitted with an underlay then the specimen shall be mounted over the underlay it is intended to be used with.

Fit new rubber soles to the Tretrad before each test.

Adjust the height of each Tretrad (see Figure 3) in relation to the bed plate in accordance with Table 1.

The tests shall be performed with the vacuum cleaner turned on continuously.

Subject the specimens to 500 double passages of the Tretrad then readjust the clamping tension to (200 ± 10) N ; operate the machine to the remaining number of the calibrated total double passages of the Tretrad.

At the end of the test clean the specimens with four passages of the vacuum cleaner (5.4) then lay the specimen, use surface uppermost, in the standard atmosphere. After about 48 h weigh the specimen to determine m_2 (see 10.1) to the nearest 0,01 g.

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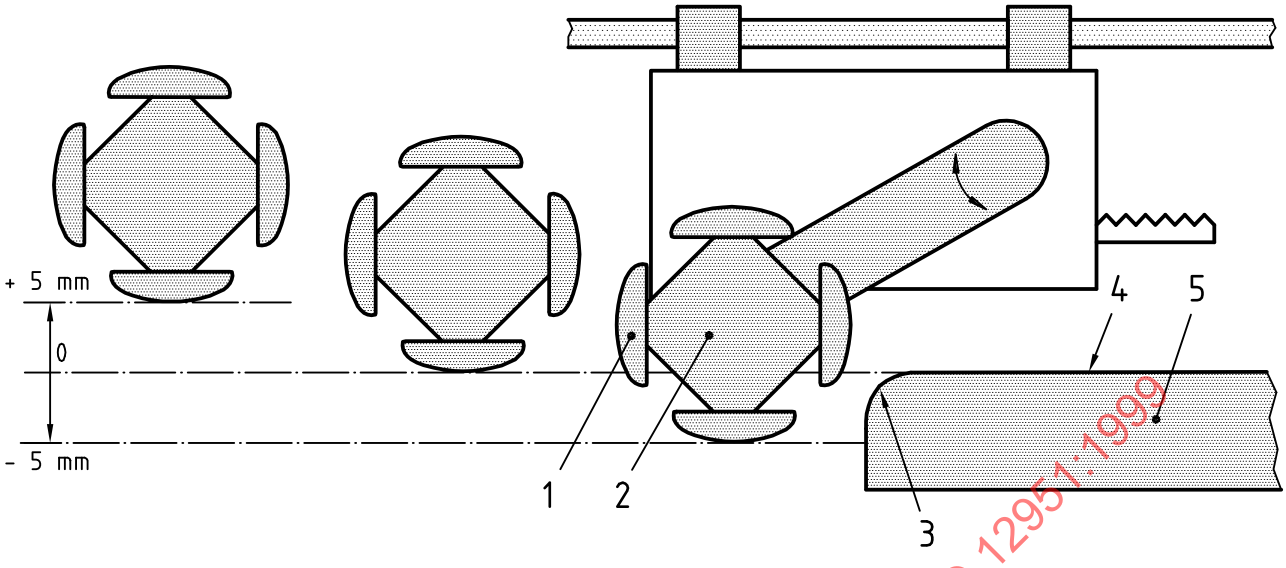
2) A standard carpet, supplied with calibration details is available from TFI, Deutsches Teppichforschungsinstitut, Charlottenburger Allee 41, 52068, Aachen, Germany.

This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product. Equivalent products may be used if they can be shown to lead to similar results.



Key

1 Foot
2 Tretrad
3 Stair nosing (= 10 mm)
4 Surface of bed plate
5 Bed plate

Figure 3 — Adjustment of wheel height

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Table 1

Total thickness of specimen measured in accordance with ISO 1765 (mm)	Adjustment of wheel height in relation to surface of bed plate (mm)
⩽ 10,0	−5
> 10,0	0
⩽ 10,0 plus underlay	0
> 10,0 plus underlay	+5

10 Calculation and expression of results

10.1 Mass loss per unit area m_v

Calculate the mass loss per unit area m_v in grams per square metre according to the following equation:

$$m_v = \frac{(m_1 - m_2)}{A}$$

where

m_1 is the mass of the initial conditioned specimen, in grams;

m_2 is the mass of the final conditioned specimen, in grams;

A is the tested area of the specimen in square metres (width of Tretrad foot × length of track over which Tretrad walks in accordance with 5.1.1).

Calculate the mean, coefficient of variation and the 95 % confidence levels.

NOTE Because of the severe mechanical damage of the Lisson Tretrad test the mass loss results of some woven carpets may not be representative of practical performance due to abnormal tufting out during the test.

10.2 Relative mas loss m_{rv} (not for needlefelt and flocked carpets)

Calculate the relative weight loss m_{rv} according to the following equation:

$$m_{rv} = \frac{m_v}{m_{AP}} \times 100$$

where m_{AP} is the mass of pile per unit area above the substrate in grams per square metre, determined according to ISO 8543.

10.3 I_{TR} (not for needlefelt and flocked carpets)

Calculate I_{TR} according to:

$$I_{TR} = 0{,}19\sqrt{m_{AP}} \times \left(\frac{100 - m_{rv}}{100}\right)$$

10.4 Unusual phenomena

The tested specimens shall additionally be inspected for unusual phenomena which may be indicative of a manufacturing fault. These may be e.g., release of tufts or loops from the pile or fibres from the substrate and changes in the back coating.

11 Test Report

The test report shall contain the following information:

a) reference to this International Standard, i.e. ISO 12951;

b) a complete identification of the product tested, including type, source, colour and manufacturer's reference numbers;

c) previous history of the sample;

d) number of test specimens;

e) mean mass loss per unit area m_v in g/m^2, rounded to the nearest 0,1 g/m^2;

f) mean relative mass loss m_{rv}, rounded to the nearest 0,1 %;

g) the value of I_{TR};

h) absolute and relative confidence limit of m_v (confidence level $1 - \alpha = 0{,}95$);

i) unusual phenomena as described in 10.4;

j) any deviation from this International Standard which may have affected results.

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Annex A
(normative)

Frictional force measurement on sole material

A.1 Brief description

A defined metal weight is dragged over the sole material by means of a tow motor. A load cell connected to an amplifier records the drag force. The results are transmitted via a programme board to an associated computer where they are stored. The sole material is evaluated by statistical analysis of the results.

A.2 Apparatus

The apparatus consists of a test-bed, a drag weight, a load cell, a signal amplifier and a tow motor. A programme board and the appropriate software and hardware are needed for analysis of the results.

The test-bed upon which the sole material is placed is at least 25 cm wide and 120 cm long.

The drag weight, with an attachment eye at the leading edge, is a metal plate which has a polished under-surface. It is connected to the tow motor by an aramid cord which passes over the sensor roll of the load cell at an angle of 90°. The drag weight has a length of 117 mm, a width of 54 mm and a mass of 650 g.

A.3 Procedure

Divide the sheet rubber as supplied (80 cm × 100 cm) into three strips each measuring approximately 25 cm × 100 cm and mark them with an identifier. Clean these strips with a soft brush until no dust particles remain visible. Also clean the drag weight with alcohol before the start of testing and after every twentieth measurement.

For the test, place one of the strips of sheet rubber on the test-bed and place the drag weight upon it. The direction in which the drag weight is pulled shall conform with the subsequent direction of travel of the Tretrad soles die-cut from the sheet rubber. Pass the drag cord around the sensor roll of the load cell at an angle of 90° so that it is held between the drive rolls of the transmission mechanism. Set the transmission mechanism to pull at speed of 1,75 m/min and start it in motion.

The results are automatically recorded and logged by computer for a drag weight travel of 0,75 m. On completion of the test the stored data from each of the strips of sheet rubber shall be statistically analysed.

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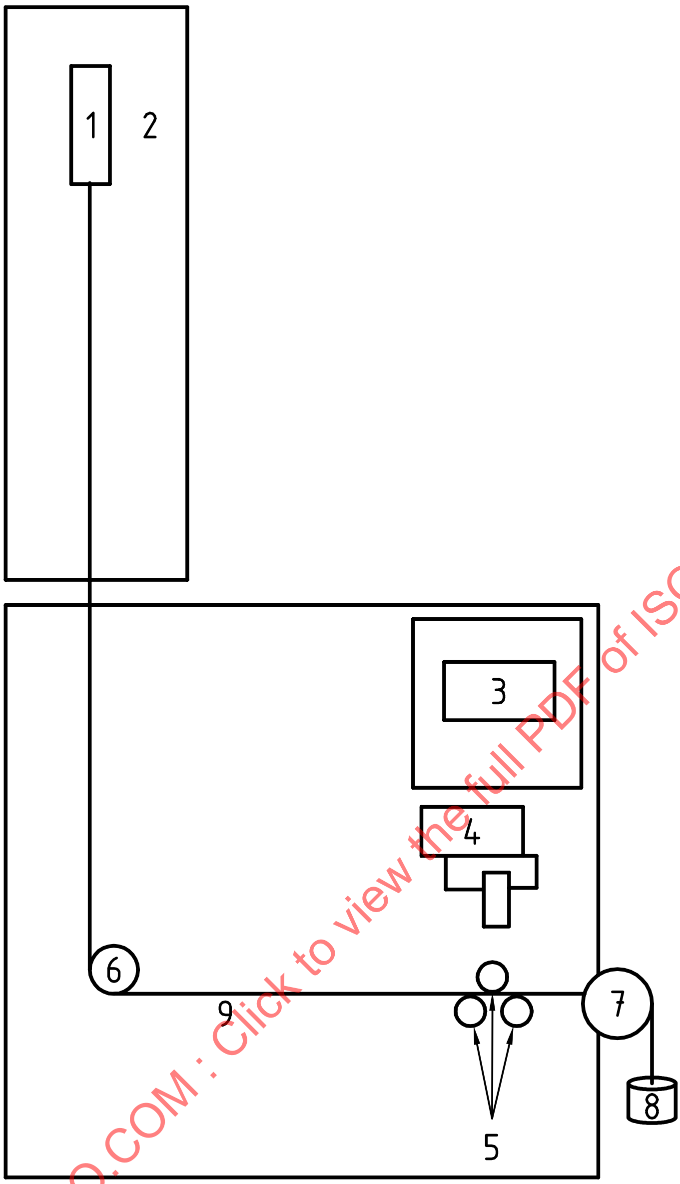

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Key

1 Drag weight
2 Test-bed
3 Signal amplifier
4 Tow motor
5 Take-up rollers
6 Load cell
7 Capstan
8 Pre-tensioning weight
9 Drag cord

Figure A.1 — Test apparatus for the measurement of friction force

Annex B
(informative)

Accuracy and precision of the Lisson Tretrad test

In the interlaboratory trial carried out by ISO/TC 38/SC 12/WG 6 in 1990, ten laboratories were involved and the results from eight laboratories were evaluated.

Six different tufted carpet samples (A to F) with abradable pile fibre material were tested. Sample A was used as a calibration carpet.

The machines were calibrated by establishing the number of treads (traverses) to produce a selected mass loss from the calibration carpet. This number of treads obtained by the calibration was then used for testing the other carpets in the series.

The constructional details of the carpet samples are given in Table B.1 and the complete results obtained from each specimen and each laboratory are presented in Table B.2. The mean values of the samples and the coefficient of variation (CV value) as a percentage of the standard deviation are listed.

The statistical evaluation was carried out according to ISO 5725. After inspection of Table B.2 for any obvious irregularities statistical tests were applied to indicate whether the result of a certain cell is a possible straggler (*) or a statistical outlier (**).

In particular laboratory 8 was evident in this respect. Additional comparative tests showed that the deviations in the results were caused by a difference in the surface (sliding resistance) of the sole material used as abradent in the Lisson-test. Laboratory 8 was therefore generally eliminated from the evaluation.

Untrustworthy results were also obtained from laboratory 7. The reason could not exactly be identified, but again it was probably the sole material, perhaps in combination with a longer traverse length of the wheels (compare Table B.4).

A to D gave partial improvements.

Outliers (**) identified by the statistical tests (significance level 1 %) were not considered for the further statistical evaluation (Table B.3), whereas possible stragglers (*), between significance levels 1 % and 5 %, have been included in particular when they depend on a high standard deviation. In a careful working laboratory the number of specimens will normally be increased when a high standard deviation is determined, so that the mean value becomes more secure.

Since the participating laboratories had only four specimens available the possibility for correction did not exist.

The results in Table B.3 are based on the rather high standard deviations which influence the reproducibility (R) as well to the repeatability (r). In Figure B.1 the values r_j and R_j are plotted against the mean value of weight loss m_j. The evaluation showed that there is no relationship with the weight loss value m_j. This means both levels are independent of the weight loss.

Figures B.2 and B.3 indicate the mean values from each carpet sample and each laboratory and the overall mean value of m_j from all laboratories included for the evaluation. Most of the results for each carpet lie within the range of tolerances of ± 7,5 % from the overall mean, except for the erroneous results of laboratory 8 and some of those of laboratory 7. The following conclusions can be drawn from this work.

a) The precision of the test depends on two main factors, the calibration of the machine and the quality of the sole material.

b) It is important to note that requirements of the precision of the test method should not be more severe than requirements of the production (construction data) of the carpets themselves.

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Table B.1 — Carpet samples used in the interlaboratory trial Tretrad test

Carpet reference	Manufacture	Surface	Pile material	Total mass g/m^2	Total thickness mm	Surface pile mass g/m^2	Surface pile thickness mm
A (calibration carpet)	Tufted 9/64"	Loop	50 W 50 PAC	2 340	8,7	400	4
B	Tufted 1/8"	Loop	35 PAC/20 W 20 PA/15 PP 10 PES	2 360	8,1	427	3,6
C	Tufted 1/8"	Cut	50 PP/20 W 20 PAC/10 CV	1 910	8,3	421	4,6
D	Tufted 5/32"	Loop	50 PP/25 W 25 PAC	2 240	10	520	4,9
E	Tufted 5/32"	Loop	70 PP/30 PAC	1 720	8,1	463	4,5
F	Tufted 5/32"	Loop	50 W/30 PAC 20 PP	1 740	6,4	405	3,8

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Table B.2 — Data weight loss comparability

Laboratory		Carpet A	Carpet B	Carpet C	Carpet D	Carpet E	Carpet F
1	1L	144,40	78,40	93,95	71,30	69,60	162,10
	1r	141,50	78,20	97,10	69,20	66,90	156,20
	2L	144,40	76,10	99,40	71,30	74,20	162,10
	2r	137,80	75,46	94,90	69,60	82,60	131,60
X mean		142,03	77,04	96,34	70,35	73,33	153,00
CV(%)		2,20	1,92	2,52	1,58	9,38	9,50
2	1L	136,10	81,30	96,70	82,20	68,50	132,80
	1r	146,10	77,60	83,70	72,40	61,10	146,30
	2L	140,00	98,90	92,80	53,30	62,20	146,30
	2r	139,40	77,60	91,30	55,20	65,20	155,20
X mean		140,40	83,85	91,13	65,78	64,25	145,15
CV(%)		2,97	12,15**	5,98	21,16**	5,17	6,37
3	1L	138,60	82,70	103,40	65,90	66,20	159,30
	1r	138,00	83,20	111,40	65,90	59,60	158,20
	2L	141,10	80,30	108,00	64,80	73,00	110,70
	2r	145,50	85,60	106,80	66,40	83,60	123,00
X mean		140,80	82,95	107,40	65,75	70,60	137,80
CV(%)		2,42	2,62	3,07	1,03	14,52	17,93**
4	1L	141,60	81,10	95,90	68,00	65,90	159,80
	1r	138,00	79,50	96,60	61,40	61,80	154,10
	2L	148,60	78,00	106,40	60,70	62,00	159,50
	2r	140,50	78,00	103,00	58,90	65,20	152,00
X mean		142,18	79,15	100,48	62,25	63,73	156,35
CV(%)		3,19	1,87	5,06	6,39	3,34	2,50
5	1L	145,70	81,80	108,70	83,20	68,20	153,80
	2r	150,20	79,10	110,80	82,50	76,90	151,10
	2L	145,70	83,40	105,40	76,00	72,00	160,50
	2r	146,00	86,10	107,80	78,80	68,20	162,80
X mean		146,90	82,60	108,18	80,13	71,33	157,05
CV(%)		1,50	3,55	2,07	4,19	5,78	3,51
6	1L	147,60	74,70	102,20	58,30	67,00	138,60
	1r	148,90	78,10	110,00	58,10	68,30	147,70
	2L	150,40	77,60	86,00	56,30	69,90	120,20
	2r	145,30	79,60	97,60	63,60	71,20	132,30
X mean		148,05	77,50	98,95	59,08	69,10	134,70
CV(%)		1,46	2,65	10,14*	5,33	2,66	8,57
7	1L	147,70	72,50	75,00	79,10	42,00	118,40
	1r	145,50	74,80	74,10	75,90	49,40	126,40
	2L	145,00	77,00	69,10	68,90	49,40	121,70
	2r	143,60	78,20	73,40	72,30	46,10	119,10
X mean		145,45	75,63	72,90*	74,05	46,73*	121,40
CV(%)		1,17	3,32	3,59	5,96	7,52	2,98
8	1L	–	53,90	78,60	42,60	49,40	78,60
	1r	–	53,90	67,30	47,10	51,60	87,50
	2L	–	56,10	92,00	47,10	51,60	83,10
	2r	–	58,40	76,30	42,60	49,40	89,80
X mean		–	55,58**	78,55*	44,85*	50,50*	84,75**
CV(%)		–	3,87	12,99*	5,79	2,52	5,84

NOTE * = possible stragglers; ** = statistical outliers; CV = coefficient of variation.

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