INTERNATIONAL STANDARD

ISO 11378-2

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Textile floor coverings — Laboratory soiling tests —

Part 2: Drum test

Revêtements de sol textiles — Essais d'encrassement en laboratoire —

Partie 2: Essai au tambour

Reference number
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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 part of ISO 11378 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11378-2 was prepared by Technical Committee ISO/TC 219, *Floor coverings*.

ISO 11378 consists of the following parts, under the general title *Textile floor coverings — Laboratory soiling tests*:

— *Part 1. Kappasoil test*

— *Part 2: Drum test*

Annexes B and C form a normative part of this part of ISO 11378. Annexes A and D are for information only.

Textile floor coverings — Laboratory soiling tests —

Part 2:
Drum test

1 Scope

1.1 This part of ISO 11378 describes the equipment and the test method for assessing the propensity of textile floor coverings to soiling in the absence of abrasive wear and texture changes using a standard artificial soil composition.

1.2 This test method is applicable for use in testing unused textile floor coverings of all types.

1.3 The scope of this test method can be extended to assess the effects of fibre finishes, cleaning chemicals and cleaning equipment (see annex A).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11378. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11378 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 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

ISO 105-J01:1997, *Textiles — Tests for colour fastness — Part J01: General principles for measurement of surface colour*

ISO 139:1973, *Textiles — Standard atmospheres for conditioning and testing*

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

ISO 9405, *Textile floor coverings — Assessment of changes in appearance*

ISO 10361, *Textile floor coverings — Production of changes in appearance by means of Vettermann drum and hexapod tumbler testers*

ISO 11379, *Textile floor coverings — Laboratory cleaning procedure using spray extraction*

3 Principle

Carpet test specimens are subjected to an accelerated soiling process. The degree of soiling is measured by calculating the change in colour between soiled and original textile floor covering, or by use of the large grey scales.

4 Apparatus and materials

4.1 Drum and driving systems, conforming to the specified hexapod tumbler tester of ISO 10361 or to the modified drum test equipment described in annex B.

4.2 Wide-mouth mixing container, such as a standard mill jar, for preparation of soiled pellets.

4.3 Polyamide polymer pellets, having a volume of (13 ± 2) mm^3 per pellet.

4.4 Chrome alloy steel balls (ball bearings), of total mass $(1\,000 \pm 10)$ g, each with a diameter of $(9{,}5 \pm 0{,}02)$ mm.

4.5 Magnet, capable of attracting and holding several chrome alloy steel balls at one time.

4.6 Standard soiling compound, compatible with the equipment, selected from those listed in annex C. The preferred soiling compound is the compound C.5.

NOTE The standard soils have a limited shelf life and should be stored in sealed containers.

4.7 Suction (vacuum) cleaner, with an airflow of (25 ± 5) l/s through the suction orifice of (125 ± 25) mm $\times$ $(15 \pm 2{,}5)$ mm.

4.8 Specimen backing sheet, a polyethylene sheet of nominal size 950 mm $\times$ 215 mm $\times$ 2 mm.

4.9 Double-sided pressure sensitive adhesive tape, approximately 50 mm in width used to secure the textile floor covering specimens to the backing sheet.

4.10 Straight edged ruler, of minimum length 200 mm.

4.11 Control textile floor covering.

A light-coloured carpet of known specifications is used as a reference for each test evaluation.

4.12 Assessment equipment

4.12.1 Colour measurement equipment, consisting of a colour measurement device with a $(50 \pm 0{,}5)$ mm aperture, capable of measuring the colour of textile floor coverings and expressing the results as ΔE or ΔL (CIELAB system) in accordance with ISO 105-J01.

4.12.2 Large grey scales, in accordance with ISO 105-A02.

4.12.3 Template, used in conjunction with the colour measurement equipment, of the same size as the test specimen(s) with six holes of the same dimensions as the measuring head of the colour measuring equipment (see Figure 1).

Dimensions in millimetres

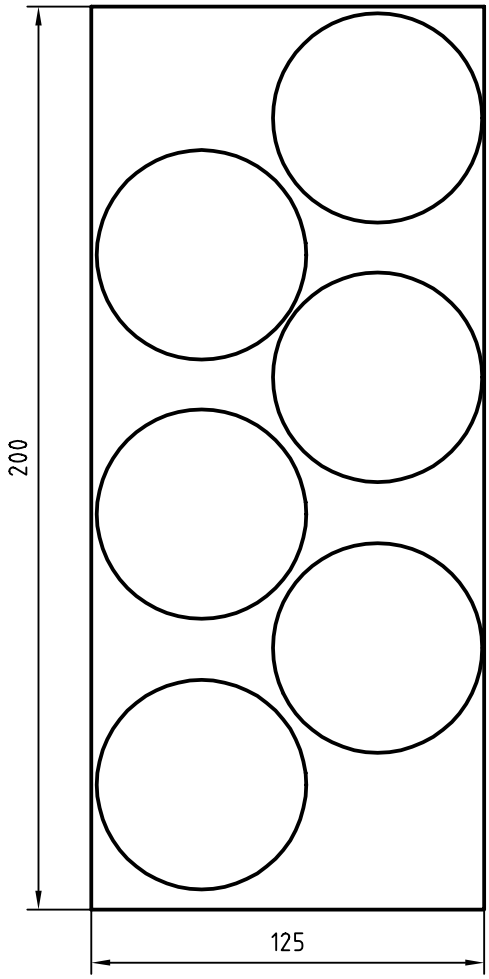


Figure 1 — Example of suitable template for colour measurement

5 Atmosphere for conditioning and testing

The standard atmosphere for conditioning and testing of textiles shall be one of those specified in ISO 139.

6 Sampling and preparation of soiled pellets and test specimens

6.1 Preparation of soiled pellets

Place (3 ± 0,1) g of the preferred soiling compound C5 and 1 000 g of polyamide pellets in the mixing container. Secure the lid and place the mixing container on the driving system (4.1) for 20 min. to ensure a homogeneous mixture of the soil and the pellets.

To simulate particular use areas it may be necessary to adjust the type and/or quantity of soiling compound

NOTE If large quantities of soiled pellets are prepared (e.g. more than 2 000 g) they should kept in an airtight container to ensure that no loss of moisture from the mixture occurs, and the supply should not be allowed to dwindle below 25 % of the original quantity prepared.

6.2 Sampling

Select test specimens of each textile floor covering being tested in accordance with ISO 1957.

NOTE Colour and design play a large part in the assessment and this should be borne in mind when selecting test specimens and when assessing.

6.3 Number and dimensions

Cut a minimum of two test specimens per textile floor covering measuring a minimum of (125 ± 1) mm in the direction of manufacture by (200 ± 2) mm wide. Mark an arrow in the direction of manufacture or, in the case of pile carpets, in the direction of the pile lay on the back of the test specimen. Allow the test specimens to condition in the standard atmosphere (clause 5), flat, singly and with use-surface uppermost, for a minimum of 24 h.

6.4 Preparation of test specimen

6.4.1 Attach double-sided adhesive tape (4.9) along each edge, across the ends and at each specimen cross junction of the specimen backing sheet. Mount the test specimens and the control textile floor covering (4.11), use surface uppermost, allowing a (5 ± 1) mm gap at each end and an (8 ± 1) mm gap between specimens to allow for the specimens to remain attached when the specimen backing sheet is curved to fit the internal circumference of the drum. Check to ensure that each test specimen is flat to the specimen backing sheet and in the direction of manufacture when it is curved to the inside drum diameter. If the test specimens are not properly secured adjust the test specimen accordingly. When test specimens of differing thickness are tested together, the difference in thickness of the adjacent test specimens shall not exceed 1 mm.

6.4.2 Use the suction cleaner (4.7) to remove loose fibre from the test specimens, using a total of four strokes, two strokes in each direction of manufacture or, in the case of pile carpets two against and two with the direction of the pile lay.

6.4.3 In the case of cut pile test specimens align the pile in the direction of natural pile lay by using the ruler (4.10). Move the ruler once across the test specimen in the direction of pile lay, applying slight pressure.

7 Procedure

7.1 If using colour measurement for assessment, locate the measuring template (4.12.3) on the test specimen and, using the colour measuring equipment (4.12.1), measure the colour of the test specimens in six places. Record these values.

7.2 Ensure that the inside of the drum (4.1) and the chrome alloy steel balls (4.4) are clean.

7.3 Fit the mounted test specimens into the clean drum, ensuring that the backing sheet fits tightly and lies smoothly around the internal circumference.

7.4 Place (1 000 ± 10) g of chrome alloy steel balls (4.4) and (250 ± 2) g of soiled pellets into the drum and secure the lid.

7.5 Place the drum on the driving system, start the machine and allow the drum to rotate for 30 min. When the test is completed stop the machine, remove the drum and sit it upright.

7.6 Remove the backing sheet (4.8) with the test specimens and carefully clean the test specimens by suction with the suction cleaner (4.7) to remove loose surface soil and fibre, using a total of four strokes in each direction of manufacture or, in the case of pile carpets, two against the direction of the pile lay and two with. In the case of cut pile carpets, ensure that the last stroke of the suction nozzle is in the direction of the pile lay. Move the straight edged rule (4.10) across the pile in the direction of the pile lay, applying slight pressure to align the pile.

7.7 Using the magnet (4.5) remove the chrome alloy steel balls (4.4) from the drum.

7.8 With the suction cleaner (4.7), vacuum the used soil pellets from the inside of the drum. Clean the inside of the drum with a damp cloth.

8 Assessment

8.1 General

Use the assessment method described in 8.2 or in 8.3 depending on availability of the relevant equipment.

8.2 Colour measurement

Using the measuring template (4.12.3) and the colour measuring device (4.12.1) measure the colour of the soiled test specimens in the same six places on each test specimen. Calculate the mean colour difference (ΔE), or mean lightness difference (ΔL) between original and soiled test specimens according to the following formulae:

$$\Delta E = \sqrt{(L_0 - L_s)^2 + (a_0 - a_s)^2 + (b_0 - b_s)^2} \text{ or } \Delta L = L_0 - L_s$$

where

L_0, a_0, and b_0 are the mean CIE colour co-ordinates of the original test specimen;

L_s, a_s, and b_s are the mean CIE colour co-ordinates of the soiled test specimen.

8.3 Large grey scales

Three operators shall assess the colour differences between the soiled and the original test specimens in accordance with ISO 105-A02. Assessment shall be made using the large grey scales (4.12.2) and under the lighting conditions specified in ISO 9405.

9 Accuracy and precision

Accuracy and precision data was obtained by means of inter-laboratory trials, and are documented in annex C. The results demonstrated that this test method has satisfactory accuracy and precision. The coefficient of variation shows repeatability is good and reliability exists with floor soiling tests. The results from laboratory to laboratory are reproducible.

10 Test report

The test report shall include the following information:

a) all the information necessary for complete identification of the test specimen;

b) reference to this part of ISO 11378, i.e. ISO 11378-2;

c) date of test;

d) conditioning and testing atmosphere used;

e) details of the soiling compound and quantity used;

f) whether assessment was by colour measurement device (see 8.2) or by large grey scales assessment (see 8.3);

g) the test results;

h) any deviation from this part of ISO 11378, or from the International Standards to which reference is made, that could have affected the results.

Annex A
(informative)

Assessment of the effects of fibre finishes, cleaning chemicals and cleaning equipment

A.1 General

The scope of this laboratory soiling test can be extended by either cleaning the soiled test specimens with different chemicals or by using different cleaning machines. Colour measurement or large grey scale assessments can then be used to quantify the relative efficiencies of the cleaning products or processes being evaluated.

A.2 Assessment of further properties

A.2.1 Dependent upon the number of chemicals and/or machines, the number of specimens per sample can be increased or decreased accordingly.

A.2.2 Carry out each test in accordance with the prescribed protocol, up to and including the assessment procedure (clause 8).

A.2.3 Clean the specimens in accordance with the method specified in ISO 11379. To assess cleaning chemical performance, use the same extraction cleaning machine for each chemical, and to assess cleaning machines use a standard cleaning chemical.

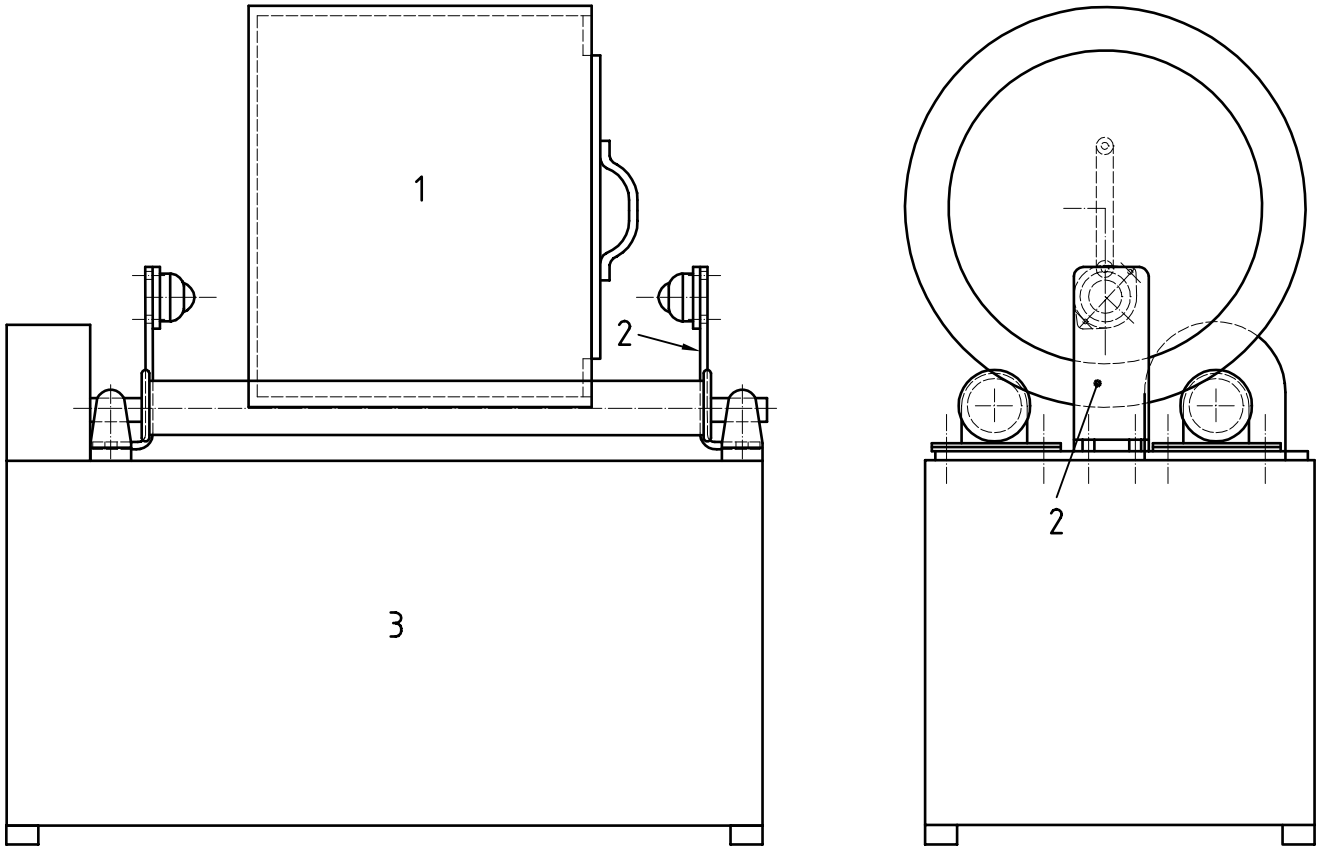
A.2.4 Assess the efficiency of the cleaning process by one of the methods given in clause 8. The efficiency is assessed by comparison to the original unsoiled material i.e. how well the cleaning process has restored the original appearance, or how much soil the cleaning process has removed.

Annex B
(normative)

Modified drum test equipment

The modified drum uses a ball mill drive (see Figure B.1) capable of characteristics similar to that of the hexapod drum apparatus. All operation conditions are retained except for the size of the backing sheet and that of the test specimens. Test specimens are cut to a minimum size of (125 ± 2) mm in the direction of manufacture by (264 ± 2) mm width. Ensure that the ball bearing is centred on the drum.

The findings in annex D indicate that both types of apparatus provide a uniformly soiled textile floor covering.



Key

1 Side of drum

2 Drum guide bracket mounts to bearing plate

3 Driving system

Figure B.1 — Modified drum tester

Annex C
(normative)

Standard artificial soiling compounds

A number of artificial soiling compounds, which can be used for laboratory soiling tests, have been available for many years. The composition of these compounds and their commercial suppliers are given below. The quantity of soil used will depend on the composition of the soil and the textile floor covering characteristics evaluated.

Ref.	Composition	% by mass	Supplier [a]
C.1	Fine grained sand ($\leqslant$ 500 μm)	83,00	Cleaning Research International
	Kaolin	7,30	49 Boroughgate
	Calcium carbonate	1,95	Otley LS21 1AG
	Calcium sulfate	1,95	UK
	Slurried chalk	1,95	Tel.: +44 1943 462389
	Peat	1,57	Fax: +44 1943 464316
	Portland cement	0,74	e-mail: cri@criuk.globalnet.co.uk
	Activated charcoal	0,57	
	Bayferrox yellow 3910	0,37	Ref.: "*ISO artificial soil*"
	Mineral oil (Nujol 014)	0,26	
	Bayferrox brown 686	0,23	
	Ferric oxide	0,11	
	Soot (carbon black)	0,11	
	Mixed metal oxides	0,01	
C.2	Peat dust	37,80	WFK Krefeld
	Portland cement	17,45	Postfach 130762
	Kaolin	17,70	D-47759 Krefeld
	Quartz	17,70	Germany
	Mineral oil (Nujol 014)	6,20	Tel.: +49 215 177 0072
	Dust	1,05	Fax: +49 215 177 0075
	Iron oxide	0,60	
	Yellow pigment (Bayferrox yellow 930)	1,50	Ref.: "*Teppichschmutz"*
C.3	Peat moss	38,40	Protective Chemical Products Div.
	Cement (vitreous or Portland)	18,00	3M Center, Building 301-1 E-03
	Kaolin	18,00	St Paul, MN 55144-1000
	Siliceous earth	18,00	USA
	Mineral oil (Nujol 014)	6,25	Tel.: +1 612 733 5996
	Carbon (lamp) black	1,05	Fax: +1 612 733 4302
	Iron oxide	0,30	Ref.: *"3 M Carpet Soil"*
C.4	Quarz silica	88,30	CTTN
	Kaolin	9,35	Av. Guy de Collonge
	Yellow ferrous oxide	0,20	BP 41, 69131 Ecully, Cedex, France
	Black ferrous oxide	0,60	Fax: +33 78 433 412
	Paraffin oil	1,55	Ref.: *"CEN Standard Soil"*
C.5	Peat moss (dark)	38,00	Textile Innovators Corporation
	Portland cement	17,00	P.O. Box 8
	Kaolin clay	17,00	101 Forest Street
	Silica (200 mesh)	17,00	Windsor, North Carolina USA
	Carbon (lamp or furnace) black	1,75	Tel.: +1 252 794-9703
	Red iron oxide	0,50	e-mail: tic@albemarlenet.com
	Mineral oil (synthetic grade)	8,75	Ref.: "*AATCC standard soil*"

[a] These trade names are examples of suitable products available commercially. This information is given for the convenience of users of this part of ISO 11378 and does not constitute an endorsement by ISO of these products.

Annex D
(informative)

Accuracy and precision

D.1 General

Accuracy and precision are defined in ISO 5725-1:1994 as follows:

accuracy
the closeness of agreement between a test result and the accepted reference value

NOTE The term accuracy, when applied to a set of test results, involves a combination of random components and a common systematic error or bias component. In the proposed test method the real-life references are floor test results, that are known to contain site and time variabilities of their own.

precision
the closeness of agreement between independent test results obtained under stipulated conditions

NOTE Precision depends only on the distribution of random errors and does not relate to the true value or the specified value.

The level of precision of a test method is defined by two indicators, the repeatability and the reproducibility.

Repeatability is expressed as the standard deviation corresponding to the variability of the measurements made under conditions where test results are obtained with the same method on the same material by the same operator using the same equipment in the same laboratory within short intervals of time.

The difference between two test results obtained under repeatability conditions will exceed the repeatability limit (r) on average not more than once in 20 cases in the normal and correct operation of the method.

Reproducibility is expressed as a standard deviation taking into consideration the variability of the measurements made under conditions where test results are obtained with the same method on the same material by different operators on the same type of equipment located in different laboratories at different times.

The results obtained under reproducibility conditions will exceed the reproducibility limit (R) on average not more than once in 20 cases in the normal and correct operation of the method.

D.2 Accuracy

International inter-laboratory studies were conducted during 1998 to determine the correlation of results between the modified hexapod drum test using artificial soiling compound C.5 (see annex C) and floor soiling trials of the type described in ISO 11377.

In the trials five textile floor coverings having different constructions and colours and with different pile or use-layer fibres (see Table D.1) were used in order to ensure that a range of different soiling characteristics were evaluated.

Laboratory soiling tests were carried out by four organizations. The results, expressed as ΔE, represent colour differences between unused and soiled test specimens. All results from tests carried out with the proposed test method are found in Tables D.2 and D.3. The floor results appear in Table D.4 and the results of tests conducted by other test methods are found in Table D.5. Grey scale results are also included for information purposes only in Tables D.6 and D.7.

The shortest traffic exposure (FIT 17 000, see Table D.4) was selected as the basis for real-life analysis of laboratory results. The correlations between the modified hexapod drum tests, modified drum test and floor traffics are 0,925 and 0,945, thus confirming good agreement with floor test results. Table D.5 includes results obtained with other laboratory soiling tests carried out in accordance with ISO 11378-1, Kappasoil test, to confirm correlation between the two laboratory soiling test methods.

Based on the above information and on the knowledge that floor test results contain site and time dependencies, the modified hexapod drum test is found to be accurate.

D.3 Precision

D.3.1 Repeatability

The modified hexapod and modified drum test were evaluated by four laboratories and six operators on two separate days of operation during the inter-laboratory study. Tables D.9, D.10, D.11 and D.12 contain the results of the repeatability trials (see: runs 100 – 107 and 116 – 123). Examination of the data (see Tables D.9 and D.11) as well as of the standard deviations (see Tables D.8, D.10 and D.12), confirms the repeatability of the method.

D.3.2 Reproducibility

Results obtained from the modified hexapod drum test machines operated by three different laboratories, six operators and two separate working days are shown in Tables D.9 to D.12. The laboratory-to-laboratory results, as well as the operator-to-operator and day-to-day comparisons and their standard deviations confirm that the method is reproducible.

D.3.3 Laboratories/test houses

I DuPont, USA (1)

II DuPont, Canada Inc.

III Bodycote Ortech Inc., Canada

IV Cleaning Research International, UK

V WRONZ Euralabs, UK

VI DuPont, USA (2)

Table D.1 — Identification of samples

Identity	Substrate	Construction	Appearance	Refectance		
				L	*a*	*b*
S1	Wool	Level loop	Off-white	72,4	1,3	11,9
S2	Polyamide	Cut	White	81,6	1,3	7,0
S3	Olefin	Level loop	Speckled white	73,7	1,0	7,0
S4	Acrylic	Hi/Lo Loop	White	77,7	1,4	9,4
S5	Polyamide	Cut	Gold	47,1	7,3	15,2

Table D.2 — Modified hexapod drum test data

Laboratory	Cycle	Day	Operator	S1	S2	S3	S4	S5
No. 1	116	Day 1	Op. 1	15,71	17,97	10,99	11,06	4,62
No. 1	100	Day 1	Op. 1	15,78	16,87	11,13	11,32	4,58
No. 1	101	Day 1	Op. 1	14,83	18,94	11,23	12,06	4,37
No. 1	101	Day 1	Op. 1	16,09	18,78	11,16	11,49	4,92
No. 1	102	Day 1	Op. 2	15,61	18,59	11,79	12,86	4,32
No. 1	102	Day 1	Op. 2	15,41	18,84	11,30	12,96	4,38
No. 1	103	Day 1	Op. 2	14,39	18,39	11,03	11,11	4,65
No. 1	103	Day 1	Op. 2	15,87	18,84	10,34	11,19	4,79
No. 1	104	Day 2	Op. 1	15,88	18,35	11,57	10,03	5,02
No. 1	104	Day 2	Op. 1	16,27	17,36	11,85	11,00	4,76
No. 1	105	Day 2	Op. 1	13,95	17,94	11,11	10,93	4,54
No. 1	105	Day 2	Op. 1	14,52	17,80	11,00	11,34	4,51
No. 1	106	Day 2	Op. 2	14,88	17,56	11,15	10,93	4,47
No. 1	106	Day 2	Op. 2	14,65	16,61	10,89	11,01	4,80
No. 1	107	Day 2	Op. 2	14,28	17,38	10,92	10,14	4,54
No. 1	107	Day 2	Op. 2	14,54	17,02	11,07	9,65	4,33
No. 2	67	Day 1	Op. 3	12,73	15,16	9,94	9,89	3,98
No. 2	67	Day 1	Op. 3	12,98	15,07	9,72	9,87	4,17
No. 2	68	Day 1	Op. 3	12,94	15,82	9,30	9,52	4,23
No. 2	68	Day 1	Op. 3	13,50	15,86	9,59	8,98	4,04
No. 2	70	Day 1	Op. 4	12,68	14,97	9,19	8,78	3,71
No. 2	70	Day 1	Op. 4	13,00	14,83	9,68	9,30	3,93
No. 2	72	Day 1	Op. 4	11,93	14,52	9,97	9,24	3,83
No. 2	72	Day 1	Op. 4	11,19	15,10	9,99	9,17	4,09
No. 2	200	Day 1	Op. 5	13,22	14,70	9,97	10,94	4,38
No. 3	200	Day 1	Op. 5	13,85	14,29	9,90	11,77	4,90
No. 3	201	Day 1	Op. 5	14,40	16,17	10,90	10,72	4,31
No. 3	201	Day 1	Op. 5	14,94	16,92	10,52	10,01	4,51
No. 3	202	Day 1	Op. 6	13,63	16,55	9,89	10,35	4,43
No. 3	202	Day 1	Op. 6	14,27	16,35	10,43	9,46	4,72
No. 3	203	Day 1	Op. 6	12,64	14,64	10,61	9,43	3,64
No. 3	203	Day 1	Op. 6	12,49	14,47	10,44	10,70	3,93
No. 3	204	Day 2	Op. 5	13,35	16,02	9,89	9,18	3,85
No. 3	204	Day 2	Op. 5	14,38	16,48	9,96	9,19	4,44
No. 3	205	Day 2	Op. 5	13,14	16,34	10,98	10,44	4,04
No. 3	205	Day 2	Op. 5	14,39	16,35	10,74	10,66	4,09
No. 3	206	Day 2	Op. 6	13,76	16,55	10,46	10,04	4,03
No. 3	206	Day 2	Op. 6	13,88	16,14	10,18	10,76	3,84
No. 3	207	Day 2	Op. 6	15,14	17,44	10,13	12,13	4,77
No. 3	207	Day 2	Op. 6	14,19	18,84	10,86	11,97	4,67

Table D.3 — Modified drum test data

Laboratory	Run	Day	Operator	S1	S2	S3	S4	S5
No. 1	116	Day 1	Op. 1	12,88	13,56	8,20	7,00	3,62
No. 1	116	Day 1	Op. 1	12,03	13,20	7,31	6,89	3,12
No. 1	117	Day 1	Op. 1	11,43	13,71	7,61	8,66	3,53
No. 1	117	Day 1	Op. 1	12,21	13,24	8,14	8,17	3,60
No. 1	118	Day 1	Op. 2	11,02	12,50	7,60	8,39	2,65
No. 1	118	Day 1	Op. 2	10,94	12,79	7,28	9,18	2,66
No. 1	119	Day 1	Op. 2	12,83	14,57	8,67	9,11	3,22
No. 1	119	Day 1	Op. 2	12,23	14,60	8,49	7,45	3,45
No. 1	120	Day 2	Op. 1	12,44	15,62	7,98	8,15	3,67
No. 1	120	Day 2	Op. 1	13,38	15,06	8,34	9,37	3,57
No. 1	121	Day 2	Op. 1	11,64	14,31	6,68	7,18	3,52
No. 1	121	Day 2	Op. 1	13,01	14,74	7,30	7,49	3,44
No. 1	122	Day 2	Op. 2	13,72	13,53	7,68	7,71	4,22
No. 1	122	Day 2	Op. 2	12,45	13,55	8,37	7,72	3,84
No. 1	123	Day 2	Op. 2	10,94	13,52	8,11	8,67	3,38
No. 1	123	Day 2	Op. 2	10,88	13,79	8,16	8,29	2,78
No. 2	61	Day 1	Op. 3	14,25	16,09	10,12	12,25	4,92
No. 2	61	Day 1	Op. 3	14,51	15,40	10,26	12,00	4,98
No. 2	62	Day 1	Op. 3	14,27	16,62	10,98	11,30	5,42
No. 2	62	Day 1	Op. 3	13,93	16,27	10,93	11,11	5,42
No. 2	63	Day 1	Op. 4	15,55	16,83	10,85	12,33	5,42
No. 2	63	Day 1	Op. 4	14,83	16,38	11,12	11,87	5,71
No. 2	64	Day 1	Op. 4	15,33	15,84	10,65	11,99	4,80
No. 2	64	Day 1	Op. 4	14,75	15,37	10,83	11,94	4,66
No. 3	200	Day 1	Op. 5	13,14	15,98	10,30	11,50	3,50
No. 3	200	Day 1	Op. 5	12,83	15,66	10,51	11,36	3,73
No. 3	201	Day 1	Op. 5	12,44	15,07	9,62	11,27	3,36
No. 3	201	Day 1	Op. 5	13,36	14,59	9,47	11,35	3,34
No. 3	202	Day 1	Op. 6	13,10	15,20	9,94	11,30	3,46
No. 3	202	Day 1	Op. 6	13,89	15,49	10,46	11,14	3,36
No. 3	203	Day 1	Op. 6	12,82	15,26	10,30	11,37	3,99
No. 3	203	Day 1	Op. 6	13,15	14,87	10,33	11,54	4,07
No. 3	204	Day 2	Op. 5	13,77	15,35	10,15	10,73	4,39
No. 3	204	Day 2	Op. 5	13,54	15,01	11,18	10,85	4,38
No. 3	205	Day 2	Op. 5	12,73	15,08	10,66	11,32	4,45
No. 3	205	Day 2	Op. 5	12,74	15,18	11,57	11,43	4,62
No. 3	206	Day 2	Op. 6	13,31	15,15	10,89	11,07	4,50
No. 3	206	Day 2	Op. 6	12,86	15,46	10,42	11,16	4,61
No. 3	207	Day 2	Op. 6	12,57	14,81	10,78	13,05	4,34
No. 3	207	Day 2	Op. 6	13,02	14,60	10,25	12,80	3,59

Table D.4 — Floor test results — ΔE readings at the end of traffic tests

Sample identity	FIT [a] (17 000 traffics)	FIT (119 000 traffics)	UK (~35 000 traffics)
S1	14,60	17,38	11,30
S2	13,40	19,09	18,90
S3	8,03	16,44	18,90
S4	10,95	18,56	18,40
S5	1,95	5,56	2,60
Site 1 – 17 000 R^2	1,00	0,86	0,75

[a] Fashion Institute of Technology, New York.

Table D.5 — Laboratory test methods versus FIT 17 000 traffics floor test results — change in appearance ΔE

Sample identity	Modified hexapod	Modified drum	Kappasoil Wronz	Kappasoil CRI	Hexapod BCTC*	Site 1
S1	14,13	13,02	18,60	14,50	10,30	14,60
S2	16,67	14,85	23,40	17,50	8,70	13,40
S3	10,54	9,49	14,90	10,90	3,20	8,03
S4	10,53	10,19	17,20	11,60	5,20	10,95
S5	4,35	3,98	5,20	1,90	2,10	1,94
R^2	0,925	0,945	0,927	0,945	0,877	1,00

Table D.6 — Soil ILC grey scale data

Laboratory	Run	Day	Operator	S1	S2	S3	S4	S5
No. 1	100	Day 1	Op. 1	2	2	2	2-3	2-3
No. 1	101	Day 1	Op. 1	2	2	2-3	2-3	2-3
No. 1	102	Day 1	Op. 2	2	1-2	2	2-3	3
No. 1	103	Day 1	Op. 2	2	2	2-3	2-3	3
No. 1	104	Day 2	Op. 1	1-2	2	2-3	2-3	3
No. 1	105	Day 2	Op. 1	2	2	2-3	2-3	3
No. 1	106	Day 2	Op. 2	1-2	2	2-3	2-3	3
No. 1	107	Day 2	Op. 2	1-2	2	2-3	2-3	2-3
No. 1	67	Day 1	Op. 3	2	1-2	2-3	2-3	2-3
No. 2	68	Day 1	Op. 3	2	2	2-3	2-3	3
No. 2	72	Day 1	Op. 4	2	1-2	2-3	3	2-3
No. 2	200	Day 1	Op. 5	2	2	2-3	2-3	2-3
No. 3	201	Day 1	Op. 5	1-2	2	2-3	2-3	2-3
No. 3	202	Day 1	Op. 6	2	2	2-3	2-3	2-3
No. 3	203	Day 1	Op. 6	2	2	2-3	2-3	2-3
No. 3	204	Day 2	Op. 5	2	2	2-3	2-3	2-3
No. 3	205	Day 2	Op. 5	2	2	2-3	2-3	2-3
No. 3	205	Day 2	Op. 5	2	2	2-3	2-3	2-3
No. 3	206	Day 2	Op. 6	2	2	2-3	2-3	2-3
No. 3	207	Day 2	Op. 6	2	2	2-3	2-3	2-3

NOTE Modified Hexapod, September 28, 1998 Miss. (Lab. 3), Kgtn (Lab. 1), Wilm (Lab. 2) NC2- Batch 2.

Table D.7 — Soil ILC grey scale data

Laboratory	Run	Day	Operator	S1	S2	S3	S4	S5
No. 1	116	Day 1	Op. 1	2	2	3	3	3
No. 1	117	Day 1	Op. 1	2	2-3	2-3	3	3
No. 1	118	Day 2	Op. 1	2	2-3	2-3	3	3
No. 1	119	Day 2	Op. 1	2	2	2-3	3	3
No. 1	120	Day 1	Op. 1	2	2-3	3	3	3
No. 1	121	Day 1	Op. 1	2	2-3	2-3	3	3
No. 1	122	Day 2	Op. 1	2	2-3	2-3	3	3
No. 1	123	Day 2	Op. 1	2	2-3	3	2-3	3
No. 2	61	Day 3	Op. 3	No reading				
No. 2	62	Day 3	Op. 3	No reading				
No. 2	63	Day 4	Op. 4	No reading				
No. 2	64	Day 4	Op. 4	No reading				
No. 3	200	Day 5	Op. 5	1-2	2	2-3	2	2-3
No. 3	201	Day 5	Op. 5	1-2	2	2-3	2-3	2-3
No. 3	202	Day 6	Op. 6	2	2	2-3	2-3	2-3
No. 3	203	Day 6	Op. 6	2	2	2	2	2-3
No. 3	204	Day 5	Op. 5	2	2	2	2	2
No. 3	205	Day 5	Op. 5	2	2	2	2	2
No. 3	206	Day 6	Op. 6	2	2	2	2	2
No. 3	207	Day 6	Op. 6	2	2	2	2	2

NOTE Modified drum tester, September 28, 1998, Miss. (Lab. 3), Kgtn (Lab. 1), Wilm (Lab. 2) NC1- Batch 1.

Table D.8 — Means and standard deviations measured in each test procedure

Sample identity	Modified hexapod		Modified drum	
	Mean	Standard deviation	Mean	Standard deviation
S1 – Wool	14,13	1,21	13,02	1,15
S2 – Polyamide	16,67	1,43	13,02	1,06
S3 – Olefin	10,54	0,68	9,49	1,41
S4 – Acrylic	10,53	1,07	10,19	1,86
S5 – Polyamide	4,35	0,36	3,98	0,78

Table D.9 — Summary of means for modified hexapod tests

Descriptor	S1	S2	S3	S4	S5
Laboratory 1	15,17	17,95	11,16	11,10	4,60
Laboratory 2	12,62	15,17	9,64	9,34	4,00
Laboratory 3	13,85	16,14	10,37	10,48	4,28
Operator 1	15,38	18,00	11,26	11,15	4,67
Operator 2	14,95	17,91	11,06	11,19	4,54
Operator 3	13,04	15,48	9,56	9,57	4,11
Operator 4	12,20	14,86	9,71	9,11	3,89
Operator 5	13,96	15,91	10,36	10,36	4,32
Operator 6	13,75	16,37	10,38	10,61	4,25
Day 1 Laboratory 1	15,46	18,40	11,12	11,76	4,58
Day 2 Laboratory 1	14,87	17,51	11,20	10,58	4,62
Run 100 Laboratory 1	15,75	17,42	11,06	41,19	4,60
Run 101 Laboratory 1	15,46	18,86	11,20	11,78	4,65
Run 102 Laboratory 1	15,51	18,72	11,55	12,91	4,35
Run 103 Laboratory 1	15,13	18,62	10,69	11,15	4,72
Run 104 Laboratory 1	16,08	17,86	11,71	10,52	4,89
Run 105 Laboratory 1	14,24	17,87	11,06	11,14	4,53
Run 106 Laboratory 1	14,77	17,10	11,02	10,79	4,64
Run 107 Laboratory 1	14,41	17,20	11,00	9,90	4,44

Table D.10 — Summary of standard deviations for modified hexapod tests

Descriptor	S1	S2	S3	S4	S5
Laboratory 1	0,74	0,76	0,36	0,90	0,21
Laboratory 2	0,73	0,46	0,28	0,41	0,17
Laboratory 3	0,75	1,18	0,39	0,93	0,38
Operator 1	0,84	0,69	0,30	0,58	0,22
Operator 2	0,60	0,87	0,41	1,19	0,19
Operator 3	0,33	0,42	0,18	0,93	0,12
Operator 4	0,81	0,25	0,37	0,26	0,16
Operator 5	0,67	0,92	0,48	0,88	0,33
Operator 6	0,87	1,41	0,30	1,02	0,45
Day 1 Laboratory 1	0,57	0,57	0,40	0,78	0,21
Day 2 Laboratory 1	0,80	0,54	0,34	0,59	0,22
Run 100 Laboratory 1	0,05	0,78	0,09	0,18	0,03
Run 101 Laboratory 1	0,89	0,11	0,05	0,40	0,39
Run 102 Laboratory 1	0,14	0,18	0,35	0,07	0,04
Run 103 Laboratory 1	1,05	0,32	0,50	0,06	0,10
Run 104 Laboratory 1	0,28	0,70	0,20	0,69	0,18
Run 105 Laboratory 1	0,40	0,09	0,08	0,29	0,02
Run 106 Laboratory 1	0,16	0,69	0,18	0,32	0,23
Run 107 Laboratory 1	0,18	0,25	0,10	0,35	0,15

Table D.11 — Summary of means for modified drum tests

Descriptor	S1	S2	S3	S4	S5
Laboratory 1	12,13	13,89	7,87	8,09	3,40
Laboratory 2	12,62	15,17	9,64	9,34	4,00
Laboratory 3	13,08	15,17	10,43	11,45	3,98
Operator 1	12,38	14,18	7,70	7,86	3,51
Operator 2	11,88	13,61	8,05	8,32	3,29
Operator 3	14,24	16,10	10,57	11,67	5,19
Operator 4	15,12	16,11	10,86	12,03	5,15
Operator 5	13,07	15,24	10,43	11,23	3,97
Operator 6	13,09	15,11	10,42	11,68	3,99
Day 1 Laboratory 1	11,95	13,52	7,91	8,11	3,24
Day 2 Laboratory 1	12,31	14,27	7,87	8,07	3,55
Run 116 Laboratory 1	12,45	13,88	7,76	6,95	3,37
Run 117 Laboratory 1	11,82	13,48	7,88	8,42	3,57
Run 118 Laboratory 1	10,92	12,65	7,44	8,79	2,66
Run 119 Laboratory 1	12,53	14,59	8,58	8,26	3,39
Run 120 Laboratory 1	12,91	15,34	8,16	8,76	3,62
Run 121 Laboratory 1	12,33	14,53	6,99	7,33	3,48
Run 122 Laboratory 1	13,08	13,54	8,03	7,72	4,03
Run 123 Laboratory 1	10,91	13,06	8,14	8,48	3,08

Table D.12 — Summary of standard deviations for modified drum tests

Descriptor	S1	S2	S3	S4	S5
Laboratory 1	0,91	0,85	0,54	0,78	0,42
Laboratory 2	0,55	0,53	0,35	0,43	0,37
Laboratory 3	0,41	0,37	0,53	0,62	0,49
Operator 1	0,68	0,90	0,57	0,88	0,17
Operator 2	1,09	0,74	0,48	0,65	0,57
Operator 3	0,24	0,51	0,45	0,55	0,27
Operator 4	0,39	0,64	0,19	0,20	0,50
Operator 5	0,46	0,43	0,72	0,28	0,54
Operator 6	0,40	0,32	0,30	0,79	0,48
Jour 1 Laboratory 1	0,75	0,76	0,53	0,90	0,40
Jour 2 Laboratory 1	1,07	0,80	0,58	0,71	0,41
Run 116 Laboratory 1	0,60	0,25	0,63	0,08	0,35
Run 117 Laboratory 1	0,55	0,33	0,37	0,35	0,05
Run 118 Laboratory 1	0,06	0,21	0,22	0,56	0,01
Run 119 Laboratory 1	0,42	0,02	0,13	1,17	0,09
Run 120 Laboratory 1	0,66	0,40	0,25	0,86	0,07
Run 121 Laboratory 1	0,97	0,30	0,44	0,23	0,06
Run 122 Laboratory 1	0,90	0,14	0,49	0,01	0,27
Run 123 Laboratory 1	0,42	0,19	0,04	0,27	0,42

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