
**Textiles — Test methods for
evaluating the electrostatic
propensity of fabrics —**

**Part 3:
Test method using manual friction**

*Textiles — Méthodes d'essai pour l'évaluation de la propension des
étoffes électrostatique —*

Partie 3: Méthode d'essai de friction manuelle

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) are worldwide federations of national standards bodies (ISO member bodies and IEC national committees). The work of preparing International Standards is normally carried out through ISO and IEC technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with IEC on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committees responsible for this document are Technical Committee ISO/TC 38, *Textiles* and IEC/TC 101 *Electrostatics* as JWG 26, *Antistatic*, in the lead of ISO/TC 38.

ISO 18080 consists of the following parts, under the general title of *Textiles — Test methods for evaluating the electrostatic propensity of fabrics*:

- *Part 1: Test method using corona charging*
- *Part 2: Test method using rotary mechanical friction*
- *Part 3: Test method using manual friction*
- *Part 4: Test method using horizontal mechanical friction*

Introduction

In addition to safety hazards and damage or disruption of sensitive electronic devices and systems which are covered by other International Standards, electrostatic charging of clothing can also cause problems of clinging, uncomfortable shocks and the attraction of airborne dust and other contaminants.

Clothing designed to avoid airborne dust contamination is required in a number of expanding industries relating to precision technology, biotechnology, food, hygiene, etc. It is also generally desirable to have clothing that does not cling or cause uncomfortable shocks.

Test methods are required to evaluate the propensity of fabrics used to make clothing designed to avoid problems associated with electrostatic charging. Test methods are specified in a number of National and International Standards, including those published by ISO and IEC. However, the relationship between measurable electrostatic properties and end use performance is rather complex and may require a combination of different test methods depending on application.

The test method described in this International Standard for measuring charge density on the surface of a textile generated by friction is one of a number of test methods that can be used to evaluate the electrostatic propensity of textile materials. As the charge density generated depends on the textile material, its surface condition, and the nature of the friction, the gentle friction action described can be considered to simulate practical wearing conditions.

As with any manual test procedure, there is a certain operator dependence that cannot be eliminated. Test results from different laboratories may differ by more than a factor of five.

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Textiles — Test methods for evaluating the electrostatic propensity of fabrics —

Part 3: Test method using manual friction

1 Scope

This part of ISO 18080 specifies a test method using manual friction with measurement of frictional charge density on specimens of fabric. The test method is suitable for fabrics of all types of composition and construction that are capable of withstanding frictional charging.

Some fabrics, e.g. fabrics of low strength or loose construction, may not be physically capable of withstanding the manual friction used in this test method or may give false results. In such cases, the test method described in ISO 18080-1 can be used to evaluate electrostatic propensity.

The test method described may not be suitable for evaluating garments and garment materials in relation to safety of personnel and protection of electrostatic discharge sensitive devices.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3175-2, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 2: Procedure for testing performance when cleaning and finishing using tetrachloroethene*

ISO 3175-3, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 3: Procedure for testing performance when cleaning and finishing using hydrocarbon solvents*

ISO 6330, *Textiles — Domestic washing and drying procedures for textile testing*

IEC 61340-5-1, *Electrostatics — Part 5-1: Protection of electronic devices from electrostatic phenomena — General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

antistatic

property of a material that reduces its propensity to acquire electrostatic charges or allows electrostatic charges to dissipate quickly

3.2

conductive

providing a sufficiently high conductivity so that potential differences over any parts of a material or object are not sufficiently large to be of practical significance

Note 1 to entry: In general, a conductive material has a resistance below about $10^5 \Omega$, but different standards may define different resistance ranges for this term.

3.3

frictional charge density

quantity of charge per unit area on a fabric specimen generated by friction between the specimen and other fabrics

4 Principle

A fabric specimen is charged by rubbing it by hand with another fabric. The quantity of charge generated is measured using a Faraday pail test apparatus.

5 Conditioning and testing atmosphere

Unless otherwise agreed or specified, the atmosphere for conditioning and testing shall be a temperature of $(20 \pm 2)^\circ\text{C}$ and a relative humidity of $(40 \pm 4)\%$. If a different temperature or humidity is used for conditioning or testing, record it in the test report.

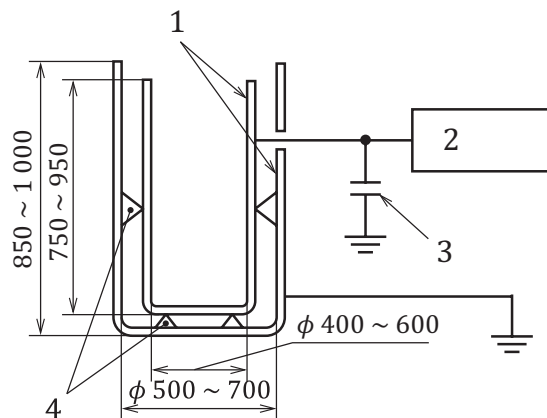
NOTE For measurements, refer to ISO 139.

6 Apparatus

6.1 Testing apparatus, an example of the testing apparatus is composed of the following parts.

- **Voltmeter**, with a DC measurement range of $\pm(10\text{ mV to }10\text{ V})$ or larger, 5 % measuring accuracy, and input resistance greater than $10^{14}\ \Omega$.
- **Faraday pail**, the basic form of a Faraday pail system for measurement of charge is shown in [Figure 1](#). It consists of two concentric metal containers, the inner container being electrically insulated from the outer which is connected to the ground. The latter is necessary to provide electrical shielding from external fields and protection for the sensitive charge measuring system.
- **Capacitor**, added to the measuring circuit to limit the pail voltage to within the range of the voltmeter used. A capacitor of $0,1\ \mu\text{F}$ with a relative tolerance of $\pm 2\%$ and insulation resistance greater than $10^{13}\ \Omega$ is suitable for the voltage measuring range shown above.
- **Insulating spacer**, made of fluoro-resin, acrylic resin or poly-carbonate resin, or other material with insulation resistance of at least $1 \times 10^{14}\ \Omega$.

Dimensions in millimetres

**Key**

- 1 Faraday pail
- 2 voltmeter
- 3 capacitor
- 4 insulating spacer

Figure 1 — Example of a charge quantity measuring apparatus**6.2 Rubbing fabric**

Rubbing fabrics for this test are selected as follows:

- acrylic filaments, interlock knit using 3 stage bat: $200 \text{ g/m}^2 \pm 15 \text{ g/m}^2$;
- nylon filaments, interlock knit using 3 stage bat: $230 \text{ g/m}^2 \pm 15 \text{ g/m}^2$;
- if other rubbing fabrics are used, they shall be described in full detail in the test report.

6.3 Rubbing bar preparation

6.3.1 Prepare a hard polyvinyl chloride pipe with an outside diameter of $32 \text{ mm} \pm 0,2 \text{ mm}$, a nominal thickness of $3,1 \text{ mm}$, and a nominal length of 400 mm .

A hard polyvinyl chloride pipe with the nearest dimension may be used for this test.

6.3.2 Prepare the nylon or acrylic rubbing fabric with a length of $500 \text{ mm} \pm 10 \text{ mm}$ in the wale direction and $450 \text{ mm} \pm 10 \text{ mm}$ in the course direction.

6.3.3 Wind the rubbing fabric around the pipe (6.3.1) so that the entire 500 mm length of the rubbing fabric is taken up around the pipe.

6.3.4 Stretch both ends and insert the extra length of rubbing fabric inside of the pipe to fix it in place.

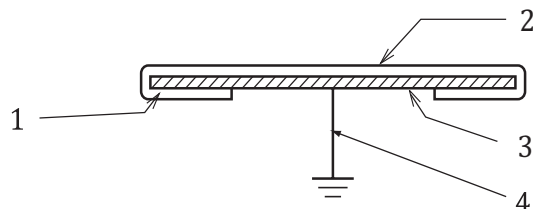
6.4 Base plate preparation

6.4.1 Prepare an aluminium plate with nominal dimensions of $320 \text{ mm} \times 300 \text{ mm}$ and a thickness 3 mm .

6.4.2 Prepare the rubbing fabric as specified in 6.3.2 with nominal dimensions of 450 mm in the wale direction and 400 mm in the course direction.

6.4.3 Place the double-sided adhesive tape (thickness 50 µm to 100 µm and nominal width 20 mm) along all four sides of the reverse surface of the base plate.

6.4.4 Wrap the rubbing fabric so as to cover the plate from all ends and fix it using the adhesive tape as shown in [Figure 2](#).



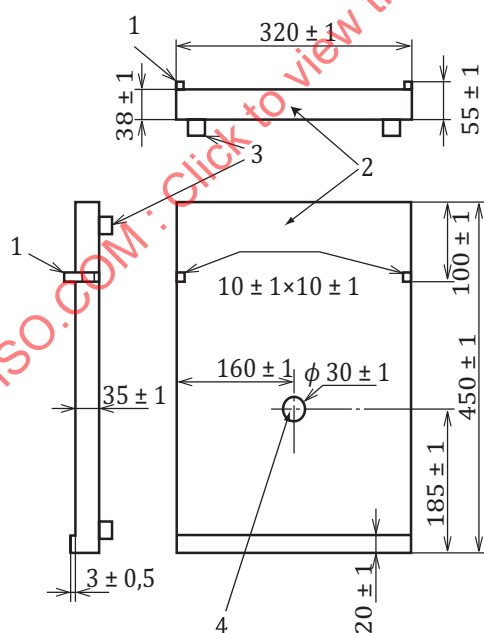
Key

- 1 folded rubbing fabric, fixed by double-sided adhesive tape
- 2 rubbing fabric
- 3 aluminium plate, 320 mm × 300 mm, thickness 3 mm
- 4 ground wire

Figure 2 — Base plate configuration

6.5 Base stand, made of wooden plate, acrylic bar for stopper, and rubber legs.

Dimensions in millimetres



Key

- 1 acrylic bar
- 2 wooden plate
- 3 rubber legs
- 4 ground wire hole

Figure 3 — Base stand configuration

6.6 Insulation bar, made of acrylic, with a nominal diameter of 20 mm and a nominal length of 500 mm.

6.7 Static electricity elimination equipment, self-discharge type or superimposed voltage type.

6.8 Oven, used to dry samples at $(70 \pm 3) ^\circ\text{C}$.

6.9 Other test apparatus. Test apparatus other than that described above may be used after appropriate validation and provided a full description of all deviations from the above specifications are included in the test report.

7 Preparation of specimen

7.1 Sampling

Prepare a sample for the test from a fabric roll or clothing.

Careful handling and the use of clean, lint free gloves is recommended to avoid contaminating the samples.

7.2 Cleansing

7.2.1 General

In case that the samples are required to cleanse, use one of the following procedures.

If the procedure used for cleansing differs from those detailed below, either in the method, number of cycles, or any other condition, details of such deviations shall be included in the test report.

7.2.2 Wash by water

Wash the samples three cycles according to ISO 6330 Procedure 4 N or 4 M at $40 ^\circ\text{C}$ water temperature using a reference detergent according to ISO 6330. Dry them by one of the natural drying procedures according to ISO 6330.

Residual detergent from previous use of the washing machine may affect the test results. Careful cleaning of the washing machine before using is recommended.

7.2.3 Dry cleaning

Dry clean samples according to ISO 3175-2 or ISO 3175-3.

7.3 Conditioning of sample

Condition samples as follows:

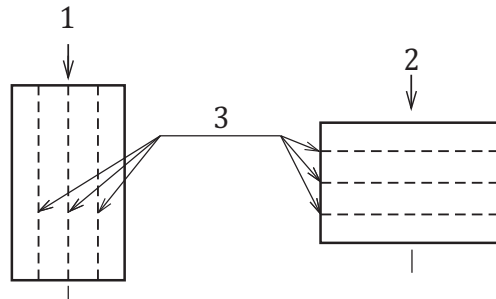
- dry two samples for one hour at $70 ^\circ\text{C}$;
- place the samples in the conditioning atmosphere specified in [Clause 5](#) for at least 24 h.

8 Testing method

8.1 After conditioning as specified in [7.3](#), cut three test specimens from the sample of dimensions $350 \text{ mm} \pm 1 \text{ mm}$ by $250 \text{ mm} \pm 1 \text{ mm}$ with the longer dimension in the direction of the warp in woven fabrics, the wale in knitted fabrics, or machine direction in nonwoven fabrics. Cut a further three

specimens with the longer dimension in the direction of the weft in woven fabrics, the course in knitted fabrics, and the cross direction in nonwoven fabrics.

For fabrics containing conductive fibres in stripe or grid patterns, specimens shall be cut so that conductive fibres are evenly distributed around the centre line of the specimen as shown in [Figure 4](#).



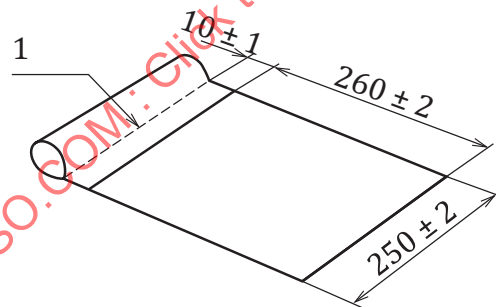
Key

- 1 conductive fibres
- 2 visual centre line of a specimen for both directions

Figure 4 — Preparation of specimen with conductive fibres

8.2 Fold the specimen to make an open space of about 260 mm along the longitudinal direction as shown in [Figure 5](#).

8.3 Sew the folded part of the specimen using a French seam with a seam tolerance of 10 mm as shown in [Figure 5](#).



Dimensions in millimetres

Key

- 1 seam line

Figure 5 — Sewing of specimen

8.4 Insert the insulation bar into the French seam.

8.5 Place the base plate as prepared in [6.4](#) on the base plate stand and connect the ground wire to the ground.

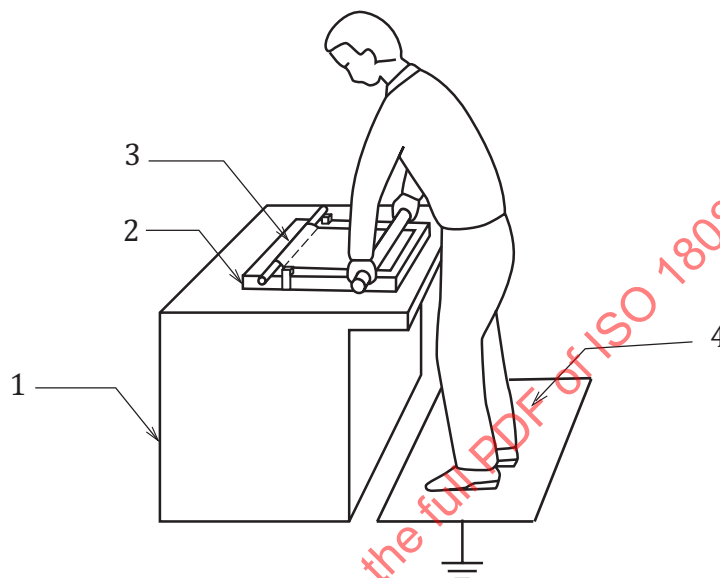
8.6 Place the specimen of [8.4](#) on the base plate so as not to have wrinkles and so as to place the insulation bar outside of stoppers.

8.7 Eliminate static electricity from the specimen, floor base plate, and rubbing bar by using static electricity elimination equipment ([6.7](#)).

8.8 Make a short circuit between both ends of the capacitor of the frictional charge measuring apparatus and open the circuit again.

8.9 Place the rubbing bar prepared in 6.3 on the specimen on the opposite side of the stoppers.

8.10 Hold both ends of the rubbing bar by hands as shown in Figure 6. The test operator shall be grounded either via dissipative footwear and flooring or by a wrist strap worn by the operator and connected to ground (see IEC 61340-5-1).



Key

- 1 bench
- 2 base plate stand
- 3 specimen
- 4 ground (connection via dissipative footwear and flooring)

Figure 6 — Example of rubbing procedure

8.11 Press uniformly with a nominal force of 40 N and pull the rubbing bar, without rotating the bar, so that it takes about 1 s to complete one rubbing stroke.

NOTE The medium force of 40 N can be controlled by weighing machine.

8.12 Repeat steps 8.10 and 8.11 a total of five times.

Use a new surface of the rubbing fabric on the bar for each procedure of 8.10 and 8.11 by rotating the bar. After using all angles, unwind the rubbing fabric from the roll, and cut off the used part to expose a new surface. Alternatively, unwind the roll and turn inside out.

Then, immediately go to next step 8.13.

8.13 Hold one end of the insulation bar and lift the bar upward to hang the test piece with care so as not to slide the specimen on the base plate. Peel the test piece within about one second as shown in Figure 7. Keep the specimen at least 300 mm away from the human body or any other objects while moving the specimen to the Faraday pail.

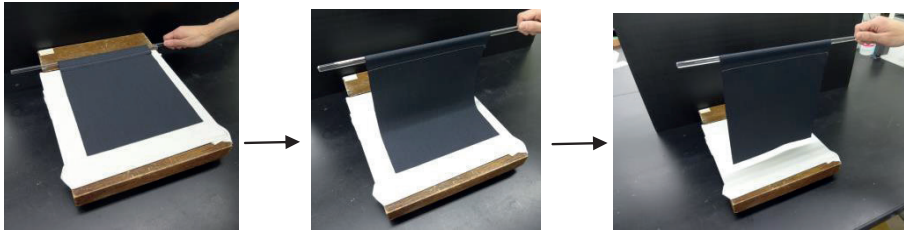


Figure 7 — Peeling off the specimen from the base plate

8.14 Put the specimen and insulation bar into the Faraday pail.

8.15 Measure the electrostatic voltage (V).

8.16 Repeat steps 8.5 to 8.15 four more times.

8.17 Obtain the average value of the electrostatic voltage (V).

8.18 Calculate the frictional charge density ($\mu\text{C}/\text{m}^2$) according to Formula (1).

$$\sigma = \frac{CV}{A} \quad (1)$$

where

σ frictional charge density ($\mu\text{C}/\text{m}^2$);

C capacitance of capacitor (μF);

V average of the electrostatic voltage (V);

A area of specimen rubbed by the rubbing bar (m^2).

8.19 Carry out the procedure from 8.4 to 8.18 on the two other warp/wale/machine direction specimens and the three weft/course/cross direction specimens.

8.20 Carry out the same procedure of 8.1 to 8.18 by using another kind of rubbing fabric for the base plate and rubbing bar.

For each fabric sample tested, the above procedures will produce four average values, one for each test fabric direction and one for each rubbing fabric. The overall test result value for the frictional charge density of the fabric sample shall be the maximum absolute value of these four averages.

9 Test report

Test report shall include the following information:

- a) a reference to this part of ISO 18080, i.e. ISO 18080-3;
- b) identification of test fabrics;
- c) atmosphere for conditioning and testing if there is deviation from this part of ISO 18080;
- d) cleansing method, if used;
- e) test result for frictional charge density;
- f) any deviation from this ISO 18080.

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Annex A **(informative)**

Round robin test results

A.1 Test sample

The following are the three samples prepared for this test:

- polyester 100 % woven fabric without treatment for antistatic: designated as A;
- polyester 100 % woven fabric with treatment for antistatic: designated as B;
- polyester 100 % woven fabric with conductive fibres in stripe: designated as C.

A.2 Round robin test condition

A.2.1 Participants

Three testing houses from Japan: designated as Ta, Tb, and Tc.

A.2.2 Equipment used

Ta: DAIEI KAGAKU SEIKI MFG. CO., LTD, FEC-100

Tb: SHISHIDO ELECTROSTATIC, LTD

Tc: TFF Corporation Keithley Instruments, No. 6517

Td: INTEC CO., LTD, EC-5N

A.2.3 Rubbing fabric

The rubbing fabrics were selected as in [6.2](#).

A.2.4 Testing condition

A.2.4.1 The temperature and relative humidity used was 20 °C and 40 %.

A.2.4.2 The cleansing method used was ISO 6330 Procedure 4 M, three cycles and then washing by 40 °C water for 10 min, then natural drying.

A.2.5 Test result

The test results are shown in [Table A.1](#) to [Table A.4](#); they include two rubbing fabrics and two specimen directions. As shown in the table below, the highest average charge quantities were obtained as in [Table A.5](#) and as follows.

Sample	Frictional charge density ($\mu\text{C}/\text{m}^2$)
A	9,9
B	7,3
C	3,9

Table A.1 — Test result using rubbing fabric of Acrylic and warp direction

Sample				A			B			C		
Test data ($\mu\text{C}/\text{m}^2$)	Rubbing fabric	Direction	No.	Testing house (TH)								
				Ta	Tb	Tc	Ta	Tb	Tc	Ta	Tb	Tc
	Acrylic	Warp	1	3,9	3,0	0,9	5,5	2,1	1,3	1,1	1,8	0,1
			2	1,5	3,0	1,1	4,8	1,9	1,7	2,0	1,8	0,2
			3	0,8	3,0	0,4	4,0	1,8	2,1	2,1	1,7	0,4
			4	2,2	3,8	0,9	3,9	2,2	1,9	2,3	1,5	0,5
			5	1,7	3,6	0,9	4,2	2,3	1,7	2,2	1,6	0,2
			1	1,9	3,8	0,5	3,9	1,6	1,8	1,9	1,5	0,6
			2	1,6	3,9	0,9	3,8	1,5	1,8	1,9	1,4	0,1
			3	0,4	4,0	0,9	4,4	1,7	1,4	2,2	1,4	0,4
			4	2,6	4,0	0,9	3,6	1,5	2,0	2,2	1,5	0,2
			5	2,7	4,0	0,7	3,6	1,6	1,8	1,8	1,7	0,4
			1	2,6	3,4	0,7	—	1,5	2,1	2,2	1,8	1,3
			2	1,5	4,0	0,6	—	1,5	1,7	2,3	1,6	0,3
			3	0,8	3,6	0,6	—	1,5	1,8	2,2	1,7	0,3
4			1,5	3,6	0,5	—	1,8	1,8	2,5	1,6	0,1	
5	1,6	3,4	0,6	—	1,9	1,7	2,3	1,8	0,3			
Average for testing house				1,8	3,6	0,7	4,2	1,8	1,8	2,1	1,6	0,4
Average for all of the testing houses				2,1			2,6			1,4		

Table A.2 — Test result using Acrylic rubbing fabric and weft direction

Sample				A			B			C		
Test data ($\mu\text{C}/\text{m}^2$)	Rubbing fabric	Direction	No.	Testing house (TH)								
				Ta	Tb	Tc	Ta	Tb	Tc	Ta	Tb	Tc
	Acrylic	Weft	1	1,3	5,1	0,3	2,5	2,7	2,5	1,8	3,3	1,5
			2	0,7	5,0	0,6	1,3	2,6	2,7	1,2	3,1	2,1
			3	1,8	5,4	0,6	1,6	2,5	2,3	0,5	3,0	1,9
			4	4,4	5,3	0,5	1,3	2,9	2,3	0,6	2,9	1,8
			5	4,4	6,0	0,4	1,2	2,8	2,4	1,0	3,0	1,6
			1	1,3	4,5	0,9	4,2	2,8	2,7	1,8	2,3	2,1
			2	1,6	4,9	1,0	3,2	2,4	2,6	1,2	1,8	2,3
			3	3,1	4,2	0,5	2,6	2,2	2,9	1,1	1,8	2,2
			4	3,7	4,9	0,5	1,8	2,4	2,7	1,0	2,0	2,4
			5	4,1	4,6	0,5	2,2	2,5	2,9	1,0	1,9	2,4
			1	3,0	4,5	0,9	—	2,3	2,9	1,0	2,0	1,6
			2	0,6	4,9	0,8	—	2,3	3,1	1,2	2,2	1,7
			3	1,5	4,7	0,7	—	2,2	3,3	0,5	2,3	2,0
4			1,9	4,8	0,6	—	2,2	3,3	0,6	1,9	2,1	
5	2,6	5,4	0,5	—	2,1	3,4	0,7	1,9	2,1			
Average for testing house				2,4	4,9	0,6	2,2	2,5	2,8	1,0	2,4	2,0
Average for all of the testing houses				2,7			2,5			1,8		

Table A.3 — Test result using Nylon rubbing fabric and warp direction

Sample				A			B			C		
Test data ($\mu\text{C}/\text{m}^2$)	Rubbing fabric	Direction	No.	Testing house (TH)								
				Ta	Tb	Tc	Ta	Tb	Tc	Ta	Tb	Tc
	Nylon	Warp	1	11,8	10,1	10,1	9,2	5,5	7,6	2,8	1,9	1,6
			2	8,2	10,0	10,6	9,2	5,1	7,1	2,3	2,0	1,8
			3	7,7	9,6	10,5	9,3	5,2	7,5	2,5	1,9	1,9
			4	5,3	9,9	9,9	9,1	5,1	7,7	2,3	2,4	1,9
			5	6,4	9,9	11,1	9,1	5,4	7,8	2,5	2,1	1,9
			1	9,8	8,9	11,0	8,3	5,3	7,7	2,7	2,1	1,8
			2	7,2	9,1	9,8	9,9	5,0	7,9	2,6	2,1	1,8
			3	7,2	9,2	11,7	8,8	5,0	7,9	2,7	2,4	1,9
			4	6,5	9,7	10,5	8,8	5,1	7,9	2,8	2,3	1,9
			5	8,6	9,2	11,6	8,9	5,1	8,1	2,5	2,1	1,9
			1	9,8	8,5	10,8	—	5,0	7,6	2,7	2,7	1,7
			2	6,4	8,9	10,5	—	5,4	7,5	2,7	2,4	1,8
			3	6,7	9,2	10,4	—	5,3	8,0	2,9	2,6	2,0
4			8,0	8,3	10,1	—	5,3	8,1	3,0	2,1	2,0	
5	7,5	8,6	9,7	—	5,7	7,3	2,8	2,1	1,9			
Average for testing house				7,8	9,3	10,5	9,1	5,2	7,7	2,6	2,2	1,8
Average for all of the testing houses				9,2			7,3			2,2		
NOTE The values in this table and in Table A.4 have negative polarity. To compare numbers, an absolute value was adopted.												