DRAFT FOR DEVELOPMENT

DD IEC/PAS
62473:2007

Clothes washing machines for household use — Methods for measuring the mechanical action in household washing machines

ICS 97.060

National foreword

This Draft for Development is the UK implementation of IEC/PAS 62473:2007.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature. It should be applied on this provisional basis, so that information and experience of its practical application can be obtained.

A PAS is a Technical Specification not fulfilling the requirements for a standard, but made available to the public and established in an organization operating under a given procedure.

A review of this Draft for Development will be carried out not later than three years after its publication.

Notification of the start of the review period, with a request for the submission of comments from users of this Draft for Development, will be made in an announcement in the appropriate issue of *Update Standards*. According to the replies received, the responsible BSI Committee will judge whether the validity of the PAS should be extended for a further three years or what other action should be taken and pass their comments on to the relevant international committee.

Observations which it is felt should receive attention before the official call for comments will be welcomed. These should be sent to the Secretary of the responsible BSI Technical Committee at British Standards House, 389 Chiswick High Road, London W4 4AL.

The UK participation in its preparation was entrusted by Technical Committee CPL/59, Performance of household electrical appliances, to Subcommittee CPL/59/1, Dishwashers and washing machines.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

This Draft for Development was published under the authority of the Standards Policy and Strategy Committee on 31 July 2007

ISBN 978 0 580 58899 0

Amendments issued since publication

Amd. No.	Date	Comments

PUBLICLY
AVAILABLE
SPECIFICATION

Pre-Standard

IEC
PAS 62473

First edition
2007-04

Clothes washing machines for household use – Methods for measuring the mechanical action in household washing machines

Reference number
IEC/PAS 62473:2007(E)

CONTENTS

INTRODUCTION

Mechanical action is a main parameter in a washing process. On the positive side, this parameter improves washing performance but can cause damage to textile goods. In today's IEC standards, mechanical action has not been determined as a single parameter in washing processes.

Mechanical action has a high relevance for consumers as well as for manufacturers of washing machines, and therefore a comparison of this parameter (especially in relation or comparison to the achieved washing performance as measured in IEC 60456) in different washing machines is very important.

The object is finally to state and define a method for the determination of mechanical action. Due to the fact that washing programmes cover a wide range of mechanical action (gentle cycles to heavy-duty cotton programmes, single cycles to multiple cycles), three systems

– the thread removal method;
– the dot removal method;
– the fraying method

can cover this area and are at the same time sensitive enough to show smaller differences.

CLOTHES WASHING MACHINES FOR HOUSEHOLD USE – METHODS FOR MEASURING THE MECHANICAL ACTION IN HOUSEHOLD WASHING MACHINES

1 Scope

This PAS deals with methods for measuring the “gentleness of action” (GoA) of clothes washing machines for household use, with or without heating devices and for cold and/or hot water supply. It is also applicable to appliances for both washing and drying textiles (called washer-dryers) with respect to the washing phase.

“Gentleness of action” defines the influence of washing machine parameters to irreversible changes of the textile properties. These changes can be visible or not visible.

Examples of these irreversible changes are:

– loss of tensile tear strengths;
– surface friction (abrasion, pilling);
– dimensional changes (shrinkage or elongation);
– creasing;
– “structural disorientation”.

Three methods for different ranges of mechanical action are described to measure and quantify the influences of the machine parameters by measuring one or several of these irreversible changes:

– thread removal method (TRM – preferable for low to medium mechanical action);
– dot removal method (DRM – preferable for high mechanical action);
– fraying method (FM – preferable for medium to high mechanical action).

2 Normative references

The following referenced document including all reference documents cited there are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60456, *Clothes washing machines for household use – Methods for measuring the performance*

3 Terms, definitions and symbols

For the purposes of this document, the terms, definitions and symbols of IEC 60456 apply.

4 General conditions for measurements

4.1 General

The measurements shall generally be carried out on a machine installed and used in accordance with the manufacturer’s instructions, except as required by this document. If there is more than one option for installation, the one chosen for testing shall be reported. If the

machine is new, the machine shall be run for two complete test **cycles** according to IEC 60456.

4.2 Resources and ambient conditions

Electricity and water supply as well as the ambient temperature shall be maintained at specified values stated in IEC 60456.

5 Materials

5.1 Base load

The base loads used shall consist of the items described for cotton, easy-care (synthetics/blends) or polyester base loads according to IEC 60456.

The base loads are adjusted and treated according to IEC 60456.

The number of items is specified in Annex B.

5.2 Test materials

5.2.1 Thread removal material

5.2.1.1 Characteristics

The thread removal material is a woven fabric having an open structure to all sides allowing loosening of threads by mechanical impact (see Figure 1).

5.2.1.2 Specification

Size:	about 29,5 × 29,5 cm
Weave:	plain woven
Yarn:	DTEX 228 F34 PA 66
Yarn count per cm:	Warp/Filling 17/17
Weight:	about 85 g/m^2

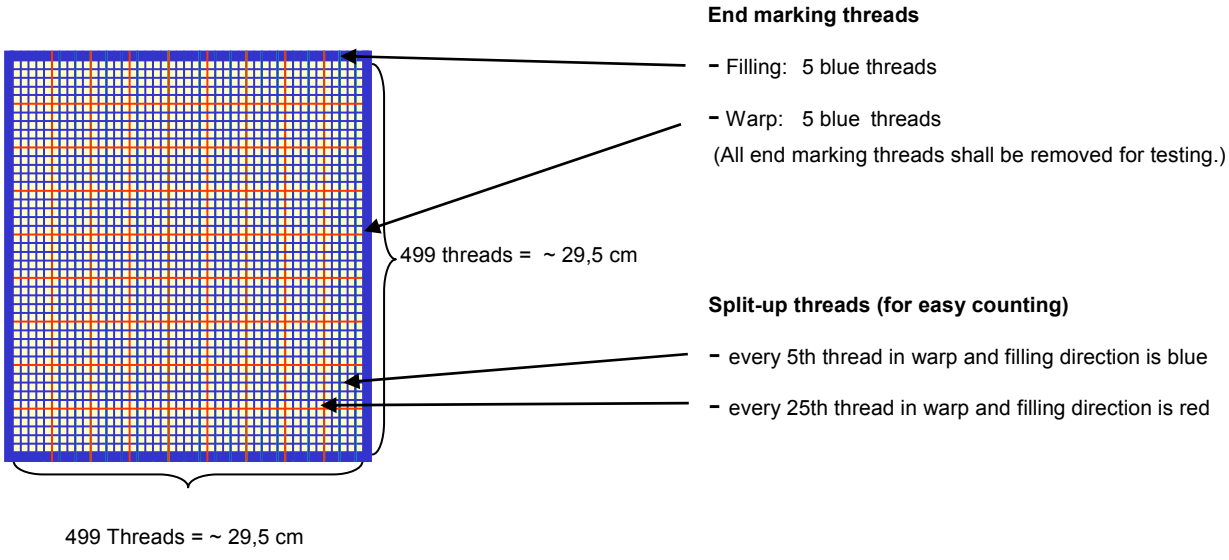


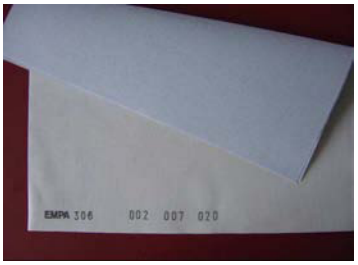
Figure 1 – Thread removal specimen

5.2.2 Dot removal material

5.2.2.1 Characteristics

The dot removal material is a stiff fabric with bonded coloured dots which are removed by mechanical impact (see Figure 2).

5.2.2.2 Specification



Size:	34 × 34 cm
Basic fabric:	00 % Cotton, plain woven, white, 125 g/m^2
Yarn:	Nm 34/34
Yarn count per cm:	Warp/Filling 19,5/19,5
Dots:	100 % PA, coloured
Density of dots:	45,5/cm^2
Density of dots:	about 45,5/ cm2
Weight	about 140 g/m^2

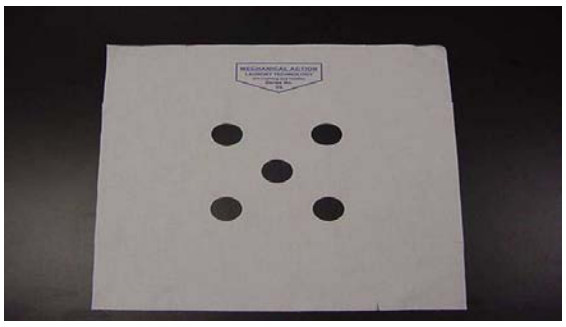
Figure 2 – Dot removal specimen

5.2.3 Fraying specimens

5.2.3.1 Characteristics

The fraying specimen is a cotton fabric with five punched holes having an open structure allowing loosening of threads by mechanical impact.

5.2.3.2 Secification



Size:	40 × 40 cm
Circular holes diameter:	35 mm
Fibre content:	100 % pure natural cotton of 27 mm minimum length
Yarn size - linear density:	single yarn 30 + 2 tex
Yarn twist:	Z 700 + 25
Warp strength:	at least 500 N
Warp yarn count:	25 + 2 threads per cm
Filling yarn count:	25 + 2 threads per cm

Figure 3 – Fraying specimen

5.3 Preparation

All test specimens shall be marked with a unique identifying reference, using an indelible marking system.

The thread removal material shall be prepared before use as described in Annex A.

The dot removal specimens have to be measured before use as described in Annex D.

5.4 Amount of test specimens used

For each wash cycle, four test specimens of only one type regardless of test load size and type shall always be used.

5.5 Detergent

The detergent used for this test shall be reference detergent A* described in IEC 60456

6 Instrumentation and accuracy

Instrumentation and accuracy of IEC 60456 apply.

For the fraying method the following tools are needed:

– magnifying glass;
– black background for assistance in counting threads;
– needle or similar instrument;
– rule calibrated in millimetres.

7 Test procedure

The test is basically run in accordance to the test of washing performance described in IEC 60456 except that, additionally, the test specimens according to this document are added to the load in the drum according to the following description.

7.1 Loading

The way of loading the machine influences the results. To get reproducible results it is necessary to define the way of loading the machine and to follow the instructions accurately.

The loading scheme of IEC 60456 is only applicable for one type of washing machine (horizontal axis). The loading procedure as described in Annex B applies to all types of washing machines and will probably be included in a future edition of IEC 60456.

The test specimens for measuring the gentleness of action according to this procedure are added as described in Annex B.

The test specimens should be placed as flat as possible.

The location of each mechanical action specimen shall be recorded (using identifying reference – number of test specimen)

7.2 Unloading and drying of test specimens

Mechanical action specimens shall be carefully removed from the load, taking care not to pull, stretch or distort the test specimens.

Base load as well as soil strips shall be dried according to the procedure described in IEC 60456.

Do not dry the mechanical action test specimens in a tumble dryer. The mechanical action test specimens are dried by laying them out flat. Take care not to apply any further mechanical action. If possible, the dot removal test specimens and the fraying test specimens should be carefully flattened by hand to avoid wrinkles.

7.3 Repeating of test procedure

The test procedure is run according to IEC 60456. A test series consists of five test runs.

For each test run new mechanical action test specimens shall be used.

NOTE It is possible to use the same specimens for more than one test run, especially for very low mechanical action.

8 Evaluation

8.1 Thread removal method

The evaluation of the thread removal specimen will be done by counting the removed threads (considered as “not remaining”).

The evaluation is described in Annex C.

8.2 Dot removal method

The evaluation of the dot removal specimens is done with a colour matching system.

The evaluation is described in Annex D.

8.3 Fraying method

The evaluation of the thread removal specimen will be done by counting of loose threads.

The evaluation is described in Annex E.

9 Data to be reported

The following data shall be recorded for all runs: cycle identification, water hardness and temperature, and number of cycles on test loads. The following information may also be recorded: total cycle time, wash time, speed, water temperature, water usage, supply voltage and frequency to the washer.

Cycle information including optional control settings shall be recorded.

10 Sources of test materials

Items may be obtained from:

10.1 Thread removal method (5.2.1)

EMPA Testmaterialien AG
Mővenstrasse 12
CH-9015 St. Gallen
Switzerland
Tel: ++41-71-311-8055
Fax: ++41 -71-311-8057
www.empa-testmaterials.ch

10.2 Dot removal method (5.2.2)

EMPA Testmaterialien AG
Mővenstrasse 12
CH-9015 St. Gallen
Switzerland
Tel: ++41 71 311 8055
Fax: ++41 -71-311-8057
www.empa-testmaterials.ch

10.3 Fraying method (5.2.3)

Teknologisk Institute
Gregersensvej
DK-2630 Taastrup
Denmark
Tel: ++45 22 70 56 46
Fax: ++45 22 70 56 44
www.danishtechnology.dk

Annex A
(normative)

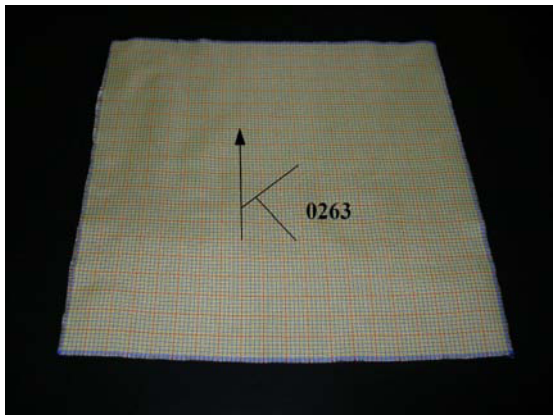
Thread removal material – Preparation of test specimen

The thread removal material is delivered with five pieces in the filling direction. Both sides of the material have a selvedge in warp direction. (The width of the material is about 170 cm.)

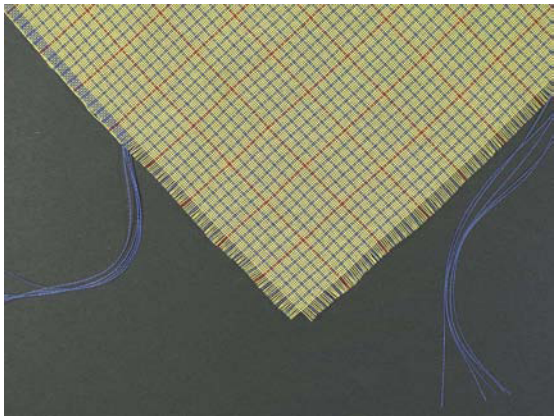
The test specimen shall be prepared in the following way.

a) The samples shall be cut between the two areas of (blue) end marking threads.

b) The sample and warp direction shall be marked in the middle of the specimen.



c) Right before testing, the blue end marking threads shall be removed.



Annex B
(normative)

Loads and loading

B.1 General

The cotton test load and the synthetics/blends test load consist of the base load and the soiled test strips. The polyester test load consists of the base load and three wool shrinkage specimens.

The four test specimens for measuring the mechanical action (only one type for each test) will be added to test loads as add on. Only the test load mass (base load + strips) is adjusted so that it corresponds to the required test load mass for the specified programme of the machine under test.

B.2 Test load mass

a) Cotton test load mass

Table B.1 – Cotton test load mass

Test load mass[a] kg	Approx. base load mass kg	Number of soiled test strips	Number of sheets	Number of pillowcases	Number of hand-towels[b]
1	0,96	2	0	2	5
1,5	1,46	2	0	3	7
2	1,96	2	0	4	9
2,5	2,44	3	0	5	11
3	2,94	3	2	4	5
3,5	3,42	4	2	4	9
4	3,92	4	2	4	14
4,5	4,4	5	2	6	14
5	4,9	5	2	6	18
5,5	5,38	6	2	8	18
6	5,88	6	2	8	23
6,5	6,36	7	2	10	23
7	6,86	7	2	12	23
7,5	7,34	8	3	12	21
8	7,84	8	3	12	25
8,5	8,32	9	3	14	25
9	8,82	9	4	14	23
9,5	9,30	10	4	14	28
10	9,80	10	4	16	28

a For test loads other than those specified, the number of sheets and pillowcases and strips in the test load shall be equal to that specified for the next lower test load listed, adding hand-towels to reach the required weight for the test load.

b The number of hand-towels shall be adjusted to make the test load as close as possible (±60 g) to the required weight of the test load. The actual number may differ from the listed number.

The numbers of sheets, pillowcases and hand-towels in the cotton base load for various required test load masses are given in Table B.1. The number of soiled test strips used for a washing performance test shall be proportional to the required test load mass as shown in Table B.1. Final adjustment of the test load mass, including the soiled test strips, is made by adding or removing hand towels so that the total mass is as close as possible (±60 g) to the required test load mass.

The location of the four test specimens for cotton test loads is marked in Tables B.4 and B.5.

b) Synthetics/blends test load mass

The numbers of pillowcases and shirts in the synthetics/blends base load for various required test load masses are given in Table B.2. The number of soiled test strips used for a washing performance test shall be proportional to the required test load mass as shown in Table B.2. The synthetics/blends base load consists of an equal number of shirts and pillowcases. Final adjustment of the test load is made after adding the soiled test strips, by adding or subtracting one shirt or one pillowcase whichever adjusts the test load to be closest to the nominal weight of the test load.

Table B.2 – Synthetics/blends test load mass

Test load mass[b] kg	**Approx. base load mass** kg	**Number of soiled test strips**	**Number of shirts**[a]	**Number of pillowcases**[a]
1	0,96	2	2	3
1,5	1,46	2	4	4
2	1,96	2	5	4
2,5	2,44	3	7	6
3	2,94	3	8	7
3,5	3,42	4	9	9
4	3,92	4	11	10
4,5	4,4	5	12	12
5	4,9	5	13	13

a The number shall be adjusted to make the mass of the test load as close as possible to the required weight of the test load. The actual number of items may differ from the listed number. The difference between the number of shirts and pillow cases shall be not more than one.

b For loads of more than 5 kg, the number of items is specified as follows. The load consists of an equal number of shirts and pillowcases. Adjustment of the test load is made after adding the soiled test strips, by adding or subtracting one shirt or one pillowcase whichever adjusts the test load to be closest to the nominal weight of the test load.

c) Polyester test load mass

The calculated number of base load items for various required test load masses is given in Table B.3. The test load should be adjusted by adding or subtracting the number of base load items to be closest to the nominal weight of the test load.

Table B.3 – Polyester test load mass

Test load mass kg	Approx. base load mass kg	Number of shrinkage specimen	Number of base load items[a]
1	0,95	3	27
1,5	1,45	3	42
2	1,95	3	56
2,5	2,45	3	70
3	2,95	3	94
3,5	3,45	3	98
4	3,95	3	113
4,5	4,45	3	127
5	4,95	3	141

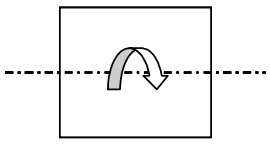
a The number shall be adjusted to make the base load as close as possible to the required weight of the base load.

B.3 Loading

B.3.1 General

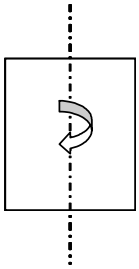
The way in which the washing machine is loaded can have an influence on the results obtained, especially for the washing performance. To obtain the most reproducible results, it is therefore necessary to specify the sequence and position that load items are placed into the machine for performance tests.

For the purposes of loading, there are two machine types defined as follows.



Type A: Horizontal axis machines
Definition:
The load is placed in a drum which rotates around an axis which is usually horizontal or close to horizontal (for the purposes of this PAS, any axis which is less than, or equal to, 45° to horizontal shall be classified as horizontal axis).

Type B: Vertical axis machines
Definition:
The load is placed in a bowl which rotates around an axis which is usually vertical or close to vertical (for the purposes of this PAS, any axis which is more than 45° to horizontal shall be classified as horizontal axis).



Components, protrusions or mechanical devices of different style (for example, agitator, impeller) inside the bowl drum of a machine of type B may necessitate slight variations and cause a slightly different loading scheme from that described. These variations are covered in the loading sequence for Type B machines.

NOTE The reference machine is always machine Type A – horizontal axis

B.3.2 General requirements for loading

Washers are always loaded item by item in layers from bottom to top. Excessive force should not be used.

Items shall be placed with alternating orientation.

Items with attached soiled test strips are always laid flat in the washing machine with the four soils of the strip side facing upwards. Items with soiled test strips attached should not be placed one top of each other.

a) Cotton loads

Follow the loading sequence step by step as given in Table B.4 for Type A horizontal axis machines and Tables B.5 to B.8 for Type B vertical axis machines. The load items defined for each step are evenly distributed in a single level of the drum Type A machine or one-quarter of the bowl for Type B machines.

b) Synthetics/blends load

The test load shall be evenly spread in the washing machine. Shirts and pillowcases are loaded alternating for Type A machines from the bottom to the top, for Type B machines clockwise with one item per quarter. Pillowcases with soiled test strips attached are evenly distributed, for example, every second pillowcase is one with soiled test strip attached.

The four test specimens for measuring the mechanical action should be evenly distributed from the bottom to the top for Type A machines and one item per quarter for Type B machines, for example, on the pillowcases without test strip.

c) Polyester load

The test load shall be evenly spread in the washing machine.

The four test specimens for measuring the mechanical action should be evenly distributed from the bottom to the top for Type A machines and one item per quarter for Type B machines.

B.3.2.1 Loading of Type A machine (horizontal axis)

Figure B.1 shows the general loading directions

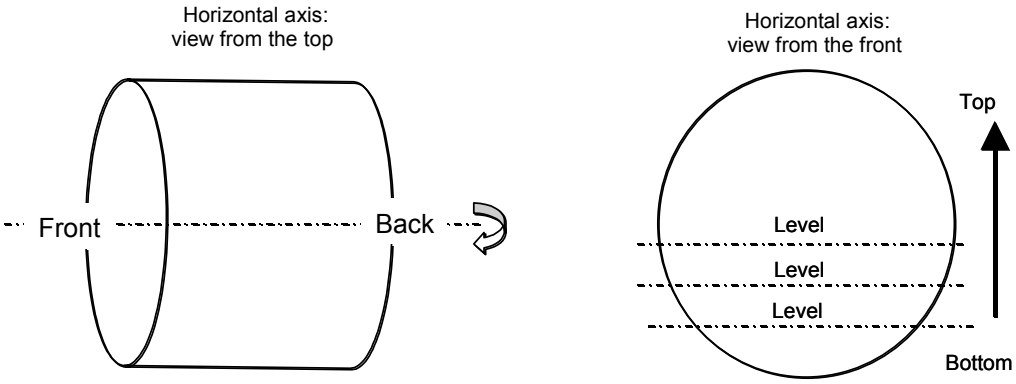
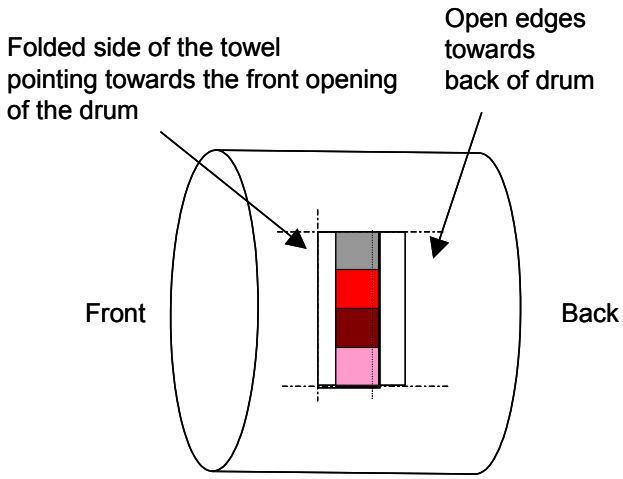


Figure B.1 – General loading direction for horizontal axis machines

Figures B.2 to B.5 show how to load items.

a) Towel/pillowcase with strip



This is a view from the top

Figure B.2 – How to load towel/pillowcase with strip

b) Towel without strip

This is a view from the top:

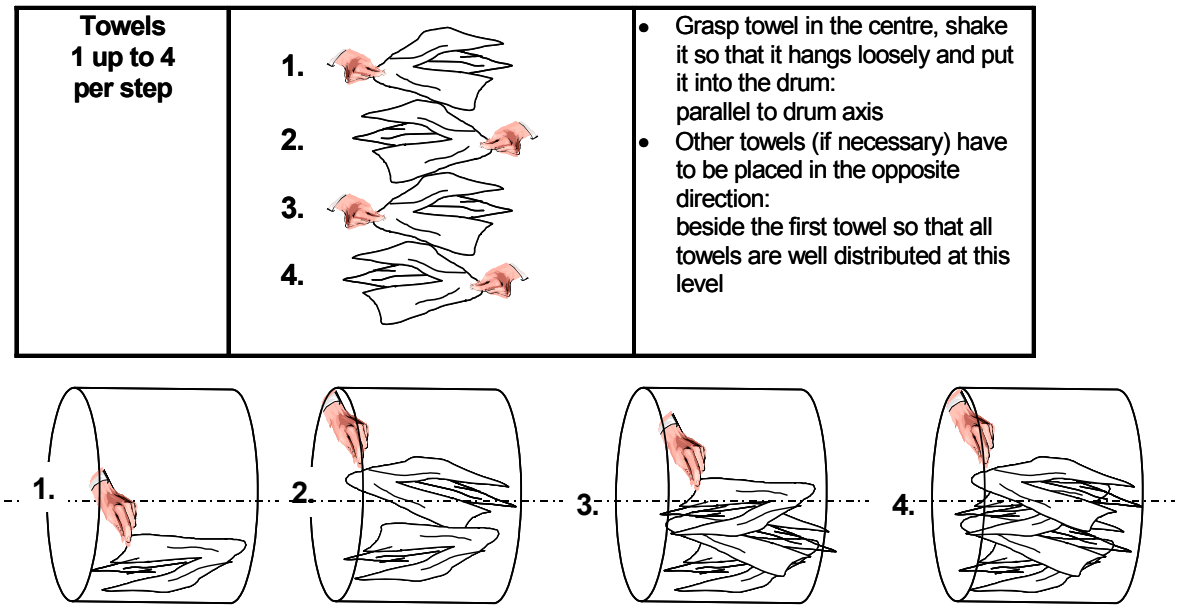


Figure B.3 – How to load towel without strip

c) Pillowcases without strip

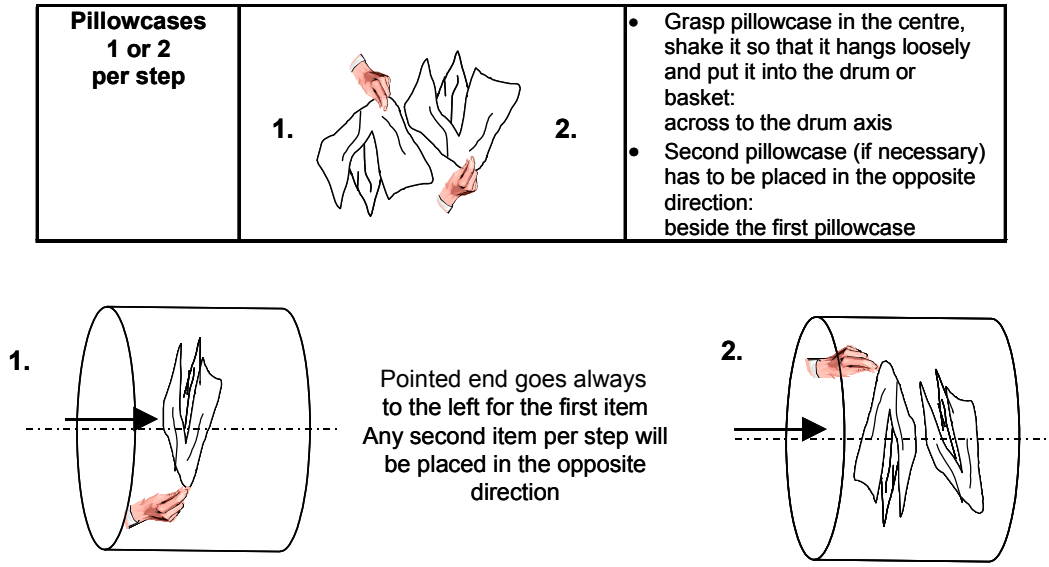


Figure B.4 – How to load pillowcases without strip

d) Bed sheet

Bed sheet max. 1 per step		• Bed sheets are folded in thirds to form letter “Z”. It should be loaded as laying Z

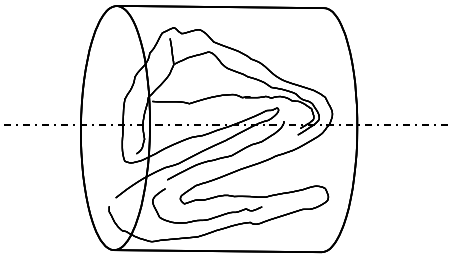


Figure B.5 – How to load bed sheets

Table B.4 – Loading sequence step by step for horizontal axis machine

step	**horizontal axis**	10,00	9,50	9,00	8,50	8,00	7,50	7,00	6,50	6,00	5,50	5,00	4,50	4,00	3,50	3,00	2,50	2,00	1,50	1,00
1	pillow	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
2	towels adjust number here	4	4	4	4	4	4	4	4	4	3	3	2	3	2	1	2	2	2	1
3	towel + strip	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	pillow	2	2	2	2	2	2	2	1	1	1									
5	towel + strip	1	1	1	1	1	1	1	1	1	1									
6	sheet	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
7	towel + strip	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
8	pillow	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
9	towels adjust number here	3	3	2	3	3	2	3	3	3	2	2	2	2	1		1	1		
10	towel + strip	1	1	1	1	1	1	1	1			1	1							
11	sheet	1	1	1	1	1	1													
12	towel + strip	1	1	1	1											1	1			
13	pillow	2	1	1	1	1	1	1	1	1	1	1	1				1			
14	towels adjust number here	4	4	2	2	3	1	2	2	3	2	3	1				2	1	1	1
15	pillow	2	1	1	1	1	1	1	1	1	1	1	1							
16	towel + strip	1	1																	
17	sheet	1	1	1																
18	towel + strip	1	1	1	1	1	1													
19	towels adjust number here	3	3	2	3	3	2	3	3	3	2	2	2	2			1	1		
20	pillow	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1		
21	towel + strip	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
22	sheet	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1				
23	towel + strip	1	1	1	1	1	1	1	1	1	1									
24	pillow	2	2	2	2	2	2	2	1	1	1									
25	towel + strip	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	towels adjust number here	4	4	4	4	4	4	4	4	4	3	3	2	3	2	1	2	2	2	1
27	pillow	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1

The four test specimens for measuring the mechanical action are distributed evenly:

1. specimen after step 1 (pillow); 2. specimen after step 8 (pillow); 3. specimen before step 20 (pillow); 4. specimen before step 27 (pillow).

For loads of 1,5 and 1 kg consider using less than four test specimens.

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B.3.2.2 Type B machine (vertical axis machine)

Figure B.6 shows the general loading directions.

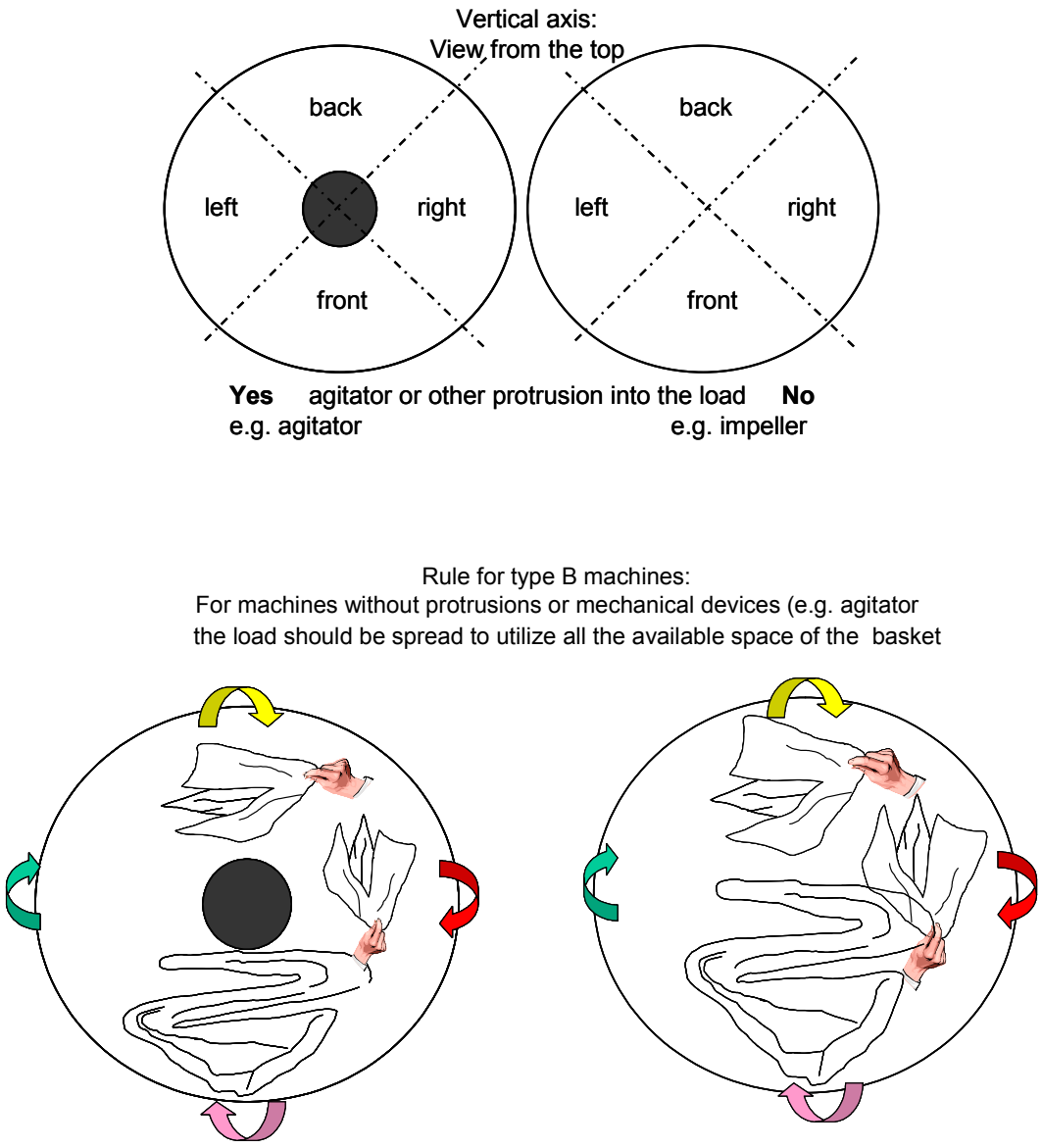
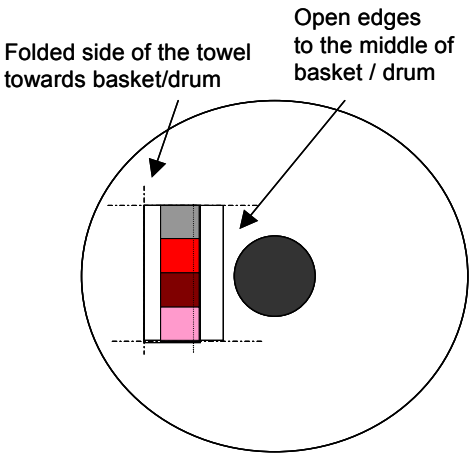


Figure B.6 – General loading directions for vertical axis machines

Figures B.7 to B.B.10 show how to load items

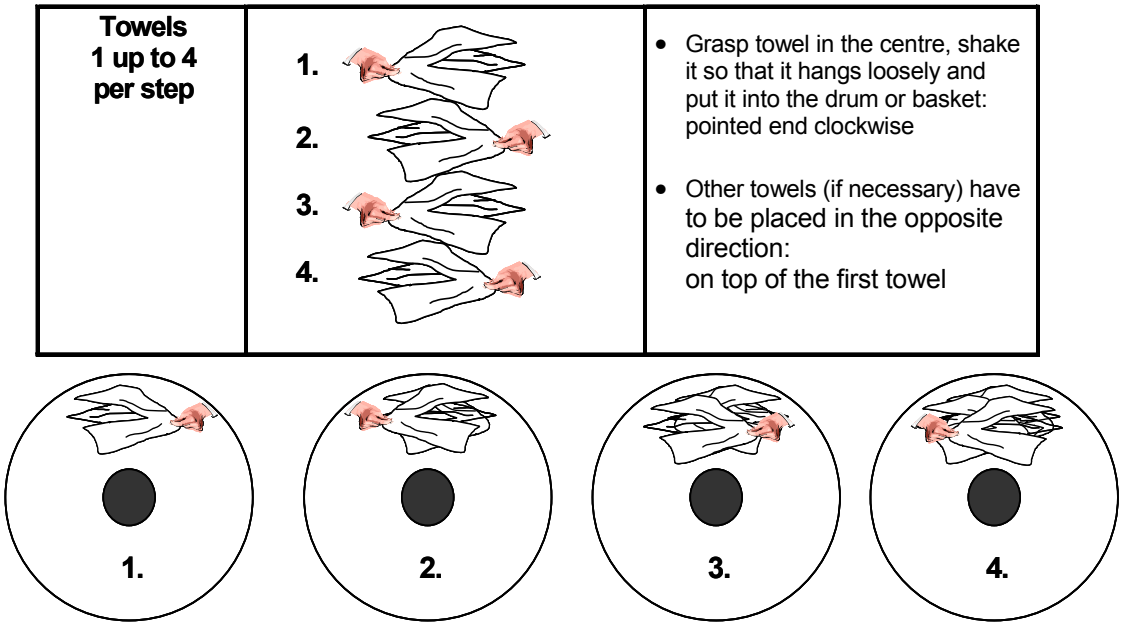
a) Towels/pillowcases with strip



This is a view from the top

Figure B.7 – How to load towels/pillowcases with strip

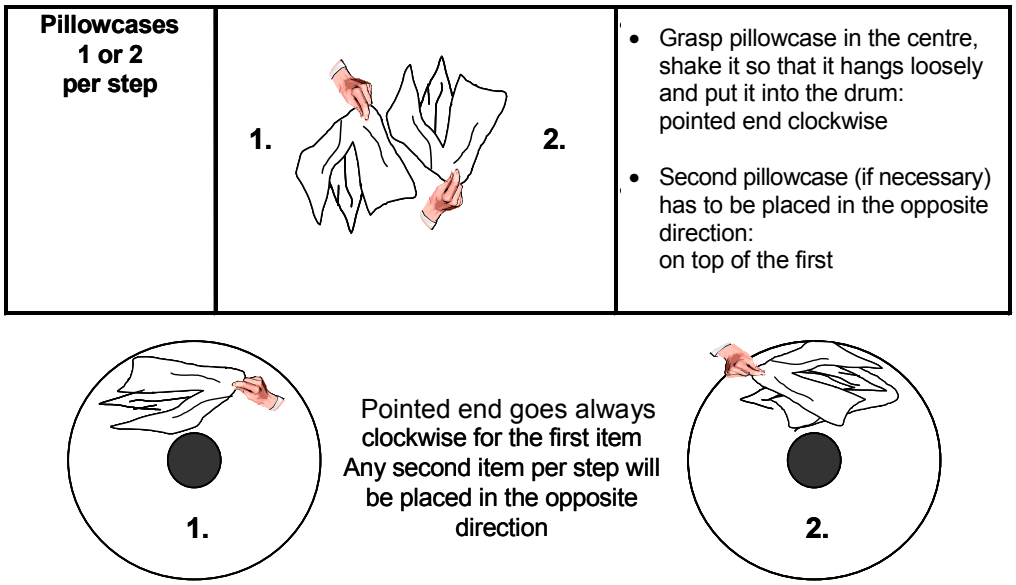
b) Towels without strip



This is a view from the top

Figure B.8 – How to load towels without strips

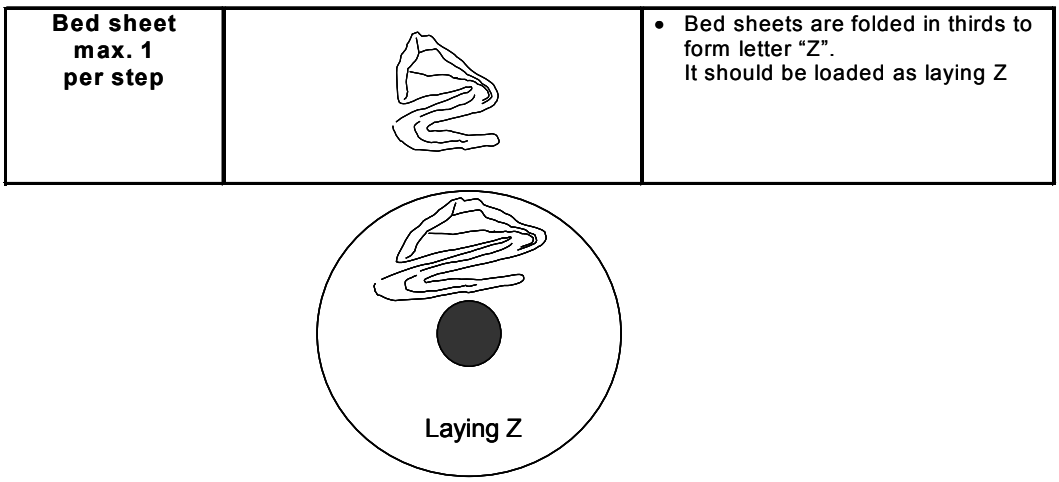
c) Pillowcases without strip



This is a view from the top

Figure B.9 – How to load pillowcases without strip

d) Bed sheets



This is a view from the top

Figure B.10 – How to load bed sheets

e) Loading step by step

The loading scheme depends on the number of sheets.

Four sheets: One goes into each quadrant

Three sheets: First goes to the front, second to left-back area, third to back-right area

Two sheets: One to the right quadrant, one to the left quadrant

In general there are four main groups, each starting in another quadrant. The number of steps for each is no more than six but depends on load size. For smaller loads, fewer steps are required.

The four test specimens for measuring the mechanical action are distributed evenly. For loads of 1,5 kg and 1 kg consider using less than four test specimens.

First specimen after step 1 of group 1(on top of pillow – front quadrant).

Second specimen after step 1 of group 2 (on top of pillow – left quadrant).

Third specimen after step 1 of group 3 (on top of pillow – back quadrant).

Forth specimen after step 1 of group 4 (on top of pillow – right quadrant).

Table B.5 – Small loads without sheet (1,0 kg to 2,5 kg)

step	group	**vertical axis**	2,50	2,00	1,50	1,00	
1	1	Pillowcases	1	1	1	1	front
2		Towels	1	1	1	1	left
3		Towel+strip	**1**	**1**	**1**	**1**	left
4		Pillowcases					back
5		Towel+strip					back
6		Sheets					
1	2	Pillowcases	1	1			left
2		Towels	1	1			back
3		Towel+strip					back
4		Pillowcases					right
5		Towel+strip					right
6		Sheets					
1	3	Pillowcases	1	1	1	1	back
2		Towels	1	1	1	1	right
3		Towel+strip	**1**	**1**	**1**	**1**	right
4		Pillowcases					front
5		Towel+strip					front
6		Sheets					
1	4	Pillowcases	1	1			right
2		Towels	1	1			front
3		Towel+strip					front
4		Pillowcases					left
5		Towel+strip					left
6		Sheets					
1	5 add on	Pillowcases	1		1		left
2		Towels	1				front
3		Towel+strip					front
4		Pillowcases					right
5		Towel+strip	1				back
6		Towels adjust number here	**3**	**3**	3	1	spread on top

Table B.6 – Average loads with two sheets (3,0 to 7,0 kg)

step	group	vertical axis	7,00	6,50	6,00	5,50	5,00	4,50	4,00	3,50	3,00	
1	1	Pillowcases	2	2	1	1	1	1	1	1	1	front
2		Towels	2	2	2	2	2	2	2	1	1	left
3		Towel+strip	1	1	1	1	1	1	1	1	1	left
4		Pillowcases	1	1	1	1	1	1				back
5		Towel+strip	1	1	1	1	1	1				back
6		Sheets	1	1	1	1	1	1	1	1	1	right
1	2	Pillowcases	2	1	1	1	1	1	1	1	1	left
2		Towels	2	2	2	2	2	2	2	1		back
3		Towel+strip	1	1	1	1	1	1	1	1		back
4		Pillowcases	1	1	1	1						right
5		Towel+strip	1	1								right
6		Sheets										
1	3	Pillowcases	2	2	1	1	1	1	1	1	1	back
2		Towels	2	2	2	2	2	2	2	1		right
3		Towel+strip	1	1	1	1	1	1	1	1	1	right
4		Pillowcases	1	1	1	1	1	1				front
5		Towel+strip	1	1	1	1						front
6		Sheets	1	1	1	1	1	1	1	1	1	left
1	4	Pillowcases	2	1	1	1	1	1	1	1	1	right
2		Towels	2	2	2	2	2	2	2	1		front
3		Towel+strip	1	1	1	1	1	1	1	1		front
4		Pillowcases	1	1	1	1						left
5		Towel+strip										
6		Sheets										
1	5 add on	Pillowcases										left
2		Towels										front
3		Towel+strip										front
4		Pillowcases										right
5		Towel+strip									1	back
6		Towels adjust number here	8	8	9	4	5	1	2	1	1	spread on top

Table B.7 – Large loads with three sheets (7,5 to 8,5 kg)

step	group	vertical axis	8,50	8,00	7,50	
1	1	Pillowcases	2	2	2	front
2		Towels	2	2	2	left
3		Towel+strip	1	1	1	left
4		Pillowcases	1	1	1	back
5		Towel+strip	1	1	1	back
6		Sheets	1	1	1	right
1	2	Pillowcases	2	2	2	left
2		Towels	2	2	2	back
3		Towel+strip	1	1	1	back
4		Pillowcases	1	1	1	right
5		Towel+strip	1	1	1	right
6		Sheets	1	1	1	front-left
1	3	Pillowcases	2	2	2	back
2		Towels	2	2	2	right
3		Towel+strip	1	1	1	right
4		Pillowcases	1	1	1	front
5		Towel+strip	1	1	1	front
6		Sheets	1	1	1	left-back
1	4	Pillowcases	2	2	2	right
2		Towels	2	2	2	front
3		Towel+strip	1	1	1	front
4		Pillowcases	1	1	1	left
5		Towel+strip	1	1	1	left
6		Sheets				
1	5 add on	Pillowcases	1			left
2		Towels	2			front
3		Towel+strip	1			front
4		Pillowcases	1			right
5		Towel+strip				back
6		Towels adjust number here	6	9	5	spread on top

Table B.8 – Extra large loads with four sheets (9,0 to 10,0 kg)

step	group	vertical axis	10,00	9,50	9,00	
1	1	Pillowcases	2	2	2	front
2		Towels	3	3	3	left
3		Towel+strip	1	1	1	left
4		Pillowcases	1	1	1	back
5		Towel+strip	1	1	1	back
6		Sheets	1	1	1	right
1	2	Pillowcases	2	2	2	left
2		Towels	3	3	3	back
3		Towel+strip	1	1	1	back
4		Pillowcases	1	1	1	right
5		Towel+strip	1	1	1	right
6		Sheets	1	1	1	front
1	3	Pillowcases	2	2	2	back
2		Towels	3	3	3	right
3		Towel+strip	1	1	1	right
4		Pillowcases	1	1	1	front
5		Towel+strip	1	1	1	front
6		Sheets	1	1	1	left
1	4	Pillowcases	2	2	2	right
2		Towels	3	3	3	front
3		Towel+strip	1	1	1	front
4		Pillowcases	1	1	1	left
5		Towel+strip	1	1	1	left
6		Sheets	1	1	1	back
1	5 add on	Pillowcases	2	1	1	left
2		Towels	3	3	1	front
3		Towel+strip	1	1	1	front
4		Pillowcases	2	1	1	right
5		Towel+strip	1	1		back
6		Towels adjust number here	3	3	1	spread on top

Annex C
(normative)

Thread removal material – Evaluation

C.1 General

The evaluation of the thread removal specimen after test run (Figure C.1) will be carried out by counting the removed threads (considered as “not remaining”).

The specimen shall be gently flattened out by hand and all threads which are considered as “not remaining” from the specimen removed.

All threads with direct contact to the remaining “fabric” count as “remaining” and stay in the fabric. All threads which have no direct contact to the remaining “fabric” shall be removed and count as “not remaining”.

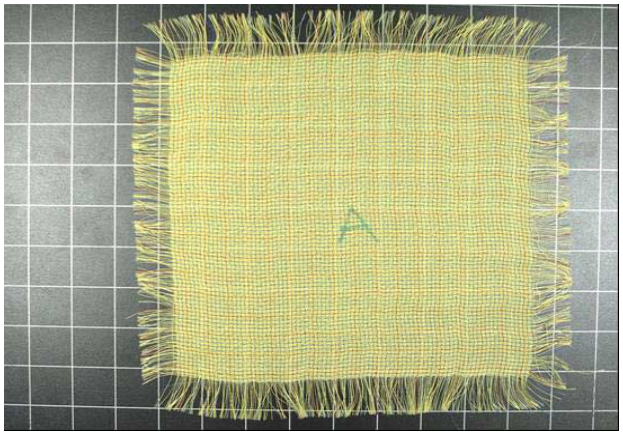


Figure C.1 – Thread removal specimen after test run

Threads which hang loose in the open threads count as “not remaining” and shall be removed – see Figure C.2a and Figure C.2c.

Threads which are all over the length very close to the remaining “fabric” but have no direct contact (see Figure C.2b) count as “not remaining”.

Threads which are mainly away from the remaining “fabric” but have contact on a short zone (more than three red squares in a row – see Figure C.2d) and/or several contacts (within three red squares – see Figure C.2e) count as “remaining”

In the very unlikely event that a thread comes out of the centre of the fabric (for example, if a single thread from the middle gets blocked and held back somewhere during the washing process), this thread will be removed but is considered as “remaining”.

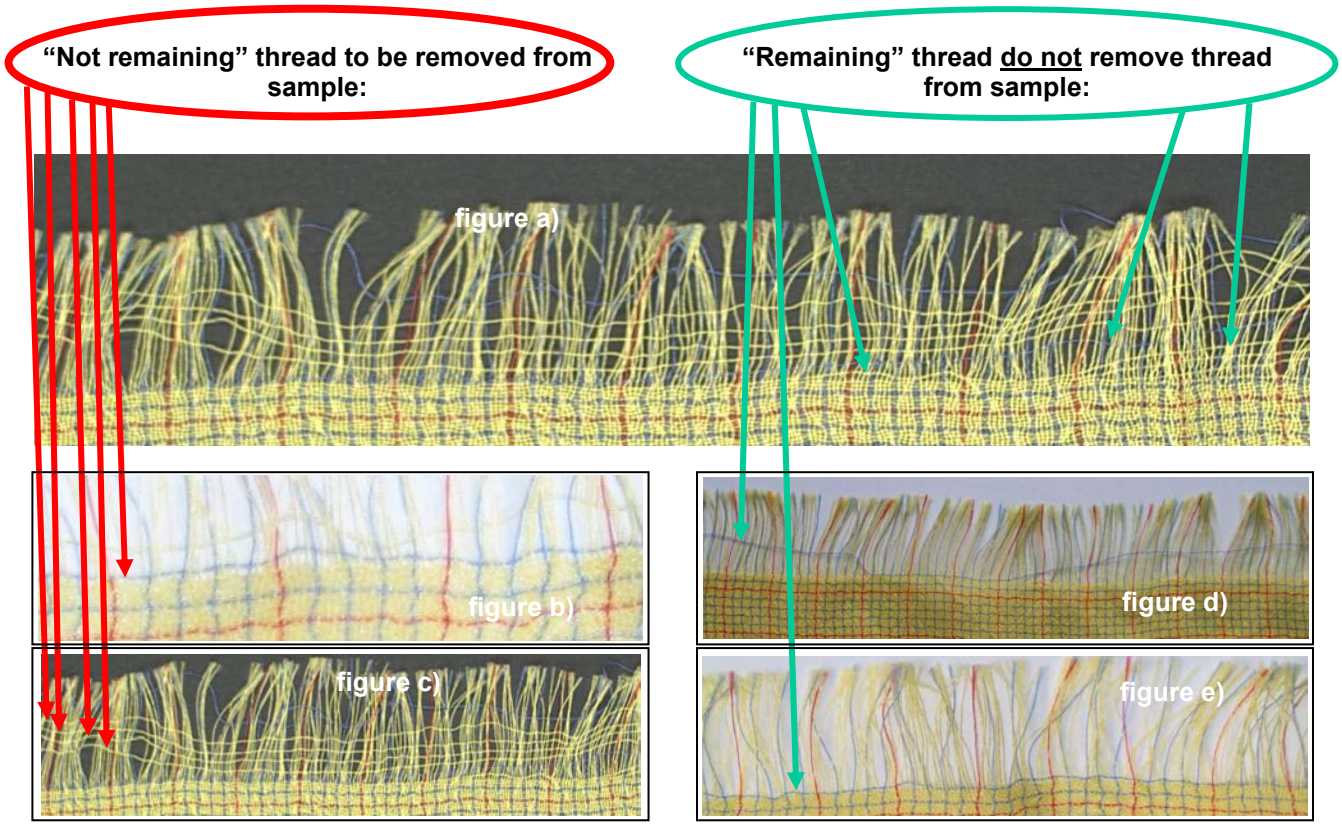


Figure C.2 – “Not remaining” and “remaining” threads

NOTE Remove all “not remaining” threads before counting.

C.2 Evaluation

a) Full remaining squares marked by a red thread in warp directions are counted first. Each square has 25 threads (first yellow thread to next red thread). Additionally, the first red thread shall be counted. See Figure C.3 for an example.

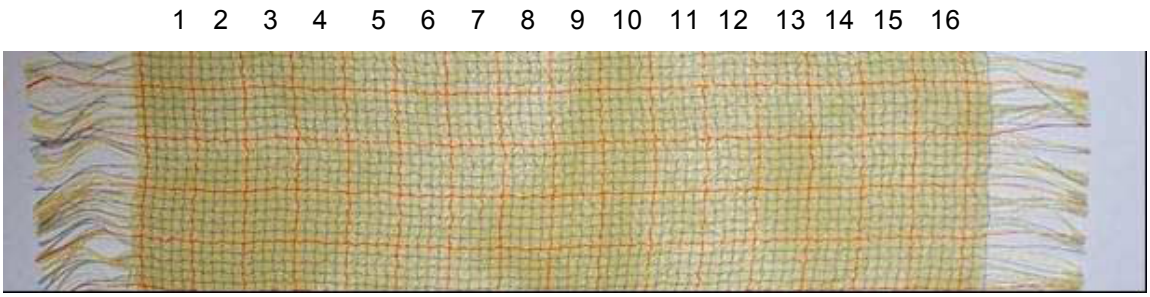


Figure C.3 – Thread counting after test run

Example:	16 left squares equals 16 × 25 threads	= 400 threads
	plus one red thread at the beginning, in total	= 401 threads

b) The full remaining squares marked with blue thread on each side in warp direction shall be counted. Each square has five threads (first yellow thread to next blue thread). See Figure C.4 for an example.

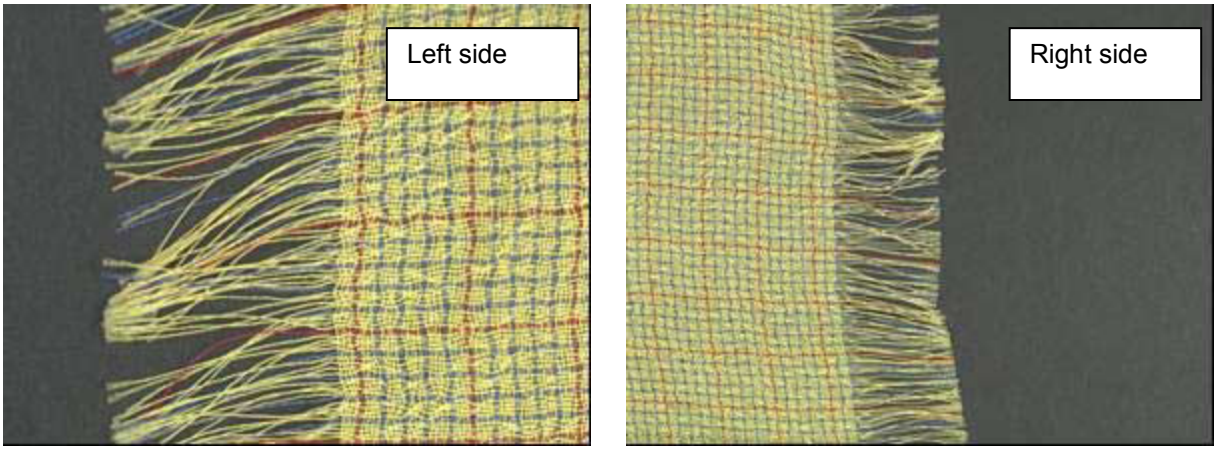


Figure C.4 – Square counting after test run: left and right side examples

Example:	0 squares on the left side equals	0 × 5 threads	= 0 threads
	2 squares on the right side equals	2 × 5 threads	= 10 threads
	Total		= 10 threads

c) Count remaining yellow single threads on each side in warp direction.

Example:	4 remaining threads on the left side	= 4 threads
	0 remaining threads on the right side	= 0 threads
	Total	= 4 threads

d) Add all remaining threads together and deduct them from 499.

Example:	New specimen	499
	remaining threads: 401 + 10 + 4 =	415
	removed threads in warp direction	84

e) Repeat the same procedure for the filling direction.

Example:	removed threads in warp direction	84
	removed threads in filling direction	83
	“not remaining” = removed threads total	167

f) Repeat the whole procedure for every test specimen.

Example:	removed threads sample 1	167
	removed threads sample 2	169
	removed threads sample 3	169
	removed threads sample 4	171
	Average “not remaining” threads	169

The final result is: “not remaining” threads 169

The result can also be expressed in % “lost area”:

Total threads warp and filling of original (100 %)	998
“not remaining” threads	169

The final result is % “lost area” 16.93%

Annex D
(normative)

Dot removal material – Evaluation

D.1 Evaluation

The evaluation of the test specimen shall be carried out by measuring four different spots on the test sample. The sample has to be laid on a white supporter, for example, the white standard ceramic tile and may not be folded (one layer). See Figure D.1.

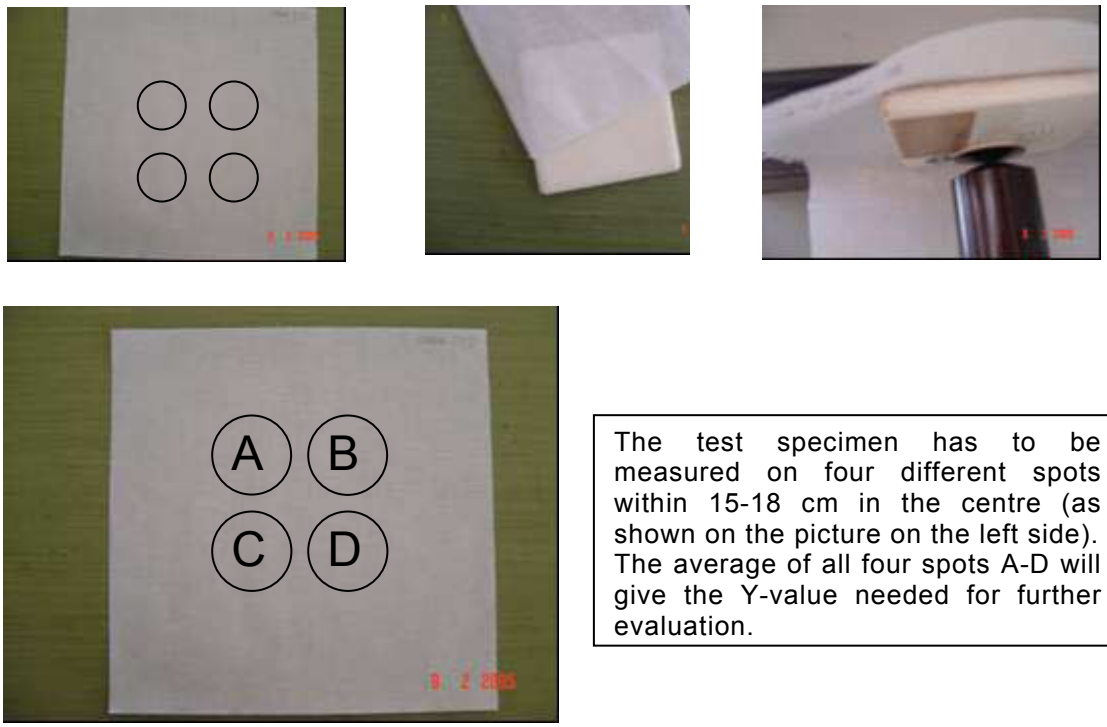


Figure D.1 – Measuring spots on dot removal specimen

Due to the fact that, during a washing process, the mechanical action can vary on different places of the machine/load/sample, an influence to the dot removal specimen can also be visible. This might be in form of “stripes” due to tangling or partly lower/higher removal of dots.

“Stripes“ mainly result from a permanent fold during the process and should not be measured.

For the evaluation the measuring spots shall be adapted, as shown in Figure D.2a). Places with lower and higher density of (left) dots result usually from the load blocking the fabric towards mechanical action (protected/non-protected areas). For the evaluation, the measuring spots should not be changed and the average can still be taken as a result, as shown in Figure D.2b).

figure a) figure b)

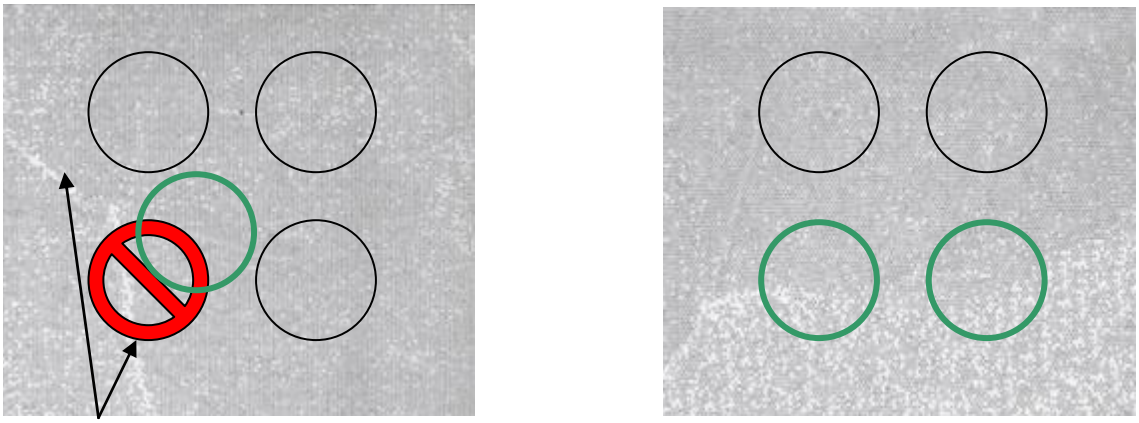


Figure D.2 – Measuring spots on uneven treated dot removal specimen

Every sample has to be measured originally and after the treatment.

Example:

Average Y values per test specimen (average of spots A-D)

Test specimen	1	2	3	4
Original measurement (average Y-values)	74,52	73,66	72,31	71,12
After wash process (average Y-values)	77,42	76,88	75,44	74,42
Difference (Y value)	2,90	3,22	3,13	3,30

Average difference Y value for all four test specimens: 3,14

Annex E
(normative)

Fraying material – Evaluation

E.1 General

The evaluation of the fraying specimen shall be carried out by counting loose threads.

The threads that are loosened but still attached to the test piece at both ends shall be counted and shall have been displaced by at least 2 mm from the undisturbed material. The total number of threads which have been displaced in each of the five holes in the swatch shall be recorded. See Figure E.1.

The total number of displaced threads in all five holes is the “mechanical action value” for the fraying specimen.

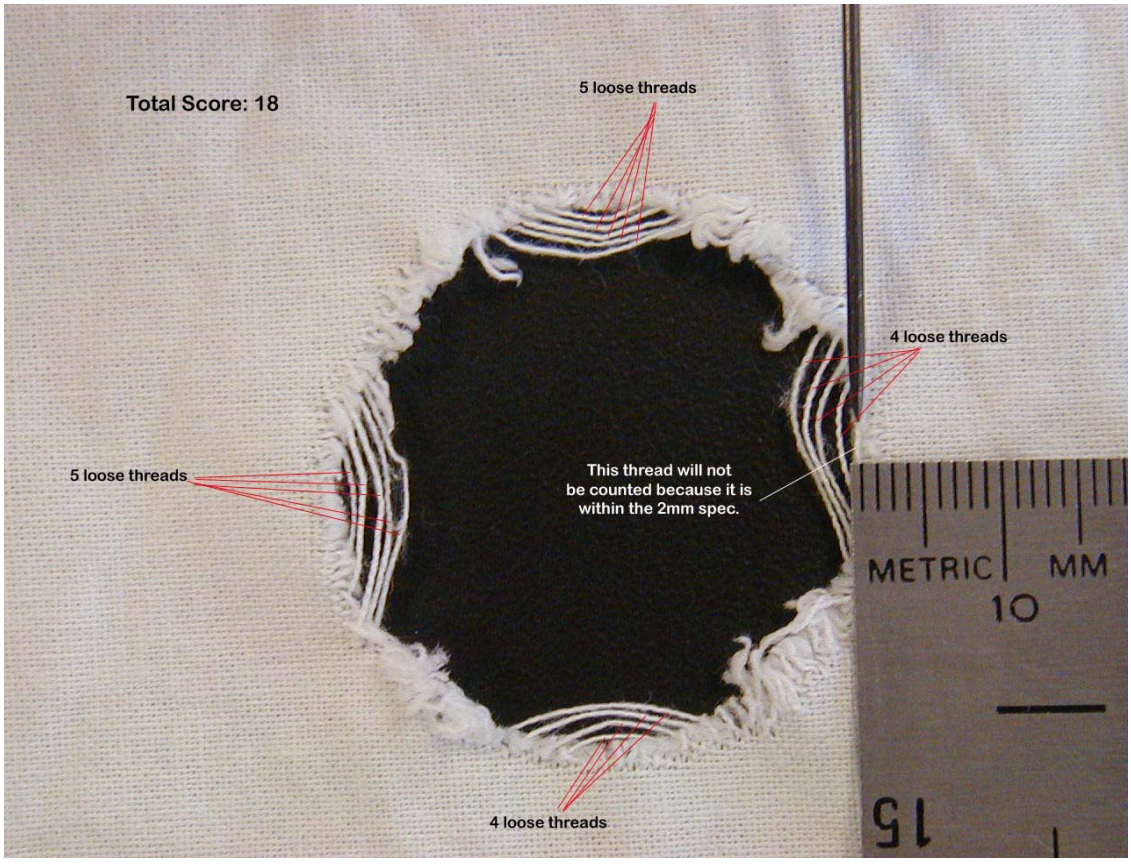


Figure E.1 – Part of fraying specimen after test run

E.2 Evaluation

a) Count loose threads for each test specimen

Li = X1 + X2 + X3 + X4 +X5

X1, X2, X3, X4, X5 = Number of threads pulled on a single hole on a test specimen

Li = Number of loose threads for each individual test specimen

b) Average number of loose threads for one test run:

Average L_{avg} = (L1+ L2+ L3+ L4) / 4

Number of test pieces = 4

Example:

Test specimen 1: L1 = 117
Test specimen 2: L2 = 108
Test specimen 3: L3 = 119
Test specimen 4: L4 = 111

Average number of loose threads: L_{avg} = 114

The evaluation for test specimen 1 of the example is shown in Figure E.2.

Top	6		8
Left	4		6
Right	5		6
Bottom	4		7
		7	
		5	
		6	
		7	
	5		7
	5		6
	5		6
	5		7
Loose Threads L		117	

Figure E.2 – Evaluation for test specimen 1

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