

## Textile Industry Standard of the People's Republic of China

FZ/T 52010—2014(2017)

Replace FZ/T 52010—2009

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### Recycled Poly(ethylene terephthalate) staple fibre

### 再生涤纶短纤维

*(English Translation)*

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## Foreword

China National Textile And Apparel Council is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This standard is drafted in accordance with the rules given in the GB/T 1.1-2009.

This standard replaces the FZ/T 52010-2009 *Recycled polyester staple fibre* in whole. The following deviations have been made with respect to the FZ/T 52010-2009.

- revision of the linear density range of fibre for spinning, nonwoven and filling (see 1);
- addition of "GB/T 17593(whole)" and deletion of "FZ/T 50009.4" (see 2);
- revision of the definitions of "silicon-containing fibre" and "silicon-free fibre"(see 3);
- addition of the terms of "products for baby", "products with direct contact to skin", "products without direct contact to skin" and "decoration material"(see 3);
- revision of the product identification(see 4.2);
- revision of the grading of fibre for spinning(see 5.1);
- addition of "Coefficient of variation of breaking strength" for cotton-like-type fibre(see 5.2);
- revision of quality indexes of fibre for spinning, nonwoven and filling (see 5.2);
- addition of test items for extractable heavy metals (see 5.3.3);

This standard was proposed and prepared by China National Textile and Apparel Council.

The previous edition of this standard are as follows:

- FZ/ T 52010—2009.

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# Recycled Poly(ethylene terephthalate) staple fibre

## 1 Scope

This standard specifies the terms and definitions, categories and identification, technical requirements, test methods, inspection rules, marking, packaging, transportation and storage for recycled Poly(ethylene Terephthalate) staple fibre(abbrev. rPET staple fibre).

This standard is applicable to rPET staple fibre with linear density of 0,8 dtex~6,7 dtex for spinning, 0,8 dtex~22,2 dtex for non-woven and 0,8 dtex~33,3 dtex for filling, which is produced by melt spinning with recycled PET as raw material.

The rPET staple fibre with linear density excluding above ranges and in other types may refer to this standard as well.

## 2 Normative references

The following referenced documents 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.

GB/T 3291.1, *Textiles—Terms of textile material properties and test—Part 1: Fibre and yarn*

GB/T 3291.3, *Textiles—Terms of textile material properties and test—Part 3: General*

GB/T 4146.1, *Textiles—Man-made fibres—Part 1: Generic names*

GB/T 4146.3, *Textiles—Man-made fibres—Part 3: Terms of inspection*

GB/T 6503, *Man-made fibres—Test method of moisture regain*

GB/T 6504, *Man-made fibre—Test method for oil content*

GB/T 8170, *Rules of rounding off for numerical values & expression and judgement of limiting values*

GB/T 14334, *Sampling method for man-made staple fibres*

GB/T 14335, *Testing method for linear density of man-made staple fibres*

GB/T 14336, *Testing method for length of man-made staple fibres*

GB/T 14337, *Testing method for tensile properties of man-made staple fibres*

GB/T 14338, *Testing method for crimping performance of man-made staple fibres*

GB/T 14339, *Testing method for defect of man-made staple fibres*

GB/T 14342, *Man-made fibre—Test method for specific resistance of staple fibres*

GB/T 17593(whole), *Textiles—Determination of heavy metals*

FZ/T 50002, *Testing method for shape factor of man-made fibre*

FZ/T 50004, *Testing method for shrinkage in hot air of polyester staple fibres*

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FZ/T 50009.1, *Testing method for linear density of three-dimensional crimp polyester staple fibres—Measure at length of single fibres*

FZ/T 50009.2, *Testing method for average length of three-dimensional crimp polyester staple fibres—Measure at length of single fibres*

FZ/T 50009.3, *Testing method for crimping performance of hollow PET staple fibres*

### **3 Terms and definitions**

For the purposes of this document, the terms and definitions given in GB/T 3291.1, GB/T 3291.3, GB/T 4146.1, GB/T 4146.3 and the following apply.

#### **3.1**

##### **recycled Poly(ethylene terephthalate) staple fibre**

rPET staple fibre

staple fibre which is produced by melt spinning process with recycled PET as raw material

#### **3.2**

##### **two-dimensional curliness**

2D curliness

mechanical crimp

curliness with curling wave of fibre distributed in a plane

#### **3.3**

##### **three-dimensional curliness**

3D curliness

conjugated crimp

curliness with curling wave of fibre distributed in three dimension

#### **3.4**

##### **silicon-containing fibre**

fibre treated with silicon-containing finishing agent

#### **3.5**

##### **silicon-free fibre**

fibre treated with silicon-free finishing agent

#### **3.6**

##### **products for baby**

products worn or used by infants under 36 months of age

#### **3.7**

##### **products with direct contact to skin**

products worn or used with most areas in direct contact with human skin

### 3.8

#### products without direct contact to skin

products worn or used of with indirect contact or small area in contact with human skin

### 3.9

#### decoration material

products used for decoration

## 4 Categories and identification

### 4.1 Product categories

**4.1.1** According to application of rPET staple fibre, there are three categories—rPET for spun, rPET for non-woven and rPET for filling.

**4.1.2** For spun, there are three types:

— Cotton-like-type: nominal linear density 0,8 dtex ~ 2,1 dtex, with general-tenacity and high-tenacity.

— Mid-length-type: nominal linear density 2,2 dtex~3,2 dtex.

— Wool-like-type: nominal linear density 3,3 dtex~6,7 dtex.

**4.1.3** For nonwoven, there are five grades subject to nominal linear density—

<1,5 dtex; 1,5 dtex~2,1 dtex; 2,2 dtex~3,2 dtex; 3,3 dtex~6,0 dtex; 6,1 dtex~22,2 dtex.

**4.1.4** For filling, there are three types according to manufacturing method—

non-hollow-type; 2D-hollow-type; 3D-hollow-type.

**4.1.5** For filling, there are two types according to finishing process—

silicon-containing-type; silicon-free-type.

### 4.2 Product identification

rPET staple fibre is identified by its linear density, length and application.

The unit is decitex (dtex) for linear density and millimeter (mm) for length.

EXAMPLE 1,5 dtex×38 mm rPET staple fibre for spinning;

3,3 dtex×38 mm rPET staple fibre for non-woven.

## 5 Technical requirements

### 5.1 Product grade

rPET staple fibre for spinning is graded into three levels: high-class, first-class and qualified-class.

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rPET staple fibre for nonwoven is graded into two levels: first-class and qualified-class.

rPET staple fibre for filling is one level: qualified-class.

## 5.2 Performance items and quality indexes

See Table 1, Table 2, Table 3 and Table 4.

## 5.3 Other items and requirements

5.3.1 Oil content shall be determined as agreement.

5.3.2 Moisture regain shall be determined as agreement, when exceeding conventional moisture regain.

5.3.3 Ten extractable heavy metals are antimony, arsenic, lead, cadmium, chromium, hexavalent chromium, cobalt, copper, nickel and mercury. There are four classes—products for baby, products with direct contact to skin, products without direct contact to skin and decoration material.



Table 1 —Properties of rPET staple fibre for spun

No.	Item	Cotton-like-type						Mid-length-type			Wool-like-type			
		High-tenacity type			General-tenacity type			High-class	First-class	Qualified-class	High-class	First-class	Qualified-class	
		High-class	First-class	Qualified-class	High-class	First-class	Qualified-class							
1	breaking tenacity/(cN/dtex) $\geq$	5,60	5,30	5,10	5,00	4,60	4,20	4,60	4,40	4,20	3,80	3,60	3,30	
2	elongation at break/% $\leq$	$M_1^a \pm 4,0$	$M_1 \pm 8,0$	$M_1 \pm 10,0$	$M_1 \pm 6,0$	$M_1 \pm 8,0$	$M_1 \pm 10,0$	$M_1 \pm 8,0$	$M_1 \pm 10,0$	$M_1 \pm 12,0$	$M_1 \pm 8,0$	$M_1 \pm 10,0$	$M_1 \pm 12,0$	
3	percentage of linear density deviation/%	$\pm 4,0$	$\pm 6,0$	$\pm 8,0$	$\pm 4,0$	$\pm 6,0$	$\pm 8,0$	$\pm 4,0$	$\pm 6,0$	$\pm 8,0$	$\pm 6,0$	$\pm 8,0$	$\pm 10,0$	
4	percentage of length deviation/%	$\pm 4,0$	$\pm 6,0$	$\pm 8,0$	$\pm 6,0$	$\pm 8,0$	$\pm 10,0$	$\pm 6,0$	$\pm 8,0$	$\pm 10,0$	—	—	—	
5	percentage of over-length fibre/% $\leq$	1,0	1,0	3,0	1,0	1,0	3,0	1,0	1,0	3,0	—	—	—	
6	content of multiple length fibre/(mg/100g) $\leq$	6,0	8,0	20,0	6,0	8,0	20,0	6,0	8,0	30,0	15,0	25,0	45,0	
7	content of defect/(mg/100g) $\leq$	10,0	30,0	60,0	50,0	80,0	150,0	70	100	150,0	100,0	150,0	300,0	
8	crimp frequency/(number/25mm)	$M_2^b \pm 3,0$	$M_2 \pm 3,5$		$M_2 \pm 3,0$	$M_2 \pm 3,5$		$M_2 \pm 3,5$			$M_2 \pm 3,5$			
9	crimp percentage/%	$M_3^c \pm 3,0$	$M_3 \pm 3,5$		$M_3 \pm 3,0$	$M_3 \pm 3,5$		$M_3 \pm 3,5$			$M_3 \pm 3,5$			
10	shrinkage in 180°C hot air/(%)	$M_4^d \pm 3,0$	$M_4 \pm 4,0$		$M_4 \pm 3,0$	$M_4 \pm 4,0$		$M_4 \pm 4,0$			—			
11	specific resistance/( $\Omega \cdot m$ ) $\leq$	$M_5^e \times 10^8$	$M_5 \times 10^9$		$M_5 \times 10^8$	$M_5 \times 10^9$		$M_5 \times 10^9$			$M_5 \times 10^9$		—	
12	tenacity at 10% specified elongation/(cN/dtex) $\geq$	3,00	2,50	2,00	—			—			—			
13	<b>coefficient of variation of breaking strength /% <math>\leq</math></b>	12,0	15,0		12,0	—			—			—		

<sup>a</sup>  $M_1$  is the central value of elongation at break, which being determined by the manufacture. No arbitrary alteration is allowed after confirmation. Due to the change of raw materials or customer requirements, appropriate adjustments can be made.

<sup>b</sup>  $M_2$  is the central value of crimp frequency, which being determined as agreement. No arbitrary alteration is allowed after confirmation.

<sup>c</sup>  $M_3$  is the central value of crimp percentage, which being determined as agreement. No arbitrary alteration is allowed after confirmation.

<sup>d</sup>  $M_4$  is the central value of shrinkage in 180°C hot air. It is  $\leq 7,0$  for high-tenacity type,  $\leq 9,0$  for general-tenacity type and  $\leq 10,0$  for mid-length-type, which being determined by the manufacture. No arbitrary alteration is allowed after confirmation.

<sup>e</sup>  $M_5$  is  $1 \sim < 10,0$ .

Table 2 —Properties of rPET staple fibre for nonwoven

NO	Item	<1.5 dtex		1.5 dtex~2.1 dtex		2.2 dtex~3.2 dtex		2.3 dtex~6.0 dtex		6.1 dtex~11.1 dtex	
		First-class	Qualified-class	First-class	Qualified-class	First-class	Qualified-class	First-class	Qualified-class	First-class	Qualified-class
1	breaking tenacity/(cN/dtex) ≥	4,80	4,60	4,60	4,20	4,10	3,80	3,60	3,20	2,80	2,60
2	elongation at break/% ≤	M <sub>1</sub> <sup>a</sup> ±8,0	M <sub>1</sub> ±10,0	M <sub>1</sub> ±8,0	M <sub>1</sub> ±10,0	M <sub>1</sub> ±8,0	M <sub>1</sub> ±10,0	M <sub>1</sub> ±10,0	M <sub>1</sub> ±12,0	M <sub>1</sub> ±12,0	M <sub>1</sub> ±15,0
3	percentage of linear density deviation/%	±6,0	±8,0	±6,0	±8,0	±6,0	±8,0	10,0	12,0	10,0	12,0
4	percentage of length deviation/%	±6,0	±8,0	±6,0	±8,0	±6,0	±8,0	—	—	—	—
5	content of multiple length fibre/(mg/100g) ≤	10,0	20,0	10,0	20,0	10,0	20,0	30,0	45,0	40,0	50,0
6	content of defect/(mg/100g) ≤	20,0	50,0	40,0	80,0	100,0	150,0	150,0	200,0	200,0	300,0
7	crimp frequency/(number/25mm)	M <sub>2</sub> <sup>b</sup> ±3,5		M <sub>2</sub> ±3,5		M <sub>2</sub> ±3,5		M <sub>2</sub> ±3,5		M <sub>2</sub> ±3,5	
8	crimp percentage/%	M <sub>3</sub> <sup>c</sup> ±3,5		M <sub>3</sub> ±3,5		M <sub>3</sub> ±3,5		M <sub>3</sub> ±3,5		M <sub>3</sub> ±3,5	
9	shrinkage in 180°C hot air/(%)	M <sub>4</sub> <sup>d</sup> ±3,5		M <sub>4</sub> ±3,5		M <sub>4</sub> ±3,5		M <sub>4</sub> ±3,5		M <sub>4</sub> ±4,0	
10	specific resistance/(Ω·m) ≤	M <sub>5</sub> <sup>e</sup> ×10 <sup>8</sup>	M <sub>5</sub> ×10 <sup>9</sup>	M <sub>5</sub> ×10 <sup>8</sup>	M <sub>5</sub> ×10 <sup>9</sup>	M <sub>5</sub> ×10 <sup>8</sup>	M <sub>5</sub> ×10 <sup>9</sup>	M <sub>5</sub> ×10 <sup>8</sup>	M <sub>5</sub> ×10 <sup>9</sup>	—	—
11	tenacity at 10% specified elongation/(cN/dtex) ≥	2,50	2,00	—	—	—	—	—	—	—	—

<sup>a</sup> M<sub>1</sub> is the central value of elongation at break, determined by the manufacturer. No arbitrary alteration is allowed after confirmation. Due to the change of raw materials or customer requirements, appropriate adjustments can be made.

<sup>b</sup> M<sub>2</sub> is the central value of crimp frequency, determined as agreement. No arbitrary alteration is allowed after confirmation.

<sup>c</sup> M<sub>3</sub> is the central value of crimp percentage, determined as agreement. No arbitrary alteration is allowed after confirmation.

<sup>d</sup> M<sub>4</sub> is the central value of shrinkage in 180°C hot air, determined by the manufacturer. No arbitrary alteration is allowed after confirmation.

<sup>e</sup> M<sub>5</sub> is 1,0~<10,0.

Table 3 —Properties of rPET staple fibre for filling

NO.	Item	non-hollow-type	2D-hollow-type			3D-hollow-type				
1	percentage of linear density deviation/%	±10,0	±10,0			±8,0				
2	percentage of length deviation/%	±10,0	±10,0			±10,0				
3	crimp frequency/(number/25mm)	M <sub>1</sub> <sup>a</sup> ±3,0	M <sub>1</sub> ±3,0			M <sub>1</sub> ±4,0				
4	content of multiple length fibre/(mg/100g) ≤	100,0	100,0			100,0				
5	content of defect/(mg/100g) ≤	500,0	500,0			<3,3 dtex	3,4 dtex~ 7,8 dtex	7,9 dtex~ 16,8 dtex	16,9 dtex~ 27,8 dtex	27,9 dtex
						100,0	300,0	800,0	1 200,0	—
6	degree of bulkiness V <sub>1</sub> /(cm <sup>3</sup> /g) ≥	—	160	silicon- containing	130	170		silicon- containing	135	
7	degree of bulkiness V <sub>2</sub> /(cm <sup>3</sup> /g) ≥	—	35		20	40			20	
8	degree of bulkiness V <sub>3</sub> /(cm <sup>3</sup> /g) ≥	—	140		110	150			130	
9	percentage of compression elastic recovery/% ≥	—	70		70	58			58	
10	degree of hollowness/%	—	12,0			12,0				

<sup>a</sup> M<sub>1</sub> is the central value of crimp frequency, which being determined as agreement. No arbitrary alteration is allowed after confirmation.

Table 4 —Content of extractable heavy metals

NO.	Item	Products for infants	Products with direct contact to skin	Products without direct contact to skin	Decorative material
1	Sb/(mg/kg) ≤	30,0	30,0	30,0	30,0
2	As/(mg/kg) ≤	0,2	1,0	1,0	1,0
3	Pb/(mg/kg) ≤	0,2	1,0	1,0	0,1
4	Cd/(mg/kg) ≤	0,1	0,1	0,1	0,1
5	Cr/(mg/kg) ≤	1,0	2,0	2,0	2,0
6	Cr <sup>+6</sup> /(mg/kg) ≤	Below the detected value			
7	Co/(mg/kg) ≤	1,0	4,0	4,0	4,0
8	Cu/(mg/kg) ≤	25,0	50,0	50,0	50,0
9	Ni/(mg/kg) ≤	1,0	4,0	4,0	4,0
10	Hg/(mg/kg) ≤	0,02	0,02	0,02	0,02

## 6 Test methods

### 6.1 Breaking tenacity, Elongation at break, Tenacity at 10% specified elongation and Coefficient of variation of breaking strength

Determined in accordance with GB/T 14337.

### 6.2 Percentage of linear density deviation

Determined in accordance with GB/T 14335, while FZ/T 50009.1 for 3D-hollow-type.

### 6.3 Percentage of length deviation, Percentage of over-length fibre and Content of multiple length fibre

Determined in accordance with GB/T 14336, while FZ/T 50009.2 for 3D-hollow-type.

### 6.4 Crimp frequency and Crimp percentage

Determined in accordance with GB/T 14338, while FZ/T 50009.3 for 3D-hollow-type.

### 6.5 Degree of hollowness

Determined in accordance with FZ/T 50002.

### 6.6 Shrinkage in 180°C hot air

Determined in accordance with FZ/T 50004.

### 6.7 Specific resistance

Determined in accordance with GB/T 14342.

### 6.8 Oil content

Determined in accordance with GB/T 6504.

### 6.9 Moisture regain

Determined in accordance with GB/T 6503.

### 6.10 Degree of bulkiness and Percentage of compression elastic recovery

Determined in accordance with Annex A.

### 6.11 Content of defect

Determined in accordance with GB/T 14339.

#### **6.12 Content of extractable heavy metals**

Determined in accordance with GB/T 17593.

### **7 Rules of inspection**

#### **7.1 Items for inspection**

All items in Table 1, Table 2 and Table 3 are for appraisal. The corresponding tests are carried out according to Chapter 6.

Items in Table 4 are determined as agreement.

#### **7.2 Requirements for batch formation**

Within a certain range, inspection lots are formed by using periodic sampling. A production batch is composed of one or several inspection lots.

#### **7.3 Requirements for sampling**

Sampling for performance items shall be carried out according to off-machine-products method specified in GB/T 14334.

#### **7.4 Comprehensive evaluation**

The measured or calculated values of performance items shall be compared with the limits in Table 1, Table 2 and Table 3, in accordance with rounded-value comparison method specified in GB/T 8170, to grade item by item.

Grading the level of this batch of products is same as the lowest level of each performance item.

Those below qualified-class are substandard products.

#### **7.5 Rules for re-inspection**

##### **7.5.1 General principle**

When the batch of products is delivered to the buyer, inspection shall be carried out promptly for consistency of outer-packing, number and quality with the packing list.

If the quality is affected by transportation, storage and other reasons, the responsibility shall be ascertained, while the responsible party holding responsibility.

Within three months from the date of receipt, a re-inspection may be applied if any objection to quality of the products. If the used quantity is more than one-third of the batch, re-inspection shall not be applied for.

The re-inspection may be conducted by either party by mutual consent. If necessary, arbitration inspection agency may be requested to sampling, inspection and arbitration, in accordance with this standard, with cost being liable to the responsible party.

When the quality of batch affects the post-processed products and causes serious losses, both supplier and buyer should analyze the reasons, clear the responsibility and negotiate the settlement.

##### **7.5.2 Items for re-inspection**

See 7.1.

##### **7.5.3 Requirements for sampling**

Sampling for performance items shall be carried out according to package-products method specified in GB/T 14334.

It is not allowed to take out package which has been accidentally moistened, contaminated, scratched or opened in transit.

Sample amount shall be double for content of multiple length fibre and content of defect.

#### **7.5.4 Requirements for batch formation**

Batch is grouped according to original production batch.

#### **7.5.5 Evaluation for re-inspection**

**7.5.5.1** The result of re-inspection shall be evaluated in accordance with 7.4. If being above or equal to the original level, it is judged as conforming, whereas being lower is judged as nonconforming.

**7.5.5.2** When percentage of deviation between average net-weight and conventional-weight exceeds  $\pm 0,5\%$ , it shall be negotiated between supplier and buyer.

### **8 Marking, packaging, transportation and storage**

#### **8.1 Marking**

The package should be marked with the product name and specification as specified categories and identification; level, batch number, net weight, production date, trademark, product-standard number, name and address of manufacturer, warning signs for product protection and handling.

#### **8.2 Packaging**

**8.2.1** Product packaging keeps the package shape intact and fibre not being exposed. The quality of packaging should ensure that fibres are not damaged.

**8.2.2** rPET staple fibres of different specifications, batch numbers and categories should be packed separately.

#### **8.3 Transportation**

When transporting, appropriate precautions should be taken to prevent moisture, exposure, contamination and damage to products. When loading and unloading, it shall be carried out in accordance with the warning signs and shall not be thrown.

#### **8.4 Storage**

Packages are stacked in batches and stored in a ventilated, dry and clean warehouse. They should be away from fire or heat sources, and avoid direct sunlight.

## Annex A (normative)

### Test method for bulkiness and compressive elastic recovery

#### A.1 Principle

After being loosened, the sample is hand-made into a fibre-net. Add light/heavy load respectively to the fibre-net and measure the height of the net. Calculate degree of bulkiness and percentage of compression elastic recovery.

#### A.2 Apparatus

##### A.2.1 Opening machine

A big roller and some small rollers are used simultaneously to loosen fibres at low speeds(1 400 r/min).

Fibres can be loosened to the maximum extent, while their smoothness and crimp are undamaged, as well as achieving desired fluffy effect.

##### A.2.2 Bulkiness instrument

The error of height measurement is to be  $\pm 0,5$  mm. Block A and Block B are applied for load. Blocks are with handle, which length suitable for operation.

Block A is 10 cm×10 cm in dimension, with a weight of 60(1±1%) g. Block B is 500(1±1%) g.

Block A is made of plexiglass and block B is made of stainless steel.

##### A.2.3 Balance

The minimum division value is 10mg.

#### A.3 Conditioning and testing atmosphere

The temperature is  $(20 \pm 2)^\circ\text{C}$  and the relative humidity is  $(65 \pm 5)\%$ .

#### A.4 Sampling and Preparation of test specimens

##### A.4.1 Sampling

**A.4.1.1** Take laboratory samples of 500 g in accordance with GB/T 14334.

**A.4.1.2** Randomly and uniformly take test samples of 200 g from laboratory samples. Condition test samples to reach moisture equilibrium, unless moisture regain being lower than conventional moisture regain.

##### A.4.2 Preparation of test specimens

**A.4.2.1** Adjust operating parameters of opener machine as required by instrument instructions.

**A.4.2.2** Run the machine empty before test to check the machine for abnormalities.

**A.4.2.3** Randomly take 50 g test specimen from the conditioned laboratory sample and spread evenly on the conveyor of opener machine.

**A.4.2.4** Turn on power switch of the main engine and wait, till the machine is in working state—i.e. reaching the rated rotation speed. Then, turn on power switch of the conveyor to loosen fibres.

**A.4.2.5** After loosening fibres, turn off power switches of the conveyor and the engine in turn.

## A.5 Test procedure

- A.5.1** Weigh  $(5 \pm 0,1)$  g loose fibres with a balance. Carefully hand-make 4~5 pieces of fibre-net with an area of about 10 cm×10 cm.
- A.5.2** Gently put fibre-nets into bulkiness instrument in a criss-cross manner and set aside for 5 min.
- A.5.3** Slowly put down block A without any bump. After 1 min, read the height of fibre-nets  $h_1$ , to an accuracy of 0,5mm.
- A.5.4** With block A inside, continue to put down block B. After 1 min, read the height of fibre-nets  $h_2$ , to an accuracy of 0,5mm.
- A.5.5** Remove all blocks and set fibre-nets aside for 3 min. Again, slowly put down block A. After 1 min, read the height of fibre-nets  $h_3$ , to an accuracy of 0,5mm.

## A.6 Calculation and expression of results

- A.6.1** Calculate Bulkiness  $V_1$ , Bulkiness  $V_2$ , Bulkiness  $V_3$ , Compressive elastic recovery  $E$ , according to *Formula A.1~A.4*.

$$V_1 = \frac{A \times h_1}{G} \quad (\text{A.1})$$

$$V_2 = \frac{A \times h_2}{G} \quad (\text{A.2})$$

$$V_3 = \frac{A \times h_3}{G} \quad (\text{A.3})$$

$$E = \frac{h_3 - h_2}{h_1 - h_2} \quad (\text{A.4})$$

where

- $V_1$  is bulkiness under light load, expressed in  $\text{cm}^3/\text{g}$ ;
- $A$  is area of block, expressed in  $\text{cm}^2$ ;
- $h_1$  is height of fibre-nets under light load, expressed in cm;
- $G$  is weight of fibre-nets, expressed in g;
- $V_2$  is bulkiness under heavy load, expressed in  $\text{cm}^3/\text{g}$ ;
- $h_2$  is height of fibre-nets under heavy load, expressed in cm;
- $V_3$  is bulkiness under light load after compressed by heavy load, expressed in  $\text{cm}^3/\text{g}$ ;
- $h_3$  is height of fibre-nets under light load after compressed by heavy load, expressed in cm;
- $E$  is percentage of compression elastic recovery, expressed in %.

- A.6.2** The result is expressed as arithmetic mean value of two parallel determinations, be accurate to the integer.