



BSI Standards Publication

**Textiles — Cotton fibres — Determination
of micronaire value**

National foreword

This British Standard is the UK implementation of [ISO 2403:2021](#). It supersedes [BS ISO 2403:2014](#), which is withdrawn.

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**Textiles — Cotton fibres —
Determination of micronaire value**

Textiles — Fibres de coton — Détermination de l'indice micronaire



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Foreword

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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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

This third edition cancels and replaces the second edition ([ISO 2403:2014](http://www.iso.org/iso/2403:2014)), which has been technically revised.

The main changes compared to the previous edition are as follows:

- an introduction clause has been added;
- a short description of the available apparatus, operation details and reference to calibration method in [5.2](#), Notes 1 and 2, respectively, has been added ;
- permission of the use of two different sample preparation methods have been added in [7.2](#);
- the specification of applied sample preparation method, the date of the test, any deviations from the procedure, and any unusual features observed have been added in the test report in [Clause 10](#);
- former Annexes B and C (operation of different instruments) have been removed;
- a new informative [Annex B](#) with precision data for micronaire measurements has been added;
- a new informative [Annex C](#) with precision data for comparison of the both test specimen preparation methods has been added;
- a bibliography has been added;
- grammar and linguistic consistency have been reviewed.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The micronaire value, one of the most important cotton fibre quality parameters, is measured on a plug of cotton fibres, it hence represents an average value. Due to a simple test specimen preparation, a measurement is carried out in relatively short time and thereby leads to fast testing results.

Based on the air permeability of a compressed cotton fibre test specimen, early manual micronaire testers used a mechanical air-flow meter, where a float sensor indicates the amount of air flowing through the test specimen, and a mechanical manometer showing the air pressure difference across the test specimen. Modern micronaire testers generally use electronic sensors for both, the air flow and the pressure difference.

In any case, the dimensionless micronaire value is calculated from the air flow through the test specimen and the pressure difference along the test specimen. Micronaire values are within a scale of 2 and 8, where a value of 2 represents a low air permeability (high packing density of the test specimen, caused by very fine and/or immature fibres) and a value of 8 represents a high air permeability (low packing density of the test specimen, caused by very coarse and/or mature fibres).

Textiles — Cotton fibres — Determination of micronaire value

1 Scope

This document specifies a method of determining the micronaire value of loose disorientated cotton fibres taken from bales, laps and slivers, or other sources of lint cotton.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

[ISO 139](#), *Textiles — Standard atmospheres for conditioning and testing*

ISO 1130, *Textile fibres — Some methods of sampling for testing*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

micronaire value

measure for the air permeability of a mass of cotton under specified conditions

Note 1 to entry: The micronaire scale is based on a range of cottons to which micronaire values have been assigned by international agreement.

Note 2 to entry: It is expressed in terms of an arbitrary scale, the so-called micronaire scale.

4 Principle

Air is passed through a test specimen consisting of a plug of fibres. The permeability is indicated on a scale for recording variations in either the rate of flow through, or the pressure difference across, the plug. The mass and volume of the test specimen are either a constant for a given type of instrument or varied appropriately in relation to each other. The scale indicating variations in permeability can be calibrated in arbitrary units of micronaire value or marked in the appropriate absolute units of rate of flow or of pressure difference and a table or graph provided for conversion of the observed readings into micronaire values.

5 Apparatus and materials

5.1 Balance, of sufficient capacity to weigh the test specimen required for the airflow instrument used, with an accuracy of $\pm 0,2$ %.

to be tested to determine whether or not the instrument is correctly adjusted and is giving results on the correct level (for more information, see [Annex A](#)).

8.1.1 Consider the performance of any instrument to be within the requirements of this document if the average results for each such calibration cotton do not differ from its corresponding established values by more than $\pm 0,10$ micronaire scale unit.

8.1.2 Re-test, by the above procedure, cottons giving differences greater than $\pm 0,10$ micronaire scale unit between the average of the two tests and the established value. Accept the results if the difference between the two new micronaire values for such a cotton does not exceed $\pm 0,10$ micronaire scale unit. If the difference continues to be greater than $\pm 0,10$ micronaire scale unit, either re-adjust the instrument and repeat the above check procedure or apply, on the basis of the established differences referred to above, an appropriate correction or adjustment to test values for subsequent samples submitted for testing.

8.2 Pack the test specimen evenly into the compression cylinder, a small portion at a time, fluffing the fibres with the fingers in order to break up any lumps and taking care that all the fibres are inserted in the cylinder. Put the compression plunger in position and lock it.

8.3 Cause the air to flow through the test specimen at the appropriate constant flow (or pressure) and note the reading on the pressure difference (or airflow) scale of the instrument to an accuracy of about ± 1 %.

8.4 If a second measurement is required for the same test specimen, remove the cotton from the instrument, taking care not to lose fibre, and repeat the procedure given in [8.2](#) and [8.3](#).

8.5 Test the number of test specimens per sample.

[Annex B](#) provides additional information and precision data.

9 Calculation and expression of results

9.1 For instruments in which the scale is graduated in micronaire values, average the readings for the test specimens tested from a sample. If necessary, apply any correction based on [8.1.2](#) and report the average to the nearest 0,1 micronaire value.

9.2 For instruments in which the scale is graduated in units other than micronaire values, convert the direct readings to micronaire values from a previously established conversion curve or statistical relation. Additional information is given in [Annex A](#). Calculate the average of the converted values as described in [9.1](#).

10 Test report

The test report shall include the following information:

- a) a reference to this document, i.e. [ISO 2403:2021](#);
- b) the material source (lint cotton, picker lap, processing waste) and, if possible, type and/or botanical species (*desi*, Upland, *G. barbadense*);
- c) method of test specimen preparation (Method "A" or Method "B");
- d) the number of test specimens tested, the number of readings per test specimen, the number of samples used, and the scheme for drawing them;
- e) the average values calculated, as specified in [Clause 9](#);

- f) the type, make, and model of instrument used;
- g) the date of the test;
- h) any deviations from the procedure;
- i) any unusual features observed.

Annex A (informative)

Method of calibration of instruments

A.1 Calibration of airflow instruments is based on samples of a series of International Calibration Cottons available at United States Department of Agriculture, see Reference [4]. These are furnished with micronaire values established by the International Calibration Cotton Standards Committee.

A.2 For calibration purposes use the full range of calibration cottons available. They approximately cover the range of the micronaire values of the world's commercial cottons.

NOTE The routine checking and adjusting of the instrument in relation to a section of the instrument's scale is to be distinguished from the more elaborate determination of the locations of numerous points along the full-scale range of the instrument when it is being calibrated. Routine checking for daily use is described in 8.1 to 8.1.2. Calibration of an instrument, such as at the factory or upon receiving it at the laboratory or occasionally under other special circumstances at the laboratory, is described in this annex.

A.3 For each calibration cotton, make a minimum of two test determinations on each of three test specimens. The difference between the micronaire values for the first and second determination shall not exceed 0,10 unit. If a greater difference is obtained, discard the result and make two determinations on a fresh test specimen. Take the average of the first readings on each of the three test specimens for each calibration cotton.

NOTE The scale from which the readings are noted can already be graduated in micronaire values (as with most commercially available instruments). For a new instrument, it may be a uniformly graduated scale.

A.4 For instruments already fitted with a scale graduated in micronaire values, determine the difference between the average scale reading and the corresponding established value for each cotton. If none of these differences exceeds 0,10 unit, regard the previous calibration of the instrument as satisfactory. If greater differences occur, make appropriate instrument checks and adjustments to bring the instrument performance into compliance with the above requirements. Alternatively, a series of appropriate scale corrections may be calculated.

A.5 For instruments fitted with a scale graduated in other than micronaire values, either plot a graph showing the average instrument readings as abscissae and the corresponding established values as ordinates and draw a smooth curve to pass evenly through the points or determine statistically the relation between average instrument readings and corresponding established values in the form of a formula.

The deviations between average scale readings and established micronaire value shall not be greater than the equivalent of 0,10 unit, as indicated by the graph or by the statistically established relation, as in A.4.

A.6 Use the calibration curve, or the corresponding statistical relation, to convert final test values yielded by cotton samples into micronaire values. Alternatively, fit the instrument with a scale graduated in micronaire values, the markings of which are obtained from the calibration curve or from the statistical relation.

Annex B (informative)

Precision experiment

B.1 General

This annex gives an analysis of the precision of micronaire measurements.

B.2 Description

The measurements within this experiment have been carried out by 72 laboratories on six test specimens taken from each of 4 different cotton samples, following the above described test specimen preparation Method B. All test results were taken from the Commercial Standardization of Instrument Testing of Cotton (CSITC), task force of International Cotton Advisory Committee (ICAC) round trial 2019-4 (day 3).

B.3 Analysis

The consigned value is determined from the whole values provided by the participants (see [ISO 13528:2015](#), 7.7), rounded to the nearest 0,01 micronaire value.

The robust mean x^* and the robust standard deviation s^* are calculated according to the Algorithm A of [ISO 13528](#). The repeatability r is calculated according to the Algorithm S of [ISO 13528](#). The variance intergroup sL^2 is deduced from s^* and r . The reproducibility R is deduced from r and sL [see [ISO 5725-5:1998](#), Formula (74)].

The assigned value is based on the robust mean.

The analysis results are listed in [Table B.1](#).

Table B.1 — Comparison of test results from 6 leaf grades

Sample identification	Cotton sample 1	Cotton sample 2	Cotton sample 3	Cotton sample 4
Number of participating laboratories	72	72	72	72
Number of test results	432	432	432	432
“robust” mean, x^*	3,31	4,99	4,01	4,16
“robust” standard deviation, s^*	0,05	0,05	0,05	0,05
Uncertainty type, u_x	0,01	0,01	0,01	0,01
Repeatability limit, r	0,08	0,09	0,09	0,11
Reproducibility limit, R	0,17	0,16	0,16	0,17

Annex C (informative)

Comparison experiment

C.1 General

This annex gives a comparative study of the preparation Methods “A” and “B”.

C.2 Description

All measurements within this study have been carried out by one operator in one laboratory using the same testing apparatus. For this purpose, 5 individual test specimens have been taken from 15 laboratory samples (i.e. cotton bales) of 6 different leaf grades, each. The test specimens were first measured following Method “A” (no removal of foreign bodies before measurement = “pre-cleaning” cotton) and adjacently following Method “B” (removal of foreign bodies before measurement = “post-cleaning” cotton), as described in [7.2](#).

C.3 Analysis

For each leaf grade, the test results of all 75 individual measurements for preparation method “A” were compared to the 75 individual measurements for preparation method “B”, a linear trendline and the coefficient of determination R^2 was calculated. In addition, the linear trendline and the coefficient of determination R^2 of all 900 tests was calculated. The test and calculation results are listed in [Table C.1](#).

Table C.1 — Comparison of test results from 6 leaf grades

Leaf grade	Method “A” (“pre-cleaning” cotton)		Method “B” (“post-cleaning” cotton)		Correlation study	
	average \bar{x}	standard deviation s	average \bar{x}	standard deviation s	Linear trendline formula	Coefficient of determination R^2
Number of test results	75	75	75	75	75	75
1	4,27	0,21	4,33	0,20	$y=0,923x + 0,384$	0,865
2	4,48	0,24	4,49	0,23	$y=0,945x + 0,250$	0,948
3	4,48	0,27	4,46	0,26	$y=0,927x + 0,312$	0,952
4	4,75	0,13	4,70	0,12	$y=0,832x + 0,744$	0,801
5	4,23	0,39	4,24	0,36	$y=0,888x + 0,488$	0,953
6	3,63	0,42	3,63	0,40	$y=0,943x + 0,212$	0,956
1-6	—	—	—	—	$y=0,951x + 0,212$	0,986

C.4 Conclusion

The comparative study clearly shows a very good agreement of micronaire values, independent of the preparation method. The variation of the micronaire values for the “pre-cleaning” cotton is slightly higher, while the average values differ in the range of the repeatability limit of the micronaire principle described in this document (reported in [Annex B](#)).

However, to avoid that the preparation method effects the test results, the separation into different methods “A” and “B” as described in [7.2](#) is advisable.

For a detailed report of the above measurement please refer to Reference [\[3\]](#).

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- [1] [ISO 5725-5:1998](#), *Accuracy (trueness and precision) of measurement methods and results — Part 5: Alternative methods for the determination of the precision of a standard measurement method*
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