

Nové možnosti rozvoje vzdělávání na Technické univerzitě v Liberci

Specifický cíl A2: Rozvoj v oblasti distanční výuky, online výuky a blended learning

NPO_TUL_MSMT-16598/2022



Experimental analysis of structures - internal standards

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Financováno
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NextGenerationEU



Národní
plán
obnovy



MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY

EXA - course content

- **What: outer, inner structure of textiles (fibers, yarns, flat fabrics)**

EXA06 - fibres, EXA07 - yarns (outer structure), EXA08 - yarns (inner structure), EXA09-10 - blended yarns (inner structure, mechanical properties), EXA11 – two-ply yarns (outer, inner structure), EXA12 - woven fabric (outer structure), EXA13 - woven fabric (inner structure), EXA14 - knitted fabric (outer structure)

- **How to: view, cross-sections**












EXA05 - microscope, microscope slides (preparation of slides)

- **What: microscope, macroscope, camera, NIS Elements image analysis**

EXA05 - microscope (light microscopy analysis), microscope slides, EXA04 - scanning, EXA03 - NIS Elements image analysis, EXA02 - digital image

KTT internal standards - use of NIS

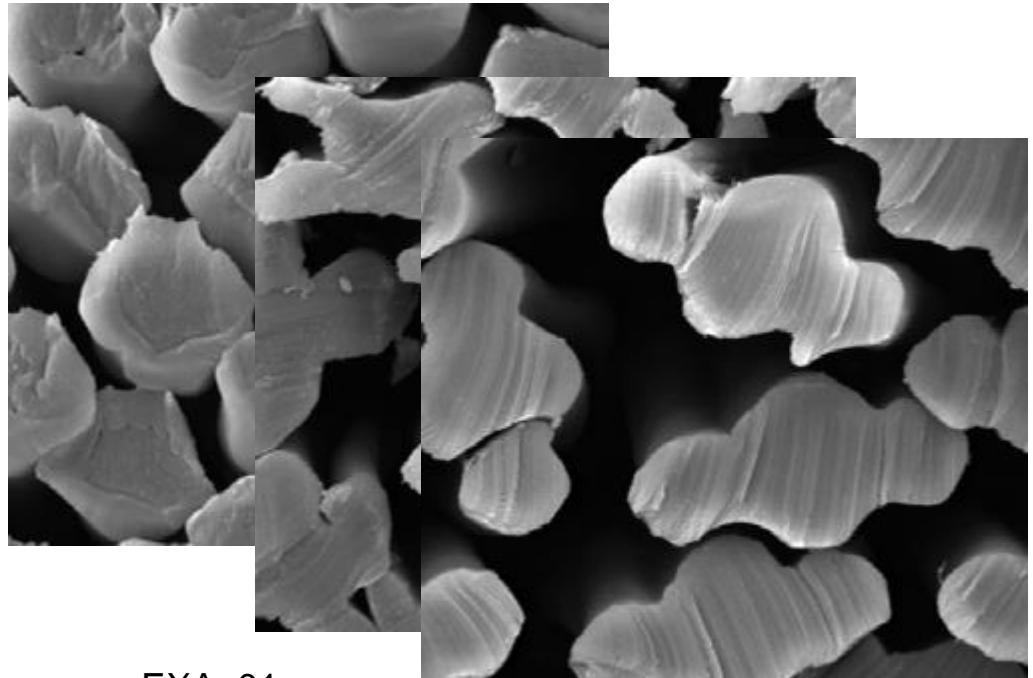
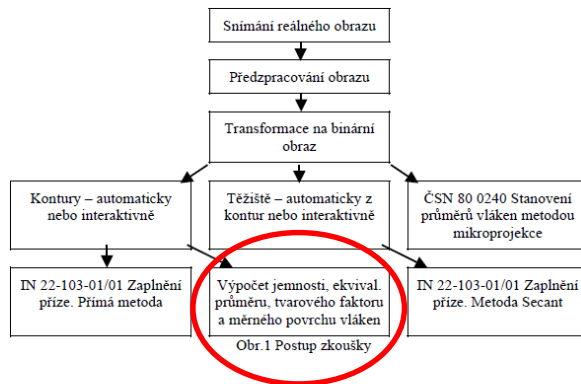
Elements image analysis

- IN 46-108-01/01 Recommended procedure for creating cross sections. Soft and hard cross-sections 
- IN 21-108-01/01/01 Determination of geometric properties of fibres 
- IN 22-102-01/01 Yarn diameter and hairiness 
- N 22-102-02/01 Cross-sectional dimensions of two-ply yarns and diameter of single yarns, Cross-sections 
- IN 22-103-01/01 Yarn packing density Direct method and Secant method 
- IN 22-103-02/01 Yarn packing density - Direct method 
- IN 22-103-03/01 Yarn packing density - Isoquantities 
- IN 22-105-01/01 O-E yarn – belt fibers
- IN 22-105-01/02 Rotor yarn belt fibers - modified version 
- IN 22-106-01/01 Determination of core coverage of spun yarn
- IN 22-109-01/01 Directional arrangement of fibres in yarn - tracer fibres
- IN 22-109-02/01 Directional arrangement of fibres in yarn - oblique yarn cross-sections
- IN 22-201-01/01 Yarn bending stiffness
- IN 23-107-01/01 Area covering of fabrics 
- IN 23-108-01/01 Definition of yarn interlocking geometry in fabric from cross-sections 
- IN 23-110-01/01/01 Comprehensive evaluation of the surface structure of textiles
- IN 23-111-01/01 Methodology for detecting non-uniformity of fabric images
- IN 23-203-01/01 Objective determination of the degree of pilling of fabrics
- IN 32-102-01/01/01 Cross-sectional dimensions of two-ply yarns and diameter of single yarns, Longitudinal views 
- IN 32-102-02/01 Geometric parameters of the rotor yarn spinneret
- IN 32-203-01/01 Evaluation of abrasion-resistance of yarns
- IN 32-204-01/01 Determination of transverse compressibility of yarns

IN 21-108-01/01 Determination of geometric properties of fibres

Křemenáková, D., Rubnerová, J.

- This internal standard specifies the procedure for obtaining primary (image) data from fibre slice images prepared according to IN 46-108-01/01. This procedure can be used to obtain contours of single fibre cuts, contours in a fibre bundle cut, yarn, flat fabric, etc. Fibre contours obtained from a bundle of parallel fibres are used according to this standard for further measurement and calculation of the geometric properties of the fibres.



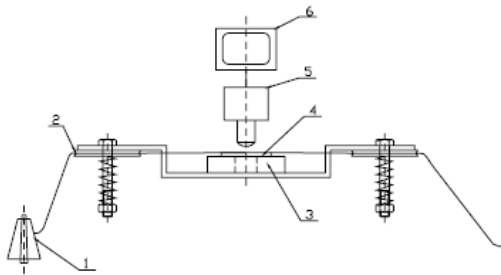
For more see exercises...



IN 22-102-01/01 Yarn diameter and hairiness

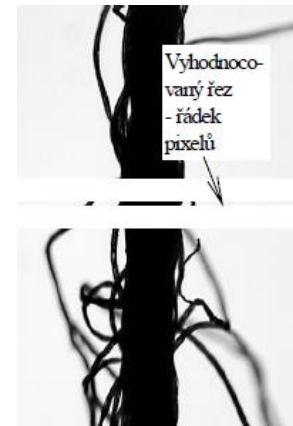
Voborová, J., Neckář, B.

- This standard specifies a procedure for measuring yarn diameter and overall hairiness from longitudinal views of yarn using image analysis software. The input data for the method are a PC set of longitudinal views of yarn in the form of binary images. The method is suitable for single yarns in the fineness range 7-50 tex.



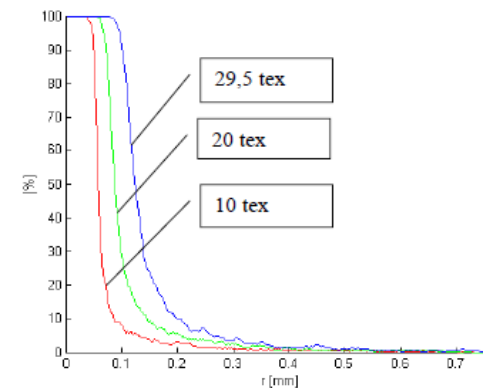
- 1- cívka s přízí
- 2- kotoučová brzdička
- 3- mostový vodič
- 4- objektiv mikroskopu
- 5- kamera
- 6- monitor počítače

Obr.2



obr.1

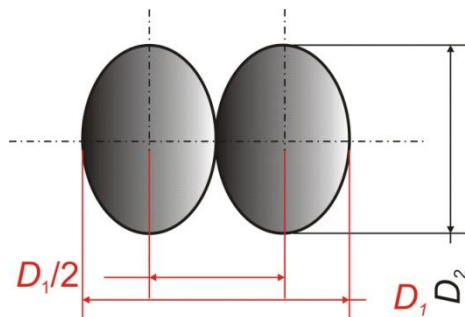
Graf 1. Funkce chlupatosti



IN 22-102-02/01 Cross dimensions of two-ply yarn and diameter of single yarn, Cross-sections

Vyšanská, M.

- This standard specifies a procedure for determining the geometric parameters and shape characteristics of two-ply and single yarns and a procedure for monitoring changes in the behaviour of single yarns in two-ply using laboratory equipment for the preparation of soft yarn cross-sections, image analysis software (e.g. NIS Elements) - obtaining images of the cross-sections and an evaluation program in the MatLab environment - obtaining data and graphical output. The method is suitable for two-ply yarns and single yarns from which the two-ply yarn was made.



Tab. 1: Znáornění možných stavů příže jednoduché v dvojmo skané srovnáním jejich rozměrů s ekvivalentním průměrem příže jednoduché

Stav1a: $\frac{D_2 \cos \beta_s}{D_{\text{ekvivalentní}}} > 1$	Rozšíření jednoduché příže v dvojmo skané ve směru minimálního rozměru	Stav1b: $\frac{D_1}{2D_{\text{ekvivalentní}}} > 1$	Rozšíření jednoduché příže v dvojmo skané ve směru maximálního rozměru
Stav2a: $\frac{D_2 \cos \beta_s}{D_{\text{ekvivalentní}}} = 1$	Žádná akce ve směru minimálního rozměru	Stav2b: $\frac{D_1}{2D_{\text{ekvivalentní}}} = 1$	Žádná akce ve směru maximálního rozměru
Stav3a: $\frac{D_2 \cos \beta_s}{D_{\text{ekvivalentní}}} < 1$	Stlačení jednoduché příže v dvojmo skané ve směru minimálního rozměru	Stav3b: $\frac{D_1}{2D_{\text{ekvivalentní}}} < 1$	Stlačení jednoduché příže v dvojmo skané ve směru maximálního rozměru

Fig. 1: Plan view of the double skein model with marked parameters D_1 , D_2

IN 22-102-02/01...continued...

Vyšanská, M.

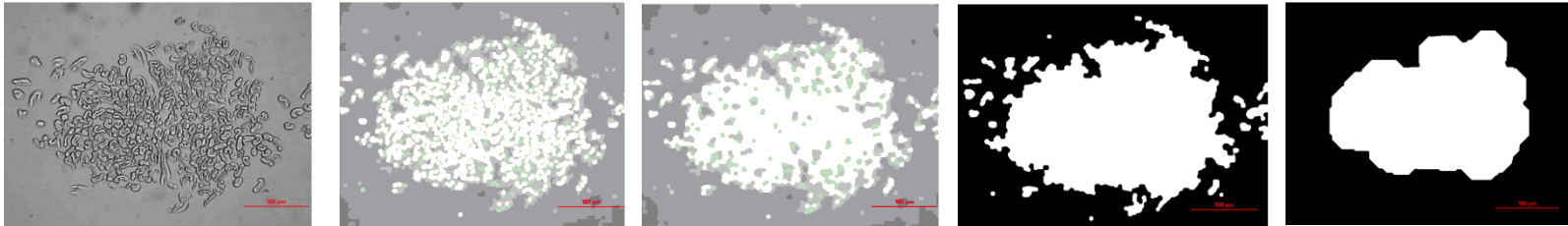
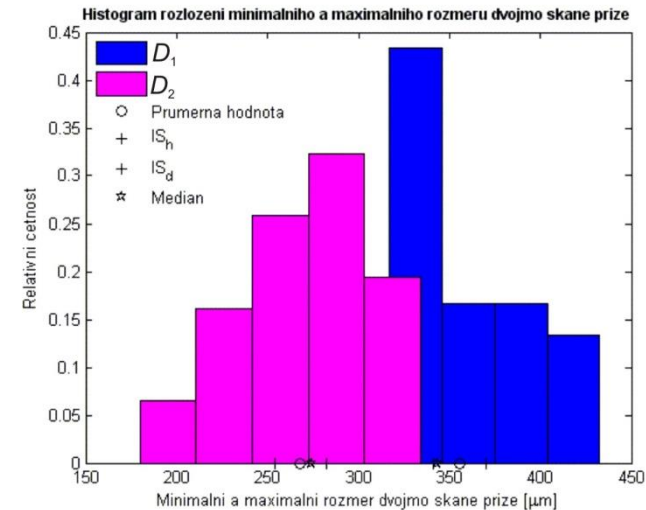
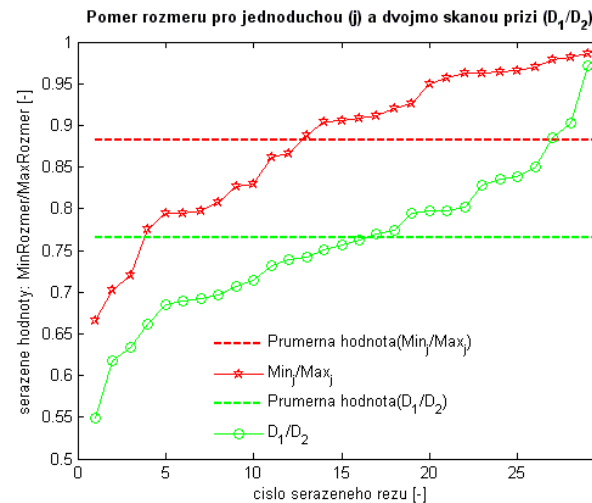
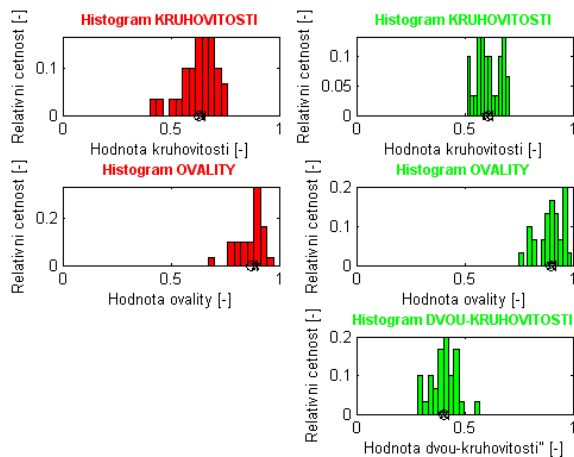


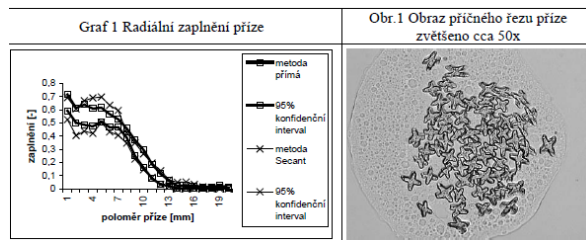
Illustration of the process of processing the cross-section image of a two-ply yarn (single yarn is subjected to exactly the same procedure)



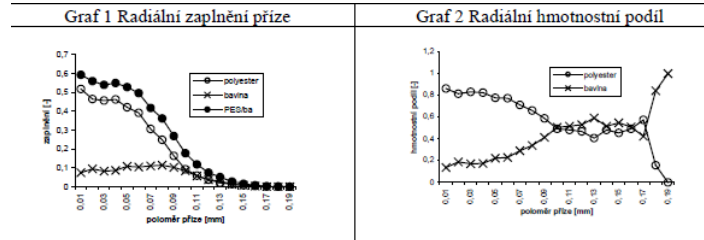
IN 22-103-01/01 Yarn packing density, Direct method and Secant method

Křemenáková, D., Rubnerová, J.

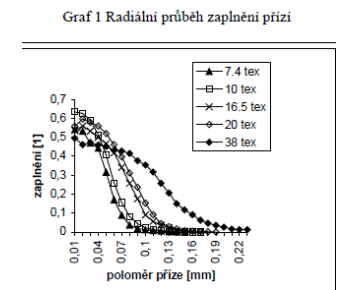
The standard specifies the procedure for calculating the packing density of single and two-component yarns. At the same time, the diameter of the yarn and the number of fibres in the cross-section can also be determined. For two-component yarns, the procedure for determining the weight fraction of the components is given. The packing density and mass fraction can also be determined as a function of the yarn radius. The direct method is used to calculate the packing density from the real contours of the fibre sections in the yarn cross-sections, and the Secant method is used to reconstruct the areas of the fibre sections from the centres of gravity of the fibre sections on the basis of fineness, density, fibre position and yarn twist. The Secant method is suitable for cotton yarns or highly twisted yarns of other materials where the contours of the individual fibre sections are difficult to distinguish.



Single yarn – various methods



Blended yarn



Single yarn – various counts

IN 22-103-02/01 Yarn packing density - Direct method

Vyšanská, M.

This standard specifies the procedure for calculating the packing density of single and double component yarns. At the same time, the yarn diameter and the number of fibres in the cross-section can also be determined. In the case of bicomponent yarns, the procedure for determining the mass fraction of the components is given. The packing density and mass fraction can also be determined as a function of radius. The direct method is used to calculate the packing density from the real contours of the fibre cross-sections of the yarn. The method is an extension of IN 22-103-01/01. Image analysis (NIS Elements) is used - obtaining images of the sections and their evaluation, as well as a program in the MatLab environment - data processing and obtaining data and graphical output.

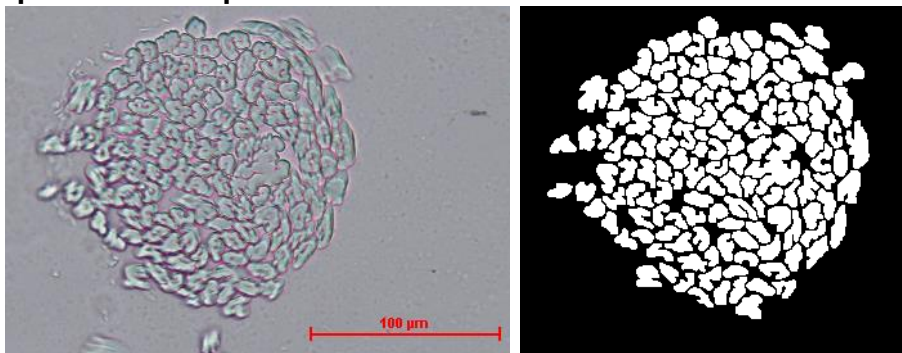


Fig. 1: Sample image with colour and binary plane



IN 22-103-02/01... continued...

Vyšanská, M.

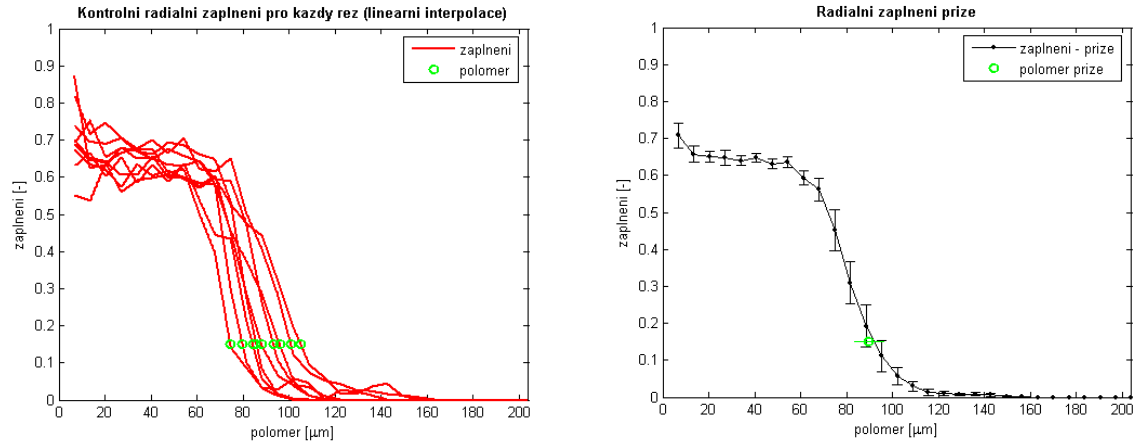


Fig. 2: Example of graphic output for single component yarn - 9 cross-sections

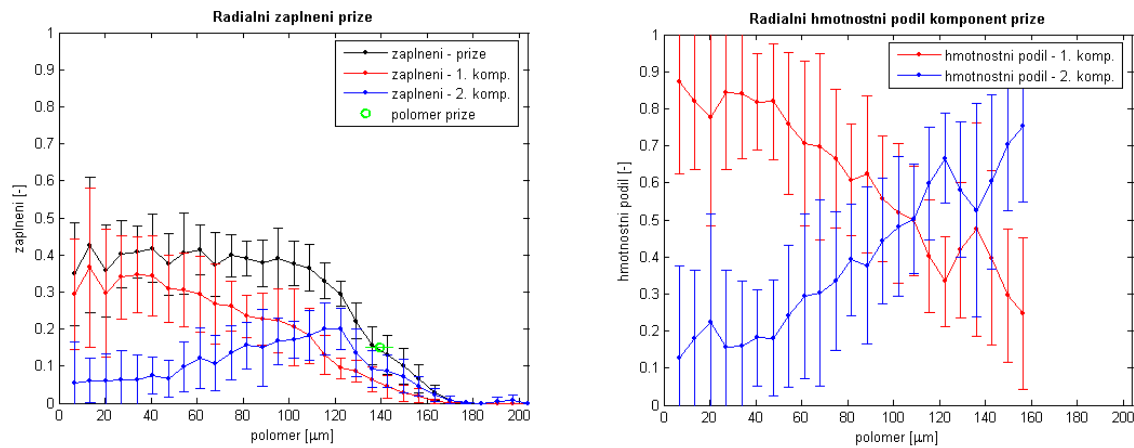
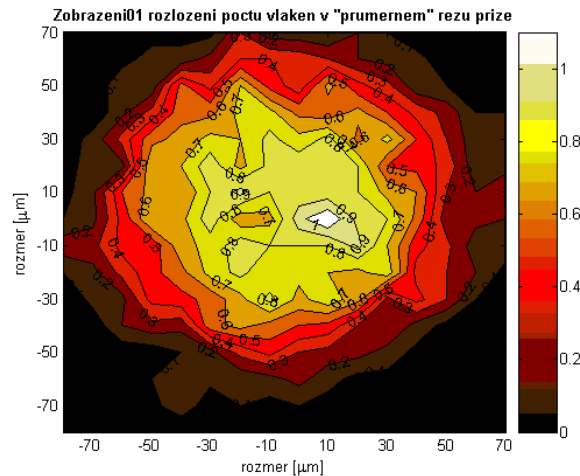
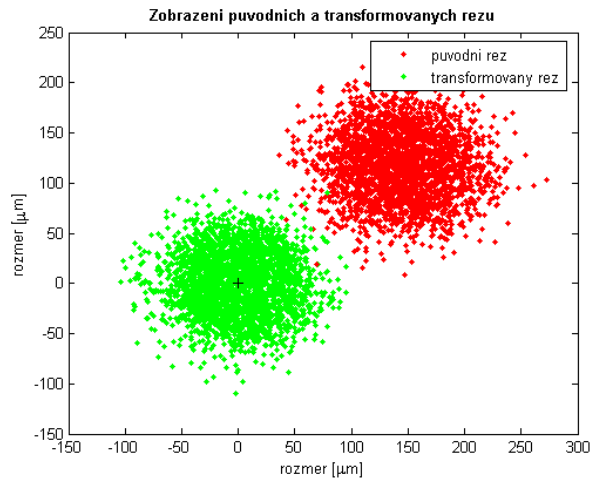


Fig. 3: Example of graphic output for two-component yarn - 5 cross-sections

IN 22-103-03/01 Yarn packing density - Isoquantities

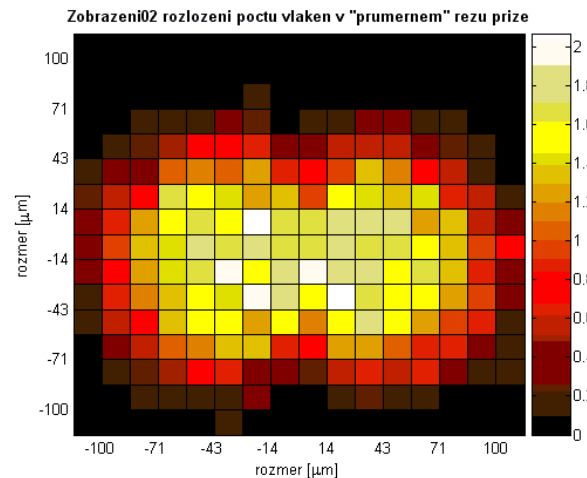
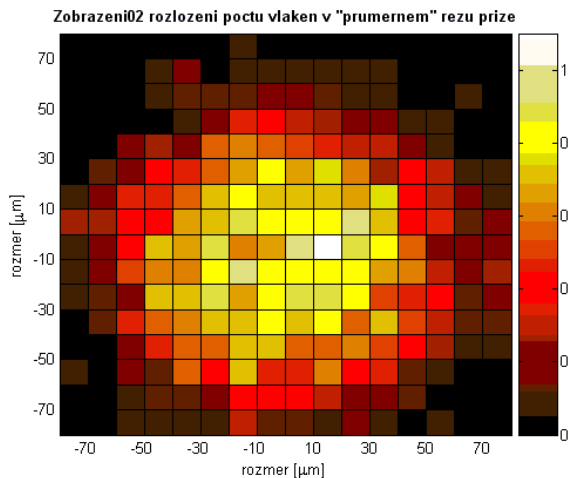
Vyšanská, M.

This standard specifies a procedure for calculating the density of fibre distribution in single and two-ply single component free yarns. Image analysis (NIS Elements) is used to obtain images of the cross-sections and to evaluate them, and a program in the MatLab environment is used to process the data and to obtain data and graphical output.

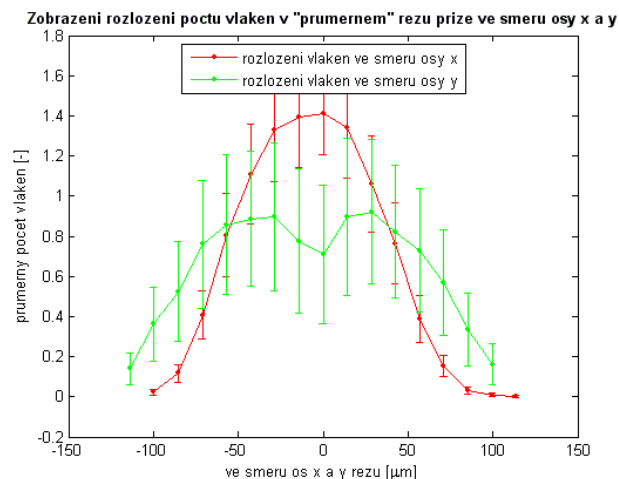
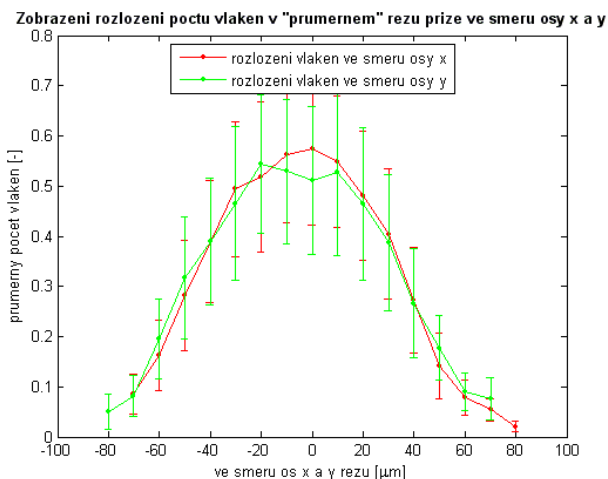


IN 22-103-03/01... continued...

Vyšanská, M.



Example of surf chart - distribution of the average number of fibres in an "average" cross-section for single (100%CO, worsted, 10tex) and double (100%CO, worsted, 2x10tex, 601 1/m)



Example of graphical representation of the distribution of the average number of fibres in an "average" cross-section with single (100%CO, worsted, 10tex) and double (100%CO, worsted, 2x10tex, 601 1/m) in the direction of the x and y axis (in the sense of an oriented cross-section)

IN 22-105-01/01 Rotor yarn belt fibers

Drašarová, J.

The standard specifies the procedure for measuring and evaluating the belt fibers of rotor yarns.

Výsledky: tabulka 1

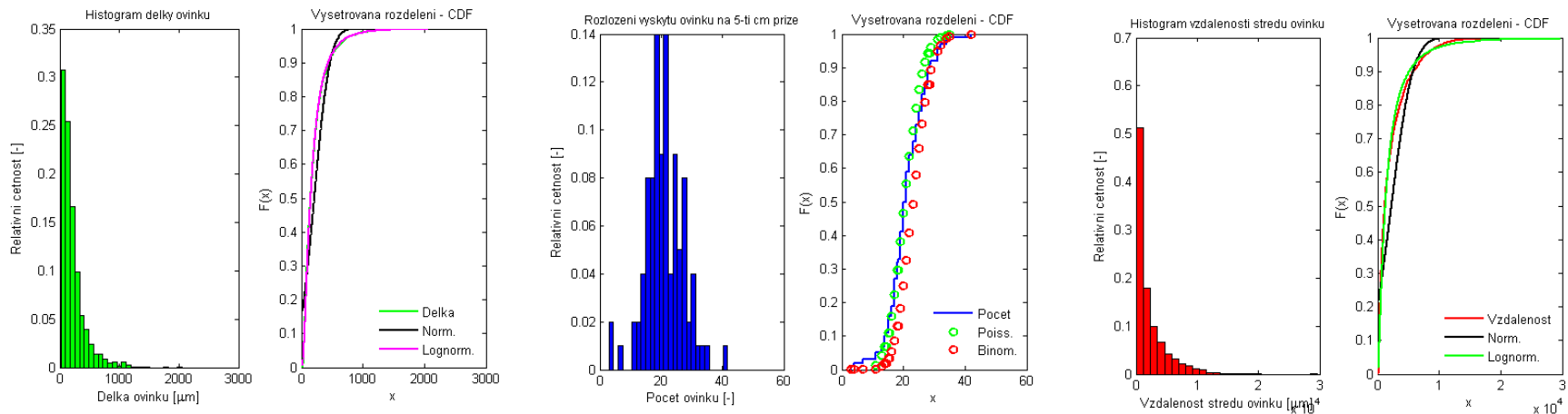
		T [tex]	a [m ⁻¹ ktex ^{2/3}]	počet ovinků [m-1]	KI 95%	střední délka [μm]	zakrytí [%]	KI 95%
1	BD D30 (H _{ovce} 90 000 min ⁻¹ , průměr ovce 34mm, nálevka R6KSS)	14,5	65	105,8	6,505	214,68	2,51	0,253
2		14,5	72	112,1	6,696	186,35	2,36	0,241
3		14,5	80	104,1	6,453	189,43	2,22	0,304
4		20	65	139,2	7,462	170,40	2,59	0,484
5		20	72	143,5	7,576	174,10	2,67	0,263
6		20	80	141,2	7,515	160,72	2,48	0,165
7		29,5	65	179,7	8,478	179,95	3,72	0,444
8		29,5	72	145,5	7,629	165,98	2,79	0,237
9		29,5	80	106,1	6,5146	161,40	1,955	0,205



IN 22-105-01/02 Rotor yarn belt fibers - modified version

Vyšanská, M.

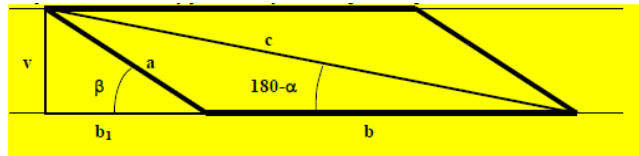
This standard is a modification of IN 22-105-01/01 of 2002 and specifies the procedure for measuring the lengths of the belt fibers, the distances of the centres of the belt fibers, the calculation of the number of belt fibers per length of yarn and the covering of the yarn by the belt fibers using image analysis software (e.g. NIS Elements) - obtaining images and data outputs and using an evaluation program in the MatLab environment - obtaining data and graphical output.



IN 22-106-01/01 Determination of the covering of the core of spun yarn

Nováková, J.

The internal standard was created for the purpose of determining the covering of the core of the spun yarn by means of image analysis. For the measurements the machine, computer and software equipment of the Department of Textile Materials is used. This includes image analysis equipment consisting of the LUCIA G software, a scanning device designated as a fibre finder (Laboratory Imaging, Prague) and Matlab data processing software. The method described in this standard is suitable for the measurement of the obscuration of a core with a differently coloured core and a sheathed material, or for materials which can be coloured to produce this colour difference without changing the geometrical structure. The method is not suitable for the measurement of materials with a core obscuration observed in lateral projection of more than 4 mm and materials with high hairiness.



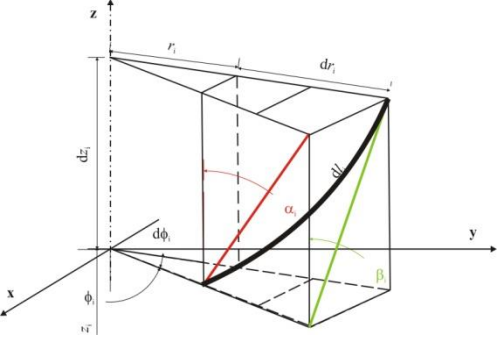
Obr.1 Schéma modelu opřádané příze

Úhel stoupání opředeného pásku v [rad] je dále vyjádřen jako:

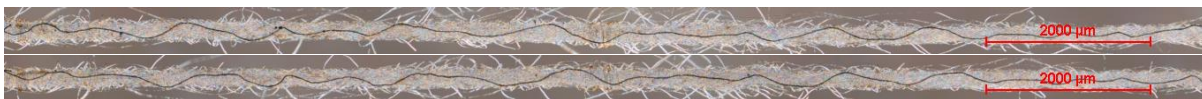
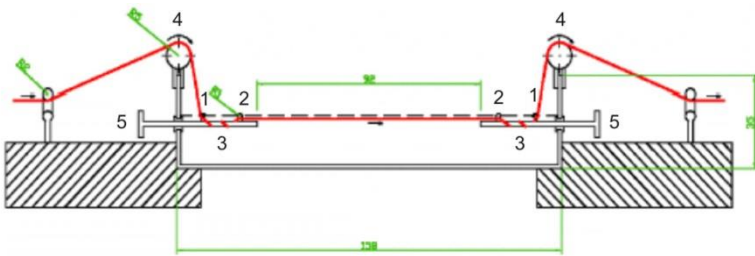
$$\beta = \operatorname{arctg} \frac{v}{b_1}$$

IN 22-109-01/01 Directional arrangement of fibres in yarn - tracer fibres

Vyšanská, M.

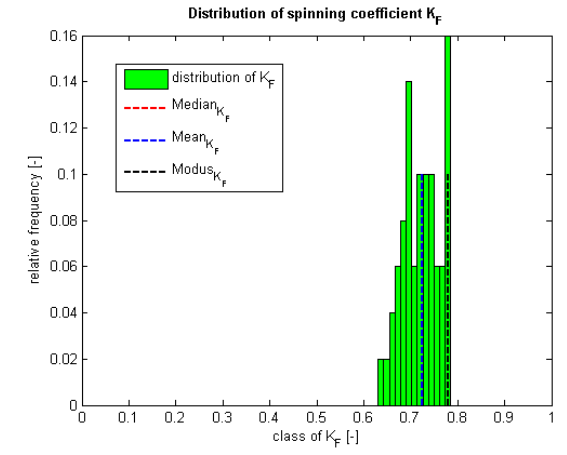
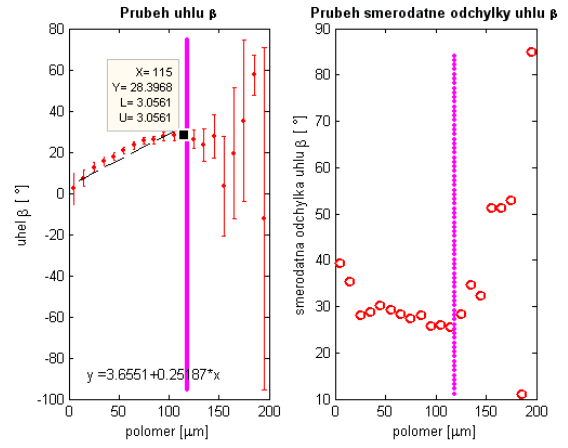
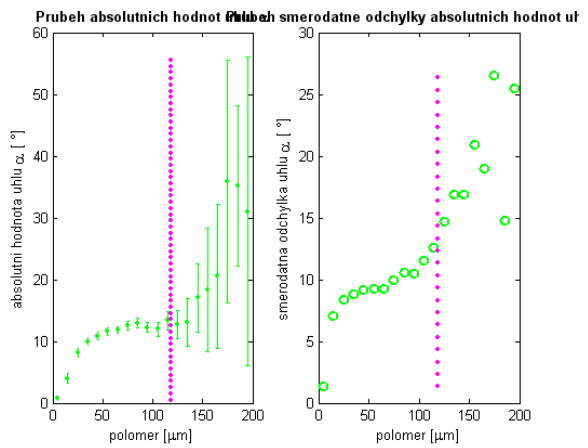
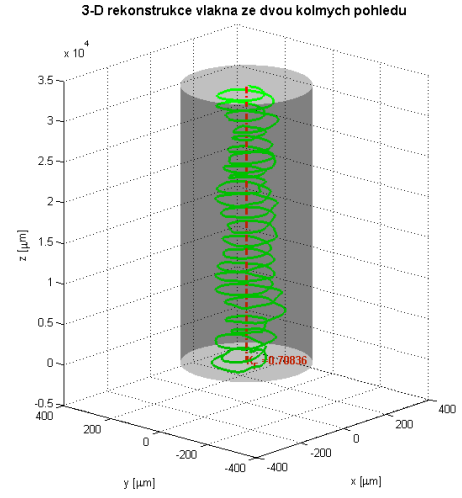
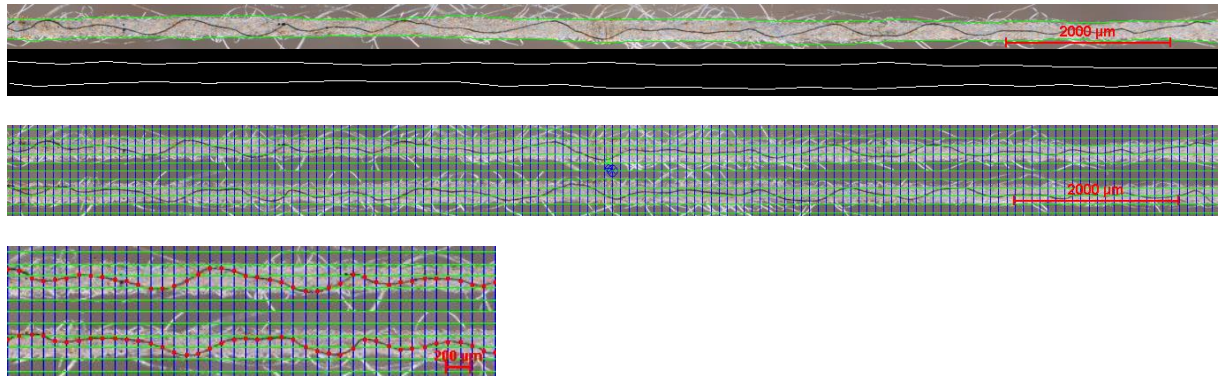
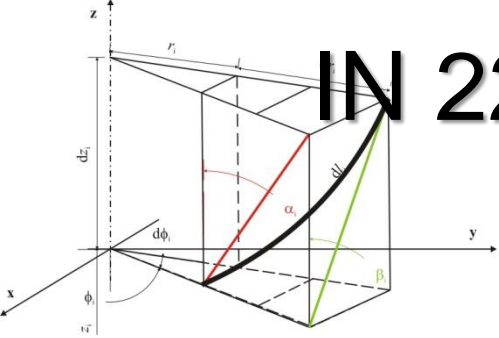


This standard specifies a procedure for taking and processing images of tracer fibres in yarn and then evaluating the data in order to determine the directional arrangement of the fibres in the yarn by means of selected parameters. The method is suitable for yarns with tracer fibres of natural and synthetic materials which are free from any optically extraneous impurities, contaminants or matting (some of which can be removed by suitable preparation of yarn samples). The method gives the best results for glossy viscose and polyamide fibres.



IN 22-109-01/01... continued...

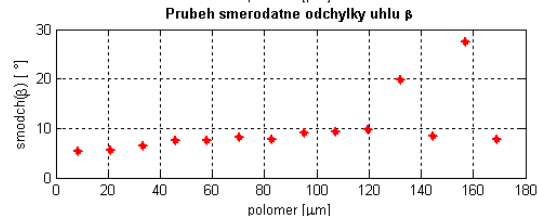
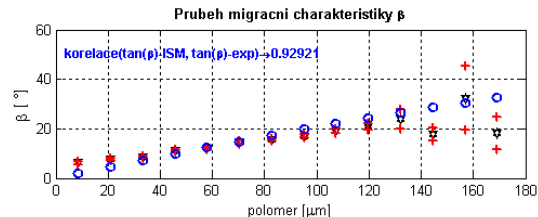
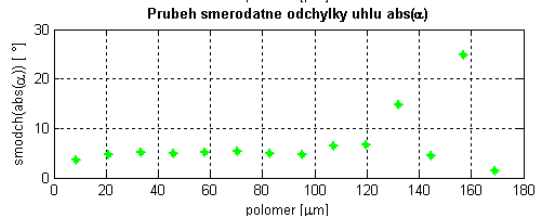
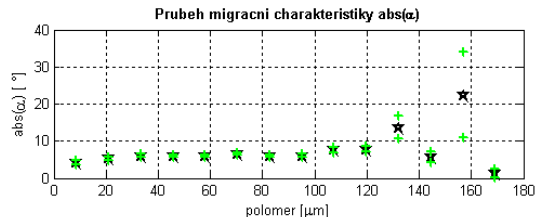
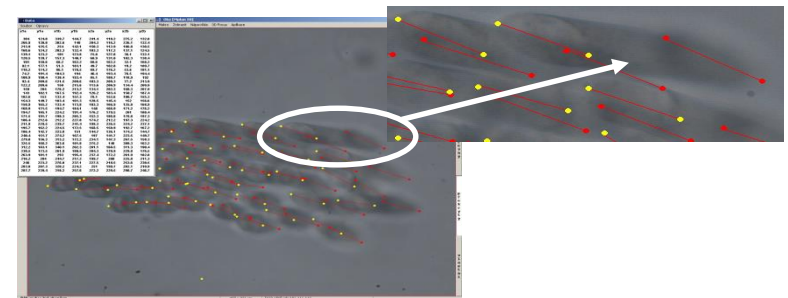
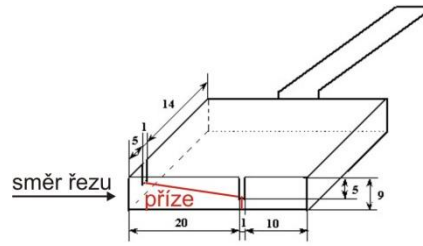
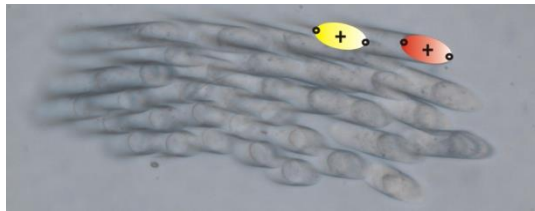
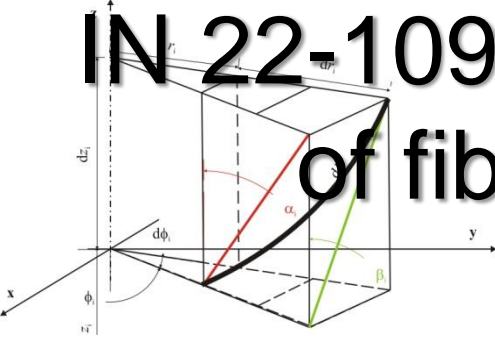
Vyšanská, M.



IN 22-109-02/01, Directional arrangement of fibres in yarn - oblique yarn cross-sections

Vyšanská, M.

This standard specifies a procedure for the processing of images of oblique cross-sections of yarns and the subsequent evaluation of the data in order to determine the directional arrangement of fibres in the yarn by means of selected parameters. The method is suitable for yarns with a symmetrical perpendicular cut and a fibre count of less than 200 fibres.



IN 22-201-01/01 Yarn bending stiffness

Kolčavová Sirková, B., Mertová, I.

The standard specifies both the calculation procedure and the procedure for measuring the bending stiffness of the yarn using image analysis (LUCIA) and a preparation in which the fabric is woven at one end and loose at the other. It is only its own weight that has an effect on it. The method is not suitable for yarns wound on a sinker because of the bending of the length section. The recommendations given in the standard apply to cotton yarns.

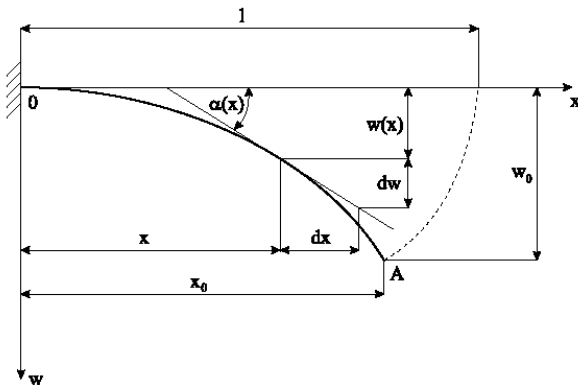


Fig. 1 Yarn deflection line representation

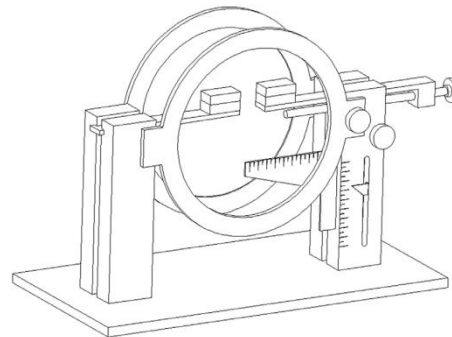


Fig. 2 Yarn bending stiffness tester

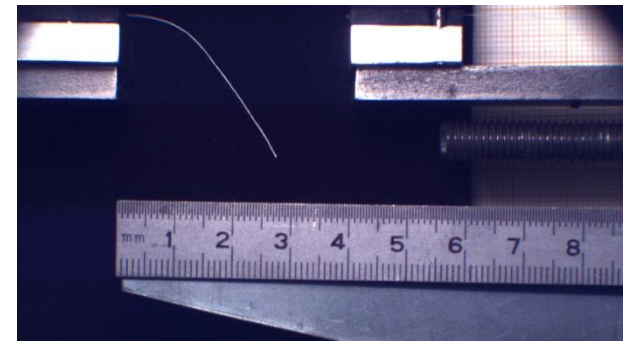


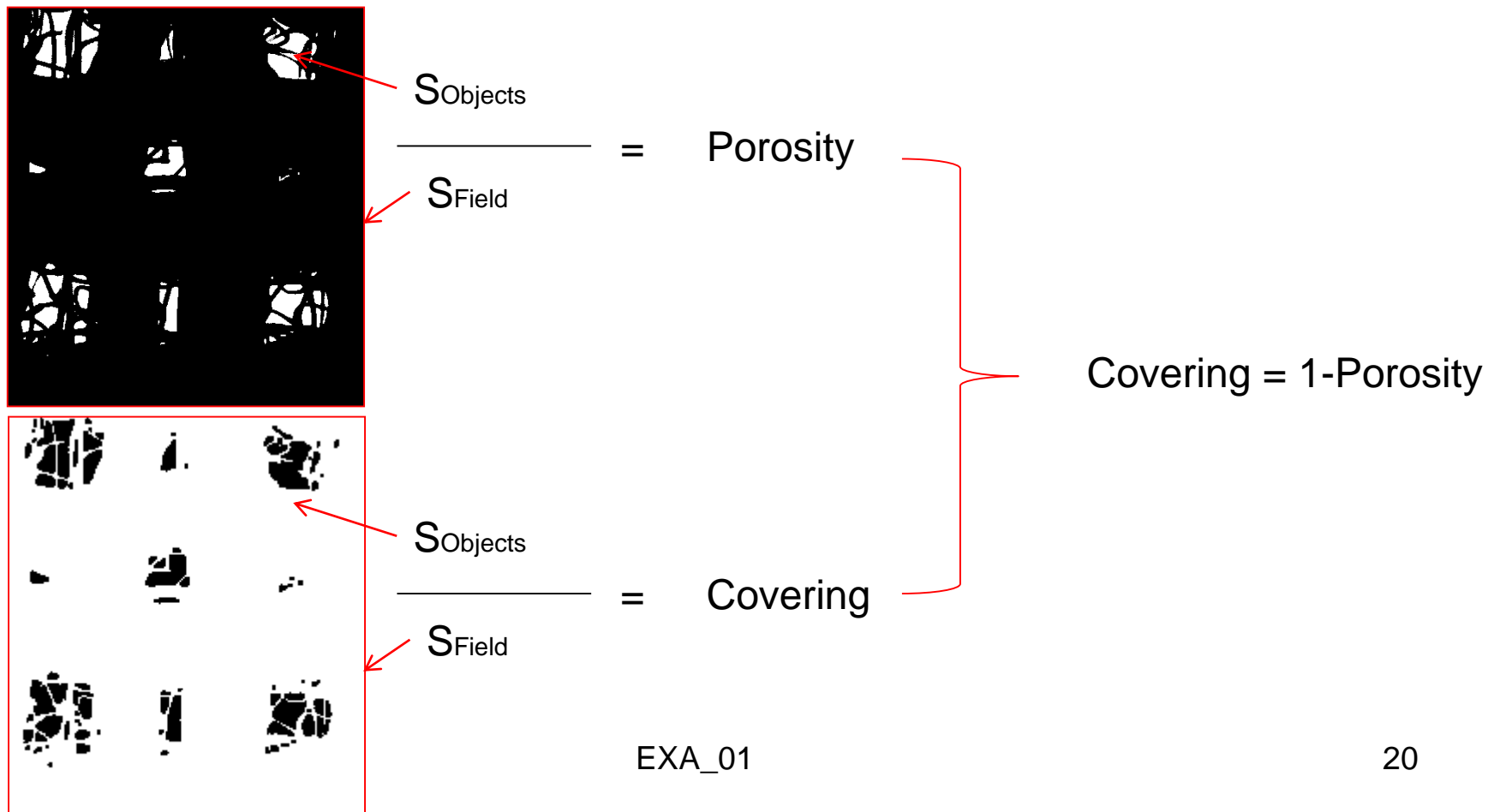
Fig. 3 Viewing the image captured by the LUCIA software



IN 23-107-01/01 Fabric covering

Drašarová, J.

The standard specifies a procedure for measuring the area coverage of fabrics by projection on a microscope in transmitted light. The method is not suitable for densely finished fabrics.

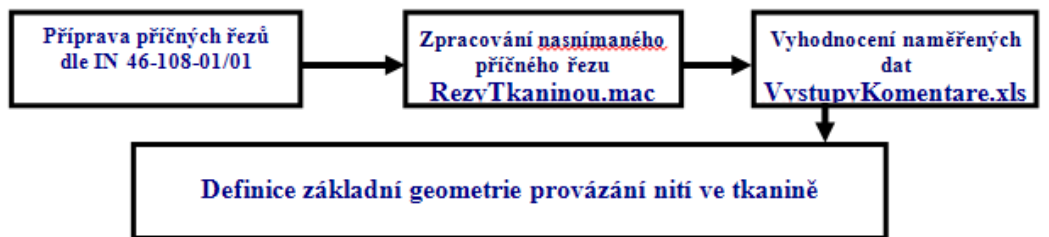




IN 23-108-01/01 Definition of the geometry of thread interlacing in cross-sectional fabric

Kolčavová Sirková, B., Vyšanská, M.

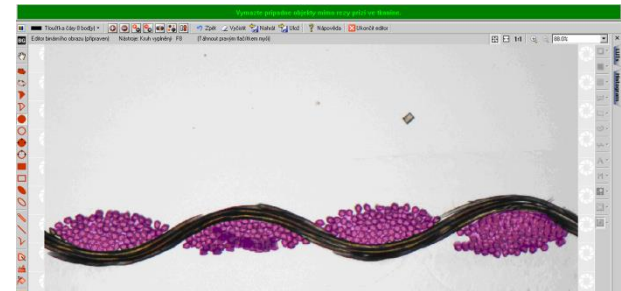
The standard specifies a procedure for measuring the basic geometry of the interlacing of threads in the fabric from cross-sections through the fabric.



Obr. 5 Schéma operací pro stanovení základní geometrie provázání nití ve tkanině

Tab. 3 Data popisující základní parametry tkaniny a přize

Data uložená v jednom textovém souboru							
Parametry tkaniny							
MinFeret	Orientation	Tloušťka					
207,812	4	207,30578					
Parametry vazné vlny							
MaxFeret	LineLength	Setkání					
1727,27	1900,41	0,10023911					
Parametry řezů přízi v tkanině - bez úpravy obrysu							
EqDiameter	Perimeter	MaxFeret	MinFeret	Circularity	CentreX	CentreY	TvarovýFaktor
211,553	1174,57	411,577	140,3	0,32	1084,30	581,08	0,767298233
208,378	1099,2	391,335	137,6	0,355	206,44	603,56	0,679093891
218,507	1062,63	380,54	147,1	0,417	1508,16	616,72	0,547985348
189,687	1004,11	398,082	113,4	0,352	636,17	625,33	0,684976513
Parametry řezů přízi v tkanině - s použitím úpravy ConvexHull							
EqDiameter	Perimeter	MaxFeret	MinFeret	Circularity	CentreX	CentreY	TvarovýFaktor
221,631	901,114	411,577	140,341	0,597037	1081,48	578,447	0,294193929
216,808	863,612	391,335	137,642	0,622034	205,417	601,822	0,267924788
227,046	869,607	380,54	145,739	0,672796	1506,48	618,913	0,219156053
202,721	849,084	398,082	113,352	0,562596	632,235	628,942	0,33322069



IN 23-110-01/01 Comprehensive evaluation of the surface structure of textiles

Bleša, M.

The test is based on the principle of optical detection of the transverse profile of the surface of the textile material. The measurement and evaluation of the surface roughness is performed by scanning virtual cross-sections of the textile or the interface between the surface of the transverse profile of the textile and the background in a randomly selected section of the textile sample. The scanning of individual virtual cross-sections is performed at defined, constant distances of the sample displacement in the measurement direction. The image of the textile surface relief on the measuring edge is subsequently recorded and processed after each frame. From a series of images of virtual cross-sections of textile samples, standard characteristics of the geometric texture of the surface are calculated, including the replacement of the curves describing the interface of the virtual cross-sections of the textile sample by a Fourier series. The standard geometric texture characteristics describe surface roughness, unevenness and shape heterogeneity. The output of the measurements are standardized surface roughness values such as MAD, SD, TP and other characteristics specified in Ch. 8. An alternative method suitable for non-contact evaluation of surface relief is represented by the use of spatial statistics tools (autocorrelation function, variogram) and fractal dimension.

IN 23-110-01/01... continued...

Bleša, M.



Obr. 3: Detail RCM systému s popisky jednotlivých funkčních částí

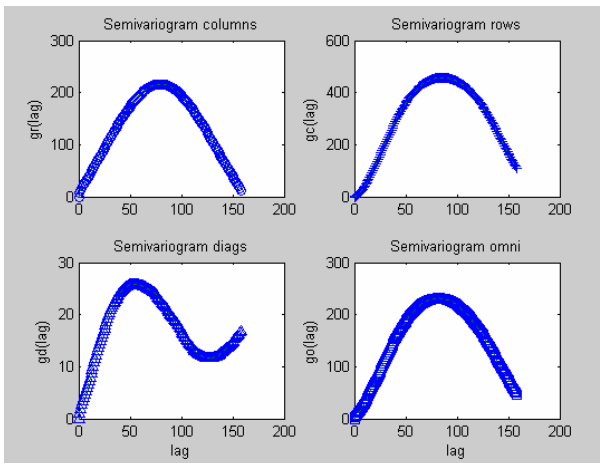
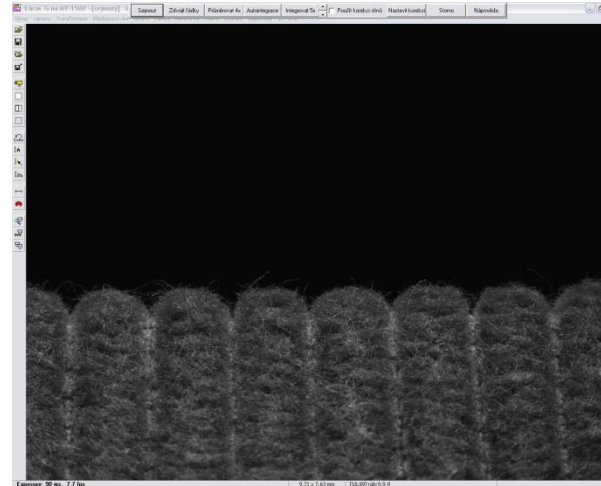


Fig. 6: illustration of semivariograms constructed in column, row, diagonal and omnidirectional directions

IN 23-111-01/01 Methodology for detecting non-uniformity of fabric images

Moučková, E., Jirásková, P.

The standard describes a methodology for detecting the visual non-uniformity of a fabric based on the variation of grey levels in the fabric image. The fabric image can be obtained by taking a photograph of the fabric sample or the fabric appearance generated by the Uster-Tester IV can be used.

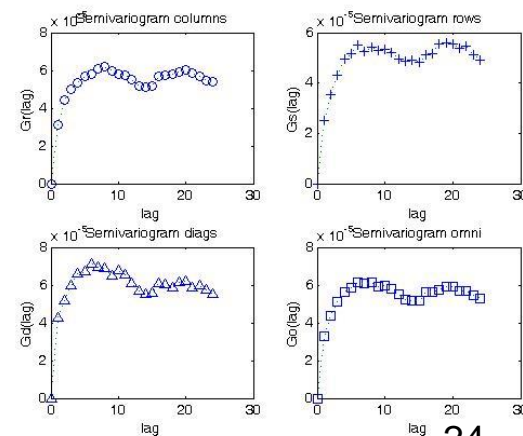
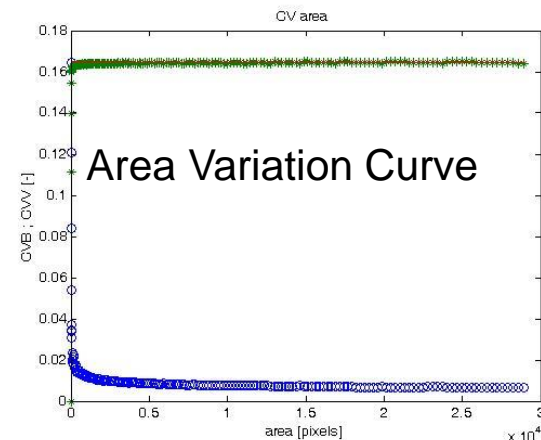
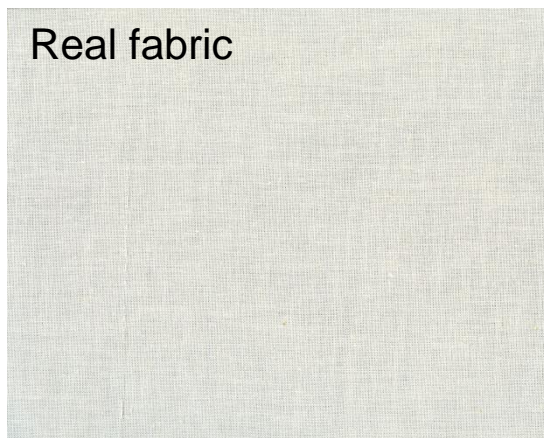
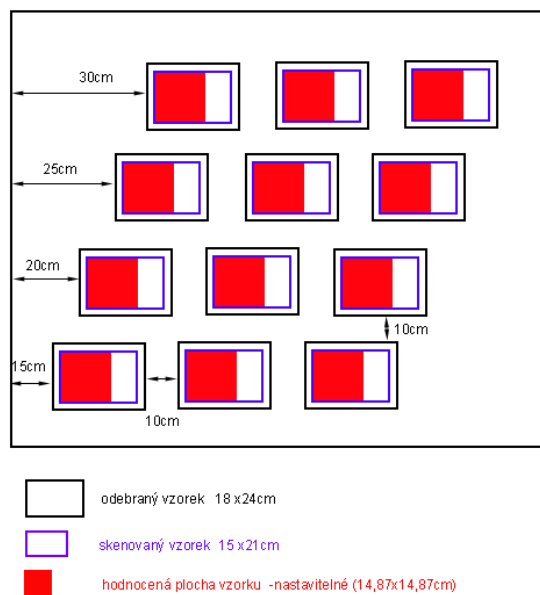
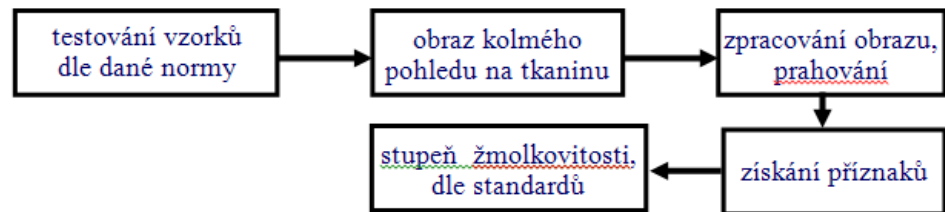


Fig. 1 Recommended fabric sampling

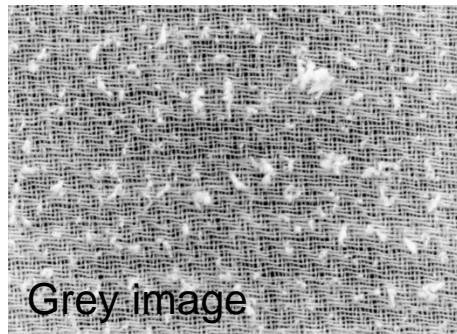
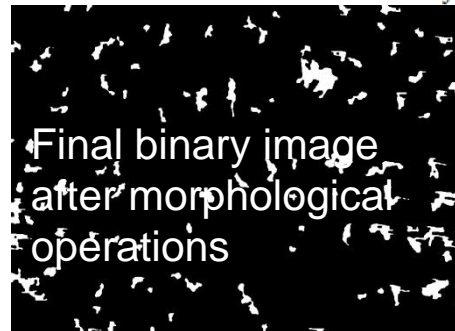
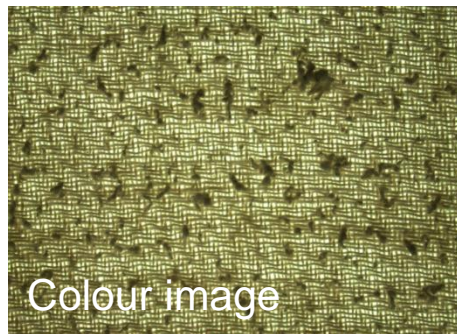
IN 23-203-01/01 Objective determination of the degree of pilling of fabrics

Mertová, I.

The standard specifies a procedure for measuring the pilling of fabrics by projection on a microscope in transmitted light. The method is not suitable for very dark fabrics and fabrics with a distinctive pattern.



Obr. 2 Schéma objektivního hodnocení žmolkovitosti tkanin v ploše textilie

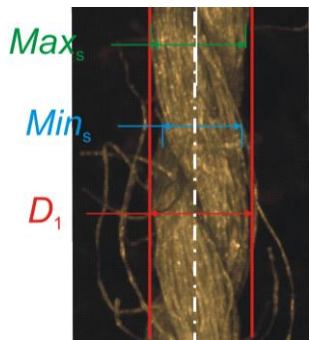


označení tkaniny	průměrný počet žmolků	celková plocha žmolků [cm ²]	podíl plochy žmolků [%]	hustota žmolků na 100cm ²	průměrná plocha žmolku [mm ²]	ekvivalent. průměr žmolku [mm]	průměrný obvod žmolku [mm]
0 PP	25 <15;35>	1,66 <0,91;2,41>	2,30 <2,09;2,51>	15 <12;18>	6,994 <6,506;7,482>	0,851 <0,822;0,88>	3,41 <2,62;3,12>

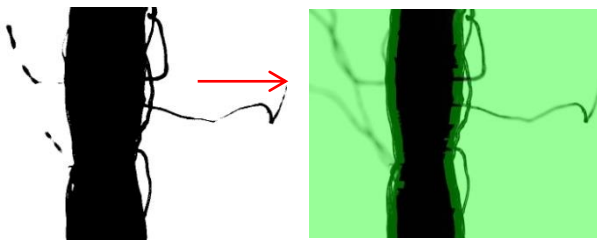
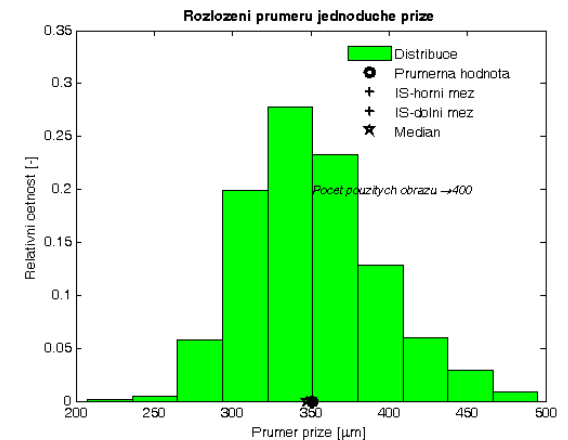
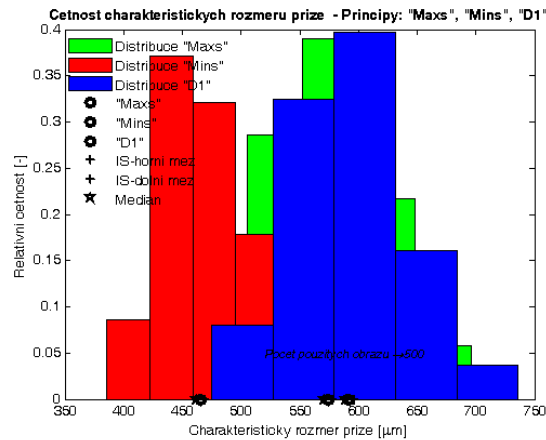
IN 32-102-01/01 Cross dimensions of two-ply yarn and diameter of single yarn, Longitudinal views

Vyšanská, M.

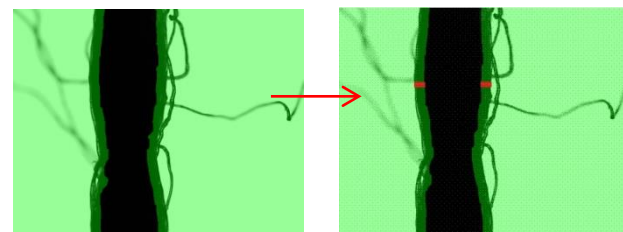
This standard specifies the procedure for measuring the geometric parameters of two-ply yarn and single yarn diameter using image analysis software (e.g. NIS Elements) to obtain images and an evaluation program in the MatLab environment to obtain data and graphical output. The method is suitable for both two-ply yarns and single yarns.



Real yarn with dimensions Max_s , Min_s , D_1



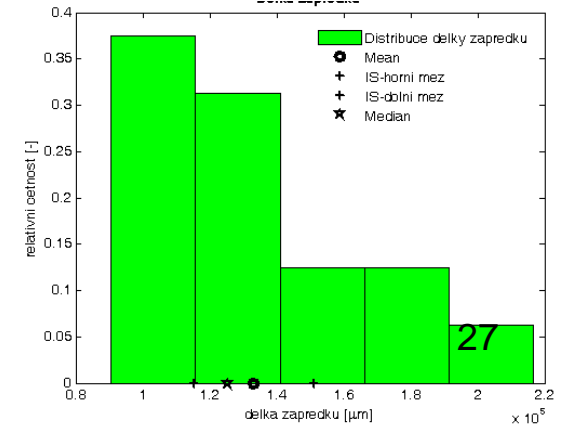
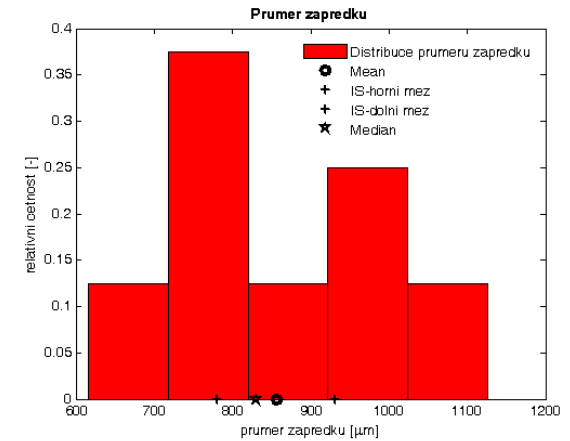
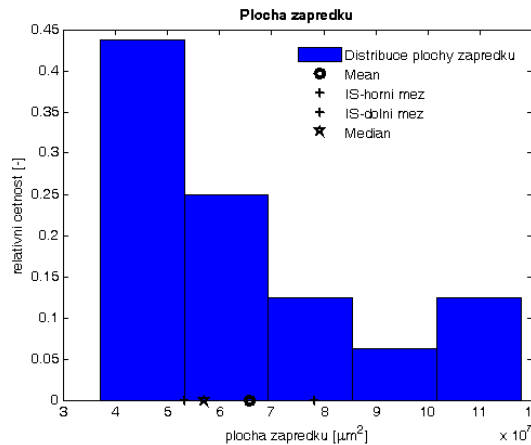
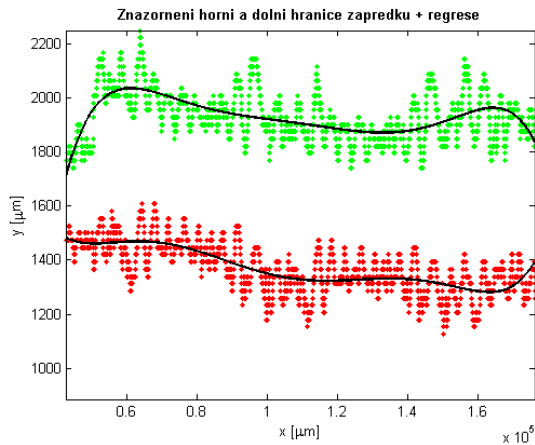
EXA_01



IN 32-102-02/01 Geometric parameters of the rotor yarn spinneret

Vyšanská, M.

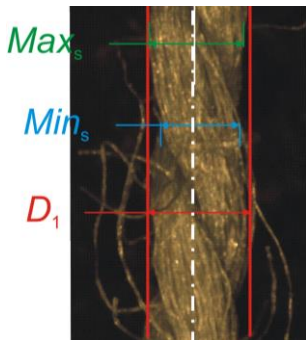
This standard specifies the procedure for measuring the basic geometric parameters of the skein and calculating their ratios to the parameters of the yarn without skeins using image analysis software (e.g. NIS Elements) - obtaining images and using an evaluation program in the MatLab environment - obtaining data and graphical output.



IN 32-203-01/01 Evaluation of abrasion-resistance of yarns

Krupincová, G.

This standard specifies the procedure for the evaluation and data processing of the abrasion-resistance of yarns.



It is based on the definition of the transverse dimensions of the two-ply yarn.



Fig. 1: 100% CO 2x29,5tex - after abrasion stress 50% of the cycles required to damage the yarn (calibration 3,72mmpx-1, image resolution 548pxl x 704pxl)

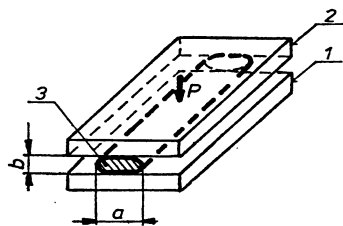
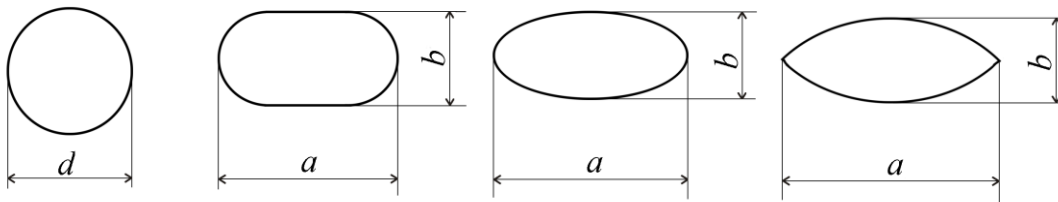


Fig. 2a, b, c: 100% CO 2x29.5tex before post-stress abrasion 50% of the cycles required to damage the yarn (calibration 3.67mmpx-1, image resolution 548px x 704px)

IN 32-204-01/01 Determination of transverse compressibility of yarns

Krupincová, G.

This standard specifies the procedure for evaluating and processing data for determining the transverse compressibility of yarns between parallel plates.



a, b ...charakteristické rozměry

p tlak působící na přízi

1, 2tuhé rovnoběžné desky

3tvar deformovaného průřezu příze

Longitudinal view of uncompressed and compressed section of 16.5tex

Compression between two parallel plates

