TUTORIAL FOR THE X-SHAPE USER Version 6.2

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"This tutorial is made for the user in order to have an easy to use tool. Starting with a Preface in which the X-Shape measuring instruments are explained. A questionnaire will help you to process a new material not yet covered by existing profiles (Chapter I). 10 measurement examples are shown and a guideline of how to follow-up the answers to make sure that you have all the required tools (Chapter II, III)."

Preface

The X-Shape laboratory equipment family enables to characterize the morphology of different materials that has to be described by different parameters. Two materials classes can be characterized by three different size measurement algorithm classes:

- Particles by PowderShape or DiaShape (just for diamond grits) for grain size measurement
- Fibres by Fibreshape or FlockShape (just for flock fibres) for fibre length and width measurement
- Fibres by Fibreshape Cross using the FiVer algorithm for length measurement of crossing fibres

A X-Shape equipment consists of

- The laptop or PC with minimum conditions: CPU i7; RAM 8Gbyte; SSD 500 Gbyte; Windows 10
- The X-Shape software under the name of the requested algorithm
- The requested scanner(s)

The mostly used laboratory equipments (X-Shape products) are:

1.) Based on a middle format scanner with 8µm optical resolution limit:

- FibreShape M
- FibreShape Cross M
- PowderShape M
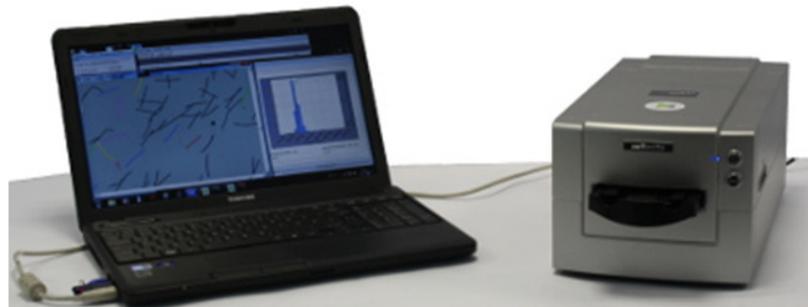
2.) Based on an A4 scanner with 16 µm optical resolution limit:

- FibreShape FH
- FibreShape Cross FH
- PowderShape FH

The 10 examples of different fibres and powders in chapter II include a description of the X-Shape products that are in use for the different types of materials.

The X-Shape laboratory equipment has to be used in a similar way as a lot of other well-known measurement instruments such as a multimeter (see below):

Before starting to work with a multimeter you have to find the answers to the 3 questions below:
- What electric part (material) has to be tested?
- What parameter?
- What range?

If you have found the answer to these questions you execute the following 3 handling steps:
- Plug in the electrical part in the appropriate plug
- Select the parameter (8 available) and choose between the 30 parameter ranges
- Measure and get result

When working with an X-Shape system you have also to find the answers to the following questions:
- What kind of material do you have?
- What parameters have to be used for the measurement?
- What is the measurement range of the parameters (size and shape)?

X-Shape is more complex than a multimeter having 300 different parameters and a huge number of freely adjustable size ranges, shape and color filters.
- How the images have to be processed?
- What has to be measured?
- How the measurement results have to be represented?

The 5 measurement steps of X-Shape:
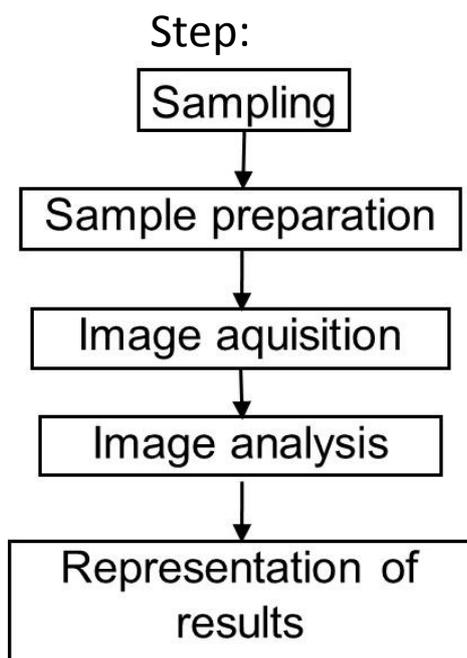
Step:	Scope:
Sampling	- Take representative material samples
Sample preparation	- Disperse the material sufficiently
Image aquisition	- Use the appropriate scanner settings for subsequent quantitative image analysis
Image analysis	- Use the appropriate measurement condition
Representation of results	- Apply the statistical evaluation and graphical parameter representation according to users need

I. FUNDAMENTAL QUESTIONS in order to find out more about the user needs and material

1. What kind of material do you have?

- Fibres?
    - o Carbon fibres (rCF – recycled Carbon Fibres)
    - o Ceramic fibres (RCF – Refractory Ceramic Fibres)
    - o Glass fibres
    - o Polymer fibres
    - o Natural fibres (hemp, flax, kenaf, sisal, cotton etc)
    - o Wool
    - o Nano fibres
    - o Others?

- Particles?
    - o Diamonds
    - o Cemented additives
    - o Sand
    - o Metal powders
    - o Ceramic powders
    - o Powders for 3d printers
    - o Nano powders
    - o Others?

- Materials made with fibres
    - o non-woven materials
    - o woven materials
    - o composite materials
    - o Others

2. What parameter do you want to measure? What is the size range?

- Length; min: max:
- Width; min: max:
- Grain size; min: max:
- Others: just write down the parameters wanted

II. Check with X-Shape "former measurements" if an example fulfils the needs of the new material

Check with X-Shape former measurements if an example fulfils the needs:

a. Open X-Shape program – on the main page of the program you click on the "Former Measurement";

b. Click on Select existing lot/file/sample and choose the .csv you need according with the client feedback.

c. If the sample is not in the former measurement please refer to X-Shape Manual Chapter 4 - X-Shape PRO or contact support@istag.ch
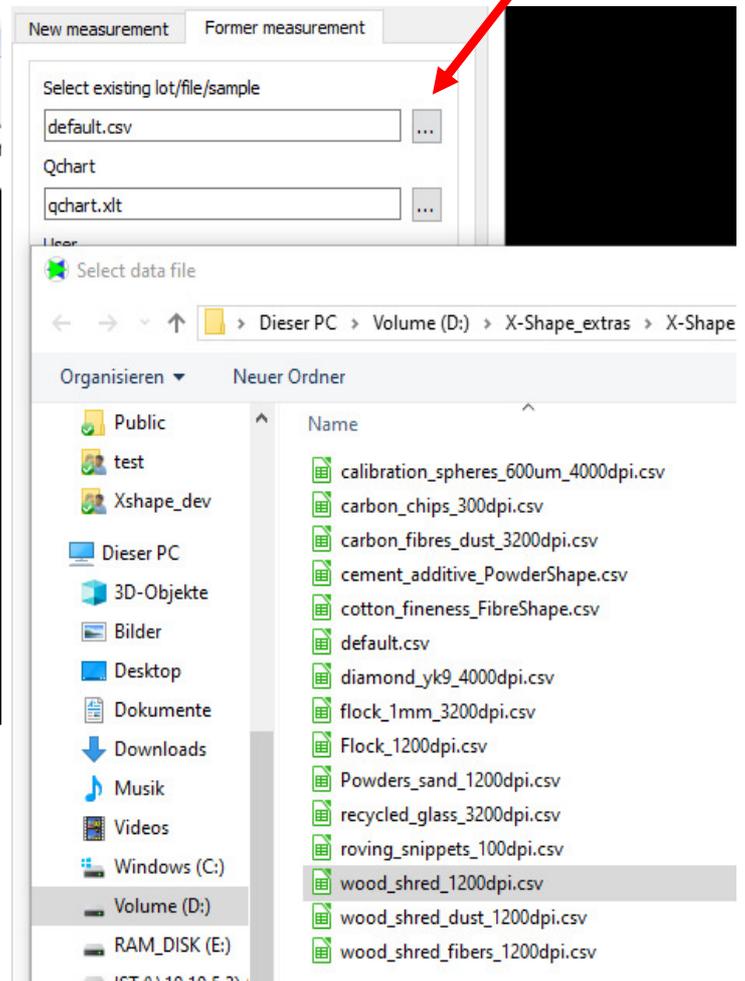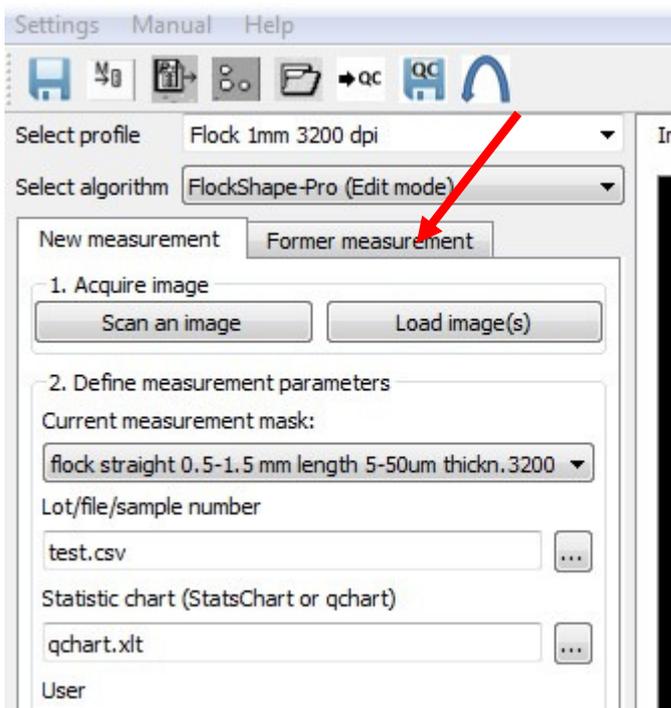
If the unknown material corresponds to one of the 10 applications shown as csv file in the browser and also listed below check if you have access to the needed algorithm and select the recommended measurement mask (shortly as mask written).

You find these 10 examples under "Former measurement" in X-Shape

Calibration Spheres 600 μm
- X-Shape System: DiaShape D or PowderShape D
- Preparation: dry, *X-Shape Manual – Appendix 1.*
  Sampling for slide scanners Reflecta ProScan 10T
- Mask: Calibration 400,600 um diam. 4000dpi, thr:200
- Parameters: multiple size and shape factors

General: grain size 20 –1000 μm; solidity 0.9 – 1.

Example: grain size 300 –900 μm; solidity 0.95 – 1.
- Former measurements: calibration_spheres_600um_5000dpi.csv
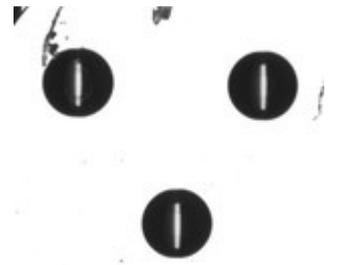
Image: calibration spheres 600um 4000dpi.jpg

Carbon fibre chips does also work for glass fibre chips
- X-Shape System: FibreShape FH
- *Preparation: dry – X-Shape Manual – Appendix A2 Sampling Sampling – A4*
- Mask: Carbon fibre 300 dpi >100um width zoom
- Parameters: geodesic length: range 0.5- 100mm; thickness range: 0.1 – 20mm; convexity 0 – 1.12; et al
- Former measurements: carbon_chips_300dpi.csv.
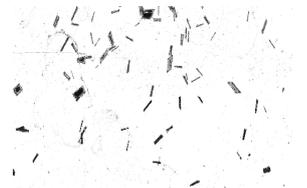
Image: carbon_fibre_chips_300dpi

Carbon staple fibres, works also for other opaque staple fibres such as basalt or PA fibres
- X-Shape System: FibreShape Cross M (includes Fiver)
- Preparation: wet, *X-Shape Manual – Appendix A2 Sampling – Sampling for MF 5000/PrimeFilm 120 Pro Scanner.*
- Parameters: geodesic length: 0.016 – 50mm
- Mask: 3200dpi_c-fibres_t241_bowed_out.fibsr
- Former measurements: carbon_fibres_dust_3200dpi.csv

Image: carbon_fibre_chips_300dpi

Diamond does also work for ABN and CBN
- X-Shape System: DiaShape D
- Preparation: dry, *X-Shape Manual – Appendix 1. Sampling for slide scanners Reflecta ProScan 10T or PrimeFilm XE*
- Mask: Diamonds 200 - 1000 um 4000 dpi Canon or Nikon
- Parameters: multiple size and shape factors

General: grain size 20 –1000 μm; solidity 0.8 – 1., et al
- Example: grain size 200 –1000 μm; solidity 0.9 – 1.
- Former measurements: Diamonds_5000dpi.csv
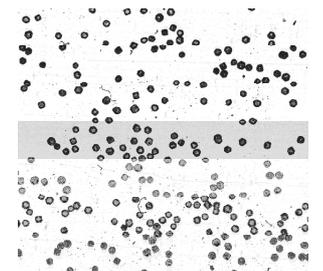
Image: stest.jpg

Flax fibres, also works for other natural fibres such as hemp fibres
- X-Shape System: FibreShape M
- Preparation: dry, *X-Shape Manual – Appendix A2 Sampling Sampling for MF 5000/PrimeFilm 120 Pro Scanner.*
- Mask: Long fibres 8-500um 3200dpi zoom 000
- Parameters: Thickness 8 – 500μm et al
- Field of use: yarns; composite materials
- Former measurements: flax_fibers_3200dpi.csv

Image: stest.jpg

Flock

- X-Shape System: FlockShape M
- Preparation: dry, *X-Shape Manual – Appendix A2*
  Sampling for MF 5000/PrimeFilm 120 Pro Scanner.
- Mask: flock straight 0.5-1.5 mm length 5-50um thickn.3200 dpi shd
- Parameters: multiple size and shape factors
  General: geodesic length: 0.04–100mm; thickness 5 –50 µm
  Example: geodesic length: 0.5–1.5mm; thickness 5–50µm
  Use for thickness measurement > 15µm
- Former measurements: flock_1mm_3200dpi.csv

Image:
Flock_1mm_3200dpi.jpg

Powders sand and other particles

- X-Shape System: PowderShape FH
- Preparation: dry, *X-Shape Manual – Appendix A2*
  Sampling – 2. Sampling for A4 scanners
- Mask: Particles 100-10000um 1200dpi Epson
- Parameters: multiple size and shape factors
Grain Size 0.1 – 10mm; Convexity 0.96-1, et al
- Former measurements: Powders_sand_1200dpi.csv
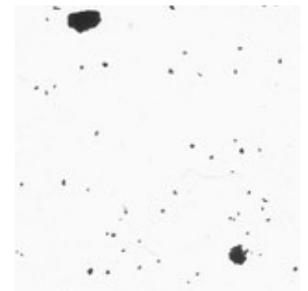
Image:
sand_1200dpi.jpg

Recycled glass fibres also works for other industrial transparent staple fibres

- X-Shape System: FibreShape Cross M (includes Fiver)
- Preparation: wet, *X-Shape Manual – Appendix A2*
  Sampling for MF 5000/PrimeFilm 120 Pro Scanner.
- Mask: 3200dpi_glass-fibres_reflecta_h241.fibsr
- Parameters: geodesic length: 0.016-50mm
- Former measurements: recycled_glass_3200dpi.csv

Image:
glass_3200dpi.jpg

Roving snippets

- X-Shape System: FibreShape FH
- Preparation: dry, *X-Shape Manual – Appendix A2*
  Sampling – 2. Sampling for A4 scanners
- Mask: Short fibres 1mm-30cm straight 100dpi Epson
- Parameters: multiple size and shape factors
  geodesic length: 1-300 mm; thickness 0,5 – 100 mm; et al
- Former measurements: roving_snippets_100dpi.csv
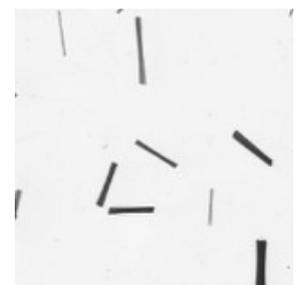
Image: rcf-roving-snippets-100dpi.tif

Wood shred

- X-Shape System: FibreShape FH
- Preparation: dry, *X-Shape Manual – Appendix A2*
  Sampling – 2. Sampling for A4 scanners
- Mask: wood shred fibers 1200 dpi
- Parameters: multiple size and shape factors
  geodesic length: 0.1-100mm; thickness 0.04 – 100mm; et al
- Former measurements: wood_shred_1200dpi.csv
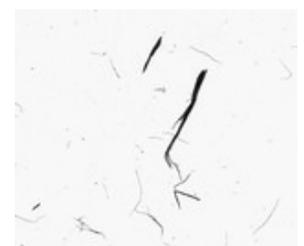
Image:
wood_shred_1200dpi

III. Check if you can measure the material with your X-Shape configuration

You must always check if the 5 steps of the X-Shape measurement system are fulfilled

1 **Sampling**

2 **Sample preparation**

3 **Image aquisition**

4 **Image analysis**

5 **Representation of results**

- How to take a representative sample of the clients' material?

- How to prepare the samples and make sure that the material is dispersed sufficiently?

- What is the appropriate scanning configuration using Silverfast (see Appendix 1)?

- What is the appropriate measurement mask?
  (see Chapter II)

- What configuration parameters are available in the interactive reporting system in order to generate a report?

Appendix 1: Scanner settings

The scanner settings have to be done in the Silverfast software (www.silverfast.de):

- Image size: usually maximum size (frame) in order to get a maximum of objects imaged;
but: < =200 million pixels for 8-bit grey images and < =50 million pixels for 24-bit colour images.
- Colour mode: Usually you need for morphology parameters just grey values with 8bit. If you need colour information, use 24bit. **Beware: Do not use colours if not needed!**
- Resolution: depends on the minimum size that has to be measured. Recommended minimum resolution = 50800/ (minimum requested size to characterize).
- The scan parameters depend on the kind of material that has to be analysed. You find more information in the description of the different scanners.

You find further information for all steps of the X-Shape measurement systems:

How to take samples and how to prepare samples?
See X-Shape Manual Chapter 6 Appendices – A2 Sampling

How to scan?
See X-Shape Manual Chapter 2 – 2.3 Scanner Settings
See X-Shape Manual Chapter 5 - Calibration

How to use calculation software?
See X-Shape Manual Chapter 4 - X-Shape PRO

How to evaluate the results?
See X-Shape Manual Chapter 3 – X-Shape QC