3D·RC
3D Retail Coalition

Standard Operating Procedures **for Digital Fabric Physics Interoperability**	
Status: Final **Valid From:** November, 2021 **Valid For:** TBD	
Created by: 3D.RC Innovation Subcommittee **Released by:** 3D.RC	

Table of Contents

1. Forward

Welcome fabric suppliers with in-house testing labs and independent testing labs and thank you for taking part in the pilot of this Standard Operating Procedure (SOP). From the 3D.RC's initial work in 2020, we have made great progress in making fabric physics data more universal and usable by brands, retailers, vendors and 3D software providers. The 3D.RC's work focuses on solving precompetitive, common issues and challenges in the apparel industry. A universal 3D fabric physics test set would dramatically change the way we work today by eliminating the need to test a single fabric multiple times to support the data needs of each 3D software provider. Rather, the universal 3D fabric physics test set includes all relevant data needed by all 3D software providers through measurement and/or mathematical conversion. This universal nature of the test set will result in a reduction of time and cost for all parties involved in this work. The following pages explain the SOP of the universal 3D fabric physics test we are suggesting, based on our previous work. As we partner together, we need your help to improve this document and its contents. Your input is specifically needed on clarity of descriptions, processes and formulas as well as testing process efficiency. We are grateful for your feedback and look forward to collaborating.

2. Scope

This document is valid from November, 2021, and covers SOP for testing fabric physics properties needed for 3D software solutions published by Assyst/Vidya, Browzwear, CLO3D, Gerber and Optitex.

3. Responsibility

For questions regarding the content, please contact:

innovation.lead@3drc.pi.tv

4. Weight & Mass per Unit Area

4.1. Scope

This method describes the determination of mass per unit area using small samples. Existing EN, ISO, and ASTM standards are sufficient to follow for generating data in any of the 3D tools studied. Some software solutions call for slight differences in units or measures, which are outlined below.

4.2. Standard

4.2.1. <u>Option 1</u>: EN 12127: 1997: Textile-Fabrics – Determination of mass per unit area using small samples.

4.2.2. <u>Option 2</u>: ISO 3801: 1977: Textiles: Woven fabrics: Determination of mass per unit length and mass per unit area.

4.2.3. <u>Option 3</u>: ASTM D3776: Option C: Small swatch of fabric.

4.3. Testing Conditions

4.3.1. Preparations for Test Specimen
<u>Option 1</u>: Condition fabric according to ASTM D1776.
<u>Option 2</u>: Condition fabric according to ISO 139.

4.3.2. Procedure: Follow the selected standard's procedure.

4.3.3. Equipment, Supplies and Reagents: Only those described in the preparation standard above.

4.4. Software Specifications

4.4.1. Assyst/Vidya, Browzwear, Gerber, Optitex:
Give the mass per unit area in g/m^2

4.4.2. CLO3D:
Give the mass in g per 198 cm^2

Software specific unit referred to as "area CLO"

g/m^2 *0.0198 = g/area CLO

5. Thickness

5.1. Scope

This method describes the determination of the thickness of textiles under a specified pressure. It is not valid of coated fabrics or non-woven fabrics (EN ISO 5084). All software providers manage this data in the same way, with only one calling for a different unit of measure.

5.2. Standard

5.2.1. <u>Option 1</u>: EN ISO 5084: 1996: Determination of thickness of textile and textile products alternative.

5.2.2. <u>Option 2</u>: ASTM D1777: 1996 (2019): Standard test method for thickness of textile material.

5.3. Testing Conditions

5.3.1. Preparations for Test Specimen:
<u>Option 1</u>: Condition fabric according to ASTM D1776.
<u>Option 2</u>: Condition fabric according to ISO 139.

5.3.2. Procedure: Follow the selected standard's procedure.

5.3.3. Equipment, Supplies and Reagents: Only those described in the preparation standard above.

5.4. Software Specifications

5.4.1. Assyst/Vidya, Browzwear, CLO3D, Gerber:
Give the thickness in mm.

5.4.2. Optitex:
Give the thickness in cm.

6. Bending

6.1. Scope

This method describes the determination of the fabric's stiffness. Multiple standards use the same Cantilever method needed for the majority of the software providers. One software provider does not follow the standard, however, data collected via the standard method may be used.

6.2. Standard

6.2.1. <u>Option 1</u>: DIN 53362: 2003 (German Standard)
6.2.2. <u>Option 2</u>: BS 3356: 1990 (British Standard)
6.2.3. <u>Option 3</u>: AS2001.2.9 (Austrian Standard)
6.2.4. <u>Option 4</u>: ASTM D1388: 2018 (USA Standard)

6.3. Testing Conditions

6.3.1. Preparations for Test Specimen:
<u>Option 1</u>: Condition fabric according to ASTM D1776.
<u>Option 2</u>: Condition fabric according to ISO 139.

6.3.2. Procedure:
The angle of inclination is 41.5° ± 0.5° on your testing equipment.

(*) software in chart below have additional documentation in section 6.4.

6.3.3. Equipment, Supplies and Reagents: See chart below for software-specific needs.

| **Bending Needs by Software**					
	Browzwear*	**Assyst/Vidya**	**CLO3D**	**Gerber**	**Optitex**
Testing Principle	Folding Loop	Cantilever	None	Cantilever	Cantilever
Number and Size of Specimen	3 per direction; determine medium value per direction; 2.5 x 25 cm: fraying not necessary				
Testing Direction	Warp, Weft, Bias	Warp, Weft	Warp, Weft, Bias	Warp, Weft	Warp, Weft
Input Variables for Results Calculation	Overhang length	Overhang length per direction Fabric weight	Contact length Contact distance	Overhang length per direction Fabric weight	Overhang length per direction Fabric weight
Output/Unit	Flexural rigidity [dyn*cm]	Bending stiffness [µNcm]	No calculation necessary before input into software [mm]	Bending rigidity [g*cm]	Flexural rigidity [dyn*cm]
Calculation	$G = m \left(\dfrac{l}{2}\right)^3 * 10^{-4} * g$ l = overhang length (cm) m = weight per unit area (g/m2) g=980 results are dyn*cm Note: see Appendix	$G = m \left(\dfrac{l}{2}\right)^3 * 10^{-4} * g$ l = overhang length (cm) m = weight per unit area (g/m^2) Recalculate from mNcm into µNm: 1 mNcm = 10 µNm	No calculation necessary	$G = \left(\dfrac{l}{2}\right)^3 * m$ l = overhang length (cm) m = weight per unit area (g/m^2)	$FR = 980 * 10^{-4} * m *$ $BL^3 * \dfrac{cos\frac{BA}{2}}{(8*tanBA)}$ FR = flexural rigidity (dyn*cm) BL = bending length (cm) m = weight per unit area (g/m^2) BA = bending angle (degree) 41.5°

6.4. Additional Documentation

6.4.1. CLO3D:

1. Take the classical instrument and additionally fix a ruler with mm increments in the instrument parallel to the top line with a distance of 25mm and the 0 point starting at the beginning of the slope.

2. Use the settings for testing with the additionally fixed ruler. In this case, two medium values are needed per direction (warp, weft and bias directions).
   a. All values in mm.
   b. Images for reference:

3. Specimen is placed on the surface of the device. Specimen is moved forward with the slider until it reaches the upper line of the attached ruler. A = contact distance.
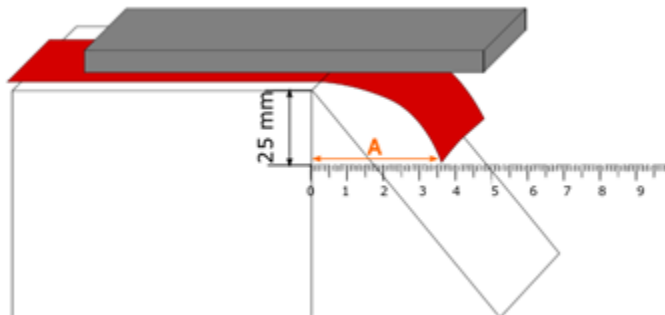
4. Keep the specimen in place and raise the part of the specimen hanging over the edge up to the slider and measure B = contact length.
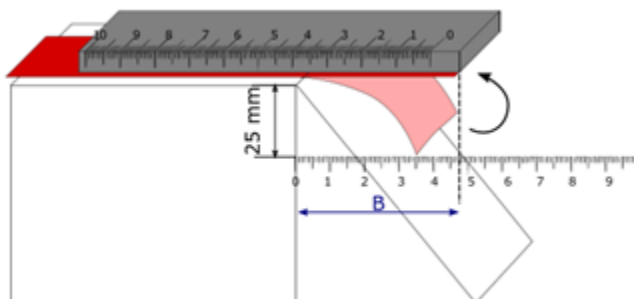
   Remark: Just test the fabric face side, no need testing the fabric back side.

7. Elongation / Shear

7.1. Scope

This method describes the determination of the elongation values needed for 3D virtualization. The 3D software providers do not follow international standards precisely, however all derive their measurements from standards. Procedural differences are described in this section.

7.2. Standard

7.2.1. <u>Option 1</u>: EN ISO 139340 1: 2013

7.2.2. <u>Option 2</u>: ASTM D5034

7.3. Testing Conditions

7.3.1. Preparations for Test Specimen

<u>Option 1</u>: Condition fabric according to ASTM D1776.

<u>Option 2</u>: Condition fabric according to ISO 139.

7.3.2. Procedure:

(*) software in chart below have additional documentation in section 7.4.

Equipment, Supplies and Reagents: See chart below for software-specific needs.

Elongation Needs by Software					
	Browzwear	**Assyst/Vidya**	**CLO3D**	**Gerber**	**Optitex**
Number and Size of Specimen	3 per direction; determine medium value per direction; 5 x 25 cm: fraying not necessary				
Machine Settings	Gauge length: 200 mm Testing rate: 100 mm/min a CRE testing machine Pretention: none Clamps: rubber clamps with 50 mm minimum width Load cells: smallest possible e.g. 120 N Maximum applied load: 25 N for woven fabrics, 12 N for knit fabrics Number of cycles: one				
Testing Direction	Warp, Weft, Bias				
Output/Unit	$$K = \frac{F * l_0}{\Delta l * w} =$$ K[N/m] F = force [N] w = specimen width (5 cm) l0 = initial length/clamp distance (8cm) Δl = extension[cm] corresponding to Force F [N]	Elongation [%] at 1 N/5 cm = 20 N/m 2 N/5 cm = 40 N/m	Read the kgf/5 cm for fabric with woven fabrics at: 2 mm 4 mm 6 mm 8 mm 10 mm Or for fabrics with knit fabrics at: 10 mm 20 mm 30 mm 40 mm 50 mm Note: if the fabric has a very low elasticity it might not be possible to measure the elongation at 10 mm. In this case the data at 2, 4, 6 and 8 mm is sufficient.	Elongation [cm] at 3.28 N/5cm [needed: elongation in cm/ 500 g (= 5 N) original specimen width: 3 inch (7,62 cm) 500g/ 7,62 cm à328 g/5cm [3,28 N/5 cm]]	Young´s modulus: $$K = \frac{F * l_0}{\Delta l * w} =$$ $$= \frac{F * l_0 * 101,97}{(l - l_0) * w}$$ F = force [N] w = specimen width (5 cm) l0 = clamp distance at the start of the test = 20 cm l = length [cm] corresponding to Force F [N} Attention: force must not reach area where plastic deformation of fabric starts

Elongation Needs by Software					
	Browzwear	**Assyst/Vidya**	**CLO3D**	**Gerber**	**Optitex**
Final Output/ Calculation	Not necessary Note: see Appendix	Not necessary	Recalculate on a stripe width 3 cm →kgf/3 cm	Not necessary	Not necessary

8.0 Additional Documentation

8.1 Appendix

8.1.1 Browzwear:

- Start the elongation test and apply 4 times approx. 5 N to the specimen. Have all specimens tested in this way

- Formulas and testing methods by Browzwear capture multiple data points for each test required for digitizing fabrics (ex. Stretch test, bend test etc.) derived from the use of the Browzwear Fabric Analyzer (FAB). Calculations in this SOP capture data for different tests, using classical testing methods. However, to enter the data created by the SOP into Browzwear applications, a single value is used at this time. *Browzwear has stated that "while this method will provide simulation results in 3D, True to Life/ Digital twin is not guaranteed but instead multiple points from the FAB are preferred for accurate true to life simulation."*
- We recommend that SOP users save the full data set from their classical equipment, in the form of a graph and a raw text file. Saving this more detailed data will preserve compatibility with any future developments from Browzwear and other 3D platforms.
- The 3DRC will continue to work with Browzwear and *other 3D software* on the best way to register multiple data points from classical equipment into their software as much as possible.