

# Raw Measurement Data from FAB

Version 1.2

Version	Date	Author	Description
1.2	Aug 2020	Browzwear	Added Measurement Data Sample Graphs
1.1	June 2020	Browzwear	

## Physics Reference

- [Raw Physics JSON Sample](#)
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## Raw Physics Schema and Sample

Link to schema version 1.1:

[https://drive.google.com/file/d/1ET77UleKJ\\_gUVuf99aUOtHK1WeS4IPVi/view?usp=sharing](https://drive.google.com/file/d/1ET77UleKJ_gUVuf99aUOtHK1WeS4IPVi/view?usp=sharing)

Link to a sample fabric:

[https://drive.google.com/file/d/1V5eaRG0ZUhCExf07\\_2\\_yc7YjLi2-cPQY/view?usp=sharing](https://drive.google.com/file/d/1V5eaRG0ZUhCExf07_2_yc7YjLi2-cPQY/view?usp=sharing)

## Labels

The following table describes the various labels used.

Label	Description
<b>B</b>	Biased grain line
<b>L</b>	Length grain line
<b>W</b>	Width grain line
<b>M</b>	Mass - the mass density of the fabric

<b>T</b>	Thickness
<b>D1</b>	Downward bend measurement at a distance of 2cm
<b>D2</b>	Downward bend measurement at a distance of 8cm
<b>S1</b>	Stretch measurement at a distance of 2cm
<b>S2</b>	Stretch measurement at a distance of 8cm
<b>U1</b>	Upward bend measurement at a distance of 2cm
<b>Width</b>	Width of measured fabric
<b>Length</b>	Length of measured fabric
<b>samplesTree</b>	The measurement raw data given as pairs in the format distance (cm), then force (g)
<b>Time</b>	Time stamp in time_t  Note: time_t base time is the number of seconds from midnight, January 1, 1970
<b>freq</b>	Sampling rate of the FAB machine

## Units of Measurement

The following units of measurement are used:

- Thickness is presented in **mm**.
- Mass is presented in **g/m<sup>2</sup>**.
- Distances are presented in **cm**.
- Forces are presented in **g**.

## Testing

The process is described as follows:

1. Three fabric strips - typically of 25cm by 5cm - are cut: one along the fabric's length direction, one along the fabric's width direction, and one along the fabric's bias direction. The bias direction is 45° between the length and the width directions..

2. The mass of the fabric in grams is measured using scales. The mass density is calculated from the measured mass and the size of the fabric strip.
3. The FAB machine is composed of two clamps. One is stationary with load cells that measure the force applied on this clamp in grams (g). The second clamp is attached to a mechanical motor and can move forwards and backwards relative to the stationary clamp. The distance between the clamps is measured in cm.
4. For the Thickness measurement, one fabric strip is attached to the moving clamp so its surface is perpendicular to the distance between the clamps. The moving clamp moves slowly towards the stationary clamp and force is recorded as a function of the distance. The thickness is calculated from this Force vs. Distance curve to  $\pm 1\text{mm}$ .
5. For each of the three directions, measurements are performed with the clamps at 2cm and at 8cm.
6. The following tests can be done and the results measured:
  - a. **Stretch**: the moving clamp moves away from the stationary clamp, stretching the fabric.
  - b. **Up bend**: the moving clamp moves towards the stationary clamp, bending the fabric upward.
  - c. **Down bend**: the moving clamp moves towards the stationary clamp, bending the fabric downward.
7. In practice, the tests described in the following table are performed and measured. For each test, we perform 3-4 measuring cycles: each cycle is divided into two parts - the bending/stretching and the relaxation (return to the initial position). We save separately the data for the bending/stretching and the relaxation.

No.	Direction	Test	Clamp Distance
1	Length	Up bend	2cm
2	Length	Down bend	2cm
3	Length	Stretch	2cm
4	Length	Down bend	8cm
5	Length	Stretch	8cm
6	Width	Up bend	2cm
7	Width	Down bend	2cm

<b>8</b>	Width	Stretch	2cm
<b>9</b>	Width	Down bend	8cm
<b>10</b>	Width	Stretch	8cm
<b>11</b>	Bias	Up bend	2cm
<b>12</b>	Bias	Down bend	2cm
<b>13</b>	Bias	Stretch	2cm
<b>14</b>	Bias	Down bend	8cm
<b>15</b>	Bias	Stretch	8cm

8. For each test, the Force vs. Distance data are recorded. From these, Force vs. Distance for the different final bend, stretch, and linearity values are calculated.

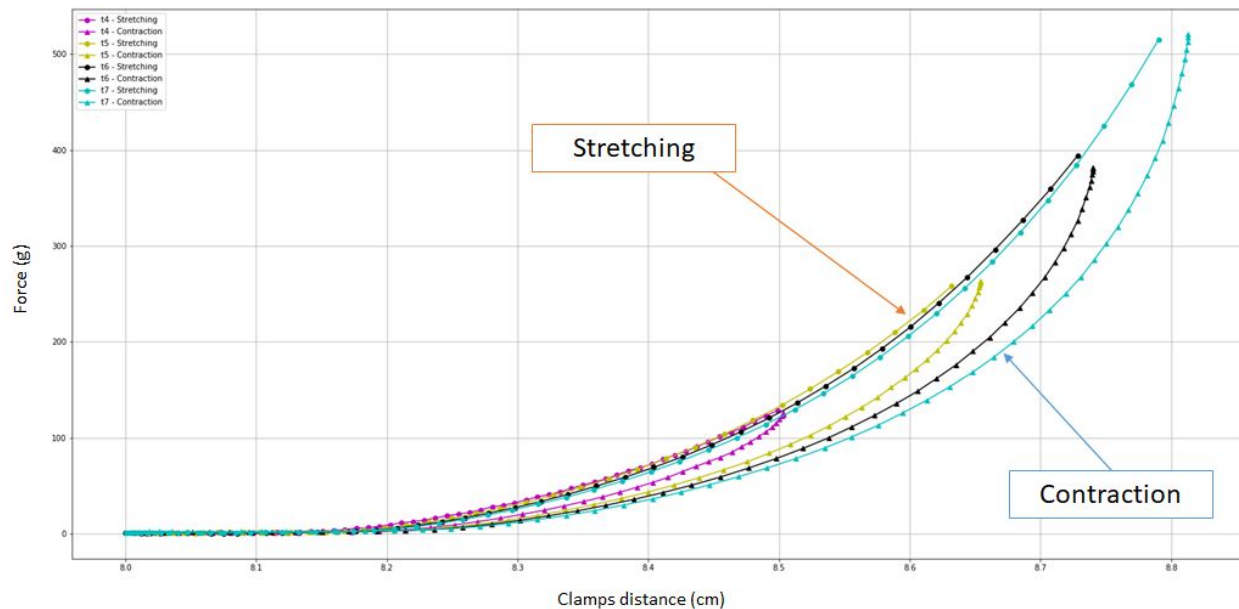
For additional information, here's a video on how to use the fab:

<https://www.youtube.com/watch?v=Q51myqbqi04&feature=youtu.be>

# Measurement Data Example

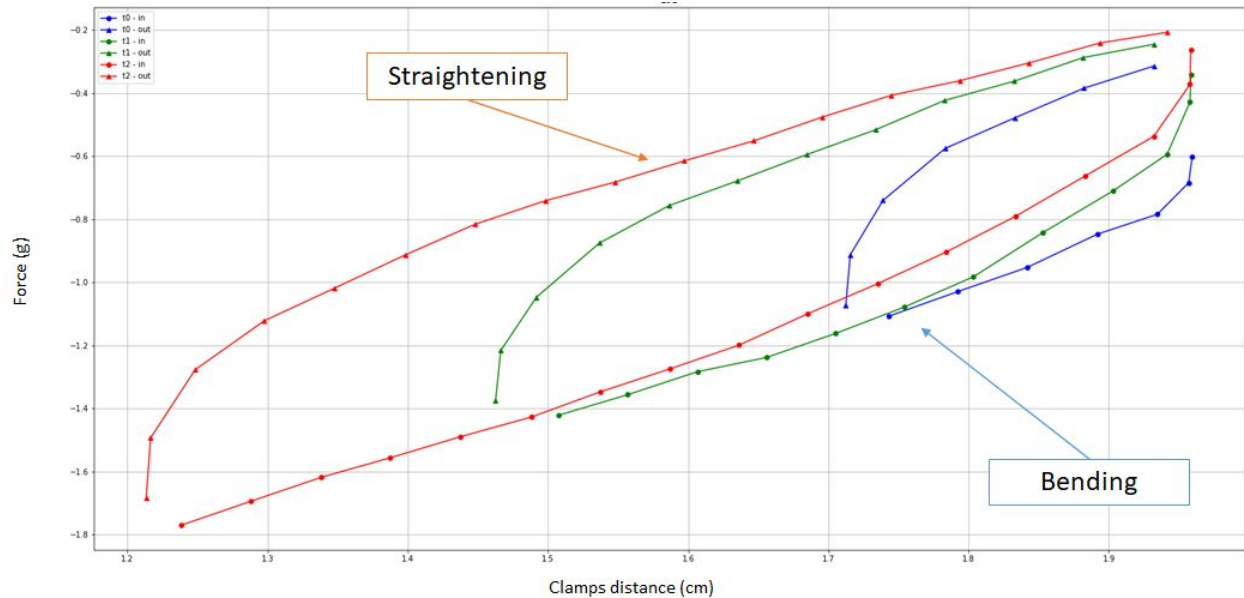
## Stretch

Here's an example for a Stretch diagram. There are 4 cycles (4 different colors) and for each cycle there is the stretching part (circles) and the relaxation (contraction) part (triangles). So, overall - for this type of measure we will have 8 different raw data sets - 4 stretching and 4 relaxation.



## Bend

Here is an example for a Bend diagram. There are 3 cycles (3 different colors) and for each cycle there is the stretching part (circles) and the relaxation (contraction) part (triangles). So, overall - for this type of measure we will have 6 different raw data sets - 3 stretching and 3 relaxation.



## Additional Reference Papers

Our bend test is based on the loop method. Here are some references to the different bend methods.

### Formulas to determine fabric bending rigidity from simple tests

Name: Formulas to determine fabric bending rigidity from simple tests

Author: Raymond H Plaut

Journal: Textile Research Journal

Year: 2015

Volume: 85

Issue:8

Pages: 884–894

DOI: 10.1177/0040517514553877

### Characterization of fabric bending behavior: A review of measurement principles

<https://drive.google.com/file/d/17piggJ9szcL38SPamGsMzk7dplg4gYVs/view?usp=sharing>

### An Analysis to Compare Conventional Methods for Estimating Bending Rigidity of Fabrics

[https://drive.google.com/file/d/1qQ0N8fJn9z6ehI9KN851o-V\\_H9gXwMIL/view?usp=sharing](https://drive.google.com/file/d/1qQ0N8fJn9z6ehI9KN851o-V_H9gXwMIL/view?usp=sharing)