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PII: S0263-2241(16)00194-9
DOI: http://dx.doi.org/10.1016/j.measurement.2016.03.030
Reference: MEASUR 3888

To appear in: *Measurement*

Received Date: 22 October 2015
Accepted Date: 12 March 2016

Please cite this article as: S. Sengupta, S. Debnath, A. Sengupta, Fabric bending behaviour testing instrument for technical textiles, *Measurement* (2016), doi: http://dx.doi.org/10.1016/j.measurement.2016.03.030

Fabric bending behaviour testing instrument for technical textiles

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ABSTRACT

Bending is a quiet common phenomenon and affects the performance of textiles. Technical textiles are subjected to different magnitude of bending force depending on applications. Hence, complete bending behaviour study is essential. Hence, an attempt has been made to develop a low cost mechanised and computerised system to study complete behaviour of bending specially for technical textiles. The modified hanging ring loop principle has been adopted to develop this instrument. The developed instrument expresses the bending behaviour in terms of change in bending load/stress/modulus after a certain bending deflection. Various technical textiles like nonwoven, tarpaulin, coated fabrics, canvas, hessian etc., have been tested with the developed instrument. This instrument can measure dynamic bending behaviour by graphical bending load-deflection, cyclic bending, bending stress relaxation etc. Statistical analysis like standard deviation and coefficient of variation can be reported. Hence, complete information of bending is available with this instrument. Data and graphs can be stored and printed. It shows reliable results when compared with standard instrument like Shirley Stiffness Tester. The same sample has been tested for 30 times and the deviation between minimum and maximum values was insignificant at 1% level. This instrument is user friendly, low cost and informative for technical textiles. Flexural rigidity and bending modulus can be calculated using standard formula from the available data.

Keywords: Bending behaviour, Fabric, Modified hanging ring loop technique, Technical textiles.

1. Introduction

The extension under load along the fabric axis is our main concern for long time. The application of vertical force on the surface of fabric has practical importance also. It builts up a torque on the fabric resulting in bending deformation. Bending is defined as stiffness or rigidity which is basically the resistance to bend. Bending of fabric influences the drape and handle properties whereas recovery from bending influences the creasing of fabric.

Study on bending behaviour of fabric was started around 1930. Peirce [1] suggested different shapes of bending and their mathematical models. Lindberg [2] plotted the bending curve of fabric strip and compared it with elastic strip. Later, scientists [3] explained the behaviour of such curve in a better way. In another work, Grosberg [4, 5] showed that at the initial stage of bending, the frictional couple is required to overcome the internal friction between the fibres in the intersection of fabric. Brown [6] described a method of measuring the bending length of limp and/or curly fabrics.

Out of different principles of measurement of bending property, cantilever technique is the most popular and commercialized internationally [7]. It was adopted by number of machine manufacturers e.g. Shirley Development Ltd, SASMIRA, Paramount Instruments Private Limited etc. In this principle, a strip of fabric is bent under its own mass from edge of a horizontal surface in a 41.5^{O} angle. The length of overhang is measured as bending length. This method is manual and hence, there is chance of error. It is suitable for apparel fabric but not suitable for thicker semi-rigid technical fabrics and knitted or unbalanced fabrics[1]. Dynamic bending behaviour of fabric is not