Draft
Tanzania Standard

FOREWORD

0.1 This standard has been reviewed to include additional sketches and illustrations showing how to measure bowness and skewness commonly experienced by textile mills during the process of fabric manufacture.

0.2 In the preparation of this draft standard, assistance was derived from ISO 13015: 2013 - woven fabrics - Distortion – Determination of skew and bow, published by International Organization for Standardization and ASTM D7811:2013 Standard test method for Bow and Skew Using a Measuring Tool published by ASTM international.

0.3 In reporting the result of a test made in accordance with this draft standard, if the final value observed or calculated is to be rounded off, it shall be done in accordance with TZS 4: 2009 (see clause 2).

SCOPE

This draft Tanzania Standard specifies a method for the determination and measuring of the bow and skew in woven fabrics.

REFERENCE

For the purpose of this draft standard the following reference shall apply:

a) TZS 3: 1979: Atmospheric conditions for testing
b) TZS 4: 2009: Rounding off numerical value
c) TZS 20: 1979: Textiles- woven fabrics-determination of number of threads per centimeter.
d) TZS 44: 1979 Textiles-woven or knitted fabrics-determination of length and width.

DEFINITIONS

3.1 Bow – curvature of the warp or weft of fabrics

3.2 Double bow – A condition in which the weft bow is of such a nature that different parts of one pick lie on opposite sides of a line joining the ends of the pick.
3.3 **Skew** – fabric condition where the picks, although straight, are not at right angles to the ends

4. **PRINCIPLE**

In a piece of the woven fabric, laid on a flat surface and without tension, skew and bow are characterized as follows;

4.1 **Overall skew** - is based on the determination of the distance between one end of a weft yarn and the point of the same edge intersected by a normal perpendicular from the other end of the weft yarn to the fabric edge, in proportion to the distance between two points at which the normal perpendicular to the fabric edge intersects both edges (woven fabric width), expressed as a percentage ratio.

4.2 **Local skew** – is determined as the distance between one end of a weft yarn to its perpendiculars to the warp running at right angles to a portion of the fabric length.

4.3 **Weft bow** – is determined as the total perpendicular distance by which a weft yarn deviates from a straight line joining both ends of the weft yarn.

4.4 **Warp bow** – is determined as the greatest perpendicular distance between the edge of the fabric and the straight line joining two selected points on the edge.

4.5 **Double bow** – is determined as one side of the smallest rectangle capable of containing pick, the other side of the rectangle being parallel to a line joining the two points where the pick cuts the selvedges.

4.6 **Skewness** – is determined as the distance between one end of a pick and the point on the same selvedge intersected by a line from the other end of the pick at right angle to the warp, expressed as a percentage of the width of the cloth.

5. **APPARATUS.**

5.1 **Set Square** – or similar device with at least two sides at right angle graduated in millimetres.

5.2 **Metallic ruler** – at least 100cm long but not less than the overall width of the fabric under test, graduated in millimetres.

5.3 **Metallic ruler** – a 20cm in length, graduated in millimetres.

5.4 **Test Fixture** – a ‘bow and skew measurement tool’ is to be used for each measurement. (See fig 1 and 2).
FIG 1; **Test Fixture** (Bow Skew tool with open Slot).

FIG 2; **Test Fixture** (Bow Skew tool with open Slot lined up to Material).
6. CONDITIONING AND TESTING ATMOSPHERE.

6.1 The conditioning and the testing shall be conducted in standardized atmosphere according to TZS3:1979 atmospheric conditions for testing.

6.2 The conditioning of the woven fabric shall be at least 16hrs.

7. TEST SPECIMENS.

7.1 When test specimens are taken from a bulk sample, care should be taken to ensure that they are removed with the minimum stress applied.

7.2 full width of test specimen not less than 500mm in length shall be taken.

Note: test specimens shall not be taken from within 1(one) mtr of the ends of a piece.

8. PROCEDURE.

8.1 General - Test specimen (excluding selvedges) shall be measured and the position of the selected weft yarn on relation to the nearest end of the test sample be recorded.

8.2 Preparation by marking – select a weft yarn and trace its course by marking successive points along its length, across the width of the test specimen, with a thin marker. If the yarn is not clearly visible, lighting of the face side of the test specimen can accentuate the relief and so facilitate the tracing of the yarn’s course. Alternately, mark and measure on the reverse side of the test specimen.

8.3 Preparation by fraying – If marking of the weft yarn is not possible, cut the woven fabric and fray it down to expose a complete weft yarn across the width of the test specimen.

8.4 - determination of overall skew and local skew.

8.4.1 – General
From the line representing the weft yarn evolution, the line is modelled on the application of one or more triangles. As each triangle is characterized by its height (identified as $a_i$) and its base (identified as $b$), the slope of each triangle can be calculated by the ratio of the height, $a$, and the base $b$.

Then, the skew is expressed as the percentage of the slope. When the line is modelled by several triangles, the highest skew is kept to represent the final result.
8.4.2 – Measurement instructions
Measure to the nearest millimeter with the metallic ruler the distance $b$ (base) in the perpendicular direction to the warp.

Measure with the set square and the small ruler the distance $a$ (height) in the warp direction (see Figure 3).

Note the values of the distance $b$ (base) of the related perpendicular for each slope that the line makes (see 8.4.3, 8.4.4, and 8.4.5, three examples of possible measurements in the relation to the type of the skew).

Measure in three different places along the length of the woven fabric in order to collect results based on three weft yarns.

![Diagram](image)

Key:
- $a$ height
- $b$ base

Fig. 3 – Determination of skew.

8.4.3 – Overall skew

Figure 4 represents the triangle model with one triangle to determine the overall skew,

Where:
- $a$ - is the maximal distance of the top of the line, measured between the top and the normal perpendicular from the beginning of the weft yarn on one fabric edge to the opposite fabric edge;

- $b$ - is the distance between the orthogonal projections of the beginning of the weft yarn on one fabric edge and the top of line on the normal perpendicular to the warp ($b$ represents the useful width of the woven fabric for which the selvedges are excluded).
Key:

- $a$ height
- $b$ base

**Fig. 4** – Principle of the measurement of the overall skew (one triangle model).

Figures 5, 6 and 7 are four examples of different configurations related to the measurement of the overall skew.

**Fig. 5** – Example 1 of overall skew.

**Fig. 6** – Example 2 of overall skew.

**Fig. 7** – Example 3 of overall skew.

**Fig. 8** – Example 4 of overall skew.
8.4.4 – **Local skew** with two triangles.

Figure 9 represents the triangle model with two triangles to determine the local skew,

Where;

- $a_1$ is the maximal distance (height) of the top of the line, measured between the top and the straight line going by the beginning of the weft yarn on left;

- $b_1$ is the distance (base) between the orthogonal projections on the perpendicular to the warp of the beginning of the weft yarn on left and the top of the line;

- $a_2$ is the maximal distance (height) of the top of the line, measured between the top and the straight line going by the beginning of the weft yarn on right;

- $b_2$ is the distance (base) between the orthogonal projections on the perpendicular to the warp of the beginning of the weft yarn on right and the top of the line;

![Diagram of Local skew with two triangles]

**Key;**

- $a_1$ height 1
- $a_2$ height 2
- $b_1$ base 1
- $b_2$ base 2

Fig. 9 – **Local skew** (model with two triangles).
8.4.5 – **Local skew** with three triangles.

Figure 10 represents the triangle model with three triangles to determine the local skew,

Where;

- $a_1$ is the maximal distance (height) of the top of the line, measured between the top and the perpendicular to the straight line going by the beginning of the weft yarn;

- $b_1$ is the distance (base) between the orthogonal projections on the perpendicular to the warp of the beginning of the weft yarn and the first top of the line;

- $a_2$ is the maximal distance (height) of the first top of the line, measured between the top and the perpendicular to the warp going by the following top;

- $b_2$ is the distance (base) between the orthogonal projections on the perpendicular to the warp of both tops of the line;

- $a_3$ is the maximal distance (height) of the second top of the line, measured between the top and the perpendicular to the straight line going by the weft yarn end;

- $b_3$ is the distance (base) between the orthogonal projections on the perpendicular to the warp of the second top of the line and the weft end;

![Diagram of local skew with three triangles](image)

**Key:**

<table>
<thead>
<tr>
<th>$a_1$</th>
<th>height 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_2$</td>
<td>height 2</td>
</tr>
<tr>
<td>$a_3$</td>
<td>height 3</td>
</tr>
<tr>
<td>$b_1$</td>
<td>base 1</td>
</tr>
<tr>
<td>$b_2$</td>
<td>base 2</td>
</tr>
<tr>
<td>$b_3$</td>
<td>base 3</td>
</tr>
</tbody>
</table>

Fig. 10 – **Local skew** (model with three triangles).
9. CALCULATION AND EXPRESSION OF THE RESULTS.

9.1 Calculations for the overall skew;

Calculate the overall skew overall skew as follows:

\[ \text{Skew\%} = \frac{a}{b} \times 100 \] (1)

Whereas \( a \) and \( b \) are defined in 8.4.3.

Calculate again the results of two other weft yarns.
Record the overall skew as the highest percentage slope met on three weft yarns.

9.2 Calculation with two triangles for local skew;

Calculate the local skew as follows:

\[ \text{Skew}_1\% = \frac{a_1}{b_1} \times 100 \] (2)

\[ \text{Skew}_2\% = \frac{a_2}{b_2} \times 100 \] (3)

Where \( a_1, b_1, a_2, \) and \( b_2 \) are defined in 8.4.4.
Record only the local skew corresponding to the highest local skew.

As given in Figure 9 the final result of the local skew is \( \text{Skew}_1\% \) as it is superior to \( \text{Skew}_2\% \).
Calculate again the result of two other weft yarns.
Record the local skew as the highest percentage of slope met on three weft yarns.

9.3 Calculation with three triangles for local skew;

Calculate the local skew as follows:

\[ \text{Skew}_1\% = \frac{a_1}{b_1} \times 100 \] (4)

\[ \text{Skew}_2\% = \frac{a_2}{b_2} \times 100 \] (5)

\[ \text{Skew}_3\% = \frac{a_3}{b_3} \times 100 \] (6)

Where \( a_1, a_2, a_3, b_1, b_2, \) and \( b_3 \), are defined in 8.4.5.
Record only the local skew corresponding to the highest local skew.
As given in Figure 10 the final result of the local skew is $\text{Skew}_2\%$ as it is superior to both $\text{Skew}_2\%$ and $\text{Skew}_3\%$.

Calculate again the results of two other weft yarns.

Record the local skew as the highest percentage of slope met on three weft yarns.

10. TEST REPORTS.

The test reports shall include the following:

a. a reference to this Tanzania Standard (i.e.…………………).

b. the identification of the tested woven fabric.

c. The procedure used to determine the line, either by
   - "marking the selected weft yarn" (see 8.2), or
   - "fraying the test specimen to expose the selected weft yarn" (see 8.3);

d. The positions of the test specimen where lines were determined regarding the beginning or selected end of the test specimen;

e. The result of the overall skew, if required;

f. The result of the local skew, if required;

g. When relevant, the weft bow (if required) (see A.1);

h. When relevant, the weft bow (if required) (see A.2);

i. Any deviation from the specified procedure likely to have influenced the result.
Annex;

WEFT BOW AND WARP BOW DETERMINATION.

1 Determination of weft bow
1.1. Procedure
1.1.1. Prepare the specimen as described in 8.2 or 8.3
1.1.2. Align the straight edge of the ruler across the fabric width with the points at which the selected weft yarn meets the fabric edges.
1.1.3. slide the set square gently along the ruler and record the greatest perpendicular distance $d$ between the weft yarn and the ruler to the nearest millimeter as shown in Figure A.1 or in figure A.2.

1.2 Expression of the result
Weft bow is expressed in mm as the distance $d$.

Key
$d$ distance

Figure A.1 – Measurement of the weft bow (general).
2 Determination of warp bow

2.1. Procedure

2.1.1. Place the ruler to form a chord 500 mm long to the curved surface as shown in figure A.3.

2.1.2. Gently slide the set square along the ruler and record the greatest perpendicular distance $d$ between the edge of the fabric and the ruler to the nearest millimeter.

2.2 Expression of the result.

Warp bow is expressed in mm as the distance $d$. 

Figure A.2 – Measurement of the weft bow (case of double bow).

Figure A.3 – Measurement of the warp bow.