Yarn Crimp in Fabric

Due to the interlacement of warp and weft thread, a certain amount of waviness is imparted to the warp and weft threads in a fabric. This waviness is called crimp.

- ✓ It can be in two direction like warp crimp and weft crimp
- ✓ Normally weft crimp is higher than warp crimp [As warp yarns work in group during fabric formation]
- ✓ It is expressed in percentage. For a normal fabric, warp crimp is about 3%, and weft crimp is about 5%

Mathematically, Crimp = $\frac{l-p}{p} \times 100\%$

Here, l = Straightened thread length

p = The distance between the ends of the thread while in cloth (crimped length or length in fabric)

For warp and weft crimp we can use suffix 1 and 2.

The Measurement of Crimp Percentage

From the definition of the crimp two values must be known. These are l and p. In order to straighten the thread, tension must be applied, just sufficient to remove all the crimps without stretching the yarn. The standardized tension as per British standards are given below-

Yarn	Count	Tension (gm)
Cotton	Finer than 7 tex	0.75 tex
	Coarser than 7 tex	0.20 tex + 4
Woolen and Worsted	15-60 tex	0.20 tex + 4
	60-300 tex	0.07 tex + 12
All Man-made continuous filament	All counts	Tex/2

The principle of yarn crimp determination is very simple. With a fine pen and a ruler, lines are drawn on a piece of cloth at a known distance. Some of the threads are raveled out, the yarns are straightened without stretching and the stretched length is noted and from that crimp is calculated. The difficulty lies in the straightening of the Year Without stretching it. To do this, the following three methods are available-

1. Straighten by hand; This is inaccurate since we do not know the force applied.

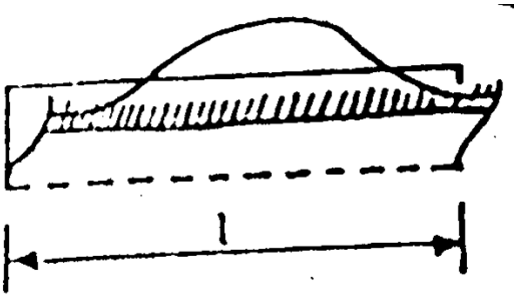
2. Straighten by a standard weight; This is satisfactory if we know what weight to use.

- Shirley Crimp Tester
- Digital Crimp Tester (Heal's Instrument)
- WIRA Crimp Tester etc

3. Determine the straightened length from the load-elongation curve; This is most accurate method.

Specimen Preparation:

Rectangular strips are carefully marked on the cloth and each strip is cut in the form of a flap. From each strip 10 threads will be removed. Normally, 3 strips in warp way and 3 strips in weft way are cut.

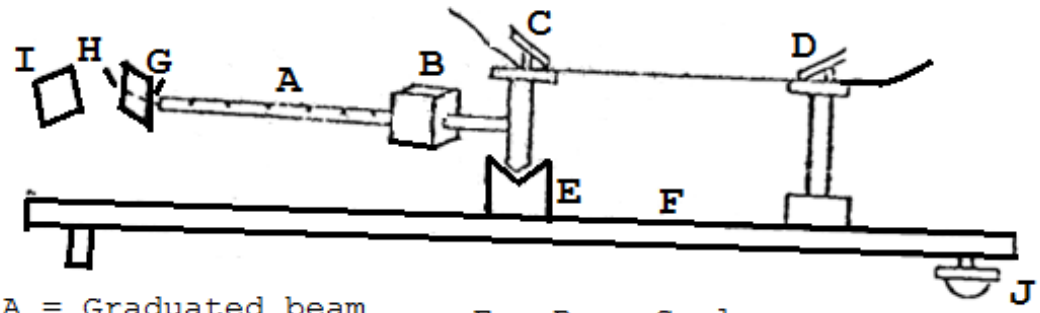


Removal of the Threads from the Flap:

The central part of the first thread is separated form the flap by means of a needle, but the two extreme ends are left secured. One end is then removed and place in the clamp of the tester and the other end is removed and placed in the second clamp. By this method, there will be no loss in the twist of the yarn and also due to minimum handling, there will be no stretch in the yarn.

Shirley Crimp Tester

The instrument consists of a scale fixed on a base. At one end of the base, V grooves are provided to support the balancing head and a mirror at the other end. At one end of the balancing head, a fixed clamp is provided and at its other end on the frame, index lines are marked. Another movable clamp is provided on the base and can be slide over the scale. Tension weight is provided on the balancing head to change the tension according to the yarn count. Tension scale is marked in two ranges, 0-35 gms and 0-175 gms.



A = Graduated beam
B = Tension weight
C = Fixed Jaw
D = Movable Jaw
E = V-Groove
F = Base Scale
G = Datum mark on the beam
H = Datum mark on the frame
I = Mirror
J = Levelling Screw

Fig: Shirley Crimp Tester

Procedure:

The counts of the warp and weft yarns are first determined and the correct tension is calculated. The sliding weight on the balancing head is adjusted to the required tension. The yarn sample si prepared as above and one end of the yarn is carefully inserted in the clamp such that the end of the yarn is in line with the rear edge of the clamp.

With the movable jaw set to a length somewhat less than the estimated length of the yarn, the other end of the yarn is inserted into it. The movable jaw is then moved slowly to the right until the index marks on the balancing head and the frame are in line. Then the length of the yarn corresponding to the red mark on the movable grip is noted from the base scale.

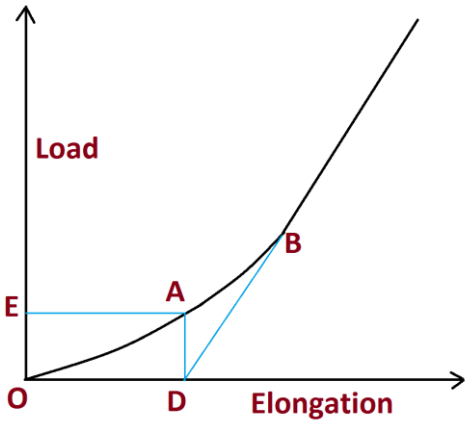
Then, the crimp can be calculated by putting l and p into the formula.

Digital Crimp Tester

Follow the link https://www.youtube.com/watch?v=bYtTLMSRYt8&t=336s

Load-Elongation Curve Method

Parallel ink lines are marked on a piece of cloth p distance apart. Five yarns are unraveled and one is tested at a time. The yarn is clamped at one of the ink spots and the yarn is allowed to hang vertically in front of the scale. A small clamp of known weight is hung on the yarn at the other ink spot. At this load, the elongation is read. Successively small loads are applied and the elongation at each new load is noted. Then a curve is drawn by taking the elongation value on the X- axis and the load values on the Y- axis.



C

In this curve, there is a curved portion OB and straight portion BC. The region OB represent the removal of the crimp. The region BC represent the stretch of the yarn. If there were no crimp, the curve would be all

the straight-line DC. Therefore, the distance OD represents the elongation of the yarn due to the removal of crimp. Then the original length P plus the value OD is the length of the yarn before weaving is equal to L. So, L = P + OD
Then, the crimp can be calculated by putting l and p into the formula.

Influence of Crimp on Fabric Properties

1. Thickness
2. Resistance to Abrasion
3. Shrinkage
4. Fabric behaviors during tensile testing
5. Faults in Fabric
6. Fabric Design
7. Fabric Costing
8. Let off and take up speed variation

Take up Percentage

Take up percentage or crimp rigidity is a measure of the ability of textured yarn to receive from stretch and is related to the bulking properties of the yarn.

Take up percentage, T= $\frac{l-p}{l}\times 100$

Where, T= Take up percentage.
l = ***L***ength of yarn before weaving.
p = ***L***ength of yarn in fabric after weaving.

Relation between Crimp % & Take up %

Crimp Percentage, C = $\frac{l-p}{p}\times 100$ ……*(1)*

& *Take up percentage,* T = $\frac{l-p}{l}\times 100$ ……*(2)*

From eq*ation* (1), $C = \frac{l-p}{p}\times 100$

=> $\frac{l-p}{p} = \frac{C}{100}$ ……*(3)*

=> $\frac{l}{p} - 1 = \frac{C}{100}$

=> $\frac{l}{p} = \frac{C}{100} + 1 = \frac{C+100}{100}$ ……*(4)*

From equation (2),

$$\Rightarrow \quad T = \frac{l-p}{l} \times 100$$

$$\Rightarrow \quad T = \frac{\frac{C}{100}}{\frac{C+100}{100}} \times 100 \qquad \textbf{\textit{[Using eauation (3) and (4)]}}$$

$$T = \frac{100C}{100+C}$$

Similarly, following equation can be developed

$$C = \frac{100T}{100-T}$$

These two are the equations on the relationship between Crimp% & Take up%

Mathematical Problems

1. To produce 5000 m of fabric with 3% warp crimp, how many yards of each warp yarn will require?

2. Let you have 24" × 20cm dimension fabric sample. Calculate the warp crimp and weft crimp when length of yarn is 62 cm and 21.1 cm respectively.

3. To produce 1500 yards of woven fabric having warp crimp 4% & weft crimp 6% of specification $\frac{114 \times 90}{20 \times 18} \times 56"$, how many cones of weft yarn will you require if the weight of each cone is 1.5 lb.

4. If the crimp% is 4.5% for warp of a fabric, then what will be its take up percentage.

5. Calculate crimp% and take-up% of woven fabric when its straightened length of yarn is 13 m and length of the warp yarn in fabric is 12.6 m.