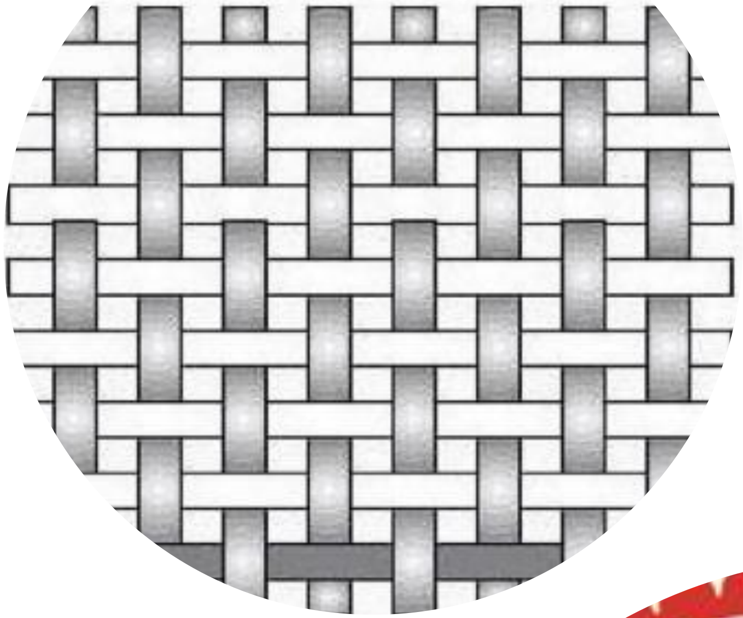
Fabric Manufacturing I (TXL231)



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Yarn Clearing: Objectives

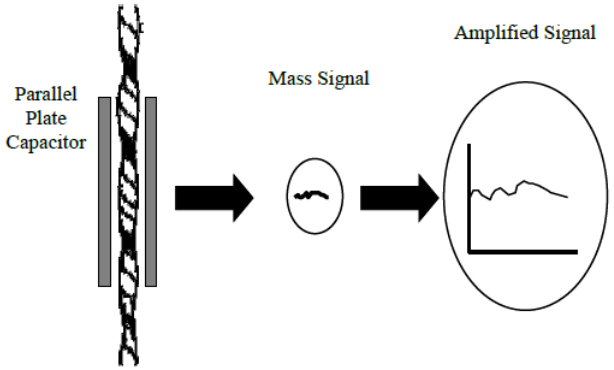
The objective of yarn clearing is to remove objectionable faults from the supply package

Can we clean all the faults?

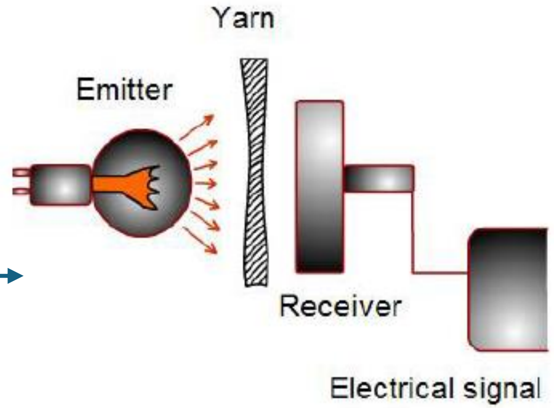
- Removal of yarn faults during winding is associated with the machine stoppages which reduces the machine efficiency
- When a yarn fault is removed, the yarns are joined again by the knotting or splicing operation which actually introduces a new blemish (we are not going to have the same strength as the original yarn)

How can we do it?

- Using capacitance



- Using optical measurement



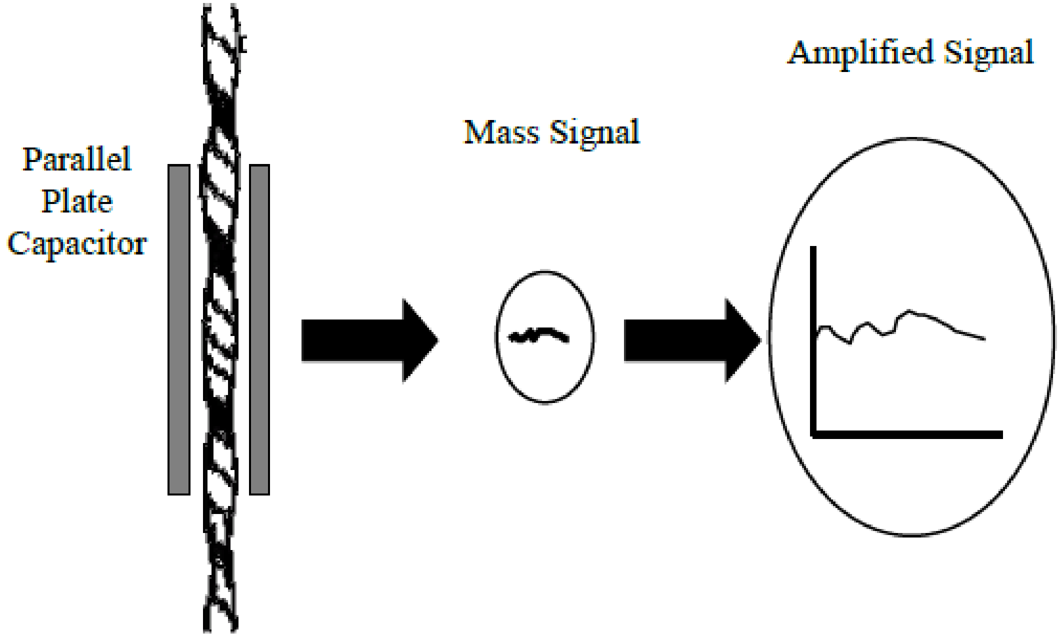
Yarn Clearing: Capacitive Measurement

The yarn is passed at a constant velocity through two parallel plate capacitors

Capacitance= C= $\varepsilon A/d = \kappa \varepsilon_0 A/d$

where A is the area of the places, d is the distance between the plates, ε is the permittivity of the medium present between the places, ε_0 is the permittivity of vacuum and κ is the dielectric constant of the medium

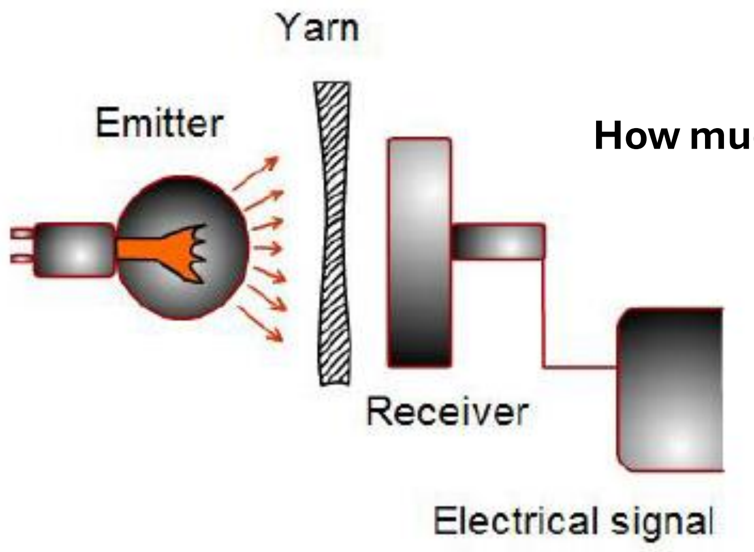
$$C = \frac{A}{\left(\frac{d_1}{\varepsilon_1} + \frac{d_2}{\varepsilon_2}\right)} = \frac{A\varepsilon_0}{\left(\frac{d_1}{k_1} + \frac{d_2}{k_2}\right)}$$



The dielectric constant of water is 80 whereas for textile fibres it is around 2-5 and for air it is nearly 1. Thus, the measurement is highly sensitive to the presence of moisture and therefore conditioning of samples in standard atmospheric conditions is of paramount importance

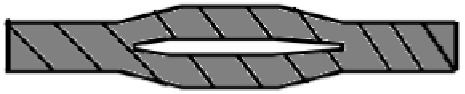
Yarn Clearing: Optical Measurement

The emitter emits light, and the receiver detects it and converts to proportional electrical signal. The light received by the receiver will obviously depend on the diameter of the yarn passing between emitter and receiver



How much deviation in measurement can we tolerate?- Mass is proportional to diameter^2

Although capacitance-based measurement is more accurate, if the fault is a low twisted region or a hole within the yarn structure and still exhibits same mass per unit length, capacitance type testers will not detect the yarn irregularity although there is a deviation in diameter that can produce fabric defects.



Yarn Imperfections

These blemishes occur very frequently in the spun yarns. However, they do not pose serious threat to the subsequent processes or fabric appearance. Frequently occurring faults are measured by yarn unevenness testers and expressed by the frequency of occurrences per km.

1) Thick places (mass exceeds by at least + 50% of the nominal mass)

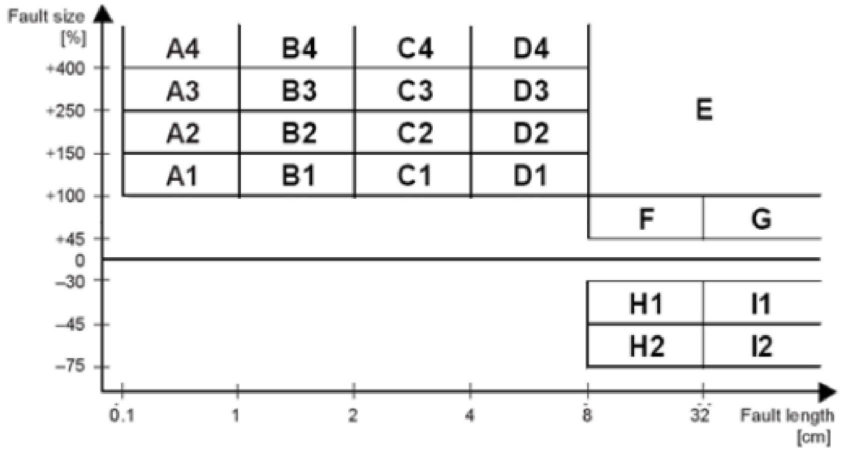
2) Thin places (mass is lower than by at least - 50% of the nominal mass)

3) Neps (mass exceeds by + 200% of the nominal mass with reference length of 1 mm)

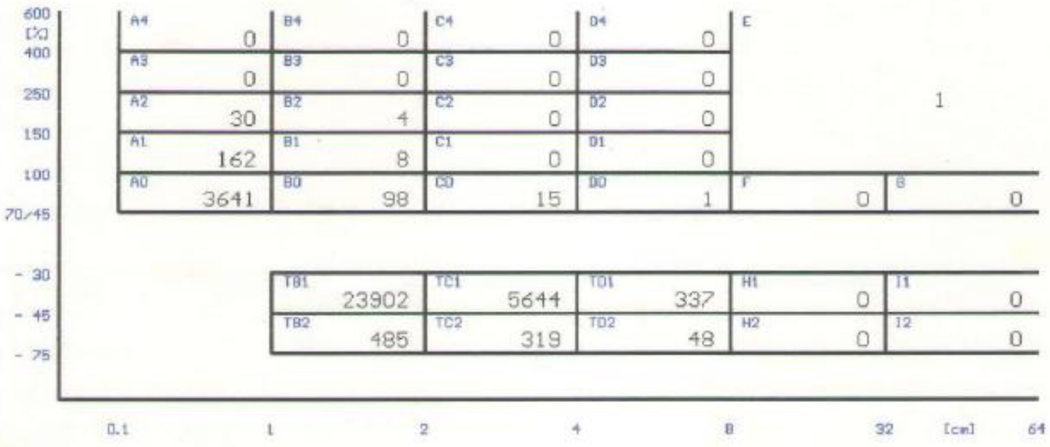
Yarn Faults

Yarn faults are seldom occurring mass variation in the yarn. They can adversely affect the running performance of the loom due to frequent breakage. Besides they can severely damage the appearance of the fabric. Yarn faults generally expressed by the number of occurrences per 100 kilometers.

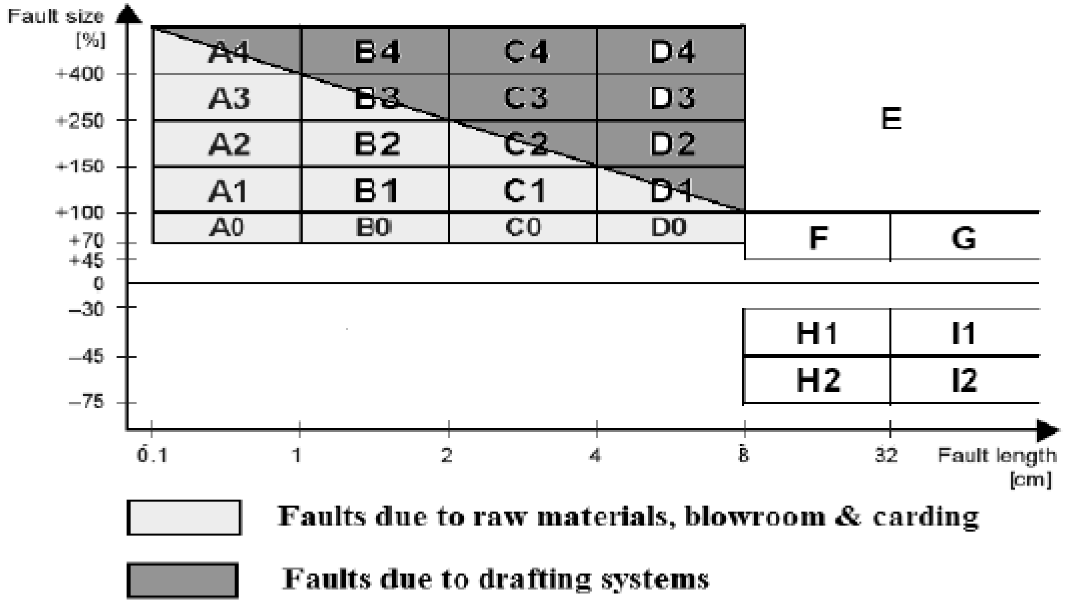
The Classimat III faults are classified under three major categories:
a) Short thick faults: A1 to D4
b) Long thick faults: E, F and G
c) Long thin faults: H1, I1, H2, I2

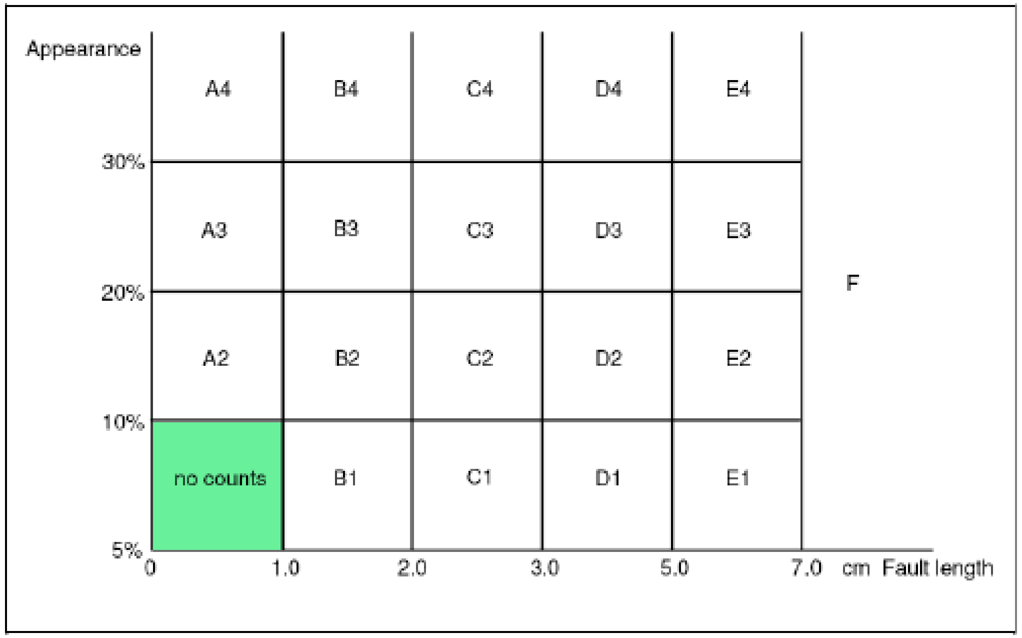


In addition to the 23 faults of Classimat III, there are 10 additional faults making up Classimat IV faults. These are as follows:
a) Very short thick fault (A0, B0, C0 and D0)
b) Short thin faults (TB1, TC1, TD1, TB2, TC2, TD2)



Yarn Faults

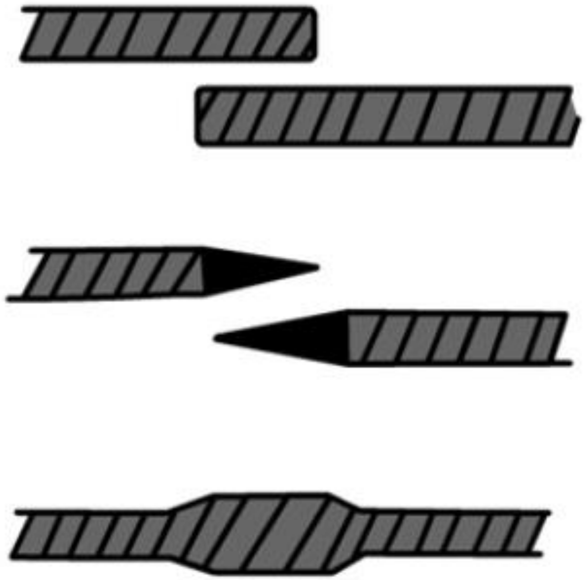




Identifying foreign fibres using Uster Quantum 2 (image analysis)

Splicing

Splicing is the process by which the two ends of yarns are joined



Robotic arms aided with air suction bring two ends of the yarns inside the splicing chamber

↓

compressed air is jetted to create turbulence inside the chamber so that the yarn is untwisted

↓

Some fibres are removed from the yarn ends to create wedge shape.

↓

Jetting of compressed air is done again to twist the two superimposed ends of yarns

$$\text{Retained splice strength (\%)} = \frac{\text{Strength in spliced yarn}}{\text{Strength in original yarn}} .100$$

$$\text{Splice breaking ratio} = \frac{\text{No of breaks in splice zone } (\pm 1 \text{ cm})}{\text{Total number of tests}}$$

Higher retained splice strength (85-90%) and lower splice breaking ratio imply good splicing performance

Splicing

The performance of a splicer is also evaluated by the parameters like clearing efficiency and knot factor (also known as splice factor)

$$\text{Clearing efficiency} = \frac{\text{Nunber of objectionable faults removed}}{\text{Total number of objectionable faults in yarn}} \times 100$$

$$\text{Knot factor} = \frac{\text{Total number of yarn clearer related breaks}}{\text{Number of objectionable faults removed}}$$

Higher clearing efficiency and lower splice factor (close to 1) signifies desirable performance of a splicer

Yarn Winding for Package Dyeing

Yarn packages intended for dyeing should have certain characteristics to facilitate uniform dyeing within and between the packages-

- For cotton yarn, the density of package should be around 0.35-0.40 g/c.c (Low density will ensure better penetration and flow of dye liquor across the yarn layers)
- Density variation within and between the packages should be less than ± 2.5%
- Dye package outer diameter variation should be ± 1mm

Some basic issues:

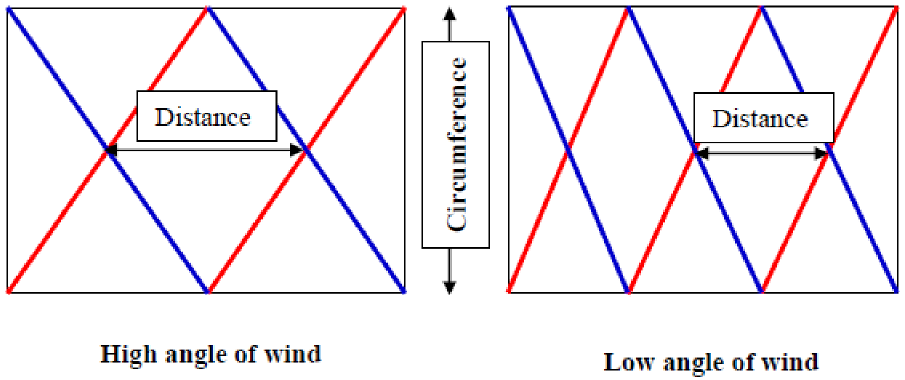
- Drum-driven random winders are not preferred for packages intended for dyeing due to patterning problem which may increase the package density drastically
- For precision winder, the angle of wind reduces as the package diameter increases. Thus, the package density increases towards the outer side of the package

Hence, digicone winders are the best for package dyeing

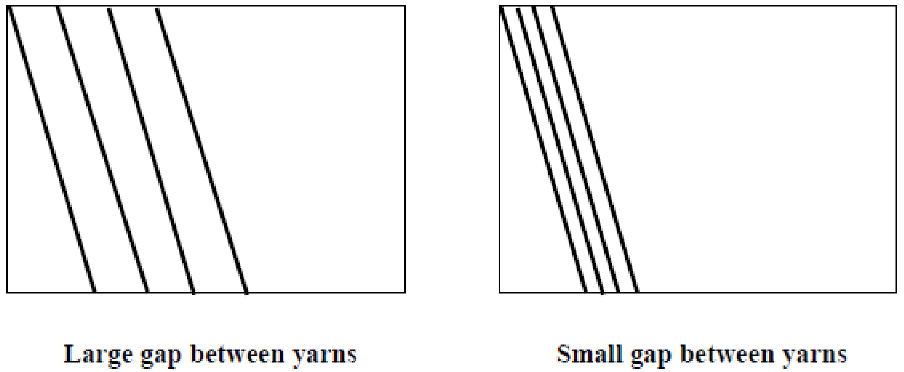
Yarn Winding for Package Dyeing

The density of the package can be varied by following ways:

- Changing the angle of wind
- Changing the distance between neighboring yarns within a layer
- Changing the pressure between the package and drum
- Changing the winding tension



Angle of wind and package density



Gap between yarns and package density