Manual Cotton Classification vs. HVI Test

Classification of Textile fibres

Based on source of raw material and its characteristics ..

1. Natural Fibres

➢ From natural resources

2. Man-made fibres

From chemicals (Refined petroleum) or From vegetable celluloses

Types of Natural fibres

- Vegetable fibres
  - Produced from plant material
  - Example: cotton, coir, hemp, jute
- Animal fibres
  - Produced from the insects (filament) or the hairs of the skin of the animals.
  - Example :Silk, Wool
  - Protein fibres (Regenerated fibres) extracted from animal sources (natural polymer)
- Mineral fibres
  - Obtained from mineral resources such as polyester, nylon, asbestos

Man made fibres

Two major groups as:

1. Regenerated fibres (Natural Polymer)
2. Synthetic fibres.

Regenerated fibres

- From raw materials such as trees or plants that make cellulose.
- Example: Rayon, Viscose, Acetate

Synthetic fibres

- From chemicals made from refined petroleum or natural gas. Examples: Polyester, Nylon

Fibre properties

Properties	Applicable to
Length	Natural/ Manmade
Length Distribution	Natural
Fineness	Natural/ Manmade
Strength (Tenacity)	Natural/ Manmade
Elongation %	Natural/ Manmade
Maturity	Natural
Trash	Natural
Colour	Natural
Absorbency	Manmade

Properties – Manual Classing

The quality of the cotton fiber is determined by three factors namely:

- Colour of ginned cotton,
- Purity, the absence of foreign matter and quality of the ginning process and
- Fiber length.

Cotton fibre

Properties

- Length
- Length Distribution

- Strength
- Elongation

- Fineness
- Maturity

- Trash
- Colour

Manual Classing

- Classification of cotton samples is based on official standards.
- Cotton classification is the process of describing the quality of cotton in terms of grade, staple length and micronaire.
- Grade classification is based on appearance through the sense of sight and hands, by integration of three factors of grade - colour, leaf and preparation in the sample; done by hands and the eyes in comparison with official standards or types.

Manual Classing: Colour

- The colour of cotton fibers is primarily determined by:
- conditions of temperature and/or humidity,
- cotton lint exposure to sunlight, and cotton varieties.
- Action by parasites or micro-organism,
- Technical defects in harvesting and subsequent storage and transportation

Manual Classing: Staple Length

- It involves both sight, touch and is made by pulling out and comparing a typical portion of fibres from a sample with the official type;

- The length of staple of any cotton shall be any length by measurement without regard to quality or value of a typical portion of its fibres

Length

- Length -

Important for determining yarn quality
(Finer yarn or coarser yarn ?)

- Fibre will not be uniform even within the fibre boll
- Vary according to nature of soil, climatical condition, and period of cultivation

the length of the longest fibre ?

Or

the length of the shortest fibre ?

Cont.

- The length is determined by a classer through pulling a tuft of fibres, lapping, discarding, parallels them and by comparing with a pull from the official staple type which most nearly corresponds with the length of the sample;
- Classers may make the pulls in their own individual ways consistently or by imitation of methods used by others;

1.Staple Length

Manual estimation

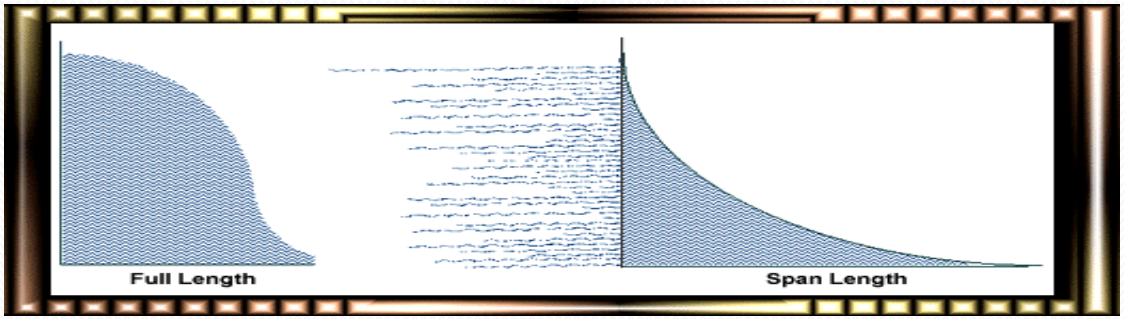
by the 'hand stapling' process. performed by an experienced person called the **classer**

Instrumental estimation

by **Stable diagram** in which fibres are aligned end to end

2.Span length

a specific percentage of fibres extending from a random catch point



Inaccuracies in Stapling Cotton

- Lack of knowledge of the official staple types;
- Erratic stapling, as well as the tendency to class too hard or too easy resulting from unfamiliarity with the standards;
- Tendency to omit certain length such as classifying cottons in 16^{th} largely ignoring 32^{nd} of an inch;
- Tendency to class all staples towards familiar length

Manual Classing: Purity

Leaf grade and extraneous matter

- Leaf grade describes the leaf or trash content in the cotton. (waste such as leaves or earth) is of the utmost importance.
- There are seven official standards of leaf grades for American upland cotton designated as "Leaf Grade 1" through "Leaf Grade 7".
- In addition, there is a descriptive "Below Leaf Grade Cotton" that is lower in leaf grade than Leaf Grade 7.
- Leaf grade, preparation, and extraneous matter determinations are made by cotton classers.

Pricing

- Classification is essential to the cotton pricing systems, but additional testing is required for high level quality control in textile production.

Instrument Testing

- HVI instrument was developed to measure most fiber properties. Its classification system currently consists the measurements for fiber length, length uniformity, strength, micronaire, trash and color.
- Instrument testing of cotton worldwide is gradually replacing hand classing, and the world cotton industry is in process of adopting standard systems and procedures for the operation of cotton testing centres;
- The industry demands for objective and reliable cotton fibre test results are increasing rapidly and major cotton importing countries are integrating instrument based data in trade;

Instrument testing

- Since 1991, US cotton classification has relied on instrumental measurements (High Volume Instruments (HVI));
- Either China, India and Pakistan are developing very fast in cotton production and investing heavily on the instrumental cotton classing system (HVI line) for their cotton.
- This means that, cotton with insufficient verification of its quality will result in price discounts for the producers or exclusion from the market.

Reasons for Testing Cotton

- To buy cotton varieties/bales fitting to envisaged yarn quality;
- To optimise bale lay-downs based on results for every single bale;
- To assure sufficient quality of cotton as the input material during the whole processing time;
- To optimise machine settings based on maximum possible information

HVI testing: Fiber length

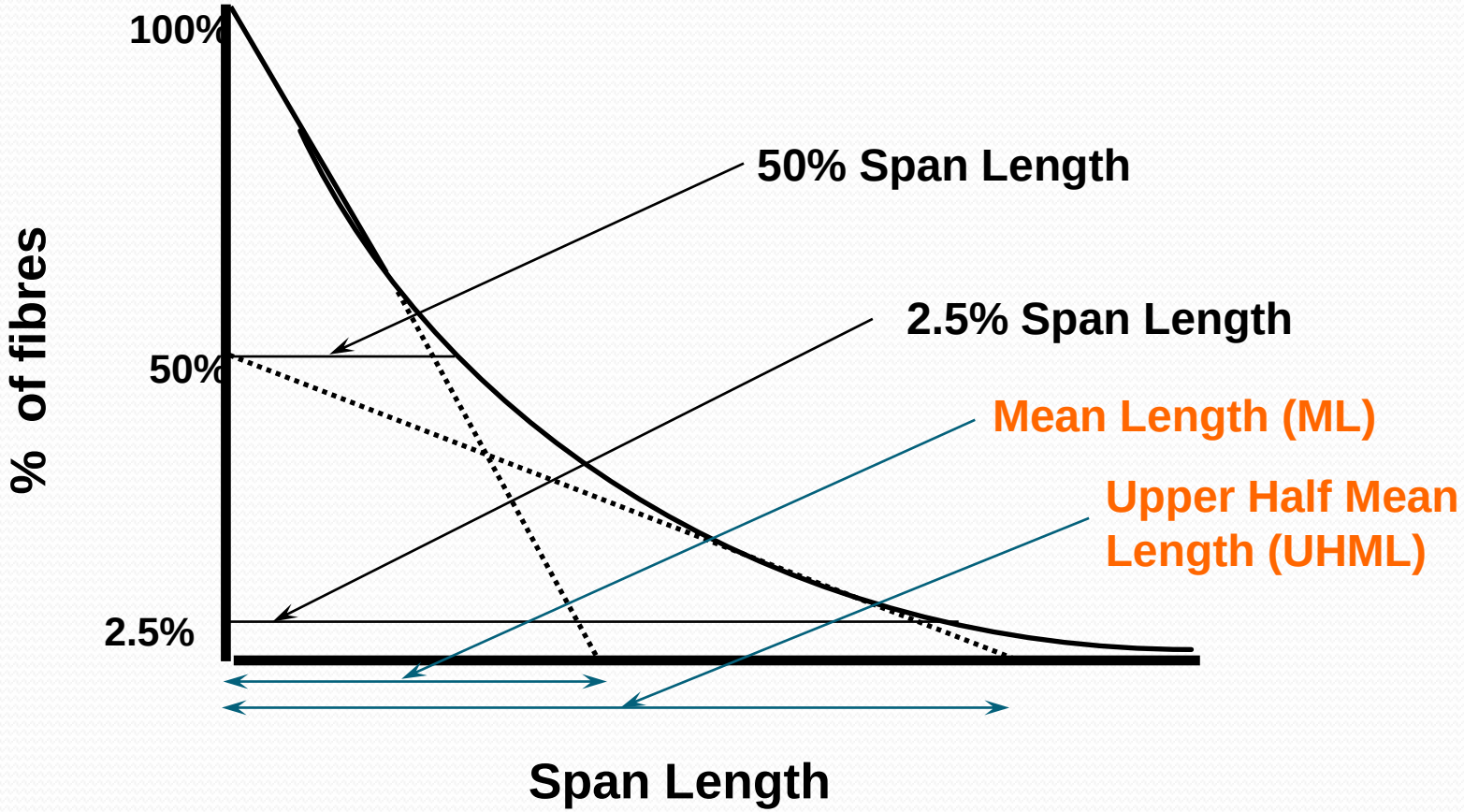
- Fiber length is defined as the average length of the longer one-half of the fibers (upper half mean length).
- Fiber length is basically an inherited / genetically character of the seed variety.
- However, weather, nutrient deficiencies, as well as excessive cleaning and /or drying at the gin may also affect the fiber length.
- Affect yarn strength and evenness, and the efficiency of the spinning process, the length of the fiber has a great influence on quality and price.

Cont.

- If all the fibers in the sample were of the same length, the mean length and the upper half mean length would be the same, and the uniformity index would be 100.
- The following tabulation can be used as a guide in interpreting length uniformity results. Measurements are performed by HVI. Cotton with a low uniformity index is likely to have a high percentage of short fibers and may be difficult to process

Span length

- Fibrogram



Different length mode

ICC Mode -(Length Parameters)

2.5 % Span Length

50% Span length

Uniformity Ratio

HVI Mode-(Length Parameters)

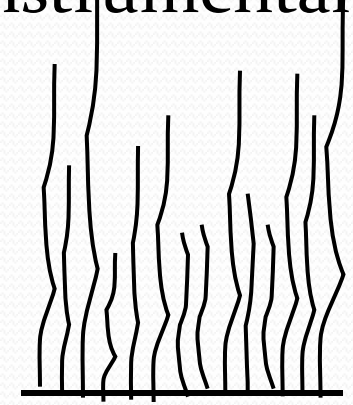
Upper Half Mean Length

Mean Length

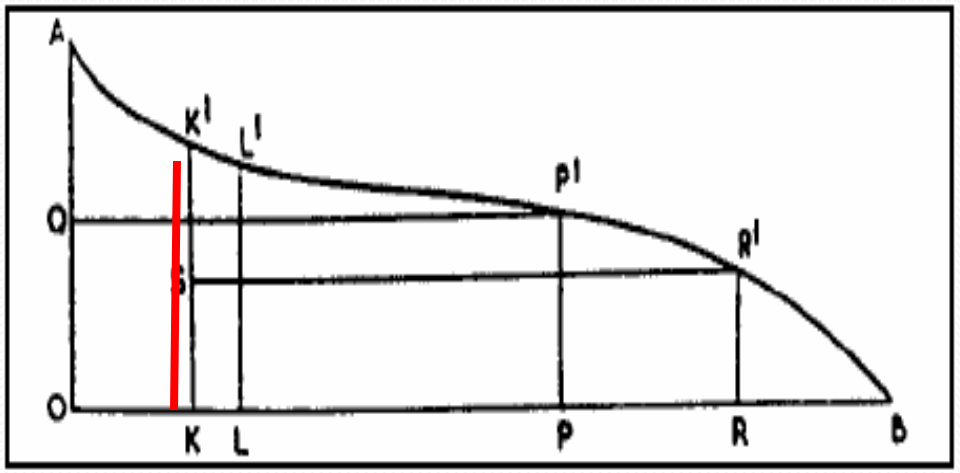
Uniformity Index

Staple length

- Instrumental estimation



End Aligned Sample



In the above figure,
OQ = OA/2
OK = OP/4
KS = KK'/2
OL = OR/4
LL' represents the Effective length
(Correlates with staple length by the classer)

HVI testing: Uniformity

- Length uniformity is the ratio between the mean length and the upper half mean length of the cotton fibers within a sample.
- It is measured on the same beards of cotton that are used for measuring fiber length and is reported as a percentage. The higher the percentage, the greater the uniformity.

Length distribution

- Higher length variability results in a number of 'floating' fibres in the drafting zone which ultimately deteriorates the yarn quality.
- Length variability can be measured from Fibro gram diagram

$$\text{Uniformity Ratio (UR)} = \frac{\text{50\% Span Length}}{\text{2.5\% Span Length}} \times 100\%$$

$$\text{Uniformity Index (UI)} = \frac{\text{Mean Length}}{\text{Upper Half Mean Length}} \times 100\%$$

- Recommended Uniformity for spinning process

Classification	Uniformity Index	Uniformity Ratio
Good	85	50
Average	82	45
Low	80	43

HVI testing: Fiber Strength

- The fiber strength measurement is made by clamping and breaking a bundle of fibers from the same beards of cotton that are used for measuring fiber length.
- Results are reported in terms of grams per tex (a tex unit is equal to the weight in grams of 1,000 meters of fiber).
- It expresses the force required to break a bundle of fibers one tex unit in size..

Fiber Strength Table

Descriptive Designation	Strength (grams per tex)
Weak	23 & below
Intermediate	24 – 25
Average	26 – 28
Strong	29 – 30
Very Strong	31 & above

Fibre Fineness

Fibre Fineness

Expressed as the mass of a given length-
(micro grams/inch)

Influences the number of f
section of yarn.

Dye ability of the yarn/fabric
Impact on process parameters ,imperfections, strength

Variation within a mixing (bales) should be below 10%.
Bare effect if more variation

Principle of measurement----
the rate of airflow through a specimen

Fineness

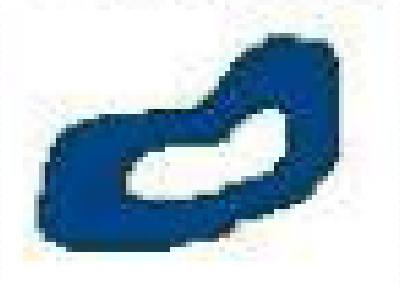
- Rating of fineness of given fibre for spinning

S.No	Type	Range
1	very fine	Below 2.9
2	Fine	2.9 -3.7
3	Medium	3.8-4.6
4	Coarse	4.7- 5.5
5	very Coarse	5.6 and above

Maturity

- The maturity of cotton is defined in terms of the development of the cell wall

Fully mature



Half mature

immature

Maturity measurement

Sodium Hydroxide Swelling Test

High Volume Fibre Testing Instruments

Maturity

When Cotton fibres are swollen in 18% NaOH solution , observed under a microscope

a. Maturity Ratio (M) = ((N-D) / 200) + 0.7

N = % of Normal , D = % of Dead fibres

Or

b. Maturity coefficient (Mc) = (M + 0.6H + 0.4I) / 100

M = % of Mature fibres, H = % of Half mature fibres I = % of Dead fibres

- Sodium Hydroxide Swelling Test
- High Volume Fibre Testing Instruments

  Using compression technique, Maturity Ratio(MR) is derived from the formula. Optical techniques which is are yet to gain complete worldwide acceptance

Maturity

- Rating of maturity value to select for spinning processing

Classification	Maturity coefficient	Maturity Ratio
Immature	Below 0.65	Less than 0.8
Average	0.75	0.80 - 0.85
Mature	0.80	0.85-1.0
very mature		Above 1.0

Colour

- Cotton grading

based on the appearance Considering the colour, leaf and trash.

Dyeablity of the finished product
More colour variation shade variation

- Measured by

Manually by classer

Good middling, Strict middling, Middling

<u>High Volume Instruments</u>

(Rd) =Whiteness

(+b) =Yellowness.

Recommended for spinning process are

Colour	within mixing	between mixings
Rd +b	2.5 , +/- +/- 1.0,	+/-1.0 +/- 0.5.

Trash

- Trash

Leaf bits, broken seed coats, micro dust etc

- measured by

Gravitational method (mechanical methods)

Through Shirley analyzer instrument, Trash separated from cotton

Expressed on % of weight proportion.

Most mills are using this method

Video analysis method

% of Trash area and numbers of trash particles can be measured.

Not popular in application part

Moisture Content

- **Moisture Content**

the amount of water present in the cotton

strength increases proportional to the moisture %.

Higher moisture content causes Realization loss and Trash will not drop in blowroom & carding

Moisture content %	Classification
Below 4.5%	Very low
4.5% -6.75%	low
6.75-8.25%	Norms/standard
8.25%- 10%	High
10% and above	Very high

Measured by

Moisture meter

High volume Instruments

Cont.

- Instrument testing classing / for trading is meant to give objective and reliable information about cotton quality;
- Only those reliable enough parameters may be tested for trading, and
- The results have to be given on the internationally accepted level (based on Universal Standard material) and have to show variability small enough to fix properties in trade contracts;

Fibre Quality Measurements

- Stand alone test instruments share are decreasing drastically for all properties and its being taken by more complex instruments like AFIS and HVI;
- AFIS and HVI are able to measure different properties at the same time;
- Have higher automation of fibre handling to reduce influence of testers;

Testing Reliability

- Measuring and testing procedures are always subject to certain, mostly unknown uncertainty factors. The job of statistics is to make these concrete and minimize them;
- By its nature, textile material exhibits greater or lesser variations that can be influenced by different stages in the production process.
- Statistical calculations are thus necessary to be able to assess the meaningfulness of test results.

Testing Reliability

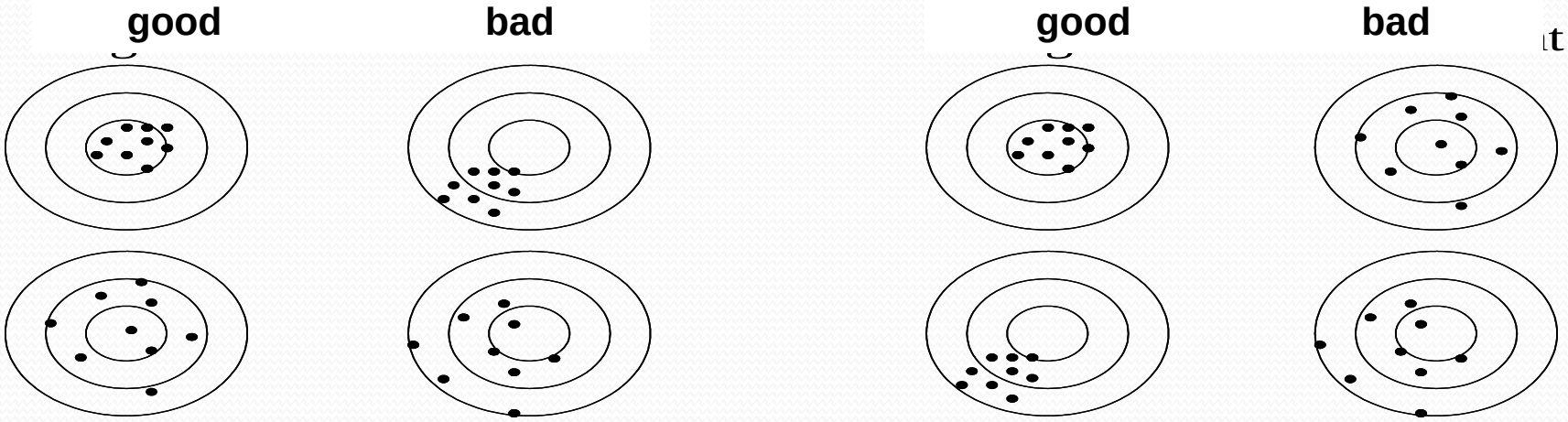
- To achieve reliable results there must be a universal standardisation and harmonisation for instrument testing for cotton;
- The prerequisite is to allow measuring every single bale by high volume testing to reduce the necessary control limits of the properties;

Testing Reliability

Measurement inaccuracy
Accuracy

Trueness | **Precision**

vom wahren Wert



Summary – 1

- Cotton classing is inevitably shifting to instrument testing
- But manual classing is still important
  - For determination of leaf content and foreign matter
  - For getting a complete impression about the cotton
- Due to the current changes in the global cotton business we have to go along with the changes in order to avoid disadvantages

Summary – 2

- Instrument testing is reducing subjective influences
- For instrument testing the labs have to care about the reliability
- The RTC East will help technically all labs within the region to fulfil the requirements

- Thank you for your attention