USTER® HVI SPECTRUM

The fiber classification system

USTER® HVI SPECTRUM – What does the data mean?

Common test results in Upland cotton

February 2004

USTER®
Think quality

Contents

1 HVI Test Results

USTER® *HVI SPECTRUM* test results are explained in this section. Data ranges are given, with the objective of providing users with information for what to expect in their results.

Table 1.1 below lists the different test results that can be obtained with the USTER® *HVI SPECTRUM*. It also shows the type of format being used (the number of decimals displayed), and the abbreviations used in the printout.

Test Result	Format	Abbreviation
1. Spinning Consistency Index	**XXXX**	SCI
2. Micronaire	**X.XX**	Mic
3. Maturity Index	**X.XX**	Mat
4. Upper Half Mean Length	**(in) X.XXX** **(mm) XX.XX**	Len
5. Uniformity Index	**XX.X**	Unf
6. Short Fiber Index	**XX.X**	SFI
7. Strength	**XX.X**	Str
8. Elongation	**XX.X**	Elg
9. Moisture	**XX.X**	Moist
10. Reflectance	**XX.X**	Rd
11. Yellowness	**XX.X**	+b
12. Color Grade	**XX-X**	C Grade
13. Trash Count	**XXX**	Tr Cnt
14. Trash Area	**XX.XX**	Tr Area
15. Trash Grade	**XX**	Tr Grade
16. Fluorescence	**XXXXX**	UV
17. Neps	**XXXX**	Nep

Tab. 1.1 HVI Test Results, Format & Abbreviations

1.1 Spinning Consistency Index (SCI)

The Spinning Consistency Index is a calculation for predicting the spinnability of the fiber. A multiple regression equation can provide valuable information to anticipate the yarn strength and spinning potential. The regression equation uses most of the individual HVI measurement results to calculate the SCI. This index can be used to simplify the category system used in the cotton warehouse. In general, the higher the index the higher the yarn strength and the better the overall fiber spinnability.

The equation for the SCI value is:

SCI = -414.67 + 2.9 x Strength – 9.32 x Micronaire + 49.17 x Length (“) + 4.74 x Uniformity + 0.65 x Rd + 0.36 x +b

The individual contributions of each fiber property can be adjusted to specific mill applications, based on the customer’s experience.

1.2 Micronaire (Mic)

A fiber sample of constant weight is measured by passing air through the fibers and measuring the drop in pressure. The micronaire scale has been established empirically with a standard set of cottons and is not linear. Other factors such as fineness and maturity have an influence on micronaire results.

Micronaire	Description
Less than 3.0	Very fine
3.0 to 3.6	Fine
3.7 to 4.7	Medium
4.8 to 5.4	Coarse
5.5 and higher	Very coarse

Tab. 1.2 Micronaire Ranges for Upland Cottons

1.2.1 Maturity Index (Mat)

The maturity index is a relative value that is calculated using a sophisticated algorithm including other HVI measurements, such as micronaire, strength and elongation. It indicates the degree of cell wall thickness within a cotton sample. The HVI Maturity Index correlates very well to the AFIS Maturity Ratio and the reference method of microscopy (cross-sectional analysis).

Maturity Index	Description
Below 0.75	Uncommon
0.75 to 0.85	Immature
0.86 to 0.95	Mature
Above 0.95	Very mature

Tab. 1.3 Maturity Ranges

1.3 Length

1.3.1 Upper Half Mean Length (Len)

The by weight measurement of the Upper Half Mean Length is calculated from the fibrogram. A fiber beard of randomly clamped fibers is scanned optically across its length and the fibrogram is derived from it. The Upper Half Mean Length corresponds to the classer's staple length as well as to the AFIS Upper Quartile Length by weight. Please note that a length range is assigned in inches for each length staple or code. The ranges calculated in millimeters do not line up exactly due to the conversion calculation. However, inches or 32nds are mainly used for staple length determination in the international cotton trade, and are therefore binding.

Inches	UHML [inches]	UHML [mm]	Code (32nds)
<13/16	<0.79	<20.1	24
13/16	0.80 – 0.85	20.1 – 21.6	26
7/8	0.86 – 0.89	21.8 – 22.6	28
29/32	0.90 – 0.92	22.9 – 23.4	29
15/16	0.93 – 0.95	23.6 – 24.1	30
31/32	0.96 – 0.98	24.4 – 24.9	31
1	0.99 – 1.01	25.1 – 25.8	32
1 1/32	1.02 – 1.04	25.9 – 26.4	33
1 1/16	1.05 – 1.07	26.7 – 27.2	34
1 3/32	1.08 – 1.10	27.4 – 27.9	35
1 1/8	1.11 – 1.13	28.2 – 28.7	36
1 5/32	1.14 – 1.17	29.0 – 29.7	37
1 3/16	1.18 – 1.20	30.0 – 30.5	38
1 7/32	1.21 – 1.23	30.7 – 31.2	39
1 1/4	1.24 – 1.26	31.5 – 32.0	40
1 9/32	1.27 – 1.29	32.3 – 32.8	41
1 5/16	1.30 – 1.32	33.0 – 33.5	42
1 11/32	1.33 – 1.35	33.8 – 34.3	43
1 3/8	>1.36	>34.5	44

Table 1.4 Staple Length Ranges and Conversions – Upland Cotton

1.3.2 Uniformity Index (Unf)

The Uniformity Index expresses the ratio of the Mean Length to the Upper Half Mean Length. It is an indication of the distribution of fiber length within the fibrogram.

Uniformity Index = Mean Length / Upper Half Mean Length

Uniformity Index	Description
Below 77	Very low
77 to 80	Low
81 to 84	Medium
85 to 87	High
87 and higher	Very high

Tab. 1.5 Uniformity Ranges

1.3.3 Short Fiber Index (SFI)

The Short Fiber Index is a value that is calculated using a sophisticated algorithm. The fibrogram is mathematically converted to a length distribution curve. The SFI is an indication of the amount of fibers (%) that are less than 0.5 inch (12.7 mm) in length. It correlates very well to the AFIS Short Fiber Content by weight (SFC w).

Short Fiber Index	Description
Below 6	Very low
6 to 9	Low
10 to 13	Medium
14 to 17	High
18 and higher	Very high

Tab. 1.6 Short Fiber Index Ranges

1.4 Strength (Str)

The bundle strength is the breaking strength of the cotton fibers in grams per tex. The fineness is calculated from the micronaire value. The fiber beard is broken at a continuous deformation rate (CRE = Constant Rate of Extension) and with a 1/8-inch distance between the clamps.

Strength (grams/tex)	Description
Less than 21	Very weak
22 to 24	Weak
25 to 27	Medium
28 to 30	Strong
31 and higher	Very strong

Tab. 1.7 Strength Ranges for Upland Cottons

1.4.1 Elongation (Elg)

Elongation is a measurement of the elastic behavior of the fibers in the bundle. The fibers are clamped in the bundle with a 1/8-inch distance between the clamps. The first pair of clamps is stationary, and the back pair of clamps is pulled away at a constant rate. The distance the fibers extend before they break is recorded and expressed as a percent elongation. For example, if you were to measure 50% elongation, the fibers would have extended 1/16th of an inch before breaking. Below is a table describing ranges of actual elongation values in cotton fibers.

Elongation	Description
Less than 5.0	Very low
5.0 to 5.8	Low
5.0 to 6.7	Medium
6.8 to 7.6	High
7.7 and higher	Very high

Tab. 1.8 Elongation Ranges

1.5 Moisture (Moist)

Moisture is the amount (%) of water (H_2O) that is present in the sample being tested. Moisture in the cotton varies with time, temperature and humidity to which the samples have been exposed. Consistent moisture is necessary to maintain HVI test results on the same level of accuracy and precision. Best precision and accuracy are obtained with an average sample moisture of 6.5% – 8%.

Moisture	Description
Below 4.5	Very low
4.5 to 6.5	Low
6.5 to 8.0	Medium
8.0 to 10.0	High
10.0 and higher	Very high

Tab. 1.9 Moisture Ranges

1.6 Color

1.6.1 Reflectance (Rd)

This value expresses the whiteness of the light that is reflected by the cotton fibers. It corresponds to the reflectance (Rd) represented in the Nickerson/Hunter color chart. It is used in conjunction with the yellowness (+b) to determine the instrument-measured color grade of the cotton.

1.6.2 Yellowness (+b)

This value expresses the yellowness of the light that is reflected by the cotton fibers. The yellowness (+b) of the sample is determined by using a yellow filter. It corresponds to the +b value represented in the Nickerson/Hunter color chart. The yellowness is used in conjunction with the reflectance (Rd) value to determine the instrument-measured color grade of the cotton.

1.6.3 Color Grade (C Grade)

The color grade of a cotton sample is determined in a two-filter colorimeter. This objective method was developed by Nickerson and Hunter in the early 1940's to check the USDA cotton grade standards. Today, it is intended to completely replace the subjective visual grade determined by the cotton classer.

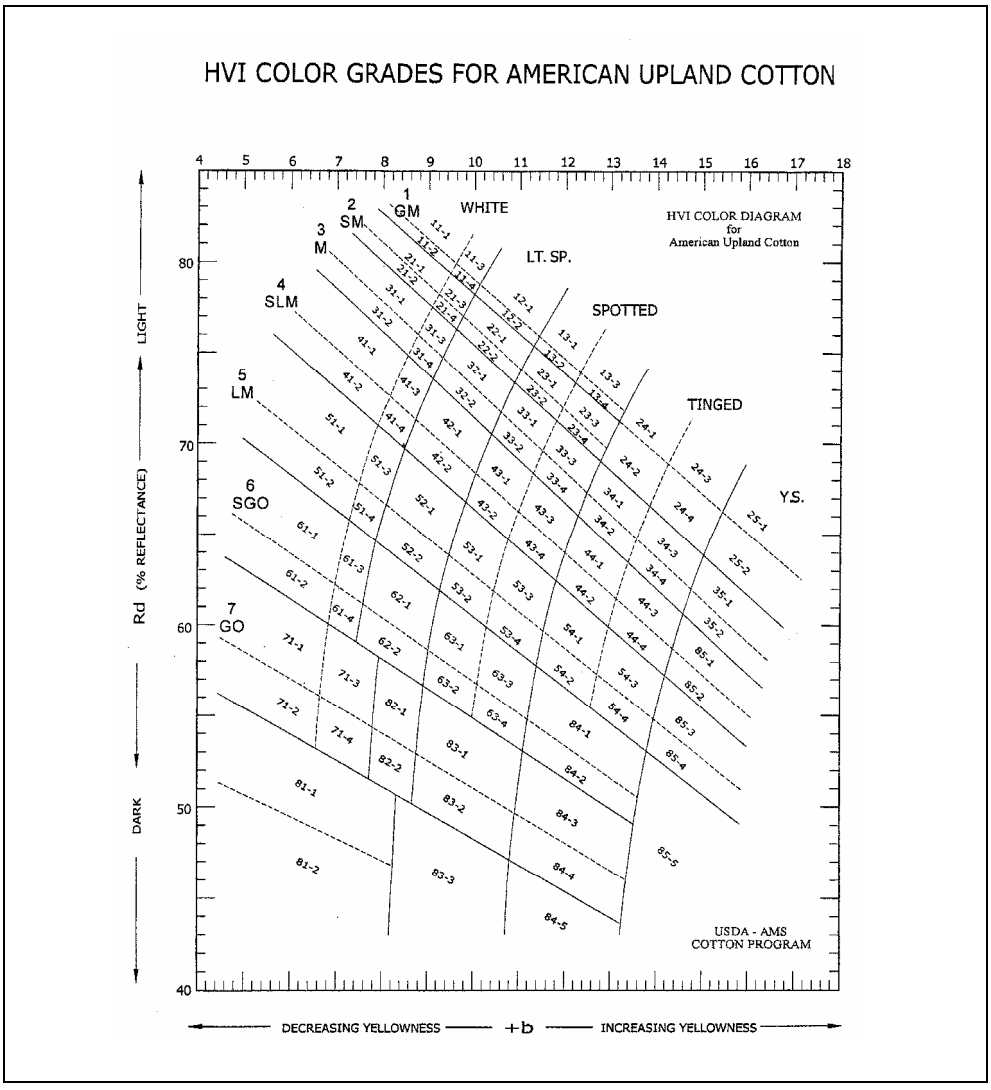

Fig. 1.1 USDA Color Grade Chart for Upland Cottons, 1999

1.7 Trash

1.7.1 Trash Count (Tr Cnt)

Trash is measured on the same glass window as the color measurement. The sample is illuminated from underneath the glass window, and a black and white CCD camera analyzes the changes in pixels. A trash particle is counted if it exceeds the grayness threshold set in the camera. All particles that cover the glass window are counted one by one, and the results are expressed in trash particle counts per surface area.

1.7.2 Trash Area (Tr Area)

The area that is covered by a trash particle is measured at the same time the particle is counted. The area that is covered by a single particle is summed up with all areas of the other particles counted on the surface of the glass window. The result is expressed in relation to the entire measuring area of the glass window and is expressed as “% Area”.

For example, a small number of trash counts can result in a high % Area values if the particles are large. On the contrary, a high number of particle counts with a small % Area value indicates the trash is smaller in size (pepper trash, for example).

1.7.3 Trash Grade (Tr Grade)

This is the trash or leaf grade that is determined by calibrating the HVI with known samples (i.e., trash standards). These samples are usually numbered from 1 to 7 with increasing amounts of trash as the number gets larger. The standards used for calibration can be supplied by the USDA or established by the official cotton standards agency in any cotton producing country.

1.8 Fluorescence (UV)

Fluorescence (UV) is the number of ultraviolet light waves that are reflected from the cotton sample measured by a photocell. The measurement does not have any units and is intended to provide a level of UV for comparison purposes. The fluorescence is greatly affected by the weather conditions at the time of cotton harvesting. Fluorescence also increases over time on cotton that is stored over several months.

1.9 Neps (Nep)

Neps are the number of fiber entanglements that are measured in the cotton sample. The amount of neps in raw cotton depends on the cotton origin or variety and harvesting method. They are created by any mechanical treatment of cotton fibers such during picking, ginning, opening and cleaning. Results are reported in neps/gram on a weight basis. The results correlate highly with the USTER® *AFIS* Nep measurement.

Neps/g	Description
<100	Very low
101 – 200	Low
201 – 300	Medium
301 – 450	High
>451	Very high

Tab. 1.10 Ranges of Neps in Raw Cotton (Upland)

Uster Technologies AG
Wilstrasse 11
CH-8610 Uster / Switzerland

Phone +41 1 943 38 88
Fax +41 1 943 38 38

www.uster.com
sales@uster.com

USTER® Think quality