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UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL MARKETING SERVICE

COTTON DIVISION

EVALUATION OF INSTRUMENT CLASSING OF COTTON

LUBBOCK, TEXAS

CROP OF 1976

STANDARDS SECTION
MEMPHIS, TENNESSEE

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Copies of this report are available on request from the Standards Section, Cotton Division, Agricultural Marketing Service, U. S. Department of Agriculture, 4841 Summer Avenue, Memphis, TN 38122.

Evaluation of Instrument Classing of Cotton
Lubbock, Texas, Crop of 1976

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Testing Section

Results for tests made on the High Volume Instrument Classing System for cotton in Lubbock during the 1976-77 season continue to indicate that the instruments provide a good measure of cotton quality and show a close relationship with processing tests.

Introduction

Development of high volume instruments and a practical system for measuring cotton quality began in 1967. Research on this project is performed by the Cotton Quality Research Station, Agricultural Research Service at Clemson, South Carolina and field trial evaluations are done by the Cotton Division, Agricultural Marketing Service.

Evaluation of the High Volume Instrument (HVI) System in essentially its present form was started in Raleigh, North Carolina in 1973. A large scale field trial of the system was made at Raleigh during the 1973-74 season. That trial was made to evaluate the system simulating an actual "production" situation during the 1973-74 season. A report on the field trial was made in November 1974.1/ That report indicated an average daily production rate of 650 samples for one instrument system with a crew of four technicians and one line loader. Results from that study indicated the various instruments to have a good repeatability. That report also showed the instrument readings to have a fairly close relationship with spinning test results.

The HVI system was operated in Raleigh, North Carolina for three consecutive seasons and was then moved to Lubbock, Texas in 1976. Lubbock was selected as the site for further evaluation of the system because of the wide range of cotton qualities available in that area.

Eight gin communities around Slaton, Texas were selected to participate in this project and approximately 265 cotton producers were involved. Each of the eight gins were visited and all agreed to cooperate in the project. The gins selected are shown below:

Caprock Gin, Ralls, Texas
Farmers Gin of Slaton, Slaton, Texas
McClung Cooperative Gin, Slaton, Texas
Posey Gin Inc., Slaton, Texas
Robertson Gin, Lorenzo, Texas
Slaton Cooperative Gin, Slaton, Texas
Southland Gin, Southland, Texas
Union Cooperative Gin, Slaton, Texas

These gins were picked to represent a wide range of cotton varieties grown on the South Plains of Texas under various cultural, harvesting, ginning and marketing practices.

Before starting the project at Lubbock in the 1976-77 season, several improvements were made in the HVI system. These improvements included: (1) overhauling and updating circuitry, (2) installing a high speed printer, (3) installing card reader/printers on each of the two lines, (4) installing a magnetic disk storage system, (5) increasing memory capacity of computer, and (6) installing new computer software.

1/ Evaluation of the Motion Control Test System, Crop of 1973, USDA, AMS, Cotton Division, November 1974.

Two HVI lines were operated in Lubbock during the 1976 season. Each line consists of three stations placed on a thirty-foot conveyor belt (Figure 1). The stations and belt are controlled by a small computer.

The first station is the micronaire instrument (Fibronaire) which measures fiber fineness. The mike readings reported from this instrument are the same as those used in cotton classification.

The second station is the length/strength analyzer. The length instrument measures upper half mean length and length uniformity. Length is expressed in hundredths of an inch and uniformity is measured as an index of the mean/upper half mean length ratio. The strength gage measures the strength of cotton fibers at 1/8 inch gage length in terms of grams force per tex.

The third station contains the color meter for measuring the color of the cotton samples in terms of grayness and yellowness. The color meter operator also visually determines the trash and condition (grass, bark, etc.) of the cotton.

Instrument readings are fed automatically into the computer as they are made. The classification card is placed into a card reader-printer which reads the gin bale number and prints test results on the card. The computer averages the instrument readings and checks the validity of the results. A high-speed printer prints daily and weekly list-outs of results for each bale in numerical order by gin.

Procedure

Two HVI lines were operated in the Cotton Division's Lubbock, Texas Classing Office during the October-January period of the 1976-77 harvesting season. Four technicians were required to operate each line. In addition, a laborer and an office clerk were assigned to the operations. One sub-professional line supervisor was needed to assist in calibrating instruments and to schedule work assignments. One professional supervisor was required to oversee operations and to monitor and calibrate instruments. Approximately two weeks were spent in training personnel to operate the lines. This training was done by the Testing Section, Memphis, Tennessee with the assistance of personnel from Motion Control, Dallas, Texas.

Producers from the eight gin communities in the Slaton, Texas territory grow a wide range of cotton varieties under both irrigated and dry land conditions. A total of 60,880 bales from this area was classed by the Lubbock office during the 1976-77 season and 50,155 of those bales were run on the HVI lines. Special classification cards (Form 1) were furnished to each gin for use in the project. The card had a machine readable bale number and a space provided for printing the results.

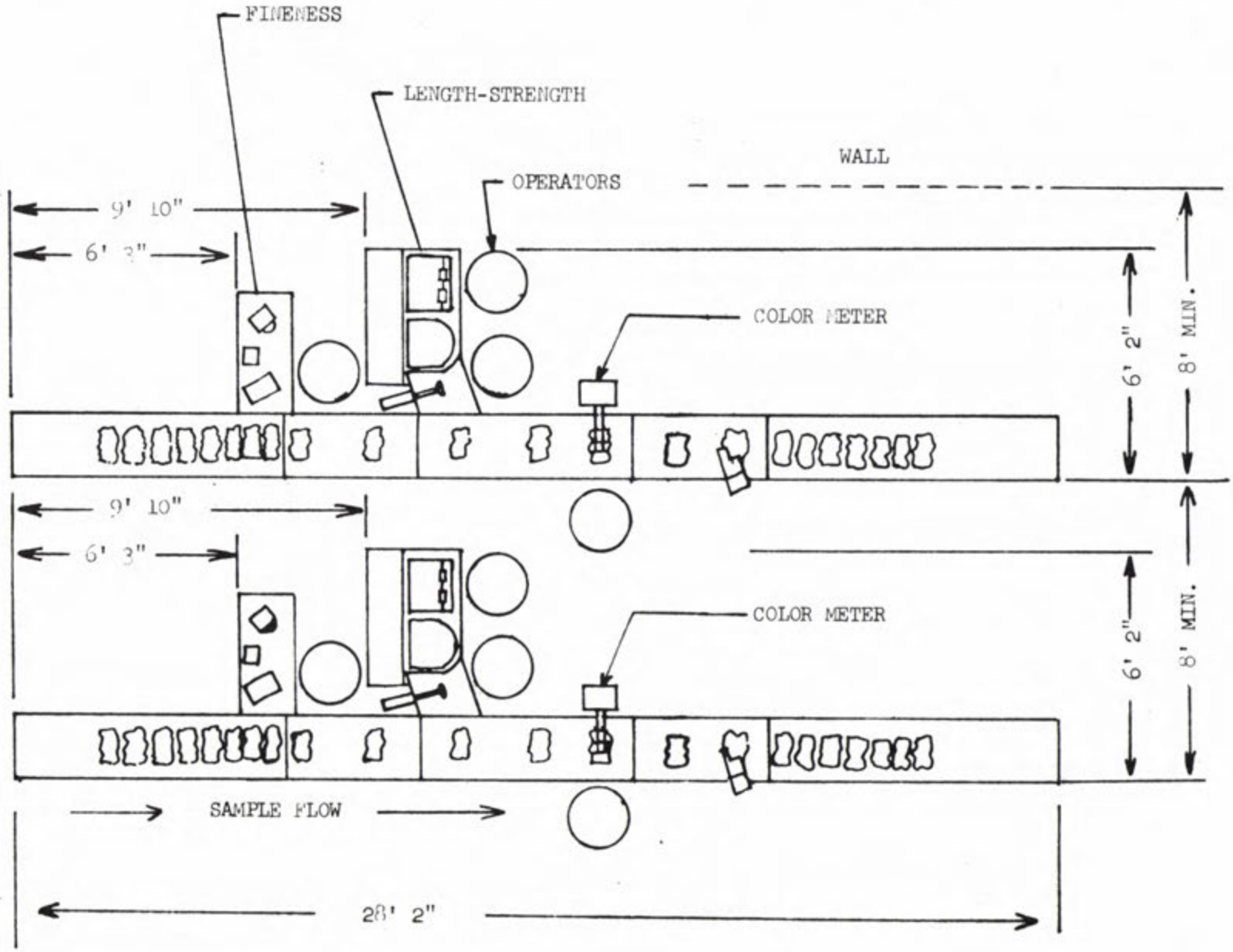
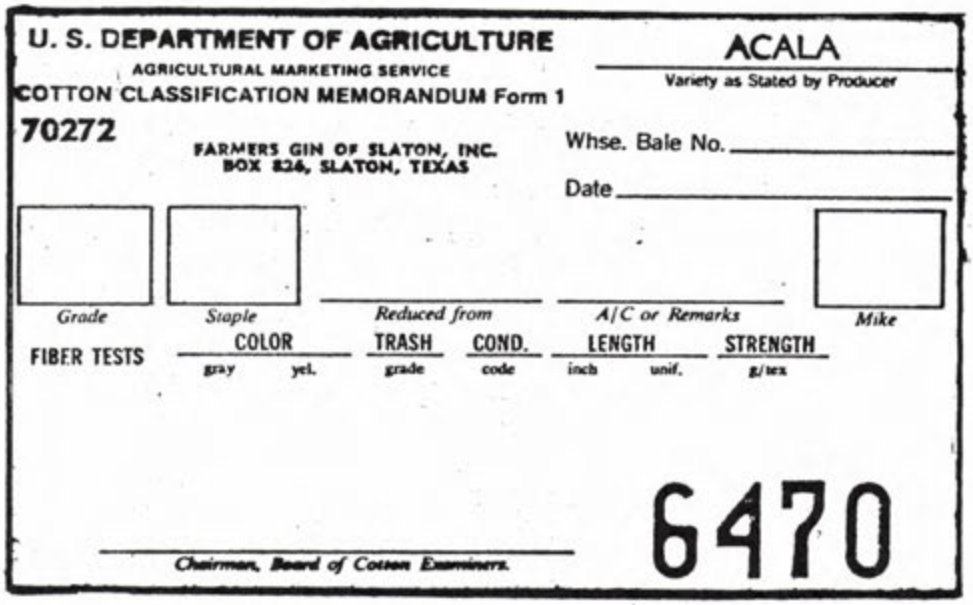


DIAGRAM OF HIGH VOLUME INSTRUMENT LINES
Figure 1.

10-6-77
Scale-$\frac{1}{4}$ inch=one inch

A sample copy of the card is shown below:



U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
COTTON CLASSIFICATION MEMORANDUM Form 1

ACALA
Variety as Stated by Producer

70272

FARMERS GIN OF SLATON, INC.
BOX 824, SLATON, TEXAS

Whse. Bale No. _____

Date _____

Grade | Staple | Reduced from | A/C or Remarks | Mike

FIBER TESTS | COLOR (gray, yel.) | TRASH (grade) | COND. (code) | LENGTH (inch, unif.) | STRENGTH (g/tex)

6470

Chairman, Board of Cotton Examiners.

Fiber Measurement

The cotton samples were divided into two parts for measurement, each part representing one side of the bale. The following number of tests were made on each sample as it went down the test line:

Fiber Measurement	No. Observations per Sample Each Side	Total
Fineness	1	2
Length	2	4
Uniformity	2	4
Strength	2	4
Color	1	2
Trash	1	2

Limits were established, based on previous work at Raleigh to insure that reliable averages were reported. If these limits were equaled or exceeded, the bale was retested. If the remeasurement sustained the original results,

a ">" was printed by the item, indicating a "two-sided" or highly variable result. A total of 9,405 Form 1 samples were remeasured at Lubbock during the 1976-77 season, equivalent to about 20 percent of all Form 1 samples measured. The computer was programmed to check the results by use of the following control limits or tolerances:

Fiber Measurement and Unit	Within Side	Between Side
Fineness. . . . . Mike rdg.	----	.7
Length. . . . . .Inch	.12	.07
Uniformity. . . . . .Pct.	8.0	5.0
Strength. . . . . .G/tx	5.0	4.0
Grayness. . . . . No.	----	2.0
Yellowness. . . . . No.	----	2.0
Trash . . . . . No.	----	2.0

Production

The two HVI lines at Lubbock, Texas Classing Office were operated approximately 800 hours during the October-February period of the 1976-77 season. During this period, 32 hours were logged as down time, representing about four percent of the total time. In addition to the logged down time, both lines were inoperative about 24 hours (3 days) in early December 1976 because of a failure in the disk drive unit.

During the 1976-77 season, approximately 66,400 samples were run on the two lines. This total included 50,200 Smith-Doxey samples, 9,400 remeasurements, 2,300 fee samples, 1,900 annual Cotton Fiber and Processing Test Survey samples, 2,000 calibration samples and 600 accomodation samples. By excluding remeasurements and calibration samples, total productive measurements during 1976-77 amounted to 55,000 samples.

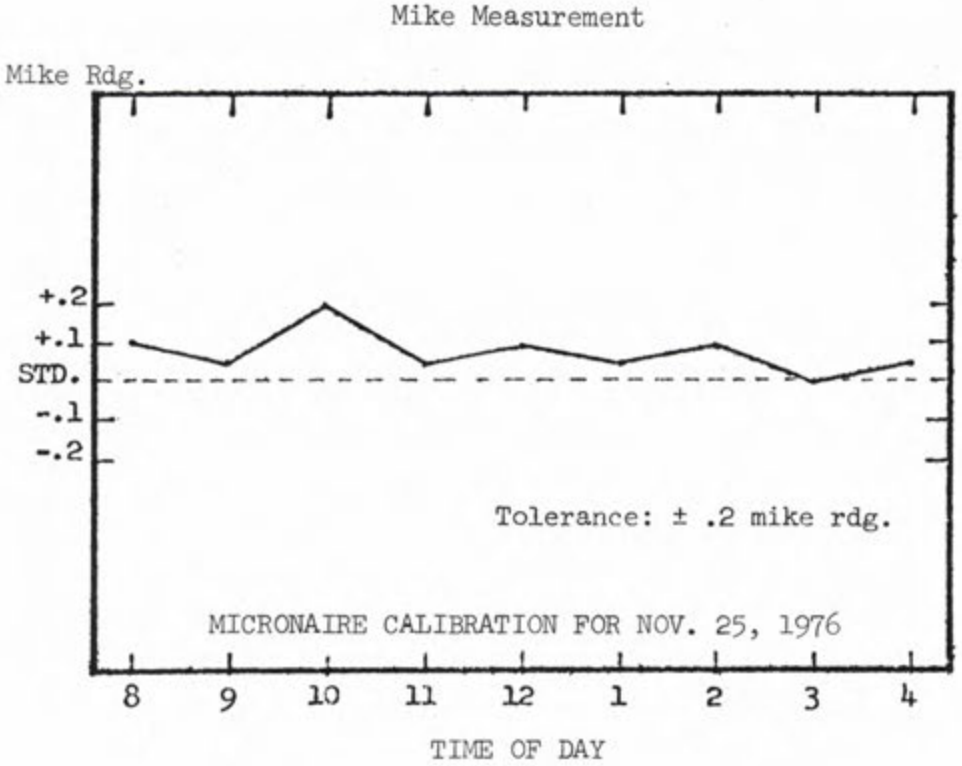
Operational Difficulties

Most of the HVI equipment problems incurred during the 1976-77 season were associated with the comber-brusher unit of the length-strength analyzer, the card printer/reader and the computer disk drive unit. The comber-brusher frequently became clogged with cotton and considerable time was spent cleaning this unit. Inadequate air pressure at times caused operational problems with the length-strength analyzer. The card printer failed to print on wrinkled or bent cards and data had to be typed on the cards. Most of the computer problems were associated with intermittent breakdowns of the disk drive unit.

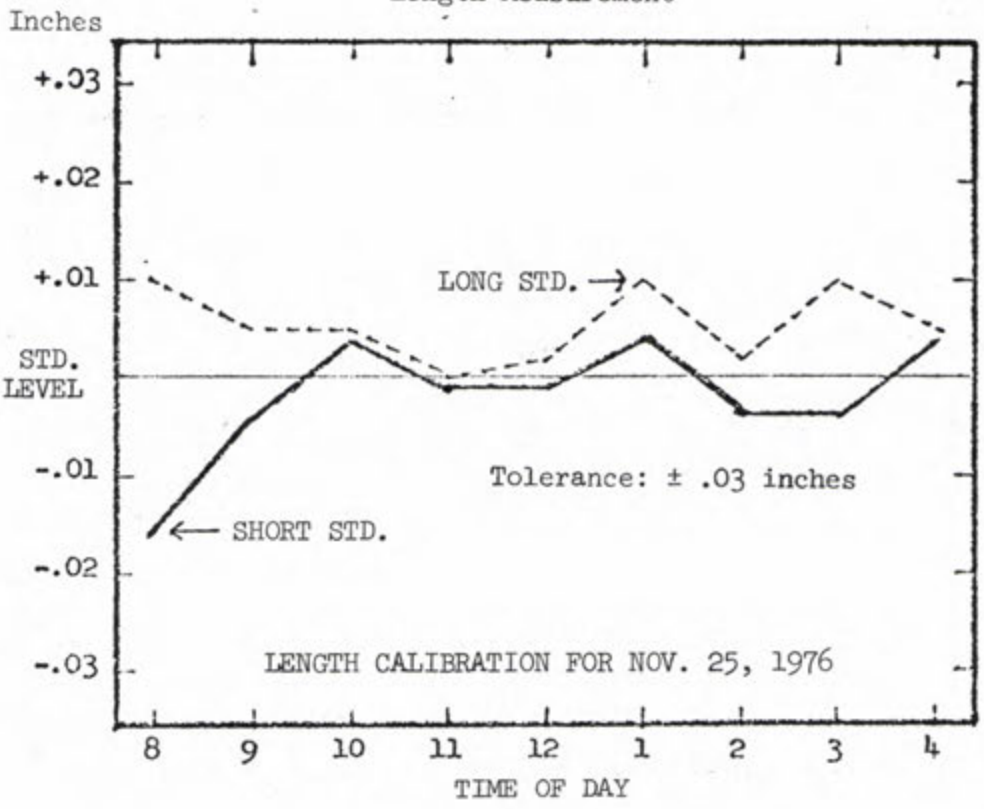
Calibration

Instruments on the HVI lines were calibrated prior to operation each day and periodically throughout the day. The Fibronaire instrument and scales were calibrated as prescribed in Cotton Division Instructions. The length, length uniformity and strength gages were checked using three different USDA calibration check test cottons. The cotton color meter was calibrated using standard tiles and a box of color test check samples. After calibration was completed, selected test samples were passed down the lines as a final check before starting regular operation. The computer was programmed to print out the instrument results, flag those that exceeded limits and file the data in disk storage.

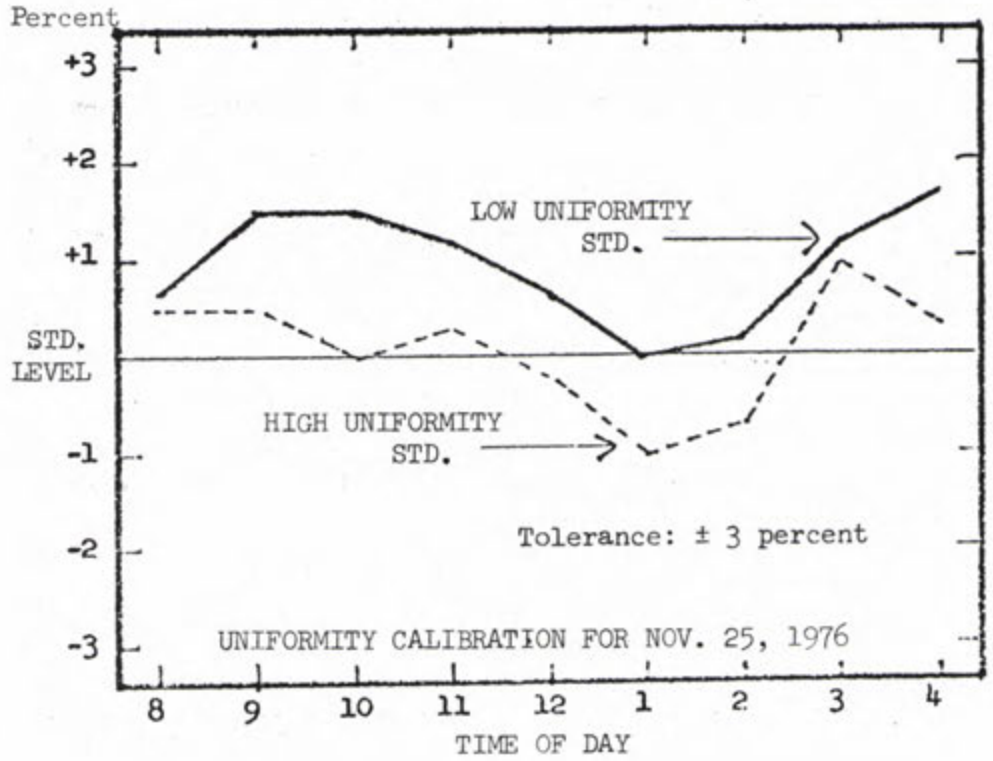
The following charts indicate that the various high volume instruments stayed in calibration fairly well during a "typical" day of operation.



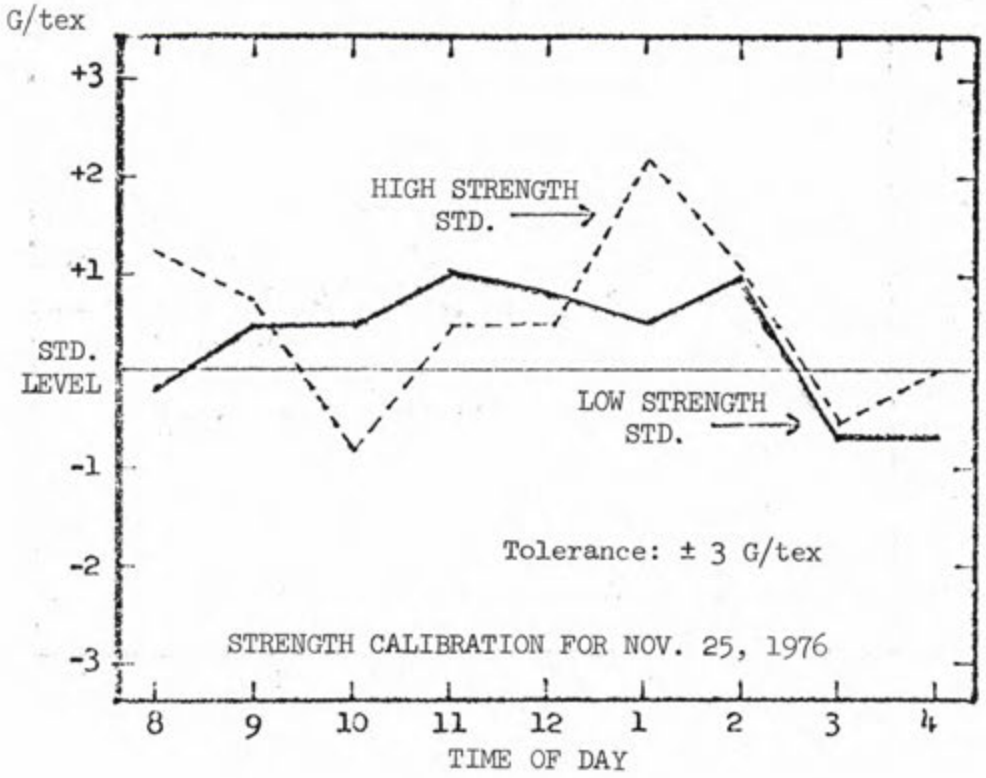
Length Measurement



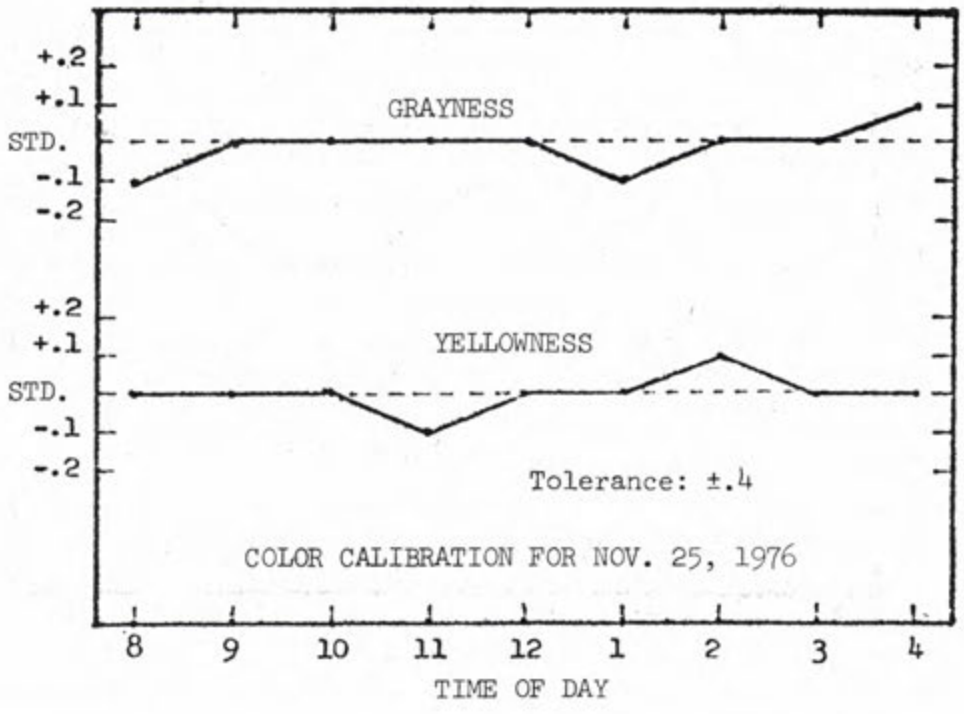
Uniformity Measurement



STRENGTH MEASUREMENT



COLOR MEASUREMENT



Repeatability of Results

REPEATABILITY - 90 PERCENT LEVEL

MIKE	.2
LENGTH	.03
UNIFORMITY	2
STRENGTH	2
GRAYNESS	1
YELLOWNESS	1
TRASH GRADE	1

Micronaire results showed that 41 percent of the samples remeasured were the same as the original mike while 83 percent were within ± .1 mike reading. Fiber length remeasurements were the same as the first measurements on 21 percent of the samples and within ± .02 inches on 78 percent. Uniformity remeasurements were the same as the originals on 31 percent of the samples and within ± 1 percent on 70 percent. The strength remeasurements showed very good repeatability with a 36 percent sustainment of the originals and 80 percent within ± 1 gram per tex. The color measurements showed fine repeatability with 81 percent of the remeasurements the same as the originals and 99.5 percent within ± 1 for both grayness and yellowness. For the trash measurement, 72 percent of the original samples were sustained, and 99.8 percent were within ± 1.

Variability of Results

A variability study was made of results from cottons measured on the HVI system at the Lubbock, Texas Classing Office during the 1976-77 season. The study was made to determine the variation of results between the two sides of the cotton sample and the variation between bales of cotton from selected modules. Items studied were upper half mean length, fiber uniformity, micronaire, fiber strength, trash grade, color grayness and color yellowness.

Data for the within-bale variation of this study were taken from each side of the sample. Results were tabulated for one out of every 25 samples measured. This provided data from 1,545 bales. The average variability of results between the two sides of a sample is shown below:

Measurement	Average variation
Fineness. . . . . .Mike rdg.	.2
Upper half mean length. . . . . inch	.02
Fiber uniformity. . . . . pct.	1
Fiber strength. . . . . g/tex	.9
Trash . . . . . No.	.2
Grayness. . . . . No.	.3
Yellowness. . . . . No.	.3

To study variability of results between bales in a rick or module, data were collected from bales ginned during the early, middle and late periods of the 1976-77 season from four of the eight gins. These results were matched with each bale number to study the variation between bales in a module. Data

were obtained on 4,014 bales from 409 lots for an average size of ten bales per lot or module. The average variation between bales in a 10-bale module is shown below:

Measurement	Average variation
Fineness. . . . . .Mike rdg.	.4
Length. . . . . inch	.06
Fiber uniformity. . . . . pct.	3
Fiber strength. . . . . g/tex	2
Trash . . . . . No.	1
Grayness. . . . . No.	1
Yellowness. . . . . No.	1

Fiber and Processing Test Survey Samples

Samples from the Annual Cotton Fiber and Processing Test Results Survey[2/] provide a basis for evaluating the high volume instrument system results in relation to processing performance, manufacturing waste and yarn quality. These samples were taken from small scale spinning test lots made up of classers' samples collected by classing offices from selected production areas throughout the United States during the 1976-77 harvesting season. A total of 365 upland lots were collected during the 1976 season. Five samples were saved from each of these lots for testing at Lubbock.

The averages and standard deviations for all the tests made in this survey are shown in tables in the Appendix by staple length groups. Results of simple and multiple correlation analyses are also shown in those statistical tables. For this evaluation, emphasis was placed mainly on cottons from the medium staple group.

Relationship of HVI Results to other Fiber Measurements

Simple correlations indicated a good relationship between high volume tests, standard laboratory tests and classification. For the medium staple group, the simple correlation coefficient (r) between upper half mean length and Fibrograph 2.5% span length was +.94. The simple correlation between HVI fiber length and classers' staple length was +.73, while that between the laboratory Fibrograph 2.5% span length and classers' staple was a little better at +.79.

There was a fairly close relationship between the two measures of fiber length uniformity as indicated by the correlation coefficient of +.75 for the medium staple group.

The correlation of +.97 between the two mike tests indicated a nearly perfect statistical relationship.

Fiber strength as measured by the HVI 1/8" gage test showed a simple correlation coefficient of +.81 to Stelometer 1/8" gage strength and +.60 to Pressley zero gage strength. The correlation of Stelometer 1/8" gage strength to Pressley zero gage was +.63.

2/ Summary of Cotton Fiber and Processing Test Results, Crop of 1976, USDA, AMS, Cotton Division, June 1977.

As would be expected, the color measurements were closely related to standard colorimeter measurements. The grayness scale showed an "r" value of +.88 for the two instruments and a +.85 was obtained for the yellowness scale.

The visual trash measurement showed a statistical relationship of +.62 to Shirley Analyzer nonlint content. This was somewhat lower than the -.73 correlation between grade index and Shirley Analyzer nonlint content.

Relationship of HVI Results to Spinning Test Results

Both simple and multiple correlations were used to study the relationships of fiber tests to manufacturing waste, processing performance and yarn quality. Three basic fiber test methods were compared to spinning test results for this evaluation. The first method was classification which includes grade index, staple length and micronaire with a fiber strength test added statistically where it makes a significant contribution to the results. The second method consisted of various combinations of laboratory measurements of mike reading, color, nonlint content, Fibrograph 2.5% span length and 1/8 inch gage fiber strength. The third method included comparable tests made on the high volume instrument system.

Picker and Card Waste. Shirley Analyzer nonlint content, with a simple correlation coefficient of +.62 showed the highest relationship to picker and card waste in the medium staple group. Grade index with -.59 was second, followed closely behind by HVI trash grade with +.55. The color measurement of grayness at +.47 ranked fourth with other fiber tests showing little relationship to picker and card waste.

The laboratory tests of color, Shirley Analyzer nonlint, 2.5 percent span length and mike showed the closest relationship to picker and card waste with a multiple correlation coefficient (R) of .68. The test system ranked second with an R value of .64 followed by classification (grade, staple and mike) with .62.

Yarn Strength, an important indicator of yarn quality, was highly related to fiber strength and length. The Stelometer 1/8 inch gage fiber strength showed the highest correlation to yarn strength of the three strength measurements studied in this report. The HVI 1/8 inch gage strength was second and Pressley zero strength was last in relation to yarn strength.

Measurement	Simple Correlation (r) Yarn Strength	
	22s	50s
Stelometer 1/8 inch gage fiber strength	+.85	+.81
HVI 1/8 inch gage fiber strength	+.75	+.71
Pressley zero gage fiber strength	+.50	+.43

Classers' staple ranked a little higher as an indicator of yarn strength than either Fibrograph 2.5% span length or HVI upper half mean length.

Measurement	Simple Correlation (r) Yarn Strength	
	22s	50s
Staple length	+.68	+.65
Fibrograph 2.5% span length	+.65	+.64
HVI upper half mean length	+.60	+.59

Multiple correlation analysis showed classification to have less relationship to yarn strength than the laboratory method or the HVI system. The addition of Pressley zero gage to classification improved the relationship to yarn strength, but it still did not rank as high as either the laboratory method or the high volume instruments. However, the addition of the 1/8 inch gage strength improved the correlation of classification to yarn strength to about the same level as the second ranked HVI system.

Measurement	Multiple Correlation (R) Yarn Strength	
	22s	50s
Laboratory with Stelometer 1/8" gage	.92	.90
Classification with Stelometer 1/8" gage	.88	.85
Classification with HVI 1/8" gage	.82	.79
HVI test system	.87	.85
Classification with zero gage	.77	.73
Classification	.72	.70

Yarn Appearance and Imperfections were influenced the most by micronaire reading. The other fiber tests showed little relationship to appearance grades and imperfection count.

For the multiple groups of measurements, the laboratory method and the HVI system had slightly higher correlations to appearance and imperfections than the classification group.

Measurement	Multiple Correlation (R)			
	Yarn Appearance		Yarn Imperfections	
	22s	50s	22s	50s
Classification	.53	.53	.55	.53
HVI test system	.58	.55	.62	.61
Laboratory group	.57	.55	.64	.61

Spinning Potential Yarn Number (SPY) is a measure of spinning efficiency and is highly related to yarn production and spinning end breakage. Fiber length, uniformity, fineness and strength are usually closely related to spinning potential.

For the medium staple group, Fibrograph 2.5% span length had a slightly higher correlation to SPY than either HVI upper half mean or classer's staple. Both Stelometer 1/8" gage and HVI 1/8" gage fiber strength showed much higher relationships to spinning potential than the Pressley zero gage. Of the two fiber uniformity measures, the HVI was the one most closely related to spinning potential.

Measurement	Simple Correlation (r) Spinning Potential
Fibrograph 2.5% span length	+.67
HVI upper half mean length	+.62
Staple	+.64
Stelometer 1/8" gage strength	+.76
HVI 1/8" gage strength	+.64
Pressley zero gage strength	+.36
Fibrograph uniformity	+.34
HVI uniformity	+.44

For the various fiber combinations, the laboratory group, including the Stelometer 1/8 inch gage strength and the Fibrograph 2.5% span length, showed the highest correlation with SPY number. The high volume system ranked second and classification was last. Classification does not include a measure of fiber strength which is highly related to the spinning potential test. As shown in the following table, the relationship of classification to SPY can be increased significantly by statistically adding 1/8 inch gage fiber strength to classification.

Measurement	Multiple Correlation (R) Spinning Potential
Laboratory Group	.88
HVI Test System	.83
Class. plus lab 1/8" gage	.81
Class. plus HVI 1/8" gage	.75
Classification	.69

Yarn Color. The color of unfinished (gray) yarn, as well as that of bleached and dyed yarn is directly related to the color of raw stock. The test system and the laboratory, both with an instrument measure of color, yield significantly higher results than classification, when a visual judgement of color and trash is included in the grade index.

Measurement	Multiple Correlation (R) Yarn Color		
	Gray	Bleached	Dyed
Classification	.66	.48	.19
Laboratory Group	.77	.57	.30
HVI Test System	.77	.55	.36

Summary

Evaluation of the High Volume Instrument Classing System in its present form was started in Raleigh, North Carolina in 1973. This work is part of a program to develop a practical system of measuring cotton quality by instruments. The research and development activities are being performed by the Cotton Division, Agricultural Marketing Service, USDA, in cooperation with the Cotton Quality Research Station, Agricultural Research Service, USDA, located at Clemson, South Carolina.

Field trials of the instrument classing system were conducted at the Raleigh Office for three consecutive seasons (1973-74 through 1975-76). The system was moved to the Lubbock, Texas Classing Office in 1976. After modification, the two lines were operated at the Lubbock Office during the 1976-77 cotton season.

The two high volume instrument systems were operated for approximately 800 hours during the November - February period of the 1976-77 season. About 66,400 samples were measured during this period, resulting in an average production rate of 83 samples per hour for each line. One permanent supervisor, one supervisory clerk, one laborer and eight technicians were used to operate the two lines.

Smith-Doxey samples from eight gins in the Lubbock, Texas Classing Office territory were measured on the two systems during the 1976-77 season. Measurements included micronaire (fiber fineness and maturity), fiber length, fiber length uniformity, 1/8 inch gage fiber strength, yellow and gray color of the cotton fibers, trash content and condition (indicating grass, bark or other extraneous matter). Results were printed directly on the Form 1 classification card using a computerized card printer.

Results made on USDA calibration standards of American upland cotton showed that the various instruments stayed in calibration most of the time. Results from 9,405 samples re-cycled on the two instrument lines showed good repeatability for all measurements at the 90 percent level.

A variability study was made to determine variation of HVI system results between the two sides of the cotton sample and the variation between bales of cotton from selected modules. Results of the within-bale variability study showed the average variation of micronaire fineness to be 0.2; length, 0.02 inch; uniformity, 1 percent; fiber strength, 0.9 gram per tex; trash, 0.2; and color grayness and yellowness 0.3. Data from the between-bale variability study indicated the average variation of results in a 10-bale module to be 0.4 for fineness; 0.06 inch for length; 3 percent for uniformity; 2 grams per tex for strength; 1 grade for trash and 1 color number for both color grayness and yellowness.

A study of the relationship of the instrument classing results to spinning tests showed the system to be more closely related to processing than classification (grade, staple and mike). In fact, it showed nearly as close a relationship to processing results as the standard laboratory measurements of the same fiber properties.

Results from the high volume instrument classing lines at Lubbock during the 1976-77 season indicate that the instruments provide a good measure of cotton quality and show a close relationship to processing.

APPENDIX

Table 1--Cotton: Means and Standard Deviations for the High Volume Instrument Classing System, Laboratory Fiber Tests, and Processing Tests for the Short, Medium and Long Staple Groups from the 1976 Cotton Fiber and Processing Test Survey.

Test Item	Short Staple Group		Medium Staple Group		Long Staple Group	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
CLASS AND LABORATORY RESULTS						
Grade Index	88.3	5.4	92.8	5.1	93.0	2.2
Staple Length	30.8	1.0	34.5	1.0	35.5	.9
Fibrograph 2.5% SL	.95	.04	1.08	.04	1.15	.04
50/2.5 Uniformity Ratio	45.2	1.5	44.6	1.6	44.6	1.8
Micronaire	4.3	0.7	4.2	0.5	4.0	0.5
Zero gage strength	84.4	3.7	86.7	4.6	87.3	3.5
1/8" gage strength	20.7	0.9	23.4	1.8	25.5	1.7
Nonlint Content	3.4	0.8	2.9	1.0	3.4	0.9
Grayness	2.6	0.7	1.6	0.9	1.5	0.8
Yellowness	4.0	1.0	2.7	0.9	2.4	0.7
TEST LINE RESULTS						
UHM Length	.95	.05	1.08	.05	1.15	.03
M/UHM Uniformity Index	80.6	1.6	81.2	1.6	81.8	1.5
Micronaire Reading	4.3	0.8	4.2	.4	4.1	0.5
HVI 1/8" gage Strength	22.5	1.1	24.1	2.0	25.3	1.1
Trash	4.0	0.7	4.0	0.9	4.0	0.6
Grayness	2.8	0.8	1.6	0.9	1.5	0.8
Yellowness	4.3	1.1	2.9	1.0	2.4	0.8
PROCESSING TEST RESULTS						
Picker and Card Waste	7.0	0.8	6.2	1.0	7.3	1.9
Yarn Strength:						
Coarse No.	278.5	17.3	109.2	12.1	121.2	14.9
Fine No.	88.4	8.2	35.7	5.6	42.5	7.4
Yarn Appearance:						
Coarse No.	125.3	6.5	95.1	10.9	98.0	12.4
Fine No.	109.3	8.3	75.8	9.4	79.5	11.9
Yarn Imperfections:						
Coarse No.	25.5	11.0	19.3	7.4	23.8	11.0
Fine No.	14.8	6.1	15.3	5.7	18.0	8.1
Spinning Potential Yarn No.	39.9	8.4	58.4	10.3	72.6	16.9
Yarn Color Index:						
Gray Yarn	88.6	4.0	91.8	4.1	91.5	3.3
Bleached Yarn	99.7	2.9	101.4	3.2	100.1	3.8
Dyed Yarn	104.8	2.6	104.7	3.0	104.2	2.0

Table 2--Cotton: Simple Correlation Coefficients for the High Volume Instrument Classing System and Selected Laboratory Fiber Tests. Based on Short, Medium and Long Staple Groups from the 1976 Cotton Fiber and Processing Test Survey.

High Volume Instrument Measurements	Grade Index	Staple Length	Fibrograph		Mike Rdg.	Fiber Strength		S.A. Nonlint Content	Color	
			2.5% SL	Unif.		"0" gage	1/8" gage		Gray	Yellow
Short Staple Group (59 Test Lots)										
Fiber Length-UHM	-.42	+.79	+.95	-.53	-.21	-.23	+.42	+.28	+.30	-.14
M/UHM Uniformity	+.03	+.29	+.19	+.41	+.51	+.20	.00	-.09	-.39	-.52
Mike Reading	+.44	-.13	-.19	+.40	+.97	+.65	-.37	-.41	-.58	-.71
Strength (1/8")	-.29	+.31	+.29	+.07	-.28	-.27	+.38	+.13	+.27	+.17
Color										
Grayness	-.54	+.01	+.17	-.31	-.49	-.45	+.03	+.42	+.81	+.45
Yellowness	-.17	-.20	-.09	-.13	-.65	-.45	+.16	+.19	+.52	+.87
Trash Grade	-.56	+.35	+.42	-.13	-.06	-.21	+.24	+.54	+.27	-.24
Trash Condition	-.38	-.02	+.06	-.09	-.22	-.17	+.09	+.33	+.24	+.09
Medium Staple Group (286 Test Lots)										
Fiber Length-UHM	+.27	+.73	+.94	+.06	.00	+.12	+.51	-.20	-.26	-.14
M/UHM Uniformity	+.22	+.37	+.36	+.75	+.51	+.29	+.44	-.18	-.13	-.16
Mike Reading	+.32	+.02	+.02	+.50	+.97	+.02	-.09	-.29	-.05	-.04
Strength (1/8")	+.16	+.60	+.51	+.31	-.06	+.60	+.81	-.12	-.09	-.15
Color:										
Grayness	-.70	-.22	-.26	-.02	-.05	-.10	-.18	+.54	+.88	+.47
Yellowness	-.32	-.17	-.16	+.01	-.09	-.20	-.12	+.14	+.50	+.85
Trash Grade	-.65	-.24	-.24	-.10	-.26	-.03	-.13	+.62	+.47	-.05
Trash Condition	-.35	-.17	-.10	-.02	-.12	-.16	-.14	+.25	+.22	+.14
Long Staple Group (20 Test Lots)										
Fiber Length-UHM	-.04	+.84	+.89	+.56	-.41	+.28	+.62	+.10	-.13	-.18
M/UHM Uniformity	+.05	+.61	+.70	+.79	.00	-.29	+.31	-.08	-.30	-.19
Mike Reading	+.13	-.39	-.32	+.15	+.99	-.28	-.60	-.51	+.49	+.58
Strength (1/8")	+.37	+.54	+.42	+.32	-.34	+.10	+.38	+.19	-.25	-.18
Color:										
Grayness	-.46	-.15	-.08	.00	+.45	+.08	-.44	+.09	+.82	+.45
Yellowness	-.40	-.22	-.13	+.01	+.62	-.07	-.52	-.01	+.64	+.85
Trash Grade	-.27	+.60	+.54	+.26	-.44	+.09	+.38	+.63	-.17	-.18
Trash Condition	+.10	-.12	-.14	-.21	-.10	+.25	+.07	+.01	+.15	-.15

Table 3--Cotton: Simple Correlation Coefficients for the High Volume Instrument Classing System, Classification and Laboratory Measurements with Selected Processing Tests and Yarn Quality. Based on 59 samples of Short Staple Cotton from the 1976 Cotton Fiber and Processing Test Survey.

Independent Variables	Dependent Variable										
	Picker & Card	Yarn Strength		Yarn Appearance		Yarn Imperf.		SPY	Yarn Color Index		
		8s	22s	8s	22s	8s	22s		Gray	Blchd	Dyed
Grade Index	-.40	-.31	-.39	+.39	+.46	-.60	-.61	-.44	+.41	-.08	+.06
Nonlint Content	+.51	+.31	+.44	-.21	-.27	+.43	+.44	+.44	-.28	+.24	-.01
Trash Grade	+.34	+.06	+.13	.00	-.21	+.16	+.18	+.19	-.10	-.05	-.18
Lab Color:											
Grayness	+.31	+.26	+.29	-.46	-.38	+.61	+.67	+.36	-.76	+.12	-.20
Yellowness	.00	+.42	+.32	-.29	-.13	+.48	+.54	+.27	-.53	+.34	+.17
Index	-.32	-.08	-.09	+.42	+.46	-.62	-.69	-.20	+.73	.00	+.18
HVI Color:											
Grayness	+.40	+.09	+.09	-.41	-.36	+.54	+.61	+.16	-.63	+.08	-.22
Yellowness	-.04	+.40	+.31	-.35	-.14	+.50	+.53	+.29	-.54	+.36	+.26
Length:											
Staple	-.17	+.48	+.56	-.03	-.06	+.03	-.02	+.62	-.20	+.17	-.06
Fibro 2.5% SL	-.07	+.46	+.51	+.08	-.04	+.05	+.09	+.62	-.21	+.19	-.14
HVI-UHM	-.04	+.43	+.47	+.02	-.06	+.07	+.10	+.61	-.24	+.14	-.26
Uniformity:											
Fibro 50/2.5	+.01	-.21	-.17	+.06	+.16	-.02	-.13	-.32	+.27	-.27	+.41
HVI M/UHM	-.12	-.18	+.01	+.15	+.07	-.11	-.24	+.03	+.20	-.28	+.02
Strength:											
Lab 1/8" gage	-.03	+.54	+.65	-.05	.00	+.15	+.14	+.61	-.35	+.10	+.09
Lab Zero gage	-.09	-.36	-.33	+.23	+.27	-.47	-.49	-.41	+.36	-.44	-.19
HVI 1/8" gage	-.05	+.24	+.28	-.18	-.04	+.29	+.19	+.30	-.36	+.02	.00
Micronaire Reading:											
Lab Mike	-.02	-.60	-.59	+.41	+.27	-.55	-.58	-.62	+.63	-.41	-.01
HVI Mike	-.01	-.60	-.57	+.41	+.26	-.53	-.57	-.61	+.61	-.43	-.03

Table 4--Cotton: Simple Correlation Coefficients for the High Volume Instrument Classing System, Classification and Laboratory Measurements with Selected Processing Tests and Yarn Quality. Based on 286 samples of Medium Staple Cotton from the 1976 Cotton Fiber and Processing Test Survey.

Independent Variables	Dependent Variable										
	Picker & Card	Yarn Strength		Yarn Appearance		Yarn Imperf.		SPY	Yarn Color Index		
		22s	50s	22s	50s	22s	50s		Gray	Blchd	Dyed
Grade Index	-.59	+.18	+.15	+.12	+.11	-.45	-.41	+.15	+.63	+.31	+.17
Nonlint Content	+.62	-.17	-.15	-.08	-.05	+.41	+.35	-.18	-.43	-.27	-.14
Trash Content	+.55	-.09	-.10	-.04	-.04	+.24	+.23	-.10	-.35	-.20	-.14
Lab Color:											
Grayness	+.47	-.26	-.24	+.04	+.03	+.30	+.28	-.21	-.77	-.48	-.22
Yellowness	+.23	-.19	-.15	-.12	-.09	+.35	+.35	-.17	-.32	-.25	-.01
Index	-.48	+.23	+.21	-.03	-.01	-.29	-.28	+.19	+.81	+.49	+.28
HVI Color:											
Grayness	+.47	-.22	-.20	-.01	-.01	+.32	+.30	-.19	-.77	-.46	-.26
Yellowness	+.21	-.13	-.10	-.16	-.09	+.38	+.37	-.10	-.31	-.26	+.03
Length:											
Staple	-.36	+.68	+.65	-.13	-.04	-.03	-.04	+.64	+.20	+.15	+.02
Fibro 2.5% SL	-.40	+.65	+.64	-.19	-.08	+.06	+.02	+.67	+.22	+.29	+.16
HVI-UHM	-.32	+.60	+.59	-.25	-.14	+.13	+.10	+.62	+.17	+.25	+.14
Uniformity:											
Fibro 50/2.5	-.19	+.34	+.35	+.39	+.51	-.31	-.36	+.34	+.05	-.16	+.13
HVI M/UHM	-.32	+.44	+.44	+.31	+.41	-.29	-.34	+.44	+.09	-.09	+.09
Strength:											
Lab 1/8" gage	-.31	+.85	+.81	-.14	.00	-.02	-.02	+.76	+.14	+.09	-.06
Lab Zero gage	-.14	+.50	+.43	+.11	+.11	-.23	-.21	+.36	+.03	-.13	-.15
HVI 1/8" gage	-.19	+.75	+.71	-.15	-.02	+.03	+.02	+.64	+.06	+.05	-.05
Micronaire Reading:											
Lab Mike	-.18	-.23	-.25	+.51	+.53	-.44	-.45	-.23	+.04	-.24	+.13
HVI Mike	-.20	-.24	-.24	+.51	+.52	-.46	-.46	-.23	+.02	-.22	+.11

Table 5--Cotton: Simple Correlation Coefficients for the High Volume Instrument Classing System, Classification and Laboratory Measurements with Selected Processing Tests and Yarn Quality. Based on 20 samples of Long Staple Cotton from the 1976 Cotton Fiber and Processing Test Survey.

Independent Variables	Dependent Variable									
	Picker & Card	Yarn Strength		Yarn Appearance		Yarn Imperf.		SPY	Yarn Color Index	
		22s	50s	22s	50s	22s	50s		Gray	Blchd	Dyed
Grade Index	-.44	.00	-.04	+.25	+.14	-.23	-.33	+.02	+.60	+.33	-.01
Nonlint Content	+.74	+.26	+.23	-.64	-.52	+.62	+.72	+.24	+.04	-.05	-.34
Trash Content	+.52	+.64	+.63	-.62	-.36	+.58	+.63	+.61	+.17	-.07	-.10
Lab Color:											
Grayness	-.23	-.42	-.40	+.28	+.32	-.36	-.27	-.43	-.82	-.64	+.14
Yellowness	-.33	-.39	-.40	+.48	+.61	-.31	-.30	-.49	-.32	-.38	+.48
Index	+.30	+.51	+.49	-.42	-.45	+.42	+.32	+.54	+.87	+.74	-.26
HVI Color:											
Grayness	-.24	-.39	-.40	+.11	+.32	-.22	-.09	-.42	-.80	-.55	+.28
Yellowness	-.24	-.35	-.33	+.37	+.49	-.23	-.18	-.38	-.42	-.35	+.41
Length:											
Staple	+.30	+.89	+.87	-.58	-.40	+.57	+.56	+.86	+.32	+.03	+.12
Fibro 2.5% SL	+.20	+.85	+.85	-.42	-.26	+.43	+.41	+.82	+.18	-.20	+.20
HVI-UHM	+.15	+.81	+.82	-.43	-.24	+.35	+.33	+.77	+.19	-.08	+.13
Uniformity:											
Fibro 50/2.5	-.11	+.61	+.61	-.06	+.04	+.16	+.09	+.63	+.16	-.22	+.56
HVI/UHM	+.12	+.70	+.68	-.19	.00	+.29	+.24	+.68	+.30	-.11	+.41
Strength:											
Lab 1/8" gage	+.45	+.68	+.68	-.44	-.34	+.49	+.36	+.64	+.40	+.28	-.05
Lab Zero gage	+.14	+.07	+.02	-.36	-.16	+.25	+.24	.00	.00	-.09	-.02
HVI 1/8" gage	-.05	+.55	+.53	-.18	-.22	+.11	+.08	+.50	+.44	+.07	-.15
Micronaire Reading:											
Lab Mike	-.62	-.58	-.57	+.80	+.80	-.59	-.60	-.59	-.40	-.40	+.44
HVI Mike	-.63	-.60	-.59	+.81	+.79	-.62	-.63	-.60	-.38	-.38	+.41

Table 6--Cotton: Multiple Correlation Coefficients for the High Volume Instrument Classing System, Various Combinations of Classification and Laboratory Measurements. Based on 59 samples of Short Staple Cotton from the 1976 Cotton Fiber and Processing Test Survey.

Independent Variables	Dependent Variable										
	Picker & Card	Yarn Strength		Yarn Appearance		Yarn Imperf.		SPY	Yarn Color Index		
		8s	22s	8s	22s	8s	22s		Gray	Blchd	Dyed
Grade, Staple, Mike	.56	.73	.77	.49	.48	.71	.74	.82	.65	.46	.08
Color, Trash, UHM, Mike	.60	.79	.76	.50	.43	.65	.71	.83	.73	.51	.52
Color, Nonlint, 2.5% SL, Mike	.65	.76	.76	.56	.43	.68	.73	.82	.80	.52	.44
Grade, Staple, Mike, '0' gage	.56	.73	.77	.50	.48	.71	.75	.82	.65	.55	.27
Grade, Staple, Mike, 1/8" gage	.56	.76	.82	.50	.50	.71	.75	.85	.66	.47	.16
Grade,Staple,Mike,HVI 1/8"gage	.56	.73	.75	.49	.49	.71	.74	.82	.66	.49	.10
Grade, UHM, Mike, HVI Str,Unif	.54	.69	.73	.53	.50	.72	.72	.84	.66	.47	.31
2.5% SL, Mike, 1/8" gage, Unif	.08	.74	.81	.46	.29	.61	.61	.84	.64	.44	.46
UHM, Mike, HVI 1/8" gage, Unif	.13	.69	.73	.45	.27	.59	.58	.83	.65	.45	.31

Table 7--Cotton: Multiple Correlation Coefficients for the High Volume Instrument Classing System, Various Combinations of Classification and Laboratory Measurements. Based on 286 samples of Medium Staple Cotton from the 1976 Cotton Fiber and Processing Test Survey.

Independent Variables	Dependent Variable										
	Picker & Card	Yarn Strength		Yarn Appearance		Yarn Imperf.		SPY	Yarn Color Index		
		22s	50s	22s	50s	22s	50s		Gray	Blchd	Dyed
Grade, Staple, Mike	.62	.72	.70	.53	.53	.55	.53	.69	.66	.48	.19
Color, Trash, UHM, Mike	.64	.65	.64	.58	.55	.62	.61	.66	.77	.55	.36
Color, Nonlint, 2.5% SL, Mike	.68	.71	.70	.57	.55	.64	.61	.73	.77	.57	.30
Grade, Staple, Mike, '0' gage	.62	.77	.73	.56	.54	.59	.57	.70	.66	.51	.26
Grade, Staple, Mike, 1/8" gage	.62	.88	.85	.53	.54	.55	.53	.81	.66	.48	.21
Grade,Staple,Mike,HVI 1/8" gage	.62	.82	.79	.53	.53	.56	.54	.75	.66	.47	.19
Grade, UHM, Mike, HVI Str, Unif	.64	.87	.85	.59	.58	.62	.59	.83	.67	.50	.25
2.5% SL, Mike, 1/8" gage, Unif	.45	.92	.90	.59	.61	.47	.48	.88	.22	.40	.30
UHM, Mike, HVI 1/8" gage, Unif	.41	.87	.85	.59	.58	.49	.50	.83	.19	.35	.22

Table 8--Cotton: Multiple Correlation Coefficients for the High Volume Instrument Classing System, Various Combinations of Classification and Laboratory Measurements. Based on 20 samples of Long Staple Cotton from the 1976 Cotton Fiber and Processing Test Survey.

Independent Variables	Dependent Variable										
	Picker & Card	Yarn Strength		Yarn Appearance		Yarn Imperf.		SPY	Yarn Color Index		
		22s	50s	22s	50s	22s	50s		Gray	Blchd	Dyed
Grade, Staple, Mike	.74	.93	.91	.88	.81	.73	.76	.91	.77	.56	.54
Color, Trash, UHM, Mike	.73	.92	.93	.87	.80	.70	.75	.89	.82	.65	.56
Color, Nonlint, 2.5% SL, Mike	.81	.93	.92	.88	.84	.77	.82	.92	.82	.75	.67
Grade, Staple, Mike, '0' gage	.74	.94	.92	.89	.82	.74	.77	.93	.81	.64	.56
Grade, Staple, Mike, 1/8" gage	.76	.94	.92	.89	.84	.73	.77	.91	.77	.56	.57
Grade,Staple,Mike,HVI 1/8" gage	.76	.93	.91	.90	.80	.78	.80	.91	.78	.60	.54
Grade, UHM, Mike, HVI Str, Unif	.77	.96	.95	.84	.80	.70	.72	.93	.81	.63	.64
2.5% SL, Mike, 1/8" gage, Unif	.63	.96	.95	.84	.84	.66	.66	.96	.53	.58	.67
UHM, Mike, HVI 1/8" gage, Unif	.72	.96	.95	.84	.80	.69	.69	.93	.62	.47	.64