AN INVESTIGATION OF THE MIXING OF COTTON FIBERS IN A VORTEX-SINK FLOW DEVICE

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Approved:

Chairman

Date approved by Chairman: 9/8/70

DEDICATION

I gratefully dedicate this thesis to my wife and son, Mrs. Janelle Conkle and Brandon Daniel Conkle, whose confidence, encouragement and cooperation made it possible for me to continue my education.

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SUMMARY

A study was conducted to determine the effectiveness of a vortex-sink air flow device as a cotton sample blender. Preliminary studies, using tracer fibers, were carried out with a two-dimensional vortex-sink as the blending apparatus. After determining that fibers could be blended in a vortex-sink air flow device, more extensive studies were made on the blending effectiveness of the "UT" Opener (a minature Creighton opener).

The blending effectiveness was evaluated by physical tests and dyed tracer fibers. Fibers to be blended were selected so that the blending of fibers with greatly different physical properties, as well as those with a nominal (bale stock) range of physical properties, could be evaluated. Specimen of fibers were selected before and after blending and the physical property measurements for each were compared for different blending apparatus parameters.

The physical property measurements indicated conclusively that fibers were being blended on the basis of fineness, length, and bundle strength. The effectiveness of the "UT" Opener as a blender was found to depend on the openess of the fibers before blending. The blending in depth and width of the samples was found to be better than blending along the length of the samples. Blending improved with the number of passes through the machine with three passes at a rotor speed of 900 rpm being the optimum condition for blending on the "UT" Opener. Damage to fiber length increased with an increase in rotor speeds above 800 rpm.

CHAPTER I

INTRODUCTION

Statement of the Problem

The major processes of textile fabrication are concerned with the production of coherent structures having maximum flexibility or low resistance to bending and buckling stresses while retaining the inherent strength of the original fiber or filament material under the action of tensile stresses. This objective is in direct contrast to that normally encountered in engineering structures, where the general problem is to produce maximum resistance to bending and compressive loads, combined with maximum tensile strength. In standard engineering the objective of maximizing the rigidity is achieved by using fixed linkages between the various components of the structure.

In textile structures the objective of maximum flexibility is achieved by the use of geometrical restraints which resist the forces of disruption, but do not interfere with the small relative movements of the individual elements associated with bending or other types of lateral deformation.

The difference of objective does not imply a difference in method of approach, and there is no reason why the design of a textile structure should not be treated by the same rigorous analytical techniques as the design of any other engineering structure, such as an automobile, a bridge, or a building.

For the solution of any engineering problem the engineer must have:

1. A complete specification of the geometry of the structure.

2. A knowledge of the mechanical and physical properties of the materials used in the structure.

3. A method of analysis that will enable him to use these pieces of information to produce a mathematical solution to the problem.

The works of Adams, Backer, Freeston, Gupta, Hearle, Merchant, Riding and many others, using synthetic fibers or idealized structures where the variability of the components was controlled, have done much to transform textile engineering from an art to a science.

However, the transformation from art to science is incomplete because the textile engineer does not have at his disposal a reliable source of knowledge of the physical properties of many of his basic materials.

The variability of the natural staple and bast fibers has made it impractical to have reliable data because of the number of tests required and the time required to perform these tests.

The development of high speed automated testing lines, capable of performing all of the essential physical tests on a 100 gram bale sample in approximately seven seconds, has done much to reduce the time required to perform a single test, but the number of tests required to give reliable results is still prohibitive.

Purpose of the Research

The purpose of the research was to examine the variability of cotton when taken from small samples and to investigate the possibility of the use of a Vortex-Sink Air Flow Device as a system of blending a group of small tufts and/or fibers so that a homogeneous mixture of physical properties will exist throughout the sample, thus reducing the number of sub-samples required to give reliability to results of the tests made on the sub-samples.

CHAPTER II

LITERATURE SURVEY

The literature search was divided into three sections. First, the variability of cotton was researched so that an understanding of the problem was obtained. Second, possible methods of blending were researched. Third, the aerodynamics of fibrous materials were investigated in hopes that aerodynamic forces could be used to perform the blending of the cotton tufts and fibers. The first two sections were very general and served only as an orientation to the third section which is quite detailed.

Variability of Cotton

The most striking characteristic of cotton fiber is its variability in practically every dimensional feature.

Undried, fresh from the boll, cotton fibers are tubular in form consisting of a thin, primary wall surrounding a secondary wall, the thickness of which depends upon the maturity of the fiber. The center opening ranges from very small for thick-walled, mature fibers to a large proportion of the whole cross-sectional area for thin-walled, immature fibers.

When the fiber dries, the lumen or central canal collapses. The mature fibers remain almost circular while the immature fibers become flat. The ratio of the minor diameter to the major diameter of the cotton fiber has been used as a shape factor for the cotton fibers. The ratio of the minor diameter to major diameter varies 67 percent while the ratio of the cross-sectional area to the perimeter of the primary cell varies 38 percent (1).

The over-all cross-sectional area of cotton fiber varies from 26 to 984 square microns or 3800 percent, while the range in wall thickness is from 0.35 micron to 15.5 microns or 4400 percent (2). The number of reversals per centimeter is between 10 and 30 (3, 4). The length of cotton fibers varies from 1/8 inches to 1-3/4 inches (5). The weight per centimeter length of cotton fiber varies from 108 milligrams to 283 milligrams. Turner (6) reported that the linear density of a single cotton fiber could vary from 215 millitex to 318 millitex while the variation from fiber to fiber was between 100 millitex and 340 millitex.

Variability from genetic instability, environmental conditions, harvesting methods and ginning techniques appear not only from fiber to fiber but in the arrangement of groups of fibers. If fibers were completely randomized in ginning, the problem of securing a representative sample would be simplified, but gins do not randomize fibers (7). J. W. McCarty, L. C. Young, and W. C. Boteler (8) showed that the physical properties of cotton fibers vary with their position within a bale. Data reported by Goldfarb (9) was used to compare the standard deviation of cotton samples before and after ginning.

Results of Levy (10) and Cromer (11) were used to study the effects of the processes included in opening through spinning on the standard deviation of Empire WR Cotton Fibers (see Table 1).

Table 1. Summary of Standard Deviation and Percent Coefficient of Variation From Work By Levy (10) & Cromer (11)

Processing Stage	Pressley Strength Weight Ratio: Standard Deviation (pounds/Microgram)	Pressley Strength Weight Ratio: % CV	Micronaire Test: Standard Deviation	Micronaire Test: % CV
Before Opening	0.530	11.85	0.101	2.52
After Opening & Cleaning	0.444	9.91	0.030	0.77
After Picking	0.580	12.42	0.29	6.19
After Carding	0.643	13.22	0.37	8.6
After Drawing	0.267	3.96	0.09	2.4
After Roving	0.222	3.18	0.07	1.9
After Spinning	0.180	2.35	0.12	3.2

Blending of Cotton

Historically, blending of fibers has been accomplished by the use of multiple feed systems which sandwich different layers of fibers either side by side or on top of each other to form a mat of fibers. This mat is then fed to an opener in which the teeth of a rotating cylinder performs a combing and blending operation.

H. H. Langdon (12) states that the sandwich-type system gives good blending. However, Goldthwait (13) in his investigation of the degree of blending of fibers found that many generally accepted methods of blending do not produce in reality a well-blended, uniform sample. Levy and Berriman (14) suggested that the major problem in blending is one of separating the fibers sufficiently to produce uniformity.

There have been many efforts to develop a suitable blender, none of which has been entirely successful. McCarty, Young, and Boteler (8) compared three of these sample blenders:

1. The Custom Scientific Instruments Blender (C. S. I.),
2. The Stanford Research Institute (S.R.I.) Blender,
3. and the Shirley Minature Card.

The methods used for evaluation were:

1. Dyeing cotton samples before blending, then examining the blend for coloration mixture.

2. Digital Fibrograph and Pressley strength measurements were made before and after blending.

3. Dyeing cotton samples after the blending of mature and immature fibers.

4. Fibronaire mixtures.

Both the physical blending and the physical test results were studied and evaluated but no comparison of the standard deviations of samples before and after blending was reported.

The minature card did the best job of blending; however, the fibers were damaged extensively. The S.R.I. Blender did a fairly good job of blending and did not damage the fiber but was too slow. The C.S.I. did a relatively poor job of blending.

Since the S.R.I. was a suction type device, it was recommended that this type of fluid flow system be further developed (8).

Several textile machinery companies have opening blending systems that are a marriage of aerodynamic and mechanical systems. Schoop, Newell, Rudnick and Higgs (15) in a panel discussion considered the Rieter, the Whitin, the Saco-Lowell, and the O-M methods of blending. Fiber Controls Corporation (16) also has a system of mechanical and aerodynamic blending. In all these, pneumatic systems are used to convey, not to blend fibers.

Radko Krcma in his book, <u>Nonwoven Textiles</u>, shows a diagram of a machine developed in the Federal Republic of Germany that uses an air vortex to blend and randomly to orient fibers.

Aerodynamics of Cotton

In the area of aerodynamics, equations have been derived for the dynamic action of two-dimensional particles (cotton fibers) in motion over right-angle corners (17, 18). The equations indicate the feasibility of utilizing ducting of suitable shape to act as a classifier of cotton clumps and to separate trash from cotton.

Ogletree (19) used these equations to design a corner-flow cotton sample blender. The blender was evaluated by physical tests and dyed tracer fibers. The dyed tracer fiber studies indicated that the system provided excellent blending across the width of the sample and through the depth of the sample, but no blending along the length of the sample was achieved. Of the physical properties determined, only the bundle strength results indicated conclusively that the sample had been effectively blended.

The aerodynamics of a tuft of fiber were used by W. Bostock, S. M. Freeman, S. A. Shorter and T. C. Williams (20) to evaluate the opening capability of textile machinery. The mean weight of a tuft and the mean flotation velocity were used to represent the looseness of a tuft. They state:

> "When a body is placed in a current of air, the force, F, acting on it, due to the relative motion of the air and the body, is given by,
>
> $$F = \tfrac{1}{2}\, CAeV^2 \ldots\ldots. 1.1$$
>
> where V is the relative velocity, e the density of the air, A the projected area of the body in the direction of the air stream, and C the "drag coefficient".
>
> When a body is just prevented from falling by means of an air stream moving vertically upwards, the force is equal to the weight of the body,
>
> $$Mg = \tfrac{1}{2}\, CAeV^2 \ldots 1.2$$
>
> where M is the mass of the body and g is the acceleration of gravity. V is now the "flotation velocity of the body".
>
> For bodies of the same shape orientated in the stream in the same manner, A will be proportional to the square of the linear dimensions, and the volume Z to

the cube, i.e.,

$$A^{3}/2 = SZ,$$

where the quantity S is the same for all bodies of the same shape, similarly orientated, but may vary for differently shaped bodies. Thus for a sphere $S = 3/4\ \pi^{\frac{1}{2}}$ and is called the "shape factor". The "shape factor" is large or small according as the ratio of the presented surface is large or small compared with the square of the linear dimensions.

If v denotes the specific volume of the body (so that $M = vZ$) then $A^{3}/2 = vSM$, and substitution of this value of A in Equation 1.2 gives

$$vSC^{3/2} = \frac{2\sqrt{2} \times g^{3/2}}{e^{3/2}} \times \frac{M^{\frac{1}{2}}}{V^{3}} \qquad 1.3$$

an equation giving the product of $vSC^{3}/2$ in terms of the mass and the flotation velocity of a body".

It will be seen that the quantity $M^{\frac{1}{2}}/V^{3}$ may vary for different bodies owing to a variation of any one of three factors, the specific volume, the shape factor, or the drag coefficient. Thus of two bodies with the same flotation velocity, the one with the larger mass has the greater "specific buoyancy", and the difference can be attributed to one or both of the following causes:

1. A difference in specific volume.
2. A difference in shape or drag coefficient.

The above definition of "specific buoyancy" implies that a difference of drag coefficient is always due to a difference in the shape of the body. There are two causes for the variation of the drag coefficient which occurs with the body. At low velocities the drag coefficient begins to increase owing to the increasing part played by the viscosity of the air and for some shapes there is a decrease of drag coefficient at very high velocities due to a change in the nature of the flow near the rear of the body. At these two extremes the definitions of specific buoyancy breaks down.

E. D. Potapov (21) expressed the equation of motion of fibrous materials in horizontal and vertical pneumatic conveyors using the boundary conditions of the starting velocity and the soaring speed. The starting velocity is the lowest air velocity at which a deposited particle passes from inactivity to movement. The soaring speed in a vertical pipe is equal to the air velocity at which the particles are in a state of suspension and oscillate within given limits of equilibrium. He found that the starting velocity for cotton was 3.60 meters per second, the soaring speed of cotton was 1.25 meters per second, and that the maximum soaring speed occurred when the area exposed to the flow was at a minimum (the case of equivalent sphere). It was also noted that loose pieces of fibrous materials have highly developed surface of contact with the air. The air currents permeate between the fibers and surround them. The friction force becomes the principal vector of resistance to the air current.

Vortex-Sink Air Flow

Soll (22) developed the equations of motion for particles in a vortex-sink air flow device and wrote an IBM 7090 computer program to solve these equations by the Runge-Kutta integration technique with error control and automatic variable step size.

The system used to test these equations involved two-dimensional low-speed air-flow combining a potential vortex and sink flow. The density of the particles in the system was approximately that of cotton that has been partially opened by a suitable opener. All equations are based on spherical particles, thus the only aerodynamic forces produced are drag forces.

When introduced into an air stream of this type, the particles are under two forces:

1. Drag, which acts to move the particles along the streamlines of the flow, and
2. Inertia, which tends to cast them out of the regions of high flow curvature.

Particles will then attain equilibrium trajectories in the flow; they will have constant angular velocity at a radius determined by the particle size and density, and zero radial velocity. According to Soll the equilibrium condition is described by the following equation:

$$reg = \frac{4}{3} \frac{B_a}{B_p} \frac{d}{C_D} \frac{T^2}{Q^2} \qquad 1.4$$

where reg is the equilibrium radius, d is the particle diameter, C_D is the drag coefficient, B_a is the fluid density, B_p is the particle density, T is the vortex flow strength, and Q is the sink flow strength.

The value of C_D was approximated by four expressions:

$$C_D = \frac{24}{Re} \qquad Re \leq 1.0 \qquad 1.5$$

$$C_D = \frac{18.5}{Re^{6}} \qquad 1.0 < Re \leq 10^3 \qquad 1.6$$

$$C_D \approx \frac{3.1}{\log Re} \qquad 10^3 < Re \leq 4.36 \times 10^3 \qquad 1.7$$

$$C_D \approx 0.37 \qquad 4.36 \times 10^3 \leq Re \leq 8 \times 10^3 \qquad 1.8$$

where Re is the Reynolds number by standard definition.

Soll's equation indicates that fibrous materials can be separated in a two-dimensional, vortex-sink air flow system. Small, light particles outside the range of the system will be pulled into the sink, while larger, heavy particles outside this range will be forced out from the flow center until the equilibrium radius or the limit radius of the system is reached.

Thus it is possible theoretically to blend textile fibers according to their mass-area ratio by two different methods in a vortex-sink air flow system; and by extending the methods discussed in An Aerodynamic Study of the Opening and Cleaning of Cotton by Existing Machinery (20) to Soll's equation, a vortex-sink air flow device could be used to compare the opening efficiency of textile equipment. By placing equal mass particles in the system, the more highly opened particles would assume a smaller equilibrium radius.

The first possible method of blending in a vortex-sink air flow device is to use the vortex as a mixing chamber. The vortex is designed so that its strength is enough to keep the smallest particle in mass per unit area from being pulled from the vortex into the sink. The particles assume an equilibrium radius. Then the vortex is closed, and the mixed sample is removed.

The second method is to use the vortex as a time delay. In this system the sink is made strong enough to pull the tuft with the highest mass-to-area ratio down the sink. The material is fed into the vortex. The light particles move quickly out of the vortex and the heavier particles move out more slowly. As more particles are fed into the system, the light particles move out with the heavy particles that were fed in earlier. In this system the fibers that are pulled in first and last are not included in the blended sample.

CHAPTER III

MATERIALS AND APPARATUS

Raw Materials

Raw materials were selected from four different sources. Source number one (USDA Calibration Cotton) was selected so that the blending of different physical properties could be evaluated. Materials from source number two (Georgia Tech Rovings) were selected so that visual appraisals of blending as well as the blending of physical properties could be compared. Materials from source numbers three (USDA Gin Stock) and four (Georgia Tech Bale Stock) were selected because these are the types of material where a sample blend will find most of its applications.

USDA Calibration Cotton

USDA Calibration Cottons with the following physical properties were selected for tests on the blending of materials by physical properties:

(a) 7.40 Micrograms per Inch

(b) 2.65 Micrograms per Inch

(c) 5.41 Micrograms per Inch; 7.40 Pressley Strength-Weight Ratio

(d) 3.58 Micrograms per Inch; 9.02 Pressley Strength-Weight Ratio

Georgia Tech Rovings

Rovings were selected from the Georgia Tech roving supply that produced different colors when subjected to Du Pont Fiber Identification Stain Number Four. Their physical properties and the color upon staining are exhibited in Tables 2, 3, 4, and 5.

USDA Gin Stock

The third source of material was USDA Gin Cotton. A test on gin cotton was done on a before and after basis. For data on physical properties, refer to Tables on USDA Gin Cotton (Appendix C).

Table 2. The Physical Properties of Roving Material Number One

Color After Staining - Blue-green

Sample Number	Micrograms per Inch	Fibrograph 66.6% Span Length	Fibrograph 2.5% Span Length
1	5.50	0.516	1.449
2	4.80	0.510	1.457
3	4.90	0.760	1.409
4	5.40	0.720	1.409
5	5.40	0.787	1.458
6	5.30	0.900	1.402
7	4.90	0.705	1.398
8	5.10	0.639	1.387
9	5.60	0.685	1.393
10	5.20	0.759	1.394
11	5.50	0.628	1.384
12	5.20	0.582	1.384
13	5.30	0.659	1.393
14	5.40	0.683	1.449
15	5.40	0.516	1.393
16	5.50	0.685	1.398
17	5.70	0.628	1.458
18	4.80	0.720	1.393
19	5.40	0.657	1.457
20	5.20	0.639	1.409
$\bar{X}$	5.28	0.668	1.414
S	0.26	0.096	0.029
%CV	5.0	14.4	2.0

Table 3. The Physical Properties of Roving Material Number Two

Color After Staining - Red

Sample Number	Micrograms per Inch	Fibrograph 66.6% Span Length	Fibrograph 2.5% Span Length
1	7.10	0.58	1.383
2	7.60	0.53	1.359
3	7.80	0.54	1.373
4	7.50	0.64	1.377
5	7.40	0.61	1.368
6	7.40	0.59	1.356
7	7.80	0.58	1.336
8	7.60	0.58	1.350
9	7.50	0.55	1.360
10	7.40	0.54	1.350
11	7.70	0.60	1.357
12	7.60	0.61	1.363
13	7.70	0.68	1.400
14	7.60	0.54	1.358
15	7.70	0.61	1.361
16	7.70	0.63	1.364
17	7.70	0.64	1.369
18	7.60	0.57	1.327
19	7.70	0.62	1.357
20	7.50	0.55	1.360
$\overline{X}$	7.58	0.59	1.361
S	0.17	0.04	0.016
%CV	2.0	7.0	1.1

Table 4. The Physical Properties of Roving Material Number Three

Color After Staining - Blue

Sample Number	Micrograms per Inch	Fibrograph 66.6% Span Length	Fibrograph 2.5% Span Length
1	4.80	0.377	1.030
2	5.00	0.408	1.030
3	5.10	0.409	1.047
4	4.90	0.443	1.044
5	4.80	0.451	1.068
6	4.70	0.434	1.031
7	5.20	0.416	1.050
8	5.00	0.406	1.046
9	5.20	0.398	1.016
10	4.90	0.467	1.072
11	4.70	0.426	1.035
12	4.90	0.434	1.066
13	5.10	0.396	1.025
14	5.00	0.415	1.030
15	5.00	0.428	1.037
16	5.20	0.417	1.035
17	4.90	0.432	1.069
18	4.90	0.390	1.007
19	5.00	0.445	1.032
20	4.80	0.347	1.022
$\bar{X}$	4.96	0.415	1.040
S	0.15	0.032	0.018
%CV	3.0	8.0	1.7

Table 5. The Physical Properties of Roving Material Number Four

Color After Staining - Gold

Sample Number	Micrograms per Inch	Fibrograph 66.6% Span Length	Fibrograph 2.5% Span Length
1	7.90	0.62	1.365
2	8.00	0.60	1.333
3	8.00	0.58	1.338
4	8.00	0.61	1.352
5	7.90	0.61	1.350
6	7.90	0.61	1.350
7	7.90	0.68	1.366
8	8.00	0.64	1.376
9	7.90	0.60	1.381
10	7.90	0.62	1.365
11	7.90	0.59	1.355
12	7.90	0.62	1.394
13	7.75	0.60	1.388
14	7.85	0.66	1.384
15	7.90	0.70	1.407
16	7.85	0.62	1.365
17	7.90	0.59	1.339
18	8.00	0.61	1.384
19	7.90	0.64	1.355
20	7.90	0.62	1.350
$\bar{X}$	7.91	0.62	1.376
S	0.06	0.03	0.047
%CV	0.8	4.9	3.4

Georgia Tech Bale Stock

The Georgia Tech Bale Stock was selected and prepared so that a "large" supply of fiber with the same physical properties could be used for comparison of the blending of physical properties at different sample blender settings.

The uniformity of the physical properties (see Tables 6 and 7) was achieved in the following manner. Five layers of cotton were peeled from the bale of cotton. Each layer was then divided into fifty sections of equal volume. One of the fifty sections from each layer was then sandwiched with one of the fifty sections from each of the other four layers. The sections were selected for the sandwiching process by the use of a Random Units Table (23).

The fifty blended samples were then halved across the sandwich to form one hundred samples. The samples were then stored in order by the use of Random Units.

Conditioning Materials for Physical Testing

All raw material samples were conditioned at 65 percent relative humidity and 70 degrees Fahrenheit for 24 hours before physical testing.

Table 6. The Physical Properties of Georgia Tech Bale Stock Before Blending

Sample Number	Micrograms per Inch	Pressley Index	Upper Quartile Length	Mean Length
1	5.20	7.43	1.30	1.09
2	5.00	7.27	1.32	1.06
3	4.90	7.75	1.14	0.94
4	5.30	7.42	1.12	0.94
5	5.20	7.21	1.23	1.08
6	5.20	7.02	1.17	1.05
7	5.30	6.78	1.15	0.90
8	5.40	7.31	1.24	1.01
9	5.20	7.54	1.41	1.12
10	5.10	7.68	1.16	1.03
11	5.40	6.98	1.12	0.93
12	4.90	7.70	1.19	0.98
13	4.60	8.23	1.18	1.00
14	5.50	7.49	1.19	0.95
15	5.10	7.59	1.33	1.06
16	5.20	7.89	1.41	1.10
$\bar{X}$	5.16	7.49	1.23	1.02
S	0.20	0.37	0.10	0.07
%CV	3.9	4.9	7.9	6.8

Table 7. Fiber Length of Georgia Tech Bale Stock Before Blending

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Uniformity Ratio
1	0.44	0.57	1.13	50.5
2	0.44	0.56	1.12	50.0
3	0.37	0.49	1.04	47.0
4	0.36	0.49	1.06	46.3
5	0.42	0.56	1.11	50.5
6	0.41	0.54	1.01	53.5
7	0.36	0.47	1.04	45.3
8	0.41	0.53	1.09	48.5
9	0.48	0.59	1.10	53.5
10	0.38	0.53	1.12	47.3
11	0.35	0.48	1.08	44.5
12	0.38	0.51	1.11	45.9
13	0.39	0.52	1.08	48.2
14	0.38	0.50	1.09	45.8
15	0.44	0.56	1.13	49.5
16	0.47	0.58	1.12	51.8
$\overline{X}$	0.41	0.53	1.09	48.6
S	0.04	0.04	0.04	2.8
%CV	10.0	7.1	3.3	5.8

Existing Apparatus

The following measuring equipment supplied by instrument manufacturers was used in this program:

1. The Fibronaire was used to measure the fineness of the fibers.

2. The fiber bundle strength was determined using the Pressley Strength Tester.

3. Changes in length distribution were detected by the Spinlab Digital Fibrograph Model 230A with Spinlab Fibrosampler Model 192.

Fibronaire

The measure of the fineness of the cotton fibers, because of their small diameters, is expressed in terms of weight per unit length, micrograms per inch. The Fibronaire is a device developed for the determination of fineness by air-flow. The apparatus seen in Figure 1 uses the principle of forcing air through a sample of fibers and measuring the resistance to the flow of the air. Thus, fiber fineness is measured indirectly (24).

Pressley Fiber Strength Tester

The Pressley Fiber Strength Tester, Figure 2, was used to determine the bundle breaking strength of the fibers. The principle of the operation is based on the application of a load to a small band of fibers which have been placed across a set of jaws at zero gauge length. The load is applied by the travel of a weight down an incline beam, the load increasing as the weight moves away from the fulcrum. The increasing load acts as a force to separate the jaws and rupture the fiber ribbon. The bottom jaw of the device is fixed while the top jaw is held in slots by the lever arm attached past the fulcrum point of the inclined beam. The beam weight is stopped when the fiber ribbon breaks and the beam swings freely, thus coming in contact with the base. The inclined beam is calibrated so a breaking strength in pounds can be read at the position where the beam weight stopped.

The Pressley Index was obtained by dividing the breaking strength of fiber ribbon by the weight of the fiber ribbon (25).

Digital Fibrograph

The Digital Fibrograph, Figure 3, was used to determine the changes in length distribution of the fibers. The Fibrograph is an optical instrument with light-sensitive cells for scanning parallel cotton fibers and calculating a length distribution on a number-length basis. Digital Fibrograph measurements are obtained by scanning fiber beards which have been prepared on the Fibrosampler, Figure 4.

The fiber beards are measured at 0.150 inches from the comb in which they are held and the number of fibers at this point is considered to be 100 percent of the fibers in the specimen. The beard is then scanned from the base toward the tip. Readings were taken at the 66.6%, 50%, and 2.5% span lengths. The span length is the distance from the comb at which a certain percentage of the original fibers is reached (26).

Strobotac *

The Strobotac electronic stroboscope is a high-speed light source

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* Type 1531-AB electronic stroboscope, USA patent by General Radio Company, West Concord, Massachusetts.

designed to fill a wide variety of both photographic and non-photographic needs in science and industry. A self-contained electronic oscillator enables the unit to operate independently at flash rates from 110 to 25,000 flashes per minute. The flash rate is continuously variable throughout this range and can be set accurately within one percent of the required value by means of the large calibrated dial on the instrument panel.

In high-speed photography the greatest advantage of the Strobotac is its ability to deliver high-intensity light flashes of extremely short time duration. When the reflector is in place, the light output is concentrated into a long-throw 10° beam with an apparent source 18 inches behind the reflector front. Outside this 10° cone the light intensity falls off sharply, so that the area of reasonably constant illumination is not large.

The Strobotac may be used for special applications. In microphotography the unit provides ample light for photographing objects or organisms under high magnifications, yet the flash duty cycle is low enough to prevent destruction of delicate subjects due to over heating. Fiber optics can be easily employed with the Strobotac to provide a small, intense light source some distance from the unit itself (27). The Strobotac was used to aid in visual observation and to determine machine speeds (see Chapter IV).

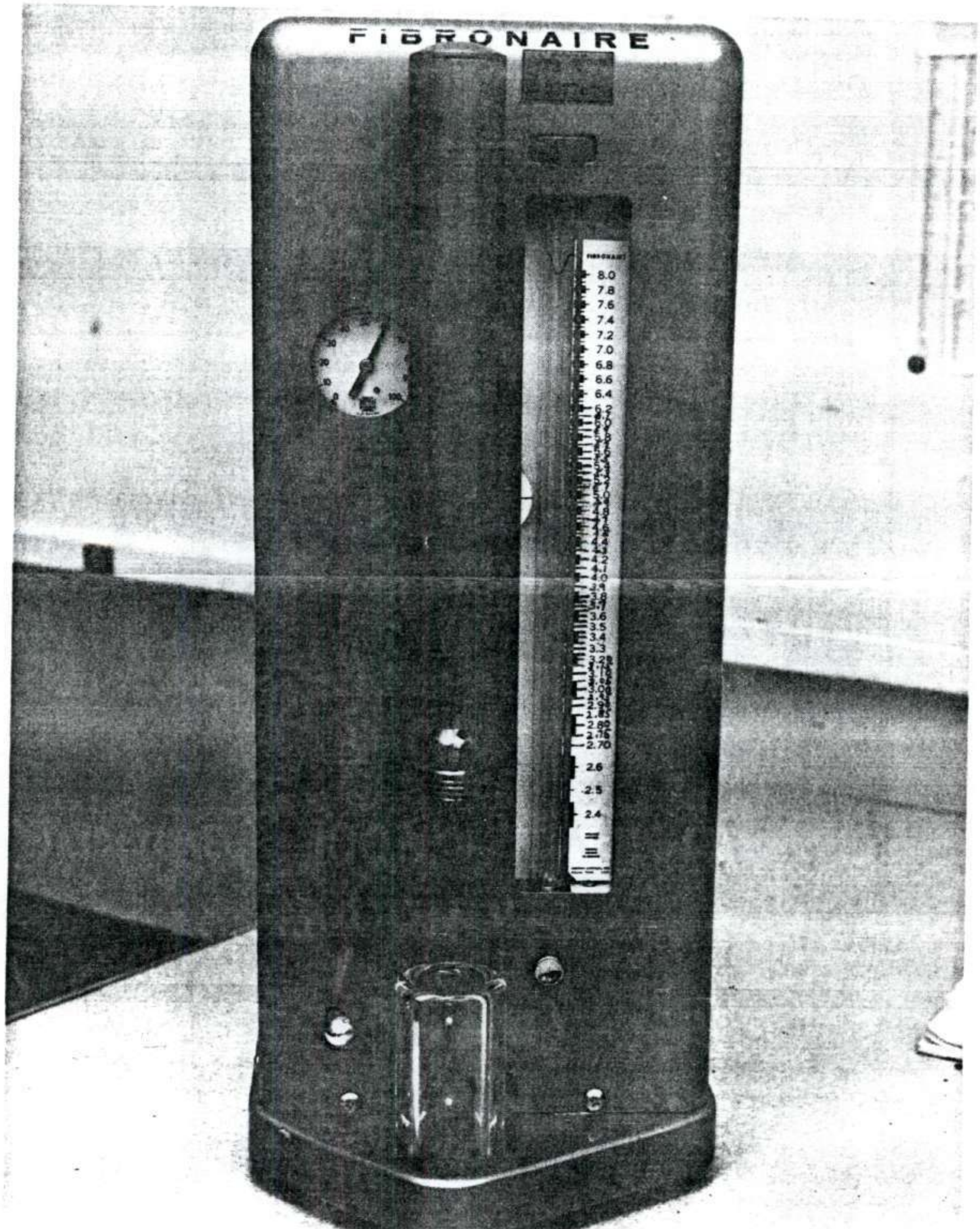

Figure 1. Fibronaire Fiber Tester

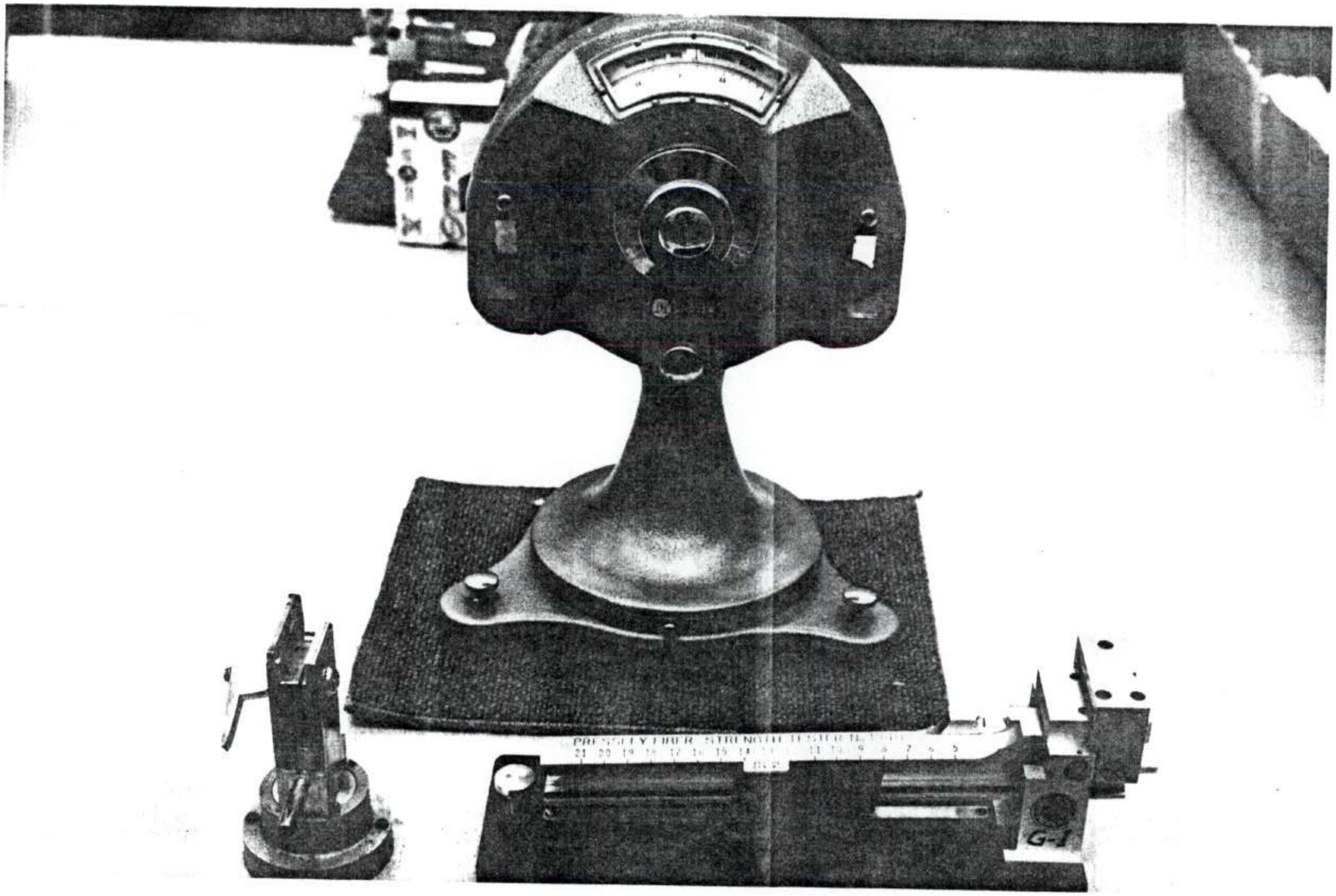

Figure 2. Pressley Fiber Bundle Strength Tester

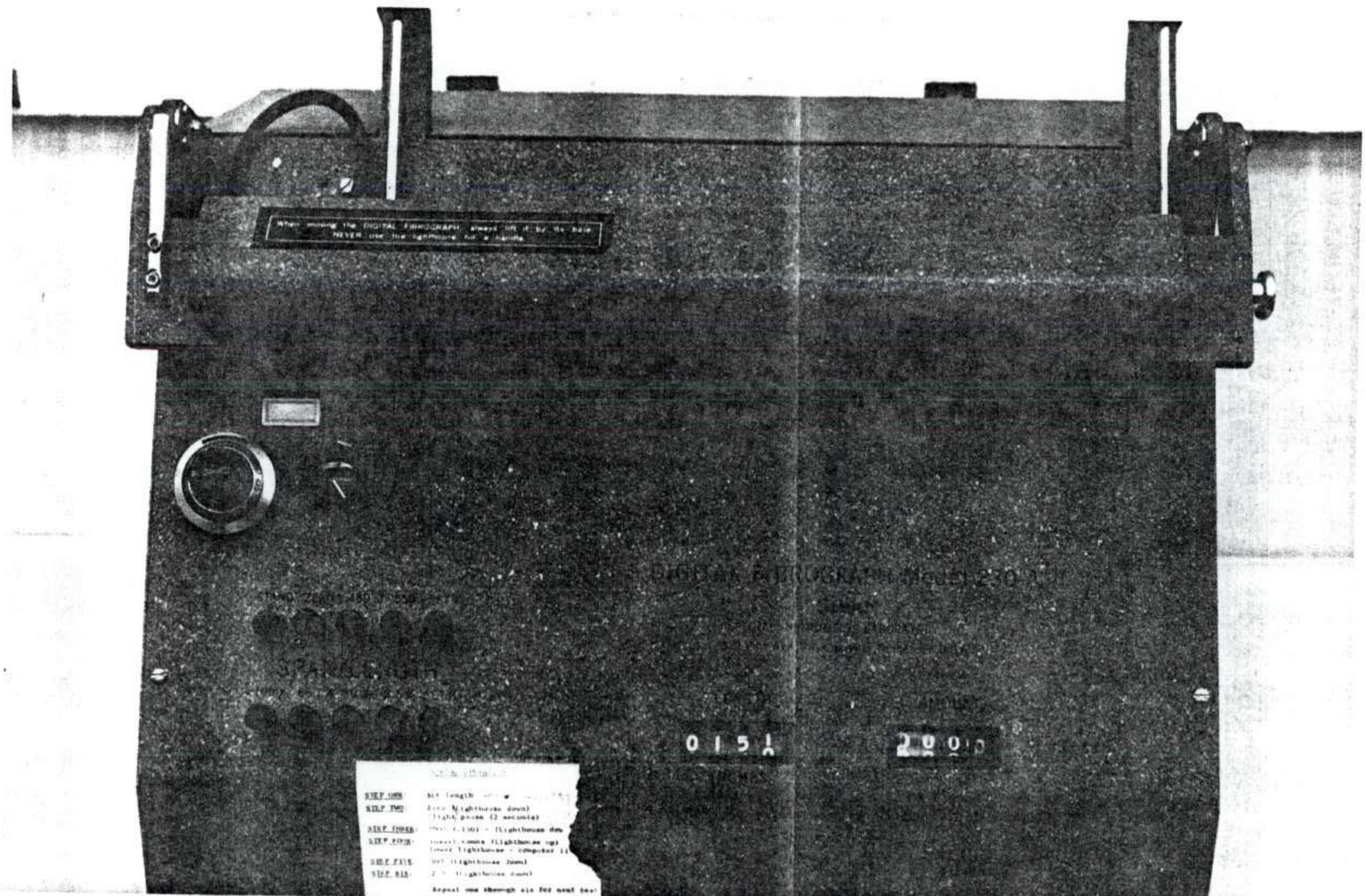

Figure 3. Digital Fibrograph Model 230-A

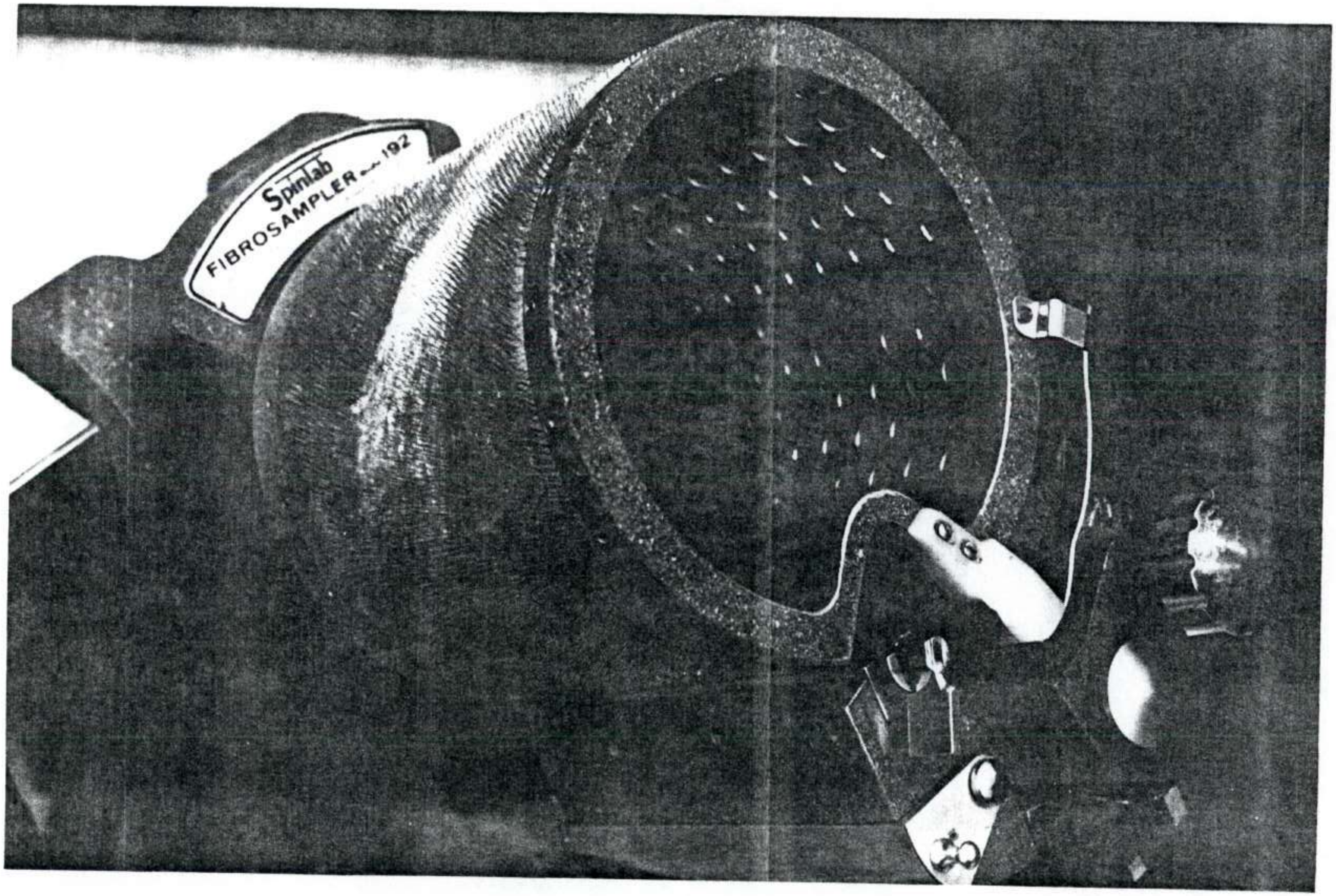

Figure 4. Fibrosampler Model 192

Opening Equipment

Shirley Analyzer

The Shirley Analyzer was developed to separate fibers from trash by air flotation; but was used to pre-open samples of fiber to study the effect of opening on the blending in the vortex-sink air flow device.

The Shirley Analyzer uses a licker-in and feed plate to open the fiber. When the fibers leave the licker-in they are carried by an air stream and deposited on a condenser cage. The air stream is adjusted so that it will carry only the cotton fibers and dust; it is not strong enough to carry the trash, so that as the fibers move from the licker-in to the cage, the trash falls to the lower section of the machine. When the fibers and dust reach the cage, the dust passes through and are exhausted (28).

Speeds: The following speeds were used on the Shirley Analyzer:

(1)	Licker-in	900 rpm
(2)	Feed roller	0.9 rpm
(3)	Cage	80 rpm
(4)	Fan	1750 rpm

Settings: The following settings were used on the Shirley Analyzer:

(1)	Feed plate to licker-in	0.004 inches
(2)	Streamer plate to licker-in	0.005 inches
(3)	Stripping knife to licker-in	0.004 inches
(4)	Stripping knife to cage	5/16 inches
(5)	Licker-in to cage	7/32 inches
(6)	Separation sheet to cage	1/4 inches

(7)	Separation sheet to licker-in	9/16 inches
(8)	Delivery plate to cage	1/16 inches

SKF Spinntester

The draft section of the SKF-Spinntester Model 82 was used to open the Georgia Tech roving materials. The SKF Spinntester draft section (see Figure 5) is a three-over-three draft system. The break draft is continuously variable from 1 to 9. The total draft of the SKF-Spinntester is continuously variable from 12 to 108. The speed of the Spinntester is controlled by a D. C. Motor that gives spindle speeds that are continuously variable from 0 to 16,000 rpm. The Spinntester is designed so that the roller nip spacing for both draft zones is easily adjustable.

The SKF-Spinntester draft system was set as follows for all tests:

(1)	Break draft	2
(2)	Total draft	60
(3)	Spindle Speed	16000 rpm
(4)	Back roll ratch	$2\frac{1}{4}$ inches
(5)	Front roll ratch	2 inches

Blending Systems

Two-dimensional Vortex-Sink Air Flow

A specially designed two-dimensional vortex-sink air flow system was constructed, Figure 6, to investigate the blending of the Georgia Tech roving materials. The base and the top of the vortex were made from three-sixteenth inch thick "Plexiglas". The bottom was painted black on the outside so that fibers could be seen in the system. A scale with one centimeter intervals was painted on the top of the system.

The sides were made of one inch by three-sixteenths inch Delrin strips rolled and secured in position between the top and bottom plates with Number 3 wire nails to form a 90 degree vortex sink 36 inches in diameter and one inch thick.

Adjustable slides scaled in increments of one-quarter square inches of open area were placed on each of the four air inlets. The slides were easily removable and four adapter blocks each with an adapter for one inch inside diameter tubing could be used in place of the slides, Figure 7.

A one foot cubic collection box was made from three-sixteenths inch thick "Plexiglas" and a frame cut from plywood and covered with a loose weave nylon fabric was placed two inches from the bottom of the cube.

The top of the cube was connected to the vortex-sink through a three inch diameter hole cut in the lower "Plexiglas" plate. The bottom of the cube was connected to a Craftsman Twin Motor Industrial Vacuum Model Number 315.16970 by a Craftsman Extension Hose and Connection Kit Number 9-16928.

The vortex was placed on a table made with a frame of soft pine 2 x 2's and with a one-half inch plywood top. The center was removed so the collection screen cube would fit below the surface of the table top.

"UT" Opener

The "UT" Opener was constructed at the Georgia Institute of Technology Engineering Experiment Station, Mechanical Science Division, in conjunction with Georgia Tech Project B-1315. The "UT" Opener was modeled after a miniature Creighton opener developed at the University of Tennessee USDA Laboratory.

The "UT" Opener (see Figure 8) consists of a conical rotor (see Figure 9) surrounded by a conical shell. The rotor consists of four pin bars secured to two one-quarter inch circular plates so that when rotated the pins generated a cone 23½ inches long with a large diameter of 18 inches, while the diameter of the smaller end was 10 inches. One-quarter inch diameter pins were secured to one-quarter-by-three inch bar stocks to make the pin bars. The pins were two and one-half inches long and rounded on the exposed end, protruding one inch outward from the bar stocks.

The conical shell was made in two sections. The top section was one-quarter inch thick "Plexiglas" and had a four by three inch inlet on the tangent to the small end of the cone. A similar opening on the large end of the cone led to a collector screen.

The bottom section of the shell was one inch diamond shaped expanded metal rolled into a conical form which cleared the pins of the rotor by one-half inch.

Between the two sections were two stationary pin bars. These pins were placed so they extended between the pins of the rotor and cleared the rotor bar by one-quarter inch.

The "UT" Opener was mounted in a box frame and driven by a variable speed D. C. motor with a maximum rotor speed of 1400 rpm.

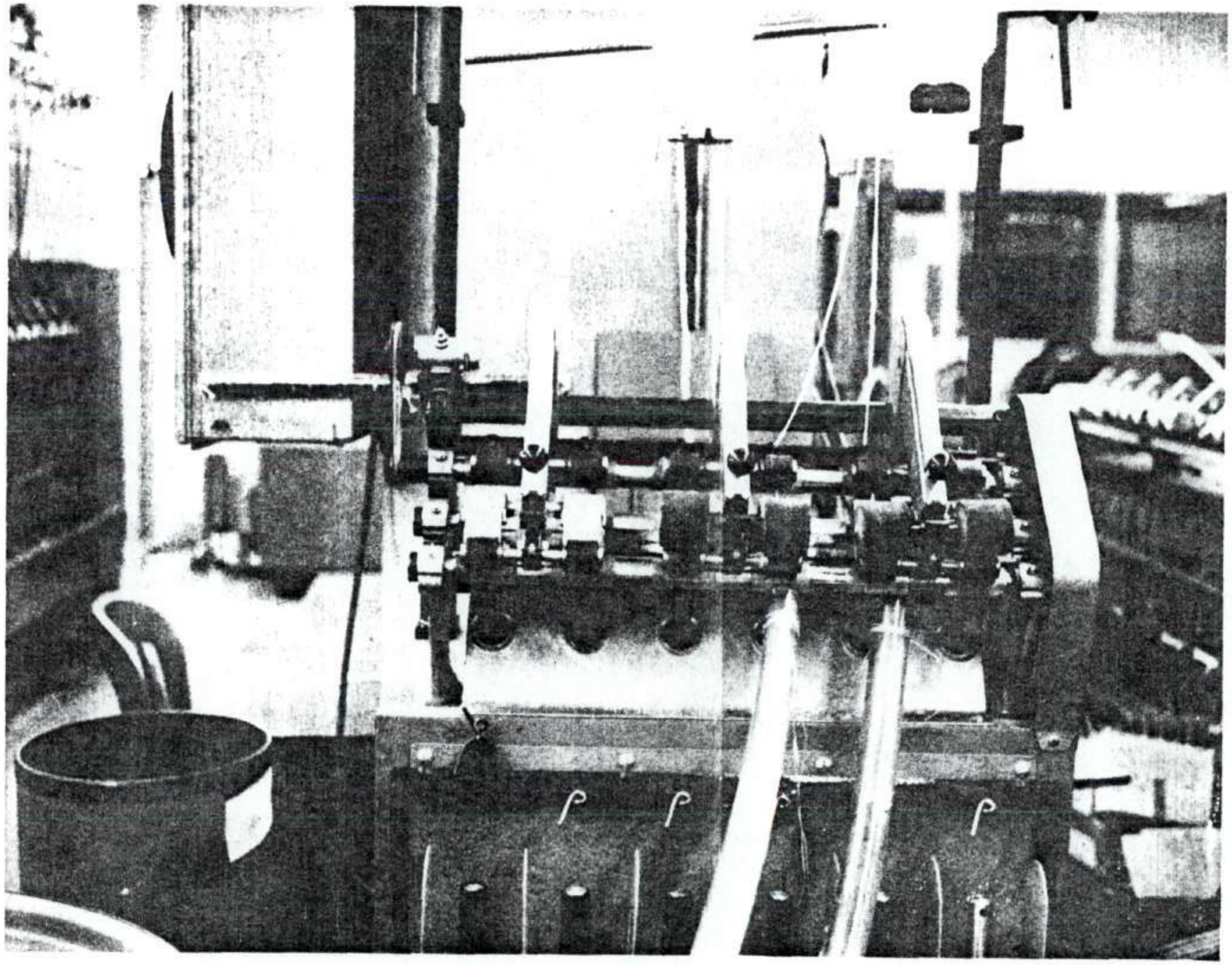

Figure 5. SKF Spinntester Draft Section

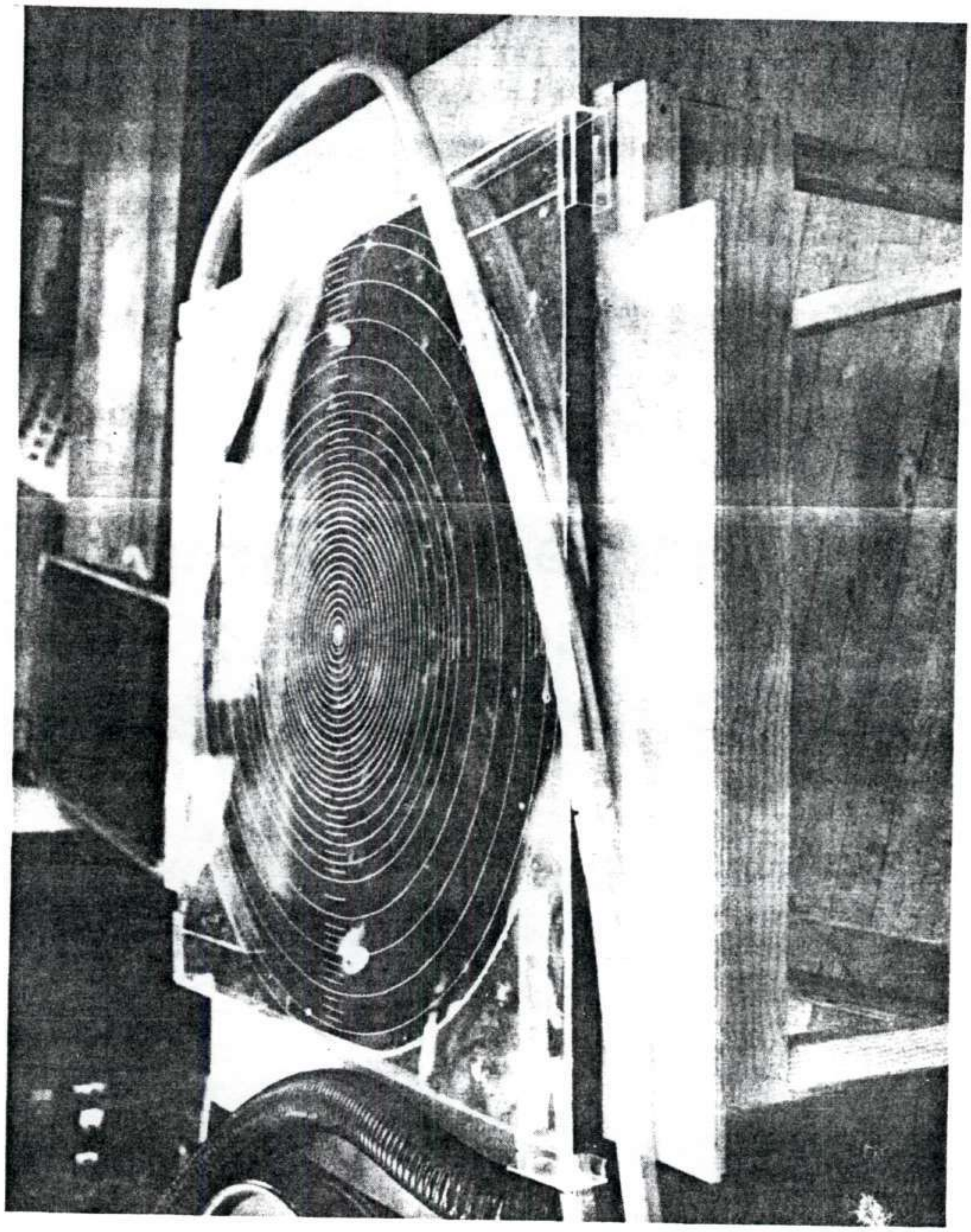

Figure 6. Two-dimensional Vortex-Sink Air Flow

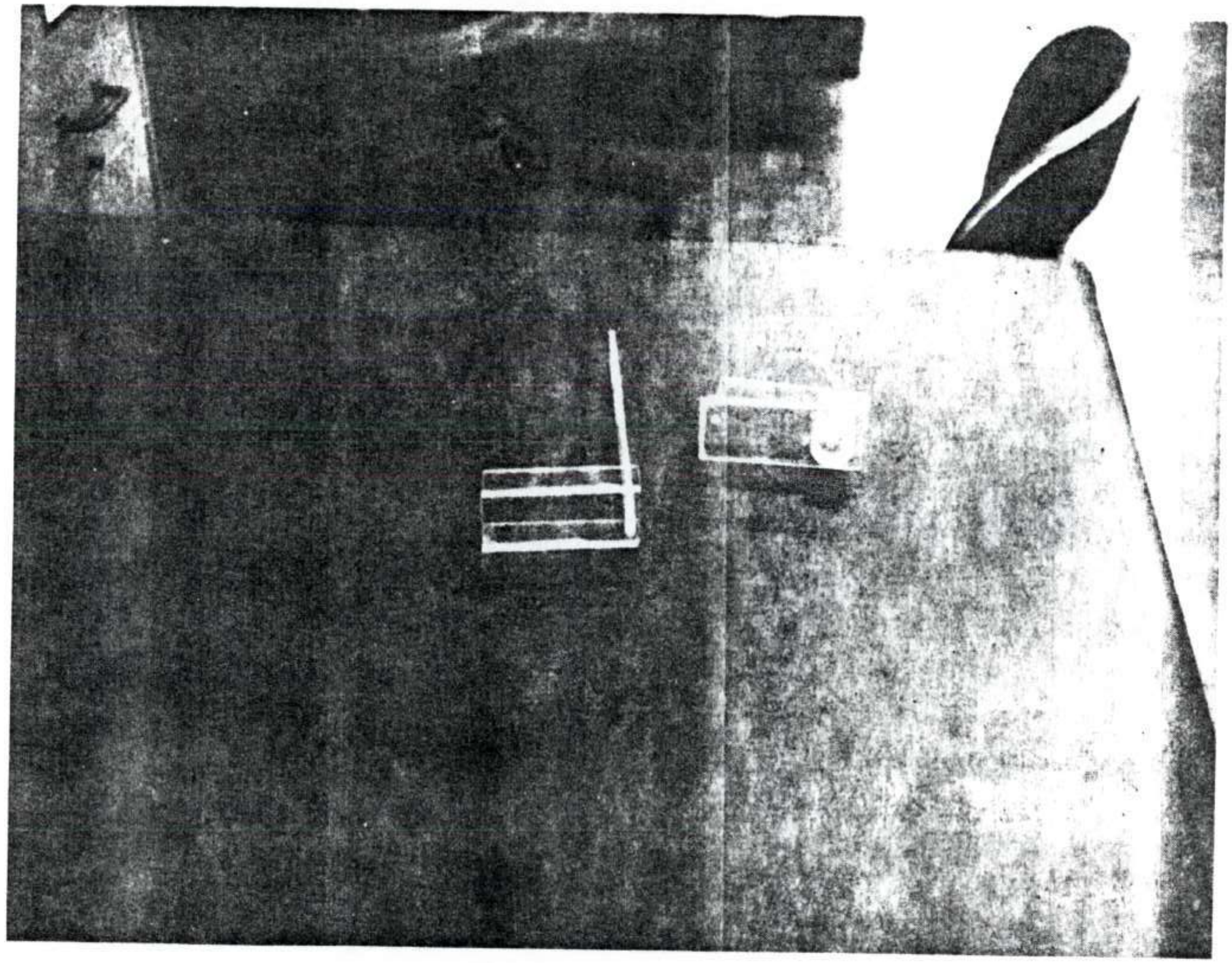

Figure 7. Adjustable Slide and Adapter Block

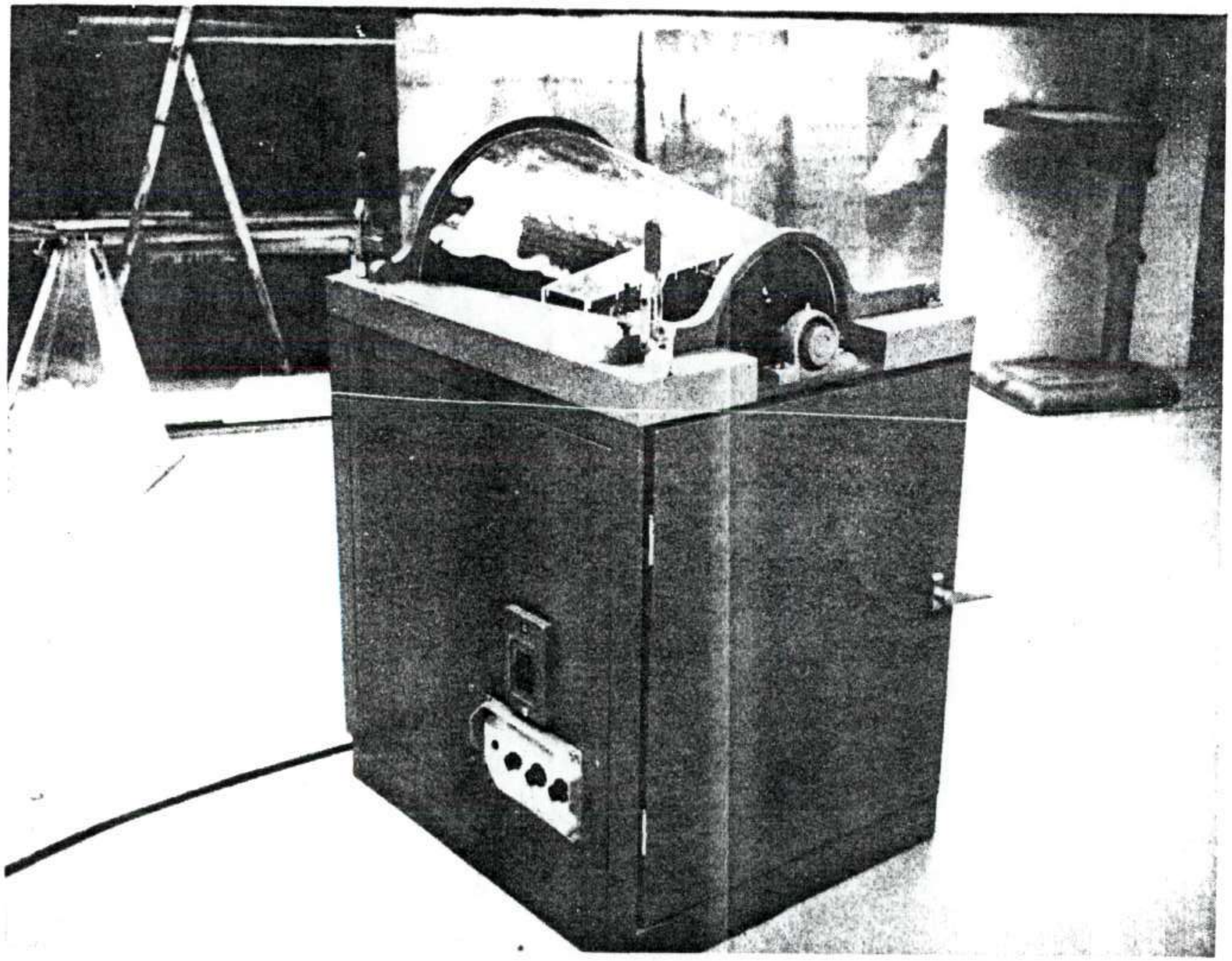

Figure 8. "UT" Opener

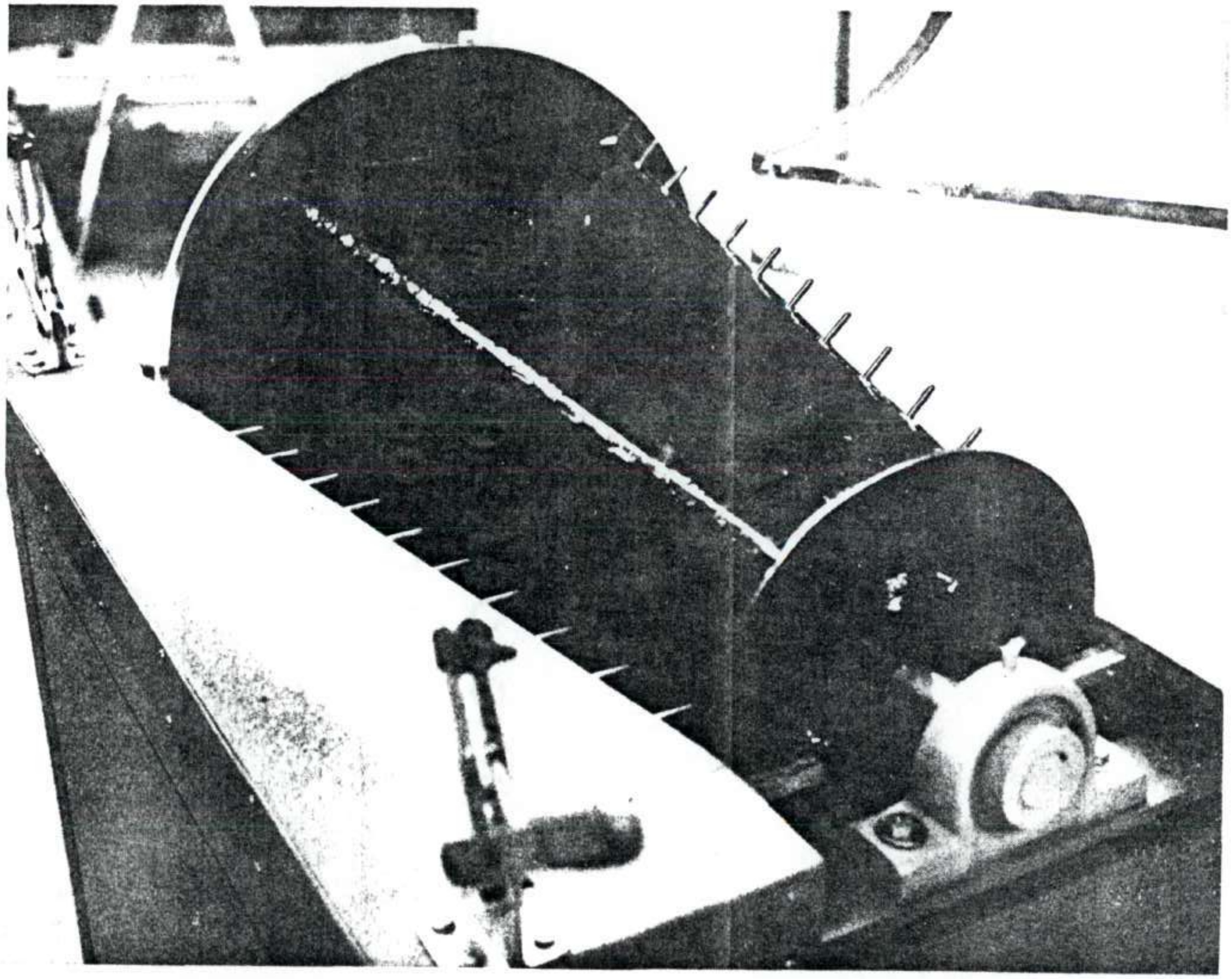

Figure 9. "UT" Opener Rotor

CHAPTER IV

PROCEDURE

Blending

USDA Calibration Cotton

Blend of 7.40 Microgram with 2.65 Microgram Cotton. This cotton was blended on the "UT" Opener. These samples were run to determine the blending within sample from end to end and from side to side.

Thirty-five grams of each of the two cottons were weighed. The "UT" Opener was then started. The rotation rate of the rotor was set at 1330 rpm with the Strobotac. The cotton samples were then fed into the "UT" Opener.

For the side-by-side tests both weighed samples were fed to the "UT" Opener at the same time. For the end-to-end blending tests all of one weighed sample was fed into the machine, then all the other was fed into the "UT" Opener. The time delay between the feeding of one material and the feeding of the next was kept to a minimum. The time required to make one pass through the "UT" Opener for a 70 gram sample was about 18 seconds. The samples were then collected on the "UT" Condenser screen and recycled or bagged for testing.

Blend of 5.41 Microgram Cotton with 3.58 Microgram Cotton. These cottons were pre-opened by running each through the Shirley Analyzer. Each cotton was pre-opened individually and stored in separate bags until blending. The blending procedure was the same as that of the 7.40/2.65 Calibration Cotton blend except that the rotor speed of the "UT" Opener was set at 800 rpm.

Georgia Tech Rovings

The Georgia Tech rovings were opened for blending on the SKF-Spinntester draft system. The blends made were:

(1) A 35/65 blend of rovings one and two.

(2) A 50/50 blend of rovings three and four.

The two rovings to be blended were creeled into the SKF-Spinntester. With the Spinntester set at the conditions given in Chapter III, the rovings were opened. The open fiber was transferred to the vortex at 180 degree intervals by two one-inch inside diameter Tygon tubes. Six gram samples were collected for stain testing and 100 gram samples were collected for physical testing. Time delay tests were also conducted on these blends. Six gram samples were collected by feeding the material through one Tygon tube, with each material being fed a specified time, up to 0.50 minutes, and then the other material being fed an equal time. The Tygon tube was switched from one position to the next by hand.

USDA Gin Stock

The USDA Gin Stock was divided into two sections; one section was used for the physical testing before blending and the other section was blended on the "UT" Opener with the revolution rate of the rotor and the number of passes through the opener being recorded as variables for each sample.

Pre-Opened USDA Gin Stock

USDA Gin Stocks were divided into two groups. One group had cottons with higher Fibronaire readings than the other group. These cottons were pre-opened and blended in the same manner as the pre-opened Calibration Cottons.

Georgia Tech Bale Stock

Seventy-five gram samples taken from the Georgia Tech Bale Stock prepared as described in Chapter III were blended on the "UT" Opener in the same manner described for the USDA Gin Cottons.

Testing

Fiber Staining

R. K. Ogletree (19) found that it was difficult to open cotton fibers after they had been dyed. To by-pass this problem of opening, the Georgia Tech rovings were selected so that they could be stained after blending. The staining was performed on all samples after opening and both before and after blending so that color could be compared.

Du Pont Fiber Identification Stain Number Four was used with the following procedure:

The six gram samples of material were throughly wetted in hot water before dying. The samples were then placed in a boiling one percent solution of Du Pont Fiber Identification Stain Number Four using a 20:1 bath-to-fiber ratio. The material remained in the boiling bath for one minute after which it was removed, lightly rinsed and dried.

Physical Testing

The samples, after sufficient time for conditioning, were evaluated for the properties of fiber fineness, bundle strength, and fiber length distribution. All investigations were made in the Textile

Cotton Testing Laboratory.

Fineness

The property of fiber fineness was assessed through the use of the Fibronaire. Fiber fineness determinations based on the principle of resistance to air flow were discussed in Chapter III.

The Fibronaire and the Shadowgraph balance were first calibrated according to the manufacturer's recommendations. From the samples, starting at one end and proceeding to the other, test specimens of 50 grains each were removed and weighed on a Shadowgraph balance. Each specimen was then placed in the Fibronaire's compression chamber, care being taken that no fiber extended over the rim of the chamber. A control lever was depressed to activate the movement of the compression plunger into the compression chamber. The cotton fiber specimens at this point were compressed into a cylindrical form one inch in diameter and one inch long. Air pressure of six pounds per square inch was then passed through the fibers in the chamber. A reading was recorded from a scale, calibrated in MICS, on the instrument. The fineness index having been recorded, the control lever was raised, causing the compression plunger to lift and the fiber specimens to be ejected by a pulse of compressed air.

Fiber Bundle Strength

The Pressley Tester was used to measure fiber bundle strength. All measurements were made at zero gauge length. The instrument was checked to insure that it was in proper operating order according to the operating manual. Then before any of the test specimens were evaluated, a correction factor was obtained by testing five specimens of USDA Calibration Cotton. The average of the five tests was divided into the specified Pressley Index of the Calibration Cotton. This ratio was then used as a correction factor. A new correction factor was obtained after every four hours of use or after any interval greater than thirty minutes in which no testing was done.

Procedure for Testing

The procedure for testing USDA Calibration Cotton for a correction factor was the same as used on the test samples. The clamps were placed in the vise and the vise tightened. After the clamps were opened, a test speciman was prepared by taking a pinch at random from the test sample. This pinch or bundle of fibers was then combed until the fibers were parallel. A fiber ribbon nearly one-fourth inch wide was placed across the open jaws of the clamps so that the fibers extended equally on each side. The top clamps were lowered and locked into place. The jaws were removed from the vise and the fibers protruding from the edge of the jaws were trimmed with a special knife.

With the beam in the raised position, the jaws containing the specimen were placed in the slots at the right end of the beam base. The beam weight was released by raising the locking lever. The breaking strength was then recorded from the incline beam at the point the weight stopped. The clamps were removed from the machine and placed in the vise. The top jaws were unlocked and the broken fiber removed with tweezers and weighed in a torsion balance to the nearest 0.01 milligram.

This procedure was repeated sixteen times for each sample. The Pressley Index for each test speciman was then calculated using the following formula:

$$\text{Pressley Index} = \frac{\text{Breaking load in pounds}}{\text{Bundle weight in milligrams}} \times \text{Correction Factor} \quad (1)$$

Fiber Length

Measurements for determination of length distribution were made using the Digital Fibrograph, Model 230-A, previously described. Calibration of the instrument was carried out in accord with the manufacturer's specifications before any samples were tested (26).

The Fibrosampler was used to prepare two combs of fiber. The combs of fiber were placed in the comb carrier of the Fibrograph. The fiber beards formed by the combs were then brushed to make the fibers parallel and to remove trash and non-uniform thicknesses. Neps in the beards were removed with tweezers. The light source was moved into position and the instrument reading of the quantity of fibers was checked at the 100 percent span length. Fiber combs which gave quantities not within the range of 1200 to 2000 were discarded. With acceptable fiber combs in place, fiber length readings were taken from the instrument at the 66.7 percent, the 50 percent, and the 2.5 percent span lengths.

The Upper Quartile Length, the Mean Length, and the Uniformity ratio were calculated by using the following equations:

$$A = 2.5 - \frac{\text{2.5\% Span Length}}{\frac{\text{50\% Span Length} - \text{2.5\% Span Length}}{47.5}} \quad (2)$$

$$B = 2.5 - \frac{2.5\%\ \text{Span Length}}{\frac{66.7\%\ \text{Span Length} - 2.5\%\ \text{Span Length}}{64.2}} \qquad (3)$$

$$C = 50 - \frac{50\%\ \text{Span Length}}{\frac{66.7\%\ \text{Span Length} - 50\%\ \text{Span Length}}{16.7}} \qquad (4)$$

$$D = -A \times \frac{66.7\%\ \text{Span Length} - 2.5\%\ \text{Span Length}}{64.2} \qquad (5)$$

$$\text{Estimated Upper Quartile Length} = \frac{D\ C}{100} \qquad (6)$$

$$\text{Mean Length} = \frac{D\ (A + B)}{200} \qquad (7)$$

$$\text{Uniformity Ratio} = \frac{50\%\ \text{Span Length}}{2.5\%\ \text{Span Length}} \times 100 \qquad (8)$$

Equations 2 through 7 were derived from the graphical solution formulated by Louis and Fiori (27).

Statistical Analysis of Physical Testing Data

A Hewlett-Packard 9100-A Programmable Calculator was used to calculate averages, standard deviations, percent coefficients of variation, the upper quartile lengths, and mean lengths of the samples of fiber.

The Student's-t Test and the F test were employed to determine if any significant difference existed between the means and variances before and after processing.

The number of tests required for the average of the statistics to be within two percent of the mean value for the materials were calculated. This involved a standard error of 1.96 for the 95 percent confidence interval in addition to a factor for ten percent probability of error.

CHAPTER V

DISCUSSION OF RESULTS

Two-dimensional Vortex-Sink

Physical and stain tests were performed on the roving specimens before and after blending to aid in the determination of the effectiveness of the blending system. The equipment and procedures described in Chapter III and IV were utilized to measure the properties of the fiber bundle strength, fiber fineness, fiber length distribution and to make visual evaluations.

Visual Evaluations

Observations. The fiber entered the vortex-sink and aligned itself so that the axis of the fiber was parallel to the air streamlines. The fibers then assumed an equilibrium radius. The radius could be enlarged by opening the adjustable slides. When the slides were closed, all the material in the vortex-sink was pulled down the sink.

Stain Tests. All stain tests showed a fiber-to-fiber blend of colors; indicating that fiber blending had proceeded on a fiber-to-fiber basis.

Fiber Fineness

The summary of micrograms per inch for blending of roving materials (Table 8) shows that the fibers were well blended with regard to fiber fineness. The average of the fineness of the fiber blends was not changed by the blending process. In both cases, however, the standard deviation was greatly reduced. For the blend of roving materials one and two, the number of tests required (refer to Chapter IV) was reduced from 310 to five.

Fiber Length

The fiber length, Table 9, was not changed by the blending process, but the standard deviation was greatly reduced. The standard deviation of the blend was equal to, or less than, the standard deviation of the components. The test sample size of the blend of rovings one and two was reduced by the blending operation from six to one.

Table 8. Summary of Micrograms per Inch of Rovings Before and After Blending

Material	Average	Standard Deviation	Percent Coefficient of Variation
Roving #1 before blending	5.28	0.26	5.0
Roving #2 before blending	7.58	0.17	2.0
Arithmetic Values for 35/65 blend of Rovings #1 & 2	6.81	1.11	16.3
Harmonic Values for 35/65 blend of Rovings #1 & 2	6.60	1.11	16.8
Values obtained from Vortex-Blended Samples	6.60	0.13	1.9
Roving #3 before blending	4.96	0.15	3.0
Roving #4 before blending	7.91	0.06	0.8
Arithemetic Values for 50/50 blend of Rovings #3 & 4	6.41	1.53	24.0
Harmonic Values for 50/50 blend of Rovings #3 & 4	6.30	1.53	24.4
Values obtained from Vortex-Blended Samples	6.49	0.27	4.2

Table 9. Summary of Fiber Length Data for Roving Materials Before and After Blending by a Two-dimensional Vortex Air Flow

Material	2.5% Span Length Average	Standard Deviation	Percent Coefficient of Variation
Roving Material #1 before blending	1.41	0.03	2.0
Roving Material #2 before blending	1.36	0.02	1.1
Arithemetic Values for 35/65 blend of Rovings #1 & 2	1.38	0.03	2.3
Sample Values for 35/65 blend of Rovings #1 & 2	1.41	0.01	0.7
Roving #3 before blending	1.04	0.02	1.7
Roving #4 before blending	1.38	0.05	3.4
Arithemetic Values for 50/50 blend of Rovings #3 & 4	1.20	0.17	13.8
Sample Values of 50/50 blend of Rovings #3 & 4	1.29	0.02	1.6

"UT" Opener

USDA Calibration Cotton

Blend of 7.40 and 2.65 Micrograms per Inch Cottons. The results of the test, Table 10 show that the blending depends on the number of passes through the machine and also that the blending in depth and width of the sample is greater than the blending along the length of the sample. The average values do not really change, but move toward the harmonic mean (32) of 3.98 micrograms per inch as the blend becomes more uniform.*

Blend of 5.41 and 3.58 Micrograms per Inch Cottons. Data from these tests, summarized in Tables 11 and 12, indicate that the efficiency blending is dependent upon the openness of the stock, and that, with highly opened materials, the degree of blending is less dependent upon the number of passes through the "UT" Opener. The blending efficiency of fiber fineness was much better than that of fiber strength. This is due to the sample size on which the physical tests were performed, that is 3.3 grams for fiber fineness tests and 2.3 micrograms for fiber strength tests.

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* The harmonic mean was calculated by

$$F'_b = \frac{n}{\frac{1}{F_1} + \frac{1}{F_2} + \cdots + \frac{1}{F_n}} = \frac{n}{\Sigma \frac{1}{F}}$$

This equation was given by Jenning's and Lewis (32), where F'_B is the harmonic mean of equal amounts by weight of N.

Table 10. The Effect of the Number of Passes Through the "UT" Opener on the Blending of a 50% 7.40 Microgram per Inch Calibration Cotton With 50% 2.65 Microgram per Inch Calibration Cotton at 1330 rpm

Number of Passes	Average Micrograms per Inch	Standard Deviation	Coefficient of Variation
End to End Blending			
0	4.83	2.42	50%
1	4.47	1.33	30%
2	4.26	0.82	19%
3	4.27	0.62	14%
4	4.19	0.32	8%
Side by Side Blending			
0	4.83	2.42	50%
1	4.57	0.97	21%
2	4.39	0.49	11%
3	4.29	0.27	6%
4	4.42	0.24	5%

Table 11. Pressley Index of 50/50 Blend of Pre-opened (5.41 Microgram per Inch - 7.40 Pressley Index and 3.58 Microgram per Inch - 9.02 Pressley Index) Calibration Cottons Blended on the "UT" Opener

Number Passes and rpm	Average	Standard Deviation	Coefficient of Variation %
Before Opening	8.21	0.84	10.0
One Pass at 800 rpm	8.13	0.39	4.8
Two Passes at 800 rpm	8.01	0.37	4.6
Three Passes at 800 rpm	8.03	0.27	3.4
Four Passes at 800 rpm	8.34	0.30	3.6
Two Passes at 1000 rpm	8.54	0.60	7.0
Two Passes at 1200 rpm	8.21	0.39	5.0
Two Passes at 1400 rpm	8.22	0.28	3.0

Table 12. Micrograms per Inch of 50/50 Blend of Pre-open (5.41 and 3.58 Microgram per Inch) Calibration Cottons on the "UT" Opener

Number Passes and rpm	Average	Standard Deviation	Coefficient of Variation %
Before Opening	4.40	0.92	20.6
One Pass at 800 rpm	4.37	0.17	4.0
Two Passes at 800 rpm	4.37	0.10	2.3
Three Passes at 800 rpm	4.35	0.10	2.4
Four Passes at 800 rpm	4.40	0.13	2.8
Two Passes at 1000 rpm	4.37	0.07	1.5
Two Passes at 1200 rpm	4.41	0.05	1.1
Two Passes at 1400 rpm	4.44	0.07	1.6

USDA Gin Stock

Processing on the "UT" Opener reduced the coefficient of variation and caused a slight rise in fiber strength (Table 13). Because each sample had a different average and standard deviation before blending, it was impossible to compare blending efficiency at the different machine parameters of number of passes through the "UT" Opener and rotor speeds.

Pre-Opened USDA Gin Cottons

The pre-opened gin cottons were well blended according to fiber fineness. Tests show that optimum blending occurred at 900 rpm (Table 14). The tests showed little or no blending of fiber by strength (Table 15). Fiber length data given in Tables 16 and 17 indicate that:

(1) The standard deviation of the mean length decreases with the increase in rotor rotation.

(2) The mean length decreases with an increase in rotor rotation. (From 0 percent decrease at 600 rpm to a 5 percent decrease at 1400 rpm.)

(3) The standard deviation of the Upper Quartile Length decreases with an increase in rotor speed.

(4) The Upper Quartile Length decreases with an increase of the rotor speed from a minimum decrease of 0 at 600 rpm to a maximum decrease of three percent at 1400 rpm.

Table 13. Summary of Data of Blending of USDA Gin Cottons by Fiber Strength on the "UT" Opener

Machine Parameters	Average		Standard Deviation		Percent Coefficient of Variation	
	Before Blending	After Blending	Before Blending	After Blending	Before Blending	After Blending
One pass at 1330 rpm	7.47	7.60	0.23	0.20	3.0	2.6
One pass at 1320 rpm	6.95	7.24	0.25	0.20	3.7	2.7
Two passes at 1330 rpm	7.20	7.38	0.21	0.19	3.0	2.6
Two passes at 1320 rpm	8.23	8.54	0.43	0.33	5.6	3.9
Two passes at 1330 rpm	7.36	7.43	0.29	0.27	4.0	3.5
Two passes at 1320 rpm	6.95	7.15	0.25	0.24	4.0	3.3
Three passes at 1330 rpm	7.94	8.12	0.44	0.30	6.0	3.7
Three passes at 800 rpm	7.64	8.02	0.30	0.15	4.0	1.9
Four passes at 500 rpm	7.59	7.59	0.30	0.30	4.0	4.0

Table 14. Summary of Micrograms per Inch of Pre-opened USDA Gin Cottons Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
0.0	5.06	0.26	5.1
600	5.08	0.07	1.4
700	5.01	0.09	1.8
800	5.07	0.07	1.4
900	5.14	0.05	1.0
1000	5.22	0.08	1.4
1100	5.12	0.06	1.2
1200	5.00	0.10	2.0
1300	5.18	0.11	2.2
1400	5.03	0.13	2.6

Table 15. Summary of Pressley Index of Pre-opened USDA Gin Cottons Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
0	7.29	0.32	4.4
600	7.89	0.39	4.9
700	7.45	0.30	4.1
800	7.34	0.39	4.9
900	7.32	0.25	3.4
1000	7.45	0.25	3.3
1100	7.31	0.34	4.6
1200	7.06	0.25	3.5
1300	7.04	0.18	2.5
1400	7.37	0.29	4.0

Table 16. Summary of Upper Quartile Length of Pre-opened USDA Gin Cottons Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
0	1.09	0.04	3.3
600	1.07	0.04	3.3
700	1.06	0.04	3.9
800	1.07	0.03	3.1
900	1.07	0.05	4.6
1000	1.05	0.03	3.1
1100	1.04	0.02	2.1
1200	1.05	0.04	3.4
1300	1.04	0.03	2.8
1400	1.05	0.02	2.3

Table 17. Summary of Mean Length of Pre-opened USDA Gin Cottons Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
0	0.85	0.04	4.3
600	0.85	0.04	4.3
700	0.83	0.03	4.0
800	0.83	0.04	4.2
900	0.82	0.04	5.0
1000	0.80	0.03	3.7
1100	0.80	0.03	4.3
1200	0.80	0.03	4.3
1300	0.82	0.03	3.8
1400	0.81	0.02	2.4

Table 18. Summary of Pressley Index of Georgia Tech Bale Stock Blended at Different Rotor Speeds by the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
		One Pass	
0	7.49	0.37	4.9
500	7.71	0.30	3.9
600	7.85	0.24	3.0
700	7.64	0.32	4.2
750	7.76	0.29	3.7
800	7.50	0.29	3.8
850	7.47	0.23	3.1
900	7.51	0.22	2.9
950	7.50	0.26	3.5
1000	7.46	0.19	2.6
1100	7.80	0.24	3.1
1200	7.42	0.40	5.4
1300	7.82	0.22	2.8
1400	7.45	0.27	3.7
		Two Passes	
600	7.18	0.29	4.0
1000	7.48	0.44	5.8
1200	7.39	0.28	3.8
1400	7.56	0.36	4.8
		Three Passes	
600	7.85	0.23	2.9
800	7.52	0.30	4.0
1000	7.86	0.28	3.5
1200	7.72	0.36	4.6
		Four Passes	
800	7.50	0.27	3.6

Georgia Tech Bale Stock

Fiber Strength. The Pressley Index of the Georgia Tech bale stock data in Table 18 shows very little correlation. Generally, the average value did not change and the standard deviations were only slightly decreased with the apparant better blending at around 900 rpm rotor speed. The number of passes through the "UT" did not greatly affect the blending.

Fiber Fineness. A study of micrograms per inch of the Georgia Tech bale stock, Table 19, showed that the average of the fiber fineness was neither dependent upon the rotor speed nor the number of cycles through the "UT" Opener. The standard deviation showed a sizable decrease on the first pass and was only slightly dependent on rotor speeds or number of cycles through the machine.

Fiber Length. Tables 20, 21, and 22, a study of length as affected by "UT" rotor speeds and number of passes through the "UT" Opener, showed:

(1) The mean length decreases with increase in rotor speeds, and the number of passes through the "UT" Opener.

(2) The standard deviations of the mean length decreased with increased rotor speeds and/or increased number of passes through the machine.

(3) The Upper Quartile length decreases with increased number of passes through the "UT" Opener or with increases in rotor speeds.

(4) The standard deviations of the Upper Quartile length decreases when the material was processed on the "UT" Opener, but no

correlation was found between the standard deviation and the rotor speeds or the number of passes through the "UT" Opener.

(5) Processing on the "UT" Opener had no effect on the uniformity ratio of the cotton samples.

Table 19. Micrograms per Inch of Georgia Tech Bale Stock Blended at Different Rotor Speeds by the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
		One Pass	
0	5.16	0.20	3.9
500	5.15	0.09	1.7
600	5.21	0.08	1.5
700	5.02	0.09	1.8
750	5.13	0.08	1.6
800	5.24	0.06	1.1
850	5.18	0.08	1.6
900	5.11	0.06	1.1
950	5.23	0.07	1.3
1000	5.15	0.08	1.6
1100	5.00	0.09	1.8
1200	5.16	0.07	1.4
1300	5.17	0.07	1.4
1400	5.25	0.06	1.2
		Two Passes	
600	5.19	0.07	1.3
1000	5.23	0.06	1.2
1200	5.20	0.07	1.4
1400	5.25	0.06	1.1
		Three Passes	
600	5.24	0.08	1.6
800	5.16	0.09	1.8
1000	5.22	0.06	1.2
1200	5.18	0.07	1.3
		Four Passes	
800	5.19	0.08	1.6

Table 20. Summary of Mean Length of Georgia Tech Bale Stock Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
		One Pass	
0	1.02	0.07	6.8
500	0.99	0.03	3.4
600	0.99	0.04	4.2
700	0.98	0.05	5.1
750	1.01	0.05	4.7
800	0.97	0.04	3.9
900	1.00	0.03	3.4
1000	0.99	0.04	3.7
1100	0.98	0.04	3.6
1200	0.98	0.04	4.2
1300	0.96	0.03	3.0
1400	0.98	0.05	4.7
		Two Passes	
600	0.99	0.05	5.5
1000	0.96	0.03	3.3
1200	0.97	0.04	4.5
1400	0.94	0.03	3.3
		Three Passes	
600	1.01	0.05	4.5
800	0.93	0.03	3.4
1000	0.96	0.02	2.0
1200	0.95	0.04	3.9
		Four Passes	
800	0.94	0.02	1.9

Table 21. Summary of Upper Quartile Length of Georgia Tech Bale Stock Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
		One Pass	
0	1.23	0.10	7.9
500	1.25	0.07	5.7
600	1.22	0.04	2.9
700	1.32	0.06	4.3
750	1.24	0.07	5.3
800	1.20	0.05	3.8
900	1.23	0.06	4.7
1000	1.23	0.04	3.6
1100	1.22	0.05	3.8
1200	1.21	0.06	4.7
1300	1.19	0.06	5.2
1400	1.23	0.07	5.4
		Two Passes	
600	1.23	0.07	5.6
1000	1.17	0.06	5.4
1200	1.21	0.06	5.1
1400	1.16	0.05	4.5
		Three Passes	
600	1.26	0.09	7.0
800	1.17	0.05	4.5
1000	1.19	0.03	2.7
1200	1.17	0.04	3.4
		Four Passes	
800	1.18	0.04	3.7

Table 22. Summary of Uniformity Ratio of Georgia Tech Bale Stock Blended at Different Rotor Speeds on the "UT" Opener

RPM	Average	Standard Deviation	Percent Coefficient of Variation
		One Pass	
0			
500	47.3	1.7	3.6
600	48.7	1.4	2.8
700	47.3	1.8	3.8
750	49.8	1.9	3.8
800	47.1	1.5	3.1
900	47.8	1.4	2.9
1000	47.9	1.9	4.0
1100	46.9	1.2	2.5
1200	46.9	1.7	3.6
1300	47.8	1.3	2.6
1400	47.7	1.5	3.2
		Two Passes	
600	48.1	2.2	4.6
1000	46.7	1.4	2.9
1200	48.5	2.0	4.1
1400	46.6	1.4	3.1
		Three Passes	
600	49.8	2.2	4.4
800	46.5	1.6	3.5
1000	47.9	1.1	2.2
1200	45.9	1.3	2.9
		Four Passes	
800	45.6	1.0	2.3

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Two-dimensional Vortex-Sink

A two-dimensional vortex-sink machine can be used to blend fibers. The size of the structure required to allow the use of the vortex-sink as a mixing chamber is prohibitive.

"UT" Opener

It is concluded that:

(1) The "UT" Opener can be used to blend cotton fibers or tufts of fibers and thus reduce the number of tests required to give reliable data.

(2) If the blend is of two materials which differ widely in the property to be blended, blending is improved substantially by reprocessing the material.

(3) The uniformity of the blend depends on tuft size, and, thus, pre-opening the material greatly improves the blending power of the "UT" Opener.

(4) The optimum rotor speed is 850 rpm because higher speeds reduce the mean and upper quartile length below the acceptable limit.

Recommendations

Two-dimensional Vortex-Sink

It is recommended that:

(1) No further labor be extended into the use of a two-dimensional vortex as a blender because of the size of the system required.

(2) The use of the two-dimensional vortex device to evaluate the openness of different cottons and the opening power of textile machinery should be studied.

"UT" Opener

It is recommended that:

(1) The effect of spacing of pins on the pin bars be studied.

(2) A pre-opener such as a minature SRRL which does not positively grip the fibers, thus causing less fiber damage, be studied.

(3) The "UT" Opener be used to blend fiber at 800-900 rpm rotor speed.

(4) Fibers not be recycled more than three times because of "roping" and fiber breakage.

APPENDIX A

PHYSICAL PROPERTIES DATA OF GEORGIA TECH ROVINGS

Table 23. Physical Properties of 35/65 Blend of Georgia Tech Rovings One and Two

Sample Number	Micrograms per Inch	Fiber Length 66.7% Span Length	Fiber Length 2.5% Span Length
1	6.40	0.61	1.42
2	6.80	0.56	1.40
3	6.50	0.60	1.42
4	6.60	0.63	1.42
5	6.55	0.61	1.42
6	6.55	0.60	1.39
7	6.40	0.56	1.41
8	6.60	0.58	1.41
9	6.75	0.58	1.42
10	6.50	0.59	1.42
11	6.60	0.49	1.39
12	6.70	0.52	1.41
13	6.55	0.57	1.40
14	6.80	0.53	1.41
15	6.75	0.61	1.42
16	6.40	0.63	1.39
17	6.60	0.49	1.40
18	6.75	0.58	1.42
19	6.60	0.57	1.41
20	6.55	0.61	1.42
$\overline{X}$	6.60	0.58	1.41
S	0.13	0.04	0.01
%CV	1.9	7.6	0.7

Table 24. Physical Properties of a 50/50 Blend of Georgia Tech Rovings Three and Four

Sample Number	Micrograms per Inch	Fiber Length 66.7% Span Length	Fiber Length 2.5% Span Length
1	6.60	0.45	1.28
2	6.35	0.47	1.28
3	6.20	0.48	1.28
4	6.65	0.44	1.25
5	7.15	0.50	1.32
6	6.55	0.45	1.30
7	6.35	0.47	1.29
8	6.40	0.44	1.31
9	6.25	0.46	1.32
10	6.75	0.42	1.30
11	6.80	0.45	1.32
12	6.60	0.41	1.28
13	6.40	0.44	1.26
14	6.15	0.44	1.30
15	6.05	0.40	1.28
16	6.35	0.39	1.28
17	6.85	0.47	1.26
18	6.60	0.44	1.30
19	6.55	0.47	1.32
20	6.25	0.42	1.27
$\overline{X}$	6.49	0.45	1.29
S	0.27	0.03	0.02
%CV	4.2	6.2	1.6

APPENDIX B

PHYSICAL PROPERTIES DATA OF BLENDED USDA CALIBRATION COTTONS

Table 25. Micrograms per Inch for Side by Side Blending of 50% 7.40 and 50% 2.65 Microgram per Inch Calibration Cottons at Different Number of Passes Through the "UT" Opener

Sample Number	One Pass	Two Passes	Three Passes	Four Passes
1	5.25	4.65	3.75	4.60
2	4.35	4.75	4.30	4.40
3	3.60	3.45	4.40	4.70
4	4.85	4.80	4.20	4.15
5	3.35	4.60	4.70	4.30
6	4.40	3.85	3.90	4.50
7	4.65	3.30	4.30	5.00
8	3.85	4.30	4.00	4.55
9	5.75	4.80	5.10	4.00
10	4.95	4.90	4.35	4.40
11	6.00	5.25	4.60	4.75
12	3.45	4.65	4.10	4.50
13	5.40	4.45	4.10	4.35
14	6.20	3.85	4.30	4.50
15	4.45	4.95	4.25	4.20
16	3.15	4.80	4.40	4.30
17	3.65	4.60	4.45	4.15
18	3.15	4.10	4.40	4.30
19	3.65	4.20	4.30	4.60
20	4.60	4.40	4.00	4.20
21	4.70	4.10	4.20	
22	5.90	4.65	4.10	
23	4.90	3.95	4.40	
24	6.20	3.75	4.30	
25	3.80	4.80		
$\overline{X}$	4.57	4.39	4.29	4.42
S	0.97	0.49	0.27	0.24
%CV	21	11	6	5

Table 26. Micrograms per Inch for End to End Blending of a 50/50 Blend of 7.40 and 2.65 Microgram per Inch Calibration Cottons at Different Number of Passes Through the "UT" Opener at 1330 rpm

Sample Number	One Pass	Two Passes	Three Passes	Four Passes
1	2.65	3.45	4.40	4.15
2	3.00	3.35	4.70	3.65
3	4.45	3.15	4.20	4.15
4	3.55	3.10	3.85	4.05
5	3.15	4.60	4.35	3.95
6	5.55	5.60	3.80	3.90
7	5.60	5.80	3.95	4.30
8	2.95	6.15	5.70	4.25
9	2.90	4.20	5.10	3.60
10	6.00	4.65	5.10	4.05
11	3.35	4.20	3.40	4.60
12	3.05	3.65	3.90	4.10
13	6.10	3.80	4.10	4.20
14	3.95	4.00	3.90	2.70
15	3.75	4.70	3.80	4.35
16	5.20	4.45	3.50	4.35
17	4.60	5.20	4.40	4.25
18	4.00	3.55	3.75	3.85
19	3.95	4.55	5.25	4.45
20	4.15	3.50	4.20	4.80
21	6.80	3.90		
22	6.85	3.90		
23	6.90	4.35		
24	4.45	4.00		
25	4.80	4.90		
$\overline{X}$	4.47	4.26	4.27	4.19
S	1.33	0.82	0.62	0.32
%CV	30	19	14	8

Table 27. Pressley Index and Micrograms per Inch of a 50/50 Blend (5.41 Microgram per Inch 7.40 Pressley Index Calibration Cotton and 3.58 Microgram per Inch 9.02 Pressley Index Calibration Cotton) Blended by One Pass Through the "UT" Opener at 800 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	7.72	4.30
2	8.56	4.45
3	8.23	4.80
4	7.56	4.35
5	8.21	4.35
6	8.40	4.55
7	8.66	4.45
8	7.77	4.25
9	8.05	4.30
10	8.08	4.50
11	8.33	4.15
12	7.39	4.40
13	7.71	4.45
14	8.35	4.05
15	8.61	4.50
16	8.39	4.20
17		4.30
$\bar{X}$	8.13	4.37
S	0.39	0.17
%CV	4.8	4.0

Table 28. Pressley Index and Micrograms per Inch of a 50/50 Blend (5.41 Microgram per Inch - 7.40 Pressley Index Calibration Cotton and 3.58 Microgram per Inch - 9.02 Pressley Index Calibration Cotton) by Two Passes Through the "UT" Opener at 800 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	8.30	4.25
2	8.64	4.45
3	8.50	4.45
4	8.13	4.40
5	8.44	4.25
6	7.95	4.30
7	8.00	4.40
8	8.02	4.35
9	7.37	4.30
10	7.80	4.15
11	7.58	4.45
12	7.47	4.45
13	7.71	4.35
14	7.91	4.50
15	8.27	
16	8.13	
$\bar{X}$	8.01	4.37
S	0.37	0.10
%CV	4.6	2.3

Table 29. Pressley Index and Micrograms per Inch of a 50/50 Blend of Pre-opened Calibration Cottons Made by Two Passes Through the "UT" Opener at 1400 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	8.61	4.50
2	8.69	4.50
3	8.32	4.45
4	7.87	4.30
5	8.19	4.40
6	8.49	4.35
7	8.20	4.45
8	8.45	4.50
9	7.96	4.55
10	8.26	4.35
11	7.99	4.40
12	8.02	4.50
13	8.59	4.45
14	7.89	4.45
15	7.97	
16	8.00	
$\overline{X}$	8.22	4.44
S	0.28	0.07
%CV	3.0	1.6

Pressley Index and Micrograms per Inch of a 50/50 Blend of Pre-opened (5.41 Microgram per Inch - 7.40 Pressley Index and 3.58 Microgram per Inch - 9.02 Pressley Index) Calibration Cottons Blended on the "UT" Opener

Note: These Readings are Compared to the Arithmetic Value of:

	Pressley Index	Micrograms per Inch
Average	8.21	4.40
Standard Deviation	0.84	0.92
Coefficient of Variation	10.0 Percent	20.6 Percent

Table 30. Pressley Index and Micrograms per Inch of a 50/50 Blend of Pre-opened Calibration Cottons Made by Two Passes Through the "UT" Opener at 1200 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	8.37	4.35
2	8.18	4.40
3	8.50	4.45
4	8.47	4.45
5	7.85	4.40
6	8.79	4.40
7	8.43	4.40
8	8.65	4.40
9	7.96	4.35
10	7.92	4.30
11	8.24	4.40
12	8.09	4.40
13	8.40	4.50
14	7.58	4.45
15	7.38	4.45
16	8.50	4.45
$\overline{X}$	8.21	4.41
S	0.39	0.05
%CV	5.0	1.1

Table 31. Pressley Index and Micrograms per Inch of a 50/50 Blend of Pre-opened Calibration Cottons Made by Two Passes Through the "UT" Opener at 1000 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	8.03	4.45
2	9.16	4.30
3	7.22	4.30
4	8.26	4.45
5	8.94	4.30
6	8.71	4.45
7	8.77	4.45
8	8.82	4.40
9	8.44	4.40
10	9.22	4.45
11	8.77	4.35
12	8.35	
13	8.12	
14	7.54	
15	9.36	
16	8.97	
$\bar{X}$	8.54	4.37
S	0.60	0.07
%CV	7.0	1.5

Table 32. Pressley Index and Micrograms per Inch of a 50/50 Blend (5.41 Microgram per Inch - 7.40 Pressley Index Calibration Cotton and 3.58 Microgram per Inch - 9.02 Pressley Index Calibration Cotton) by Three Passes Through the "UT" Opener at 800 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	8.02	4.25
2	8.19	4.20
3	7.87	4.25
4	7.55	4.35
5	7.61	4.20
6	8.17	4.30
7	8.31	4.45
8	7.88	4.30
9	8.43	4.55
10	8.53	4.45
11	8.25	4.45
12	7.97	4.25
13	7.86	4.35
14	7.90	4.45
15	8.01	4.35
16	7.92	4.35
17		4.45
$\overline{X}$	8.03	4.35
S	0.27	0.10
%CV	3.4	2.4

Table 33. Pressley Index and Micrograms per Inch of a 50/50 Blend of Pre-opened Calibration Cotton Made by Four Passes Through the "UT" Opener at 800 rpm

Sample Number	Pressley Index	Micrograms per Inch
1	7.98	4.20
2	8.97	4.30
3	8.17	4.50
4	8.39	4.50
5	8.09	4.30
6	8.02	4.40
7	8.27	4.30
8	8.62	4.30
9	8.49	4.40
10	8.46	4.30
11	8.35	4.30
12	8.05	4.60
13	8.11	4.60
14	8.70	4.50
15	8.17	4.50
16	8.71	
$\bar{X}$	8.34	4.40
S	0.30	0.13
%CV	3.6	2.8

APPENDIX C

PHYSICAL PROPERTIES DATA OF USDA GIN COTTONS BEFORE AND AFTER BLENDING

Table 34. Pressley Index of USDA Gin Cottons Before and After Opening at Different rpms and Number of Passes on the "UT" Opener

Sample Number	One Pass at 1320 rpm Before	One Pass at 1320 rpm After	Two Passes at 1330 rpm Before	Two Passes at 1330 rpm After
1	7.23	7.15	7.12	7.73
2	7.15	7.33	7.14	7.44
3	7.51	6.98	7.04	7.64
4	6.89	6.94	7.02	7.11
5	7.28	7.47	6.91	7.30
6	6.86	7.38	7.17	7.68
7	6.96	6.92	7.06	7.42
8	7.00	7.60	6.89	7.21
9	6.79	7.40	7.12	7.43
10	6.76	7.40	7.52	7.35
11	7.08	7.32	7.39	7.03
12	6.60	7.20	7.49	7.41
13	6.82	7.16	7.10	7.40
14	6.96	7.17	7.28	7.30
15	6.52	7.14	7.49	7.27
16	6.74	7.20	7.44	7.39
$\overline{X}$	6.95	7.24	7.20	7.38
S	0.25	0.20	0.21	0.19
%CV	3.7	2.7	3.0	2.6

Table 34 Continued

Sample Number	One Pass at 1330 rpm Before	After	Two Passes at 1320 rpm Before	After
1	7.13	7.71	7.81	8.63
2	7.54	7.65	7.64	8.55
3	7.35	8.00	7.51	8.71
4	7.06	7.45	7.94	8.73
5	7.77	7.48	7.91	7.39
6	7.23	7.55	7.80	8.69
7	7.92	7.74	7.76	8.44
8	7.67	7.57	8.79	8.40
9	7.41	7.26	8.63	8.90
10	7.64	7.37	8.70	8.55
11	7.31	7.78	8.75	8.68
12	7.33	7.69	8.36	8.67
13	7.54	7.37	8.38	8.57
14	7.59	7.78	8.68	8.62
15	7.49	7.39	8.63	8.41
16	7.58	7.78		8.68
$\overline{X}$	7.47	7.60	8.23	8.54
S	0.23	0.20	0.43	0.33
%CV	3.0	2.6	5.6	3.9

Table 34 Continued

Sample Number	Two Passes at 1330 rpm Before	After	Two Passes at 1320 rpm Before	After
1	7.04	7.64	7.00	7.25
2	7.11	7.87	6.58	7.12
3	7.12	7.25	6.95	7.47
4	7.40	7.60	7.09	7.21
5	7.29	7.41	6.90	6.65
6	6.73	7.48	7.08	7.25
7	7.46	7.17	7.09	7.35
8	7.29	7.34	7.23	7.31
9	7.81	7.34	7.28	7.05
10	7.76	7.68	6.96	7.47
11	7.57	7.30	6.94	6.91
12	7.52	6.74	7.33	7.35
13	7.54	7.59	6.62	6.90
14	7.18	7.66	6.51	7.27
15	7.68	7.47	7.01	7.01
16	7.29	7.29	6.63	6.83
$\overline{X}$	7.36	7.43	6.95	7.15
S	0.29	0.27	0.25	0.238
%CV	4.0	3.5	4	3.3

Table 34 Continued

Sample Number	Three Passes at 1330 rpm Before	After	Three Passes at 1320 rpm Before	After
1	7.65	8.07	8.97	7.44
2	7.72	8.12	8.85	7.93
3	7.88	7.97	8.75	7.78
4	8.80	8.36	8.78	7.55
5	8.38	8.00	8.76	7.64
6	8.47	8.32	8.79	7.80
7	7.70	7.50	8.61	7.38
8	8.33	7.93	8.35	7.65
9	8.18	8.59	7.53	7.68
10	7.37	8.35	7.31	7.86
11	7.39	8.23	7.30	7.66
12	8.29	7.77	7.48	7.77
13	7.36	8.55	7.58	7.80
14	7.76	7.78	7.43	6.92
15	7.61	8.04	7.57	7.86
16	8.14	8.34	7.33	
$\overline{X}$	7.94	8.12	8.09	7.65
S	0.44	0.30	0.68	0.254
%CV	6.0	3.7	8.4	3.3

Table 34 Continued

Sample Number	Three Passes at 800 rpm Before	After	Two Passes at 495 rpm Before	After
1	8.14	7.99	7.15	7.12
2	7.62	8.12	7.42	6.83
3	7.46	8.11	7.31	7.71
4	7.49	8.04	7.39	7.82
5	7.32	7.92	7.47	7.96
6	7.63	8.12	7.74	7.67
7	7.40	8.18	7.55	7.71
8	7.74	8.21	7.26	7.78
9	7.27	8.02	7.51	7.43
10	7.33	8.07	7.77	7.42
11	7.46	7.96	7.79	7.60
12	7.91	7.87	7.84	7.97
13	7.57	7.60	7.91	7.46
14	7.63	7.89	7.23	7.86
15	8.24	8.11	7.85	7.48
16	8.04	8.14	8.23	7.63
$\overline{X}$	7.64	8.02	7.59	7.59
S	0.30	0.15	0.30	0.30
%CV	4.0	1.9	4.0	3.9

Table 35. Pressley Index of Pre-opened USDA Gin Stock Samples Before Blending

Sample Number	Pressley Index Low Mic Cotton	Pressley Index High Mic Cotton
1	7.46	6.80
2	7.49	7.05
3	7.08	7.09
4	6.96	7.18
5	6.91	7.09
6	7.86	7.27
7	7.35	8.04
8	7.03	7.04
9	7.35	7.86
10	7.19	7.79
11	6.91	7.75
12	7.19	7.67
13	7.23	7.33
14	7.08	7.52
15	7.17	7.20
16	7.13	
$\overline{X}$	7.21	7.38
S	0.25	0.37
%CV	3.4	5.0

Note: The Arithmetic Values for a 50/50 Blend of these Cottons is:

Average	7.29 Pressley Index
Standard Deviation	0.32
Percent Coefficient of Variation	4.4

Table 36. Pressley Index of 50/50 Blend of High and Low Microgram per Inch Pre-opened USDA Gin Cottons Made by One or Two Passes Through the "UT" Opener at Different Rotor Speeds

Sample Number	600 rpm	700 rpm	800 rpm	900 rpm	1000 rpm	1100 rpm
1	7.21	7.24	7.57	7.72	7.54	7.62
2	7.22	7.19	7.17	7.13	6.98	7.28
3	7.71	6.96	7.85	7.23	7.38	7.42
4	7.16	7.33	7.59	7.43	7.42	7.06
5	7.75	7.45	7.66	7.68	7.44	7.42
6	8.22	6.99	7.29	7.12	7.69	7.52
7	8.03	7.56	7.44	7.40	7.58	7.47
8	8.10	7.80	7.34	7.26	7.86	7.12
9	8.21	7.75	7.22	7.76	7.15	7.00
10	8.47	7.05	6.62	7.02	7.55	7.30
11	8.02	7.61	7.07	7.49	7.54	6.81
12	8.16	7.41	6.82	7.31	7.15	7.38
13	7.86	7.66	7.75	7.12	7.44	7.84
14	7.07	7.97	7.82	6.93	7.48	7.50
15	8.11	7.60	6.98	7.21	7.18	6.72
16	8.06	7.70	7.27	7.27	7.88	6.97
$\overline{X}$	7.89	7.45	7.34	7.32	7.45	7.31
S	0.39	0.30	0.39	0.25	0.25	0.34
%CV	4.9	4.1	4.9	3.4	3.3	4.6

Table 36 Continued

Sample Number	1200 rpm	1300 rpm	1400 rpm	Two Passes 900 rpm	Two Passes 1400 rpm
1	6.56	7.11	7.18	7.60	7.41
2	6.79	6.99	7.31	7.63	7.32
3	7.16	7.12	7.35	7.47	7.48
4	7.24	7.39	7.73	7.51	7.87
5	7.30	6.90	7.62	7.49	7.55
6	7.08	7.12	6.99	7.70	7.39
7	6.97	6.96	7.34	7.14	7.55
8	7.04	7.16	7.45	7.53	7.58
9	6.92	7.03	7.81	7.51	7.51
10	6.75	6.95	7.37	7.69	7.87
11	7.35	7.28	7.25	7.52	7.70
12	6.84	6.87	7.41	7.30	7.61
13	7.08	6.77	7.49	7.31	7.55
14	7.52	7.00	7.04	7.16	7.30
15	7.10	7.19	6.75	7.71	8.06
16	7.28	6.72	7.82	7.56	
$\overline{X}$	7.06	7.04	7.37	7.49	7.58
S	0.25	0.18	0.29	0.18	0.21
%CV	3.5	2.5	4.0	2.4	2.8

Table 37. Micrograms per Inch of Pre-opened USDA Gin Stock Samples Before Blending

Sample Number	Micrograms per Inch Low Mic Cotton	Micrograms per Inch High Mic Cotton
1	4.85	5.40
2	4.70	5.20
3	4.75	5.30
4	4.70	5.35
5	4.85	5.20
6	4.65	5.25
7	4.70	5.30
8	4.85	5.25
9	4.75	5.40
10	4.90	5.30
11	4.85	5.40
12	4.80	5.35
13	4.85	5.30
14	4.85	5.35
15	4.85	5.30
16	4.75	5.20
17	4.85	5.35
18	4.90	5.25
19	4.85	5.30
20	4.90	5.30
$\overline{X}$	4.81	5.30
S	0.08	0.06
%CV	1.6	1.2

Note: The Arithmetic Values for a 50/50 Blend of These Cottons is:

Average	5.06 Micrograms per Inch
Standard Deviation	0.26
Percent Coefficient of Variation	5.1

Table 38. Micrograms per Inch of 50/50 Blend of High and Low Microgram per Inch Pre-opened USDA Gin Cottons Made by One Pass Through the "UT" Opener at Different Rotor Speeds.

Sample Number	600 rpm	700 rpm	800 rpm	900 rpm	1000 rpm	1200 rpm	1300 rpm
1	5.10	5.15	5.20	5.20	5.20	5.00	5.10
2	5.05	5.05	5.05	5.25	5.10	5.10	5.05
3	5.05	5.00	5.10	5.20	5.30	5.00	5.15
4	5.10	5.10	5.05	5.15	5.20	4.95	5.10
5	5.10	5.15	5.00	5.10	5.20	5.20	5.05
6	5.15	4.90	5.10	5.10	5.30	5.05	5.25
7	4.95	4.90	5.20	5.10	5.30	5.10	5.40
8	5.05	5.05	4.95	5.10	5.10	5.10	5.30
9	5.10	5.10	5.05	5.15	5.20	4.95	5.10
10	4.90	5.00	5.05	5.20	5.20	4.80	5.25
11	5.10	5.05	5.10	5.15	5.30	4.85	5.20
12	5.20	4.85	5.00	5.15	5.30	4.95	
13	5.10	4.90	5.10	5.10	5.20	5.05	
14	5.10	5.00	5.15	5.10	5.20	5.10	
15	5.10	4.95	5.10	5.10	5.30	5.00	
16		5.10	5.05	5.05	5.10	4.95	
17		5.00	5.05			4.90	
18			4.95				
19			5.00				
20			5.15				
$\bar{X}$	5.08	5.01	5.07	5.14	5.22	5.00	5.18
S	0.07	0.09	0.07	0.05	0.08	0.10	0.11
%cv	1.4	1.8	1.4	1.0	1.4	2.0	2.2

Table 38. Micrograms per Inch of 50/50 Blend of High and Low Microgram per Inch Pre-opened USDA Gin Cottons Made by One or Two Passes Through the "UT" Opener at Different Rotor Speeds. (Continued)

Sample Number	One Pass		Two Passes	
	1100 rpm	1400 rpm	900 rpm	1400 rpm
1	5.20	4.90	5.10	4.90
2	5.20	4.90	4.90	4.90
3	5.20	4.90	4.90	4.90
4	5.00	5.10	5.00	5.00
5	5.10	5.10	4.90	5.00
6	5.10	4.90	5.00	4.90
7	5.10	4.90	5.00	4.80
8	5.10	5.00	5.00	5.00
9	5.10	5.00	4.90	5.00
10	5.20	5.00	4.90	5.00
11	5.20	4.90	5.10	5.00
12	5.15	5.30	5.10	5.10
13	5.15	5.30	4.90	5.00
14	5.10	5.10	4.90	5.00
15	5.05	5.10	4.90	5.00
16	5.10	5.10	4.90	5.00
17	5.05	4.90	4.90	
18	5.10	5.10	5.00	
19	5.10	5.10	5.00	
20	5.05	4.90	4.90	
$\bar{X}$	5.12	5.03	4.96	4.97
S	0.06	0.13	0.08	0.07
%cv	1.2	2.6	1.5	1.4

Table 39. Fibrograph Data for Low Microgram Per Inch Pre-open USDA Gin Cotton Before Blending.

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.31	0.42	1.01	1.04	0.82
2	0.34	0.46	1.05	1.10	0.89
3	0.31	0.42	1.01	1.04	0.82
4	0.33	0.44	1.01	1.07	0.85
5	0.32	0.42	1.04	1.11	0.82
6	0.33	0.44	1.02	1.08	0.85
7	0.34	0.45	1.03	1.10	0.86
8	0.30	0.41	0.99	1.01	0.80
9	0.34	0.44	1.00	1.11	0.84
10	0.34	0.45	1.02	1.10	0.86
11	0.34	0.45	1.02	1.10	0.86
12	0.30	0.40	0.99	1.03	0.78
13	0.33	0.44	1.04	1.10	0.85
14	0.33	0.44	1.02	1.08	0.85
15	0.31	0.42	1.00	1.03	0.82
16	0.31	0.40	0.99	1.08	0.78
$\bar{X}$	0.32	0.43	1.02	1.07	0.84
S	0.02	0.02	0.02	0.03	0.03
%cv	4.6	4.3	1.8	3.1	3.7

Table 40. Fibrograph Data for High Microgram Per Inch Pre-open USDA Gin Cotton Before Blending.

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.35	0.45	1.00	1.13	0.86
2	0.36	0.47	1.01	1.12	0.90
3	0.36	0.47	1.00	1.11	0.90
4	0.35	0.46	1.00	1.10	0.88
5	0.36	0.46	0.99	1.14	0.87
6	0.37	0.47	1.00	1.16	0.89
7	0.37	0.48	1.00	1.13	0.91
8	0.35	0.46	0.99	1.09	0.88
9	0.35	0.46	0.98	1.08	0.88
10	0.34	0.45	0.98	1.07	0.86
11	0.35	0.46	0.98	1.08	0.88
12	0.37	0.49	1.01	1.12	0.94
13	0.34	0.44	0.98	1.09	0.84
14	0.33	0.44	0.98	1.05	0.84
15	0.33	0.44	0.96	1.03	0.84
16	0.33	0.43	0.97	1.07	0.82
$\bar{X}$	0.35	0.46	0.99	1.10	0.87
S	0.01	0.02	0.01	0.03	0.03
%cv	4.0	3.5	1.5	3.2	3.5

Table 41. Fibrograph Data for 50/50 Blend of High and Low Microgram per Inch Pre-opened USDA Gin Cottons Made by One Pass Through the "UT" Opener at Different rpms.

600 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.31	0.41	0.98	1.04	0.79
2	0.34	0.45	1.01	1.09	0.86
3	0.32	0.44	1.01	1.04	0.85
4	0.36	0.47	1.04	1.15	0.90
5	0.34	0.46	1.03	1.08	0.89
6	0.32	0.42	0.99	1.07	0.81
7	0.33	0.44	1.00	1.06	0.85
8	0.34	0.45	0.99	1.07	0.86
9	0.33	0.44	1.00	1.06	0.85
10	0.33	0.45	1.02	1.06	0.87
11	0.32	0.44	1.00	1.03	0.85
12	0.34	0.45	1.01	1.09	0.86
13	0.31	0.41	0.96	1.02	0.79
14	0.35	0.47	1.02	1.09	0.90
15	0.37	0.48	1.00	1.13	0.91
16	0.32	0.43	0.99	1.04	0.83
$\bar{X}$	0.33	0.44	1.00	1.07	0.85
S	0.02	0.02	0.02	0.04	0.04
%cv	5.1	4.6	2.0	3.3	4.3

Table 41. Continued.

700 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.33	0.43	0.98	1.07	0.82
2	0.31	0.42	0.97	1.01	0.81
3	0.32	0.42	0.97	1.05	0.81
4	0.31	0.41	0.97	1.03	0.79
5	0.32	0.42	0.98	1.06	0.81
6	0.31	0.42	0.99	1.02	0.81
7	0.33	0.44	1.00	1.06	0.85
8	0.32	0.42	0.97	1.05	0.81
9	0.33	0.44	1.00	1.06	0.85
10	0.32	0.41	0.99	1.10	0.79
11	0.35	0.46	1.00	1.10	0.88
12	0.35	0.46	0.99	1.09	0.88
13	0.30	0.41	0.98	1.00	0.80
14	0.32	0.42	0.98	1.06	0.81
15	0.37	0.47	1.00	1.16	0.89
16	0.31	0.42	0.97	1.01	0.81
$\bar{X}$	0.33	0.43	0.98	1.06	0.83
S	0.02	0.02	0.01	0.04	0.03
%cv	5.6	4.5	1.2	3.9	4.0

Table 41. Continued.

800 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.36	0.48	1.06	1.14	0.92
2	0.32	0.42	1.00	1.07	0.81
3	0.32	0.43	1.03	1.07	0.83
4	0.31	0.41	1.02	1.07	0.80
5	0.31	0.41	0.99	1.05	0.79
6	0.31	0.41	0.98	1.04	0.79
7	0.30	0.41	1.00	1.02	0.80
8	0.31	0.43	1.01	1.02	0.84
9	0.33	0.44	1.00	1.06	0.85
10	0.34	0.45	1.04	1.11	0.87
11	0.32	0.42	1.02	1.09	0.81
12	0.34	0.45	1.05	1.12	0.87
13	0.33	0.43	1.01	1.10	0.83
14	0.33	0.44	1.02	1.08	0.85
15	0.33	0.44	1.01	1.07	0.85
16	0.32	0.42	1.00	1.07	0.81
$\bar{X}$	0.32	0.43	1.02	1.07	0.83
S	0.02	0.02	0.02	0.03	0.04
%cv	4.6	4.4	2.1	3.1	4.2

Table 41. Continued

900 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.30	0.40	0.97	1.02	0.78
2	0.32	0.42	0.97	1.05	0.81
3	0.34	0.45	1.02	1.10	0.86
4	0.31	0.42	0.99	1.02	0.81
5	0.35	0.47	1.02	1.09	0.90
6	0.37	0.47	1.01	1.19	0.89
7	0.33	0.43	1.01	1.10	0.83
8	0.32	0.42	1.00	1.07	0.81
9	0.32	0.43	1.04	1.08	0.84
10	0.30	0.41	0.98	1.00	0.80
11	0.32	0.41	1.01	1.12	0.79
12	0.33	0.43	0.99	1.08	0.82
13	0.36	0.46	1.04	1.16	0.87
14	0.32	0.43	1.01	1.06	0.83
15	0.30	0.40	0.97	1.02	0.78
16	0.30	0.39	0.95	1.03	0.75
$\bar{X}$	0.32	0.43	1.00	1.07	0.82
S	0.02	0.02	0.03	0.05	0.04
%cv	6.7	5.7	2.6	4.6	5.0

Table 41. Continued

<u>1000 rpm</u>

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.33	0.44	1.01	1.07	0.85
2	0.30	0.40	1.00	1.04	0.78
3	0.30	0.40	0.99	1.03	0.78
4	0.34	0.45	1.04	1.11	0.87
5	0.29	0.39	0.99	1.02	0.77
6	0.29	0.39	0.98	1.01	0.77
7	0.30	0.40	1.00	1.04	0.78
8	0.33	0.43	1.00	1.09	0.82
9	0.30	0.40	0.97	1.02	0.78
10	0.31	0.41	1.00	1.06	0.80
11	0.30	0.40	1.00	1.04	0.78
12	0.30	0.41	0.99	1.01	0.80
13	0.32	0.42	1.03	1.10	0.82
14	0.30	0.40	1.01	1.05	0.79
15	0.30	0.40	0.98	1.02	0.78
16	0.29	0.39	0.99	1.02	0.77
$\bar{X}$	0.31	0.41	1.00	1.05	0.80
S	0.02	0.02	0.02	0.03	0.03
%cv	5.0	4.4	1.8	3.1	3.7

Table 41. Continued

1100 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.31	0.41	0.97	1.03	0.79
2	0.32	0.43	1.00	1.05	0.83
3	0.31	0.42	0.99	1.02	0.81
4	0.31	0.41	0.98	1.04	0.79
5	0.33	0.44	1.00	1.06	0.85
6	0.33	0.44	1.00	1.06	0.85
7	0.31	0.41	0.97	1.03	0.79
8	0.32	0.42	1.00	1.07	0.81
9	0.33	0.44	0.99	1.06	0.84
10	0.30	0.40	0.96	1.01	0.78
11	0.29	0.39	0.96	0.99	0.76
12	0.29	0.38	0.95	1.01	0.74
13	0.30	0.39	0.98	1.05	0.76
14	0.31	0.41	0.97	1.03	0.79
15	0.31	0.41	0.97	1.03	0.79
16	0.29	0.38	0.97	1.03	0.75
$\bar{X}$	0.31	0.41	0.98	1.04	0.80
S	0.01	0.02	0.02	0.02	0.03
%cv	4.4	4.9	1.7	2.1	4.3

Table 41. Continued

1200 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.30	0.40	0.98	1.02	0.78
2	0.31	0.41	1.01	1.07	0.80
3	0.30	0.40	0.99	1.03	0.78
4	0.29	0.39	0.98	1.01	0.77
5	0.31	0.42	0.96	1.00	0.81
6	0.33	0.44	1.03	1.09	0.85
7	0.32	0.42	1.01	1.08	0.81
8	0.36	0.47	1.03	1.14	0.90
9	0.30	0.40	0.98	1.02	0.78
10	0.31	0.41	0.99	1.05	0.79
11	0.31	0.42	1.00	1.03	0.82
12	0.30	0.40	0.97	1.02	0.78
13	0.31	0.42	1.01	1.04	0.82
14	0.31	0.40	0.97	1.06	0.77
15	0.29	0.39	0.99	1.02	0.77
16	0.31	0.41	0.99	1.05	0.79
$\bar{X}$	0.31	0.42	0.99	1.05	0.80
S	0.02	0.03	0.02	0.04	0.03
%cv	5.9	6.3	2.1	3.4	4.3

Table 41. Continued

1300 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.29	0.39	0.96	0.99	0.76
2	0.31	0.41	1.00	1.06	0.80
3	0.29	0.39	0.97	1.00	0.76
4	0.31	0.41	0.98	1.04	0.79
5	0.32	0.42	0.99	1.07	0.81
6	0.32	0.43	0.98	1.03	0.83
7	0.34	0.45	1.00	1.06	0.86
8	0.31	0.41	0.98	1.04	0.79
9	0.31	0.42	1.00	1.03	0.82
10	0.32	0.43	0.98	1.03	0.83
11	0.33	0.44	1.03	1.09	0.85
12	0.32	0.44	1.02	1.04	0.85
13	0.31	0.43	1.00	1.01	0.84
14	0.33	0.43	0.99	1.08	0.82
15	0.33	0.44	1.00	1.06	0.85
16	0.31	0.42	0.97	1.01	0.81
$\bar{X}$	0.32	0.42	0.99	1.04	0.82
S	0.01	0.02	0.02	0.03	0.03
%cv	4.3	4.1	1.9	2.8	3.8

Table 41. Continued

1400 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.31	0.41	1.02	1.07	0.80
2	0.31	0.41	1.00	1.06	0.80
3	0.32	0.43	1.01	1.06	0.83
4	0.31	0.42	1.00	1.03	0.82
5	0.31	0.40	0.99	1.08	0.78
6	0.30	0.40	0.96	1.01	0.78
7	0.30	0.40	1.01	1.05	0.79
8	0.32	0.43	1.01	1.06	0.83
9	0.33	0.43	1.00	1.09	0.82
10	0.31	0.43	0.99	1.01	0.84
11	0.30	0.41	1.02	1.03	0.81
12	0.31	0.41	1.00	1.06	0.80
13	0.31	0.42	1.01	1.04	0.82
14	0.31	0.42	1.00	1.03	0.82
15	0.30	0.40	0.99	1.03	0.78
16	0.31	0.42	1.00	1.03	0.82
$\bar{X}$	0.31	0.42	1.00	1.05	0.81
S	0.01	0.01	0.01	0.02	0.02
%cv	2.6	2.8	1.4	2.3	2.4

Table 42. Fibrograph Data for 50/50 Blend of High and Low Microgram Per Inch Pre-opened USDA Gin Cottons Made by Two Passes Through the "UT" Opener at 900 and 1400 rpms

900 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.31	0.41	0.98	1.04	0.79
2	0.31	0.41	0.99	1.05	0.79
3	0.31	0.41	0.97	1.03	0.79
4	0.31	0.41	0.99	1.05	0.79
5	0.32	0.42	0.99	1.07	0.81
6	0.34	0.45	1.01	1.09	0.86
7	0.31	0.41	1.00	1.06	0.80
8	0.28	0.39	0.99	0.98	0.77
9	0.30	0.40	1.00	1.04	0.78
10	0.32	0.42	1.02	1.09	0.81
11	0.31	0.41	0.99	1.05	0.79
12	0.31	0.41	1.00	1.06	0.80
13	0.32	0.42	1.02	1.09	0.81
14	0.33	0.43	1.00	1.09	0.82
15	0.31	0.41	1.02	1.07	0.80
16	0.34	0.45	1.04	1.11	0.87
$\bar{X}$	0.31	0.42	1.00	1.06	0.81
S	0.01	0.02	0.02	0.03	0.03
%CV	4.6	3.8	1.8	3.0	3.3

Table 42. Continued

<u>1400 rpm</u>

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.34	0.45	1.04	1.11	0.87
2	0.33	0.45	1.02	1.06	0.87
3	0.34	0.45	1.07	1.14	0.87
4	0.32	0.44	1.03	1.05	0.86
5	0.32	0.42	1.02	1.09	0.81
6	0.33	0.43	1.02	1.11	0.83
7	0.32	0.43	1.04	1.08	0.84
8	0.32	0.43	1.04	1.08	0.84
9	0.31	0.42	1.05	1.07	0.82
10	0.32	0.43	1.04	1.08	0.84
11	0.31	0.42	0.99	1.02	0.81
12	0.33	0.44	1.01	1.07	0.85
13	0.31	0.42	1.02	1.05	0.82
14	0.33	0.45	1.04	1.07	0.87
15	0.32	0.43	1.05	1.09	0.84
16	0.31	0.41	1.03	1.09	0.80
$\bar{X}$	0.32	0.43	1.03	1.09	0.84
S	0.01	0.01	0.02	0.03	0.02
%cv	3.1	3.0	1.8	2.6	2.8

Table 43. Summary of Mean Length of Pre-open USDA Gin Cottons Blended on the "UT" Opener at Different rpms.

rpm	Average	Standard Deviation	Percent Coefficient of variation
		One Pass	
0.0	0.85	0.04	4.3
600	0.85	0.04	4.3
700	0.83	0.03	4.0
800	0.83	0.04	4.2
900	0.82	0.04	5.0
1000	0.80	0.03	3.7
1100	0.80	0.03	4.3
1200	0.80	0.03	4.3
1300	0.82	0.03	3.8
1400	0.81	0.02	2.4
		Two Passes	
900	0.81	0.03	3.3
1400	0.84	0.02	2.8

Table 44. Summary of Upper Quartile Length of Pre-open USDA Gin Cotton Blended on the "UT" Opener at Different rpms.

rpm	Average	Standard Deviation	Percent Coefficient of variation
		One Pass	
0.0	1.09	0.04	3.3
600	1.07	0.04	3.3
700	1.06	0.04	3.9
800	1.07	0.03	3.1
900	1.07	0.05	4.6
1000	1.05	0.03	3.1
1100	1.04	0.02	2.1
1200	1.05	0.04	3.4
1300	1.04	0.03	2.8
1400	1.05	0.02	2.3
		Two Passes	
900	1.06	0.03	3.0
1400	1.09	0.03	2.6

APPENDIX D

PHYSICAL PROPERTIES DATA OF BLENDED GEORGIA TECH BALE STOCK

Table 45. Micrograms Per Inch of Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at Different rpms.

Sample Number	500 rpm	600 rpm	700 rpm	750 rpm	800 rpm	850 rpm	900 rpm
1	5.20	5.30	4.90	5.00	5.30	5.05	5.10
2	5.00	5.10	4.90	5.20	5.10	5.25	5.10
3	5.10	5.15	5.10	5.10	5.20	5.10	5.00
4	5.20	5.10	5.10	5.10	5.20	5.25	5.10
5	5.20	5.20	5.10	5.10	5.20	5.25	5.10
6	5.30	5.25	5.10	5.00	5.20	5.20	5.10
7	5.10	5.10	5.10	5.00	5.20	5.05	5.10
8	5.10	5.10	4.90	5.10	5.30	5.15	5.20
9	5.10	5.20	4.90	5.20	5.30	5.25	5.10
10	5.20	5.25	4.90	5.20	5.30	5.25	5.20
11	5.10	5.35	5.00	5.20	5.25	5.10	5.10
12	5.00	5.25	5.00	5.10	5.30	5.20	5.10
13	5.10	5.25	5.10	5.30	5.25	5.25	5.10
14	5.00	5.25	5.00	5.10	5.20	5.25	5.10
15	5.20	5.25	5.00	5.20	5.30	5.10	5.10
16	5.20	5.20	5.10	5.20	5.20	5.25	5.10
17	5.30	5.30	4.90	5.20	5.30	5.20	5.00
18	5.20		4.90	5.10	5.30	5.20	5.20
19	5.20		5.10	5.10		5.00	5.20
20	5.20		5.10	5.10		5.25	5.10
$\bar{X}$	5.15	5.21	5.02	5.13	5.24	5.18	5.11
S	0.09	0.08	0.09	0.08	0.06	0.08	0.06
%cv	1.7	1.5	1.8	1.6	1.1	1.6	1.1

Table 46. Micrograms Per Inch of Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at Different rpms.

Sample Number	950 rpm	1000 rpm	1100 rpm	1200 rpm	1300 rpm	1400 rpm
1	5.25	5.10	4.90	5.10	5.10	5.10
2	5.20	5.20	5.00	5.00	5.10	5.25
3	5.10	5.10	5.00	5.20	5.15	5.25
4	5.20	5.10	4.90	5.25	5.10	5.25
5	5.30	5.20	5.00	5.20	5.05	5.25
6	5.10	5.00	5.10	5.30	5.20	5.25
7	5.20	5.00	5.00	5.20	5.15	5.30
8	5.30	5.20	5.10	5.20	5.15	5.25
9	5.30	5.10	5.10	5.10	5.20	5.30
10	5.20	5.30	5.00	5.20	5.10	5.35
11	5.15	5.20	5.00	5.20	5.20	5.25
12	5.30	5.20	4.80	5.10	5.20	5.30
13	5.30	5.30	4.90	5.10	5.25	5.20
14	5.30	5.20	5.10	5.20	5.05	5.15
15	5.30	5.20	5.00	5.20	5.10	5.25
16	5.20	5.10	5.00	5.10	5.25	5.30
17	5.15	5.10	4.90	5.10	5.25	5.25
18	5.25	5.10	4.90	5.10	5.20	5.15
19	5.20	5.10	5.10	5.05	5.25	5.35
20	5.30	5.10	5.10	5.20	5.30	5.30
$\bar{X}$	5.23	5.15	5.00	5.16	5.17	5.25
S	0.07	0.08	0.09	0.07	0.07	0.06
%cv	1.3	1.6	1.8	1.4	1.4	1.2

Table 47. Micrograms Per Inch of Georgia Tech Bale Stock Blended by Two Passes Through the "UT" Opener at Different rpms.

Sample Number	600 rpm	1000 rpm	1200 rpm	1400 rpm
1	5.20	5.35	5.25	5.30
2	5.20	5.25	5.25	5.25
3	5.20	5.20	5.20	5.20
4	5.20	5.30	5.15	5.30
5	5.20	5.25	5.20	5.20
6	5.10	5.20	5.15	5.30
7	5.30	5.15	5.25	5.30
8	5.20	5.30	5.20	5.20
9	5.10	5.25	5.25	5.25
10	5.20	5.15	5.05	5.25
11	5.30	5.20	5.15	5.30
12	5.30	5.20	5.30	5.10
13	5.20	5.10	5.10	5.20
14	5.20	5.20	5.25	5.25
15	5.25	5.30	5.20	5.25
16	5.10	5.25	5.30	5.25
17	5.10	5.30	5.25	5.30
18	5.20	5.20	5.25	5.20
19	5.10	5.25	5.20	5.35
20	5.20	5.15	5.05	5.30
$\bar{X}$	5.19	5.23	5.20	5.25
S	0.07	0.06	0.07	0.06
%cv	1.3	1.2	1.4	1.1

Table 48. Micrograms Per Inch of Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at Different rpms.

Sample Number	600 rpm	800 rpm	1000 rpm	1200 rpm
1	5.25	5.20	5.15	5.15
2	5.30	5.20	5.20	5.15
3	5.10	5.25	5.20	5.20
4	5.30	5.20	5.10	5.20
5	5.25	5.20	5.25	5.10
6	5.30	5.20	5.10	5.10
7	5.00	5.00	5.20	5.20
8	5.30	5.00	5.25	5.25
9	5.15	5.00	5.20	5.10
10	5.30	5.20	5.20	5.20
11	5.30	5.25	5.25	5.20
12	5.25	5.15	5.30	5.30
13	5.25	5.20	5.25	5.20
14	5.20	5.20	5.15	5.20
15	5.25	5.10	5.20	5.20
16	5.25	5.20	5.30	5.20
17	5.30	5.00	5.20	5.20
18	5.20	5.10	5.30	5.00
19	5.30	5.25	5.30	5.25
20	5.15	5.25	5.30	5.20
$\bar{X}$	5.24	5.16	5.22	5.18
S	0.08	0.09	0.06	0.07
%cv	1.6	1.8	1.2	1.3

Table 49. Micrograms Per Inch of Georgia Tech Bale Stock Blended by Four Passes Through the "UT" Opener at 800 rpms.

Sample Number	800 rpm
1	5.20
2	5.20
3	5.20
4	5.20
5	5.20
6	4.90
7	5.20
8	5.10
9	5.20
10	5.10
11	5.25
12	5.20
13	5.20
14	5.20
15	5.15
16	5.25
17	5.30
18	5.20
19	5.25
20	5.25
$\bar{X}$	5.19
S	0.08
%cv	1.6

Table 50. Pressley Index of Georgia Tech Bale Stock Blended by One Pass Through "UT" Opener At Different rpms.

Sample Number	500 rpm	600 rpm	700 rpm	750 rpm	800 rpm	850 rpm	900 rpm
1	8.37	7.51	7.68	7.82	7.32	7.43	7.53
2	7.75	7.95	7.68	7.89	7.35	7.43	7.26
3	7.78	7.97	7.80	7.86	7.47	7.43	7.43
4	7.41	8.11	7.82	7.55	7.45	7.43	7.53
5	8.23	7.89	7.37	7.74	7.66	7.81	7.14
6	7.76	7.55	7.78	8.11	7.67	7.62	7.55
7	7.45	7.98	8.32	7.40	7.47	7.64	7.78
8	8.00	7.89	7.44	8.08	7.74	7.35	7.54
9	7.57	8.00	7.18	7.68	7.86	7.52	7.75
10	7.40	8.01	7.20	7.90	7.59	7.47	7.47
11	7.55	8.02	7.76	8.46	7.64	7.38	7.52
12	7.87	7.82	7.21	7.47	7.72	7.03	7.63
13	7.70	7.80	7.47	7.57	7.40	7.19	7.13
14	7.25	8.04	7.71	7.37	7.81	7.20	7.75
15	7.78	7.21	8.10	7.75	6.76	7.99	7.88
16	7.54	7.82	7.74	7.57	7.05	7.59	7.35
$\bar{X}$	7.71	7.85	7.64	7.76	7.50	7.47	7.51
S	0.30	0.24	0.32	0.29	0.29	0.23	0.22
%cv	3.9	3.0	4.2	3.7	3.8	3.1	2.9

Table 50. Continued

Sample Number	950 rpm	1000 rpm	1100 rpm	1200 rpm	1300 rpm	1400 rpm
1	7.66	7.42	7.30	7.18	7.96	7.43
2	7.30	7.57	7.78	7.25	7.69	7.33
3	7.69	7.54	8.28	8.16	7.84	7.81
4	7.35	7.57	7.57	7.75	7.71	7.12
5	7.40	6.91	8.14	7.08	7.47	7.63
6	7.58	7.70	7.79	7.65	7.51	6.97
7	7.68	7.62	7.65	7.21	8.21	7.59
8	7.09	7.47	7.62	7.10	7.78	6.86
9	7.42	7.33	7.98	7.10	7.75	7.56
10	7.18	7.66	7.63	8.01	7.80	7.71
11	7.26	7.42	7.87	8.00	7.71	7.72
12	7.97	7.31	7.62	7.38	7.84	7.23
13	7.88	7.53	7.90	6.99	7.76	7.46
14	7.22	7.27	7.95	7.55	7.82	7.58
15	7.58	7.49	7.76	7.43	8.31	7.59
16	7.77	7.55	7.99	6.80	7.93	7.54
$\bar{X}$	7.50	7.46	7.80	7.42	7.82	7.45
S	0.26	0.19	0.24	0.40	0.22	0.27
%cv	3.5	2.6	3.1	5.4	2.8	3.7

Table 51. Pressley Index of Georgia Tech Bale Stock Blended by Two Passes Through the "UT" Opener at Different rpms.

Sample Number	600 rpm	1000 rpm	1200 rpm	1400 rpm
1	7.12	7.41	7.59	7.95
2	7.15	7.77	7.51	7.41
3	7.56	7.33	6.87	7.52
4	6.86	7.66	7.51	8.00
5	7.35	7.54	7.02	7.53
6	7.48	7.67	7.50	7.32
7	6.66	7.35	7.43	7.53
8	6.90	6.75	7.63	7.73
9	6.89	7.66	7.35	8.06
10	7.21	7.31	7.59	8.10
11	7.27	7.19	7.42	7.44
12	7.47	8.14	7.01	7.38
13	7.25	8.39	7.18	7.33
14	6.80	7.62	8.00	7.66
15	7.45	7.20	7.43	6.68
16	7.53	6.69	7.18	7.31
$\bar{X}$	7.18	7.48	7.39	7.56
S	0.29	0.44	0.28	0.36
%cv	5.6	5.8	3.8	4.8

Table 52. Pressley Index of Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at Different rpms.

Sample Number	600 rpm	800 rpm	1000 rpm	1200 rpm
1	7.73	6.90	7.92	7.85
2	7.76	7.49	7.65	7.63
3	8.08	7.21	7.76	7.93
4	7.80	7.53	7.59	8.03
5	8.14	7.36	7.93	7.86
6	7.87	7.70	8.32	7.04
7	7.83	7.10	8.08	7.99
8	8.24	7.38	7.72	7.96
9	7.95	7.73	7.85	8.14
10	7.91	7.33	7.37	7.63
11	7.89	7.78	7.63	8.08
12	7.19	7.66	8.32	7.02
13	7.89	7.84	8.07	7.20
14	7.87	7.51	7.55	7.71
15	7.78	7.66	8.17	7.57
16	7.68	8.08	7.76	7.92
$\bar{X}$	7.85	7.52	7.86	7.72
S	0.23	0.30	0.28	0.36
%cv	2.9	4.0	3.5	4.6

Table 53. Pressley Index of Georgia Tech Bale Stock Blended by Four Passes Through the "UT" Opener at 800 rpms.

Sample Number	800 rpm
1	7.40
2	7.43
3	7.52
4	7.88
5	7.96
6	7.58
7	7.83
8	7.79
9	7.31
10	7.40
11	7.22
12	7.10
13	7.30
14	7.17
15	7.75
16	7.32
$\bar{X}$	7.50
S	0.27
%cv	3.6

Table 54. Fibrograph Data for Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at 500 and 600 rpms.

500 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.40	0.53	1.09	1.21	1.01	48.6
2	0.37	0.50	1.13	1.19	0.96	44.2
3	0.40	0.52	1.11	1.24	0.99	46.8
4	0.39	0.52	1.09	1.19	1.00	47.7
5	0.37	0.48	1.08	1.20	0.92	44.4
6	0.41	0.53	1.11	1.26	1.01	47.7
7	0.40	0.52	1.09	1.23	0.99	47.7
8	0.43	0.54	1.11	1.33	1.02	48.6
9	0.37	0.50	1.11	1.17	0.96	45.0
10	0.42	0.54	1.11	1.28	1.03	48.6
11	0.46	0.56	1.11	1.43	1.05	50.5
12	0.39	0.52	1.12	1.21	1.00	46.4
13	0.44	0.55	1.12	1.36	1.04	49.1
14	0.39	0.51	1.08	1.20	0.97	47.2
15	0.41	0.52	1.09	1.27	0.98	47.7
16	0.39	0.51	1.09	1.21	0.97	46.8
$\bar{X}$	0.40	0.52	1.10	1.25	0.99	47.3
S	0.03	0.02	0.02	0.07	0.03	1.7
%cv	6.3	3.8	1.4	5.7	3.4	3.6

Table 54. Continued

600 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.39	0.51	1.06	1.19	0.97	48.1
2	0.44	0.56	1.09	1.30	1.07	51.4
3	0.40	0.52	1.06	1.20	0.99	49.1
4	0.39	0.51	1.06	1.19	0.97	48.1
5	0.42	0.55	1.09	1.24	1.05	50.5
6	0.41	0.53	1.07	1.23	1.01	49.5
7	0.40	0.51	1.07	1.24	0.96	47.7
8	0.41	0.54	1.09	1.22	1.03	49.5
9	0.38	0.50	1.06	1.17	0.95	47.2
10	0.42	0.54	1.09	1.26	1.03	49.5
11	0.38	0.50	1.06	1.17	0.95	47.2
12	0.39	0.50	1.07	1.22	0.95	46.7
13	0.39	0.51	1.06	1.19	0.97	48.1
14	0.38	0.49	1.06	1.20	0.93	46.2
15	0.41	0.53	1.07	1.23	1.01	49.5
16	0.42	0.54	1.09	1.26	1.03	49.5
$\bar{X}$	0.40	0.52	1.07	1.22	0.99	48.7
S	0.02	0.02	0.01	0.04	0.04	1.38
%cv	4.4	4.0	1.2	2.9	4.2	2.8

Table 55. Fibrograph Data for Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at 700 and 750 rpms.

700 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.46	0.57	1.12	1.39	1.07	50.9
2	0.46	0.57	1.16	1.43	1.07	49.1
3	0.44	0.54	1.14	1.42	1.01	47.4
4	0.41	0.52	1.09	1.27	0.98	47.7
5	0.46	0.57	1.12	1.39	1.07	50.9
6	0.39	0.49	1.09	1.28	0.93	45.0
7	0.40	0.50	1.08	1.29	0.94	46.3
8	0.40	0.50	1.07	1.28	0.94	46.7
9	0.42	0.53	1.11	1.31	1.00	47.7
10	0.40	0.50	1.09	1.29	0.94	45.9
11	0.42	0.53	1.12	1.32	1.00	47.3
12	0.41	0.51	1.08	1.30	0.96	47.2
13	0.40	0.50	1.10	1.30	0.94	45.5
14	0.41	0.52	1.07	1.26	0.98	48.6
15	0.39	0.49	1.08	1.27	0.93	45.8
16	0.40	0.50	1.10	1.27	0.98	45.5
$\bar{X}$	0.42	0.52	1.10	1.32	0.98	47.3
S	0.02	0.03	0.03	0.06	0.05	1.8
%cv	5.9	5.4	2.3	4.3	5.1	3.8

Table 55. Continued

750 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.39	0.51	1.09	1.21	0.97	46.8
2	0.43	0.55	1.07	1.26	1.05	51.4
3	0.48	0.59	1.10	1.41	1.12	53.6
4	0.43	0.54	1.05	1.28	1.02	51.4
5	0.39	0.52	1.06	1.17	1.00	49.1
6	0.38	0.51	1.06	1.15	0.98	48.1
7	0.44	0.56	1.08	1.29	1.07	51.9
8	0.41	0.53	1.06	1.22	1.01	50.0
9	0.41	0.52	1.03	1.23	0.99	50.5
10	0.41	0.53	1.08	1.24	1.01	49.1
11	0.39	0.50	1.05	1.21	0.95	47.6
12	0.45	0.57	1.10	1.32	1.09	51.8
13	0.39	0.50	1.05	1.21	0.95	47.6
14	0.42	0.53	1.07	1.28	1.00	49.5
15	0.40	0.53	1.07	1.19	1.02	49.5
16	0.39	0.52	1.07	1.17	1.00	48.6
$\bar{X}$	0.41	0.53	1.07	1.24	1.01	49.8
S	0.03	0.03	0.02	0.07	0.05	1.9
%cv	6.6	4.7	1.8	5.3	4.7	3.8

Table 56. Fibrograph Data for Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at 800 and 900 rpms.

800 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.35	0.47	1.04	1.11	0.90	45.2
2	0.38	0.50	1.06	1.17	0.95	47.2
3	0.40	0.52	1.09	1.23	0.99	47.7
4	0.38	0.50	1.07	1.18	0.95	46.7
5	0.44	0.55	1.09	1.33	1.04	50.5
6	0.41	0.53	1.08	1.24	1.01	49.1
7	0.37	0.48	1.07	1.19	0.91	44.9
8	0.38	0.50	1.08	1.19	0.95	46.3
9	0.40	0.53	1.11	1.22	1.01	47.7
10	0.40	0.52	1.08	1.22	0.99	48.1
11	0.38	0.49	1.08	1.21	0.93	45.4
12	0.40	0.52	1.08	1.22	0.99	48.1
13	0.38	0.50	1.06	1.17	0.95	47.2
14	0.38	0.50	1.09	1.19	0.95	45.9
15	0.39	0.51	1.07	1.19	0.97	47.7
16	0.38	0.50	1.07	1.18	0.95	46.7
$\bar{X}$	0.39	0.51	1.08	1.20	0.97	47.1
S	0.02	0.02	0.02	0.05	0.04	1.5
%cv	5.1	4.0	1.5	3.8	3.9	3.1

Table 56. Continued

900 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.37	0.49	1.09	1.18	0.94	45.0
2	0.43	0.55	1.11	1.30	1.04	49.5
3	0.43	0.55	1.12	1.30	1.04	49.1
4	0.41	0.53	1.11	1.26	1.01	47.7
5	0.44	0.55	1.11	1.35	1.04	49.5
6	0.38	0.51	1.09	1.17	0.98	46.8
7	0.40	0.52	1.09	1.23	0.99	47.7
8	0.41	0.54	1.11	1.24	1.03	48.6
9	0.37	0.50	1.07	1.14	0.96	46.7
10	0.40	0.52	1.10	1.24	0.99	47.3
11	0.42	0.54	1.10	1.27	1.03	49.0
12	0.40	0.53	1.09	1.21	1.01	48.6
13	0.41	0.54	1.10	1.23	1.03	49.1
14	0.41	0.53	1.12	1.27	1.01	47.3
15	0.38	0.51	1.08	1.17	0.98	47.2
16	0.37	0.49	1.08	1.17	0.94	45.4
$\bar{X}$	0.40	0.53	1.10	1.23	1.00	47.8
S	0.02	0.02	0.01	0.06	0.03	1.4
%cv	5.6	3.9	1.3	4.7	3.4	2.9

Table 57. Fibrograph Data for Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at 1000 and 1100 rpms.

1000 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.38	0.50	1.09	1.19	0.95	45.9
2	0.42	0.54	1.06	1.24	1.03	50.9
3	0.42	0.54	1.08	1.25	1.03	50.0
4	0.40	0.52	1.07	1.21	0.99	48.6
5	0.39	0.50	1.09	1.24	0.95	45.9
6	0.38	0.51	1.09	1.17	0.98	46.8
7	0.41	0.53	1.11	1.26	1.01	47.7
8	0.42	0.53	1.09	1.29	1.00	48.6
9	0.38	0.50	1.08	1.19	0.95	46.3
10	0.37	0.49	1.09	1.18	0.94	45.0
11	0.41	0.53	1.12	1.27	1.01	47.3
12	0.38	0.51	1.08	1.17	0.98	47.2
13	0.44	0.56	1.12	1.32	1.06	51.9
14	0.41	0.54	1.11	1.24	1.03	48.2
15	0.38	0.50	1.08	1.19	0.95	46.3
16	0.41	0.53	1.08	1.24	1.01	49.1
$\bar{X}$	0.40	0.52	1.09	1.23	0.99	47.9
S	0.02	0.02	0.02	0.04	0.04	1.9
%cv	5.1	3.8	1.6	3.6	3.7	4.0

Table 57 Continued

1100 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.37	0.48	1.05	1.17	0.91	45.7
2	0.37	0.50	1.10	1.16	0.96	45.5
3	0.42	0.55	1.13	1.27	1.05	48.7
4	0.38	0.50	1.10	1.20	0.96	45.5
5	0.38	0.51	1.09	1.17	0.98	46.8
6	0.39	0.51	1.07	1.19	0.97	47.7
7	0.40	0.52	1.11	1.24	0.99	46.8
8	0.37	0.51	1.11	1.15	0.99	45.9
9	0.39	0.52	1.09	1.19	1.00	47.7
10	0.40	0.50	1.10	1.30	0.94	45.5
11	0.40	0.53	1.11	1.22	1.01	47.7
12	0.40	0.52	1.09	1.23	0.99	47.7
13	0.40	0.52	1.10	1.24	0.99	47.3
14	0.38	0.50	1.09	1.19	0.95	45.9
15	0.43	0.55	1.12	1.30	1.04	49.1
16	0.40	0.53	1.12	1.23	1.01	47.3
$\bar{X}$	0.39	0.52	1.10	1.22	0.98	46.9
S	0.02	0.02	0.02	0.05	0.04	1.2
%cv	4.4	3.6	1.8	3.8	3.6	2.5

Table 58. Fibrograph Data for Georgia Tech Bale Stock Blended by One Pass Through the "UT" Opener at 1200 and 1300 rpms.

1200 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.41	0.53	1.08	1.24	1.01	49.1
2	0.42	0.54	1.09	1.26	1.03	49.5
3	0.39	0.51	1.11	1.23	0.97	45.9
4	0.38	0.50	1.09	1.19	0.95	45.9
5	0.43	0.55	1.10	1.29	1.05	50.0
6	0.38	0.51	1.11	1.19	0.98	45.9
7	0.42	0.54	1.13	1.29	1.02	47.8
8	0.38	0.51	1.09	1.17	0.98	46.8
9	0.42	0.53	1.09	1.29	1.00	48.6
10	0.36	0.48	1.06	1.14	0.92	45.3
11	0.37	0.50	1.11	1.17	0.96	45.0
12	0.40	0.52	1.08	1.22	0.99	48.1
13	0.35	0.47	1.05	1.11	0.90	44.8
14	0.38	0.49	1.06	1.20	0.93	46.2
15	0.37	0.50	1.08	1.15	0.96	46.3
16	0.37	0.50	1.10	1.16	0.96	45.5
$\bar{X}$	0.39	0.51	1.09	1.21	0.98	46.9
S	0.02	0.02	0.02	0.06	0.04	1.7
%cv	6.3	4.4	1.9	4.7	4.2	3.6

Table 58 Continued

1300 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.39	0.51	1.05	1.18	0.97	48.6
2	0.36	0.48	1.04	1.12	0.92	46.2
3	0.37	0.49	1.06	1.15	0.94	46.2
4	0.42	0.53	1.05	1.26	1.00	50.5
5	0.37	0.49	1.05	1.15	0.94	46.7
6	0.43	0.52	1.07	1.39	0.97	48.6
7	0.39	0.52	1.05	1.16	1.00	49.5
8	0.39	0.51	1.07	1.19	0.97	47.7
9	0.39	0.52	1.08	1.18	1.00	48.1
10	0.40	0.51	1.06	1.23	0.97	48.1
11	0.38	0.49	1.05	1.19	0.93	46.7
12	0.38	0.50	1.05	1.16	0.95	47.6
13	0.37	0.48	1.05	1.17	0.91	45.7
14	0.39	0.51	1.06	1.19	0.97	48.1
15	0.39	0.52	1.08	1.18	1.00	48.1
16	0.39	0.51	1.07	1.19	0.97	47.7
$\bar{X}$	0.39	0.51	1.06	1.19	0.96	47.8
S	0.02	0.02	0.01	0.06	0.03	1.3
%cv	4.6	3.1	1.1	5.2	3.0	2.6

Table 59. Fibrograph Data for Georgia Tech Bale Stock Blended at One Pass Through the "UT" Opener at 1400 rpms.

1400 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length	Uniformity Ratio
1	0.44	0.56	1.14	1.34	1.06	49.1
2	0.40	0.52	1.10	1.24	0.99	47.3
3	0.38	0.50	1.09	1.19	0.95	46.3
4	0.37	0.50	1.08	1.15	0.96	46.3
5	0.38	0.50	1.08	1.19	0.95	46.3
6	0.43	0.54	1.12	1.34	1.02	48.2
7	0.41	0.53	1.10	1.25	1.01	48.2
8	0.44	0.56	1.11	1.31	1.06	50.5
9	0.43	0.55	1.12	1.30	1.04	49.1
10	0.40	0.52	1.10	1.24	0.99	47.3
11	0.38	0.50	1.10	1.20	0.96	45.5
12	0.41	0.53	1.11	1.26	1.01	47.7
13	0.37	0.48	1.06	1.18	0.91	45.3
14	0.37	0.49	1.07	1.16	0.94	45.8
15	0.37	0.49	1.06	1.15	0.94	46.2
16	0.37	0.49	1.07	1.16	0.94	45.8
$\bar{X}$	0.40	0.52	1.09	1.23	0.98	47.7
S	0.03	0.03	0.02	0.07	0.05	1.5
%cv	6.7	5.1	2.1	5.4	4.7	3.2

Table 60. Fibrograph Data for Georgia Tech Bale Stock Blended at Two Passes Through the "UT" Opener at 600 rpms.

600 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.42	0.53	1.08	1.28	1.00
2	0.39	0.51	1.07	1.19	0.97
3	0.47	0.58	1.11	1.40	1.10
4	0.38	0.50	1.09	1.19	0.95
5	0.37	0.49	1.05	1.15	0.94
6	0.36	0.48	1.07	1.15	0.92
7	0.39	0.51	1.08	1.20	0.97
8	0.39	0.50	1.05	1.21	0.95
9	0.38	0.50	1.08	1.19	0.95
10	0.43	0.55	1.08	1.27	1.05
11	0.40	0.52	1.09	1.23	0.99
12	0.38	0.50	1.10	1.20	0.96
13	0.39	0.51	1.07	1.19	0.97
14	0.46	0.58	1.12	1.36	1.10
15	0.41	0.54	1.11	1.24	1.03
16	0.42	0.54	1.08	1.25	1.03
$\bar{X}$	0.40	0.52	1.08	1.23	0.99
S	0.03	0.03	0.02	0.07	0.05
%cv	7.7	5.7	1.8	5.6	5.5

Table 61. Fibrograph Data for Georgia Tech Bale Stock Blended at Two Passes Through the "UT" Opener at 1000 rpms.

1000 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.36	0.49	1.05	1.11	0.94
2	0.40	0.51	1.08	1.25	0.96
3	0.31	0.49	1.06	1.01	0.98
4	0.38	0.50	1.05	1.16	0.95
5	0.39	0.51	1.09	1.21	0.97
6	0.38	0.50	1.04	1.16	0.95
7	0.37	0.49	1.07	1.16	0.94
8	0.34	0.46	1.06	1.11	0.89
9	0.39	0.51	1.08	1.20	0.97
10	0.39	0.50	1.08	1.23	0.95
11	0.40	0.53	1.08	1.20	1.02
12	0.39	0.51	1.11	1.23	0.97
13	0.35	0.49	1.08	1.10	0.95
14	0.40	0.53	1.10	1.21	1.01
15	0.37	0.48	1.04	1.16	0.91
16	0.39	0.50	1.08	1.23	0.95
$\bar{X}$	0.37	0.50	1.07	1.17	0.96
S	0.03	0.02	0.02	0.06	0.03
%cv	6.9	3.5	1.9	5.4	3.3

Table 62. Fibrograph Data for Georgia Tech Bale Stock Blended by Two Passes Through the "UT" Opener at 1200 rpms.

1200 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.38	0.50	1.04	1.11	0.95
2	0.43	0.54	1.04	1.27	1.03
3	0.37	0.49	1.03	1.13	0.94
4	0.38	0.51	1.05	1.14	0.98
5	0.42	0.54	1.06	1.24	1.03
6	0.43	0.54	1.04	1.27	1.03
7	0.42	0.52	1.05	1.30	0.98
8	0.35	0.46	1.03	1.12	0.88
9	0.40	0.52	1.07	1.21	0.99
10	0.37	0.49	1.05	1.15	0.94
11	0.40	0.50	1.06	1.27	0.94
12	0.38	0.50	1.05	1.16	0.95
13	0.37	0.49	1.05	1.15	0.94
14	0.40	0.52	1.06	1.20	0.99
15	0.40	0.50	1.06	1.27	0.94
16	0.42	0.54	1.08	1.25	1.03
$\bar{X}$	0.40	0.51	1.05	1.21	0.97
S	0.02	0.02	0.01	0.06	0.04
%cv	6.2	4.5	1.3	5.1	4.5

Table 63. Fibrograph Data for Georgia Tech Bale Stock Blended by Two Passes Through the "UT" Opener at 1400 rpms.

1400 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.36	0.48	1.04	1.12	0.92
2	0.35	0.47	1.05	1.11	0.90
3	0.37	0.49	1.07	1.16	0.94
4	0.39	0.50	1.05	1.21	0.95
5	0.34	0.47	1.04	1.07	0.91
6	0.36	0.48	1.06	1.14	0.92
7	0.37	0.50	1.07	1.14	0.96
8	0.41	0.53	1.08	1.24	1.01
9	0.42	0.53	1.07	1.28	1.00
10	0.35	0.47	1.05	1.11	0.90
11	0.36	0.48	1.06	1.14	0.92
12	0.38	0.50	1.06	1.17	0.95
13	0.37	0.49	1.04	1.14	0.94
14	0.38	0.49	1.05	1.19	0.93
15	0.38	0.49	1.05	1.19	0.93
16	0.37	0.49	1.05	1.15	0.94
$\bar{X}$	0.37	0.49	1.06	1.16	0.94
S	0.02	0.02	0.01	0.05	0.03
%CV	5.7	3.7	1.2	4.5	3.3

Table 64. Fibrograph Data for Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at 600 rpms.

600 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.40	0.52	1.05	1.20	0.99
2	0.43	0.54	1.04	1.27	1.03
3	0.43	0.53	1.06	1.33	1.00
4	0.45	0.56	1.09	1.35	1.06
5	0.47	0.57	1.07	1.41	1.08
6	0.48	0.58	1.07	1.43	1.10
7	0.39	0.51	1.08	1.20	0.97
8	0.42	0.55	1.08	1.23	1.06
9	0.37	0.49	1.06	1.15	0.94
10	0.41	0.53	1.06	1.22	1.01
11	0.37	0.49	1.05	1.15	0.94
12	0.43	0.53	1.06	1.33	1.00
13	0.42	0.53	1.07	1.28	1.00
14	0.39	0.52	1.05	1.16	1.00
15	0.41	0.53	1.10	1.25	1.01
16	0.40	0.52	1.08	1.22	0.99
$\bar{X}$	0.42	0.53	1.07	1.26	1.01
S	0.03	0.03	0.02	0.09	0.05
%cv	7.6	4.7	1.5	7.0	4.5

Table 65. Fibrograph Data for Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at 800 rpm.

800 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.42	0.52	1.03	1.28	0.98
2	0.38	0.49	1.07	1.20	0.93
3	0.40	0.51	1.08	1.25	0.96
4	0.34	0.46	1.05	1.10	0.89
5	0.40	0.52	1.07	1.21	0.99
6	0.36	0.47	1.03	1.14	0.90
7	0.38	0.50	1.05	1.16	0.95
8	0.37	0.48	1.06	1.18	0.91
9	0.36	0.47	1.02	1.13	0.90
10	0.37	0.48	1.06	1.18	0.91
11	0.35	0.47	1.05	1.11	0.90
12	0.38	0.50	1.06	1.17	0.95
13	0.36	0.49	1.04	1.10	0.94
14	0.37	0.48	1.05	1.17	0.91
15	0.35	0.47	1.03	1.10	0.90
16	0.38	0.50	1.05	1.16	0.95
$\bar{X}$	0.37	0.49	1.05	1.17	0.93
S	0.02	0.02	0.02	0.05	0.03
%cv	5.6	3.8	1.6	4.5	3.4

Table 66. Fibrograph Data for Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at 1000 rpms.

1000 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.38	0.50	1.06	1.17	0.95
2	0.39	0.51	1.05	1.18	0.97
3	0.40	0.52	1.08	1.22	0.99
4	0.39	0.51	1.05	1.18	0.97
5	0.37	0.49	1.04	1.14	0.94
6	0.37	0.50	1.07	1.14	0.96
7	0.40	0.53	1.07	1.20	0.99
8	0.40	0.52	1.05	1.20	0.99
9	0.38	0.49	1.06	1.20	0.93
10	0.38	0.50	1.08	1.19	0.95
11	0.40	0.51	1.07	1.24	0.96
12	0.37	0.49	1.04	1.14	0.94
13	0.37	0.50	1.07	1.14	0.96
14	0.39	0.51	1.05	1.18	0.97
15	0.40	0.52	1.08	1.22	0.99
16	0.39	0.50	1.07	1.22	0.95
$\bar{X}$	0.39	0.51	1.06	1.19	0.96
S	0.01	0.01	0.01	0.03	0.02
%cv	3.1	2.4	1.3	2.7	2.0

Table 67. Fibrograph Data for Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at 1200 rpms.

1200 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.35	0.46	1.05	1.14	0.88
2	0.36	0.49	1.09	1.14	0.94
3	0.37	0.50	1.07	1.14	0.96
4	0.37	0.49	1.07	1.16	0.94
5	0.39	0.51	1.06	1.19	0.97
6	0.36	0.48	1.04	1.12	0.92
7	0.36	0.50	1.07	1.11	0.97
8	0.37	0.50	1.08	1.15	0.96
9	0.38	0.50	1.10	1.20	0.96
10	0.39	0.50	1.09	1.24	0.95
11	0.42	0.55	1.12	1.26	1.05
12	0.37	0.49	1.07	1.16	0.94
13	0.37	0.49	1.09	1.18	0.94
14	0.36	0.48	1.07	1.15	0.92
15	0.37	0.50	1.09	1.16	0.96
16	0.36	0.47	1.06	1.16	0.90
$\bar{X}$	0.37	0.49	1.08	1.17	0.95
S	0.02	0.02	0.02	0.04	0.04
%cv	4.5	4.0	1.9	3.4	3.9

Table 68. Fibrograph Data for Georgia Tech Bale Stock Blended by Four Passes Through the "UT" Opener at 800 rpms.

800 rpm

Sample Number	66.7% Span Length	50.0% Span Length	2.5% Span Length	Upper Quartile Length	Mean Length
1	0.36	0.48	1.06	1.14	0.92
2	0.38	0.50	1.05	1.16	0.95
3	0.37	0.49	1.09	1.18	0.94
4	0.37	0.49	1.09	1.18	0.94
5	0.39	0.50	1.10	1.25	0.95
6	0.38	0.50	1.11	1.21	0.96
7	0.36	0.48	1.07	1.15	0.92
8	0.35	0.47	1.08	1.14	0.91
9	0.35	0.48	1.06	1.10	0.93
10	0.38	0.50	1.06	1.17	0.95
11	0.39	0.50	1.10	1.25	0.95
12	0.36	0.48	1.07	1.15	0.92
13	0.38	0.50	1.10	1.20	0.96
14	0.37	0.48	1.06	1.18	0.91
15	0.40	0.51	1.08	1.25	0.96
16	0.38	0.50	1.08	1.19	0.95
$\bar{X}$				1.18	0.94
S				0.04	0.02
%cv				3.7	1.9

Table 69. Uniformity Ratio of Georgia Tech Bale Stock Blended by Two Passes Through the "UT" Opener at Different rpms

Sample Number	600 rpm	1000 rpm	1200 rpm	1400 rpm
1	49.1	46.7	48.1	46.2
2	47.7	48.1	51.9	44.8
3	52.3	46.2	47.6	45.8
4	45.9	47.6	48.6	47.6
5	46.7	46.8	50.9	45.2
6	44.9	48.1	51.9	45.3
7	47.2	45.8	49.5	46.7
8	47.6	43.4	44.7	49.5
9	46.3	47.2	48.6	49.5
10	50.9	46.3	46.7	44.8
11	47.7	49.1	47.2	45.3
12	45.5	45.9	47.6	47.2
13	47.7	45.4	46.7	47.1
14	51.8	48.2	49.1	46.7
15	48.6	46.2	47.2	46.7
16	50.0	46.3	50.0	46.7
$\bar{X}$	48.1	46.7	48.5	46.6
S	2.2	1.4	2.0	1.4
%cv	4.6	2.9	4.1	3.1

Table 70. Uniformity Ratio of Georgia Tech Bale Stock Blended by Three Passes Through the "UT" Opener at Different rpms.

Sample Number	600 rpm	800 rpm	1000 rpm	1200 rpm
1	49.5	50.5	47.2	43.8
2	50.9	45.8	48.6	45.0
3	50.8	47.2	48.1	46.7
4	51.4	43.8	48.6	45.8
5	53.3	48.6	47.1	48.1
6	54.2	45.6	46.7	46.2
7	47.2	47.6	49.5	46.7
8	50.9	45.3	49.5	46.3
9	46.2	46.1	46.2	45.5
10	50.0	45.3	46.3	45.9
11	46.7	44.8	47.7	49.1
12	50.0	47.2	47.1	45.8
13	49.5	47.1	46.7	45.0
14	49.5	45.7	48.6	44.9
15	48.2	45.6	48.1	45.9
16	48.1	47.6	46.7	44.3
$\bar{X}$	49.8	46.5	47.7	45.9
S	2.2	1.6	1.1	1.3
%cv	4.4	3.5	2.2	2.9

Table 71. Uniformity Ratio of Georgia Tech Bale Stock Blended by Four Passes Through the "UT" Opener at 800 rpms.

Sample Number	800 rpm
1	45.3
2	47.6
3	45.0
4	45.0
5	45.5
6	45.0
7	44.9
8	43.5
9	45.3
10	47.2
11	45.5
12	44.9
13	45.5
14	45.3
15	47.2
16	46.3
$\bar{X}$	45.6
S	1.0
%cv	2.3

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