TECHNICAL BULLETIN

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SUEDING OF COTTON FABRICS

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INTRODUCTION

Cotton fabrics are valued for their many outstanding attributes, including their natural softness which improves with wear and age as they are "broken-in". This ability to age gracefully makes cotton the fabric of choice for the enlightened consumer. However, when a super soft, broken-in hand is desired for a brand new fabric, it can be produced by a mechanical finishing process known as sueding or sanding. Sueding can also be used to create a visible pile effect on the surface of a fabric. The purpose of this technical bulletin is to provide general technical information on the process of sueding as it applies to cotton fabrics, both knit and woven.

Cotton Incorporated has developed a wide variety of sueded fabric samples with excellent appearance and performance characteristics. Samples of these developments can be requested from any Cotton Incorporated representative.

DEFINITION OF SUEDING

Sueding is a mechanical finishing process in which a fabric is abraded on one or both sides to raise or create a fibrous surface. This fibrous surface improves the fabric appearance, gives the fabric a softer, fuller hand, and can mask fabric construction and subdue coloration. These improved aesthetics can increase the value of a fabric in the marketplace.

In the textile industry, the process of sueding is also commonly known as "sanding" or "emerizing".

SINGLE CYLINDER VERSUS MULTI-CYLINDER SUEDERS

A wide variety of sueding equipment is available from machinery manufacturers throughout the world, and no two models are exactly alike. But basically, these machines fall into two categories - multi-cylinder and single cylinder sueding machines.

The multi-cylinder sueder has two or more abrasive covered rolls rotating with and/or against the flow of material. To create abrasive action on the fabric surface, the fabric wraps over a segment of the rotating abrasive roll. A variable amount of tension is applied to the fabric to engage the abrasive action, and once this action has begun, the pull of the abrasive as it works on the fabric surface adds to the overall fabric tension generated. Control and regulation of the amount of overall fabric tension is an important consideration in multi-cylinder sueding machine design.

Single cylinder sueders, as their name indicates, have a single abrasive covered roll. Rather than using tension to create abrasive action, the single cylinder sueder uses a back-up roll to support the fabric at the point of contact with the abrasive roll. In sueding, the pile is created as the fabric passes through a gap between the rotating abrasive roll and the resilient back-up roll. Since the fabric is held in contact with the back-up roll, inches away from where the abrasive action takes place, very little tension is induced. Also, since the sueding action takes place on a fine line, little or no fabric tension is created by the abrasive action.

HISTORY OF SUEDING

Before the Industrial Revolution brought mechanization to the textile industry, surface finishing, or "raising", as it was then called, was a hand labor operation. Teasels, which are the bristly flower heads of the *Dipsacus fullonum* plant, were arranged on a workboard. This "tool" was passed back and forth across the fabric surface to create a pile. This labor-intensive process was slow and tedious, and results were often inconsistent.

In an early effort to mechanize the process of surface finishing, a machine was developed with a large diameter cylinder to which rows of teasels were affixed. As the cylinder rotated slowly, the fabric surface was exposed to a small segment of the teasel cylinder. The length of fabric being processed was sewn into a continuous circle, and on the next pass, a machine adjustment allowed greater cylinder exposure. With each pass, cylinder exposure was increased, creating a deeper pile.

Later, the art of "raising" was advanced when cardcloth replaced teasels. Several cardcloth covered cylinders rotated with and against the flow of material to create the desired surface effect.

Finally, coated abrasive technology furnished the current alternative. Both economical and efficient, coated abrasives made modern sueding machines feasible and practical.

The multi-cylinder sueding machine is a direct descendant of the early raising machines, while the single cylinder sueder is a descendant of a buffing machine used in the leather industry. This buffing machine was used to create a soft nap on the surface of a skin. The soft garment leather produced from buffing was called "suede", a reference to Sweden, where it originated. The transition from a leather buffing machine to a fabric sueder took many years and required so many innovations that the entire machine and process were patented.

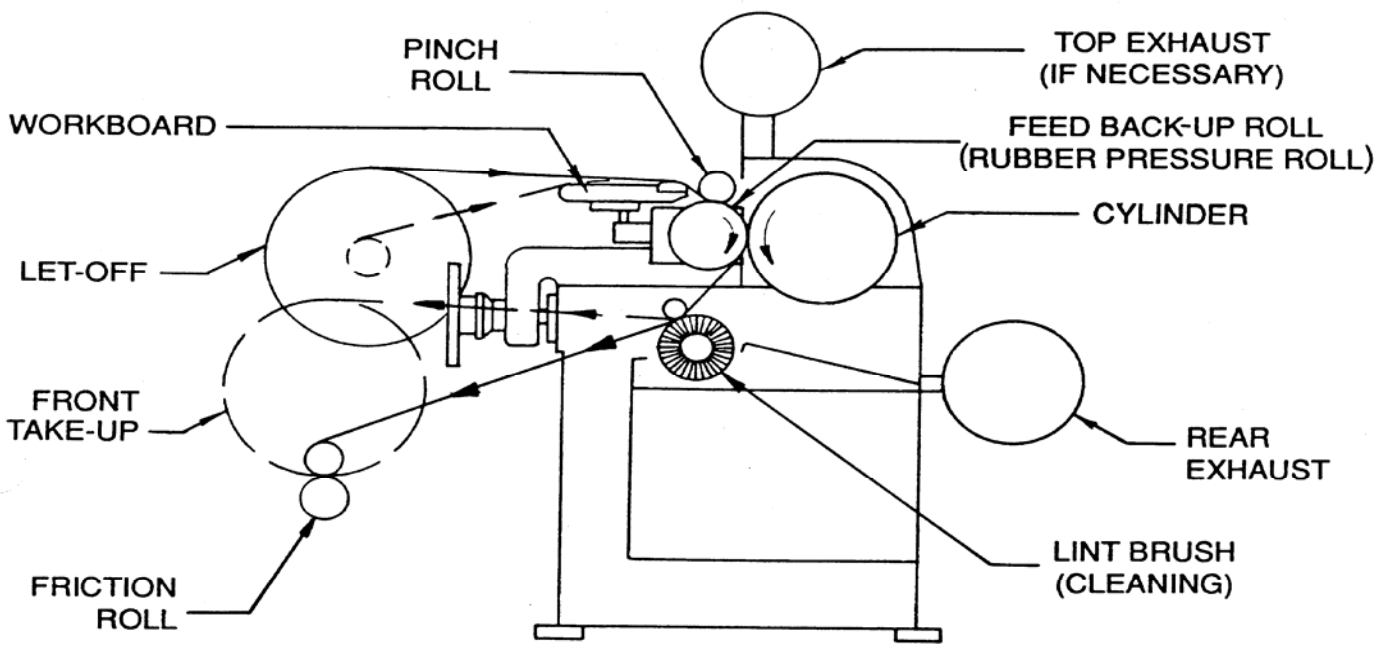
MACHINE DESIGN - SINGLE CYLINDER SUEDERS

With a single cylinder sueder, sueding takes place when the fabric passes between the abrasive covered roll and the feed back-up roll. The opening is adjustable to within 1/10,000th of an inch on contemporary machine models. Designing a machine with such accuracy requires close tolerance manufacturing and a method of maintaining this accuracy under operating conditions in a textile mill.

At a typical contemporary workstation, the sueder provides a digital readout of the work gap in increments of 0.0001 inches. The operator also has a reading of power draw on the cylinder motor, which translates directly into sueding pressure on the fabric. In addition, readouts on feed rate and cylinder temperature provide necessary information feedback. Precise control of the back-up feed roll for adjusting suede results or passing seams, and the ability to regenerate parallelism in the feed roll/abrasive cylinder relationship provide the safeguards required in high production plants.

NOTE: Because all machine settings are based on thickness control, fabric thickness must be identified in 0.001 inch increments. A gauge is furnished with each machine for this purpose. Once the fabric thickness is established, gap settings and sueding pressure requirements can be set.

Single Cylinder Sueding Machine Schematic



Source: Curtin-Hebert Company, Inc.

The main components of a single roll sueder are as follows:

1. Cylinder - an extremely accurate, balanced roll which is covered with coated abrasives (sandpaper), secured to the expanding cylinder ends using special clamps.

2. Feed Back-Up Roll - a rubber covered roll, adjustable in relation to the above cylinder, and controlled by a variable rate motor.

3. Pinch Roll - holds fabric securely to the feed roll as abrading action takes place.

Other components:

Oscillation - provides horizontal movement to the cylinder to avoid abrasive grit pattern.

Rotary Unions - permit water circulation inside the cylinder for temperature uniformity.

Lint Brush - removes lint after sueding.

Optional Equipment:

Exhaust Systems

Let-off & Take-up

Water Temperature Control Unit

Anti-Static Bars

Uncurlers (in-feed)

Air Knife (to clean abrasive cover)

MACHINE VARIABLES - SINGLE CYLINDER SUEDERS

Variables which can affect the performance of a single cylinder sueder include the following:

1. Speed of abrasive cylinder:

   The fastest speeds have the most aggressive cutting action. As cutting action is increased, a shorter pile is produced. Slower cylinder speeds create a combing or raking effect, usually producing a deeper pile.

2. Size and type of abrasive:

   Coarse abrasives are more aggressive, and can be used to break the surface of dense materials or to cut projected loops. Usually, 80 grit is the coarsest abrasive used. Finer grit abrasives (280-400 grit) produce finer suedes.

3. Rate of feed:

   Normally the above two variables determine the rate of feed used. A slower feed rate permits more abrasive action at the point of contact.

4. "Nip" or opening between abrasive cylinder and feed back-up roll:

   As the opening is decreased (smaller than the material thickness passing through), abrasive penetration into the fabric is increased.

5. Feed back-up roll hardness:

   This roll is covered with rubber. A soft rubber is more resilient and will absorb fabric defects more readily than a hard rubber. However, with a soft rubber, more pressure is required than when a hard rubber is used.

The hardness or softness of rubber is measured on a durometer scale. A 25 durometer covered roll is soft to the touch; a 60 durometer covered roll is hard. For fabric sueding, the most commonly used durometer range is between 25 and 35.

A soft-covered feed back-up roll has a resilience which can modify the abrasive action during sueding. When used in conjunction with a fine abrasive grit on the cylinder, fabric defects will be better tolerated than when a harder back-up roll is used. A faster feed rate can also improve the tolerance of fabric defects. A hard feed back-up roll (35-45 durometer) can be helpful in producing a short, dense suede. The support of a hard back-up roll maximizes grinding action of the abrasive.

The feed back-up roll can be engraved or decorated with appliques to produce a pattern on the fabric being sueded. The back-up roll is adjusted to present only the pattern to abrasive action. If this is done before dyeing, the sueded pattern area usually takes a deeper hue.

TROUBLESHOOTING - SINGLE CYLINDER SUEDERS

Chatter/Shadows

The source of chatter or shadows can originate from any of four general areas:

1. Abrasive

   The abrasive cover must be applied properly, or the leading edge will mark as it rotates. If the abrasive cover was not slit, the leading edge may have a build-up of grit and be over tolerance. When manufactured, coated abrasives are made in large rolls 50" wide. Abrasive grain is added to the paper or fiber base using an electro-static method that could cause a build-up of abrasive along the edges. This uneven condition would destroy the accuracy required in sueding. All single roll sueders use a 24" wide abrasive cover, which allows the slitting of a 24" strip from each side of the 50" width. When both edges are slit, an acceptable tolerance is maintained.

   If an abrasive grit which is too fine is used, it may bounce off the fabric instead of penetrating it. The same result may occur if the sueding pressure is insufficient. Also, a fully worn abrasive may not be able to cut the fibers cleanly, causing skipping or chatter.

   If the backing of a coated abrasive cover is left exposed to humidity or moisture, it will warp. A warped cover may not lay flat on the cylinder, and chatter could result. The care of abrasives is covered in detail in a later section.

2. Machine

   If the sueding machine itself is the source of chatter on a fabric, the probable cause is vibration. The vibration could be caused by:

   -Mis-matched clamp sets on the cylinder

-Damaged cylinder (out-of-round caused by wrap-up)
-Faulty cylinder bearings
-Tension from let-off and wind-up overriding the pinch roll control of fabric feed
-Stability of the machine on the floor
-Improper lint brush settings

3. Fabric

Defects in the fabric construction, especially in the filling direction, may give the appearance of chatter, but this only reflects the variation in fabric surface or thickness caused by the defect.

4. Ambient Conditions

This includes conditions in the shop not related directly to the machine but which may cause chatter, such as vibrations from outside sources or an exhaust system which affects the sueder.

Seams

Seams are only a problem when the operator allows a seam to enter the sanding area without opening the back-up roll gap momentarily. The precise nature of a single roll sueding machine dictates that it cannot discriminate the thickness of a seam from the nominal fabric thickness. The fabric will be levelled to the nominal thickness, causing a break in the fabric. The disconnected end will wrap itself around the cylinder, which can result in severe damage to the machine and fabric.

An experienced operator avoids wrap-ups and loses only a few inches on each side of the seam. Automatic seam detectors have been developed but are not infallible.

Edge-to-Edge Shading

The feed back-up roll must be parallel to the abrasive covered cylinder. Edge-to-edge shading indicates that this parallel is faulty. To correct this condition, the back-up roll carriage can be adjusted on either side. Under circumstances of roll damage or taper, it may be necessary to re-grind the back-up roll.

Loss of Strength

Producing a suede always causes a loss of fabric strength, and fabric design must accommodate this factor. Frequently, loss of strength can be minimized by using a finer abrasive grit, running at a faster feed rate, or by reducing sueding pressure.

Holes in Fabric

As with seams, the sueder cannot discriminate in thickness determinations. Knots and slubs in a fabric are sanded to the nominal thickness. For this reason, spliced yarns which are fairly even should be used in fabrics which will be sueded on a single roll sueder. Also, a softer rubber covering on the back-up roll offers some solution to this problem.

Short Abrasive Life

Abrasive life can vary according to the fabric and abrasive force used. Occasionally, a fine abrasive will "load up" or have its abrasive grain coated over by some ingredient in the fabric. The use of a different size abrasive or type of grain may be indicated (see the section on ABRASIVES for more information).

DATA COLLECTION - SINGLE CYLINDER SUEDERS

To fully utilize the capabilities of the single cylinder sueder, data from each suede run should be recorded. This information should include:

-Date/specifics of last calibration
-Abrasive used (size grain, type)
-Cylinder speed
-Feed rate
-Size of opening between cylinder and back-up roll
-Hardness durometer of the back-up roll
-Power drain on the abrasive cylinder
-Fabric thickness
-Fabric construction details, including fiber content
-Fabric pre-treatment (softeners, moisture content)
-Previous operations (scouring, dyeing) which might affect suede results

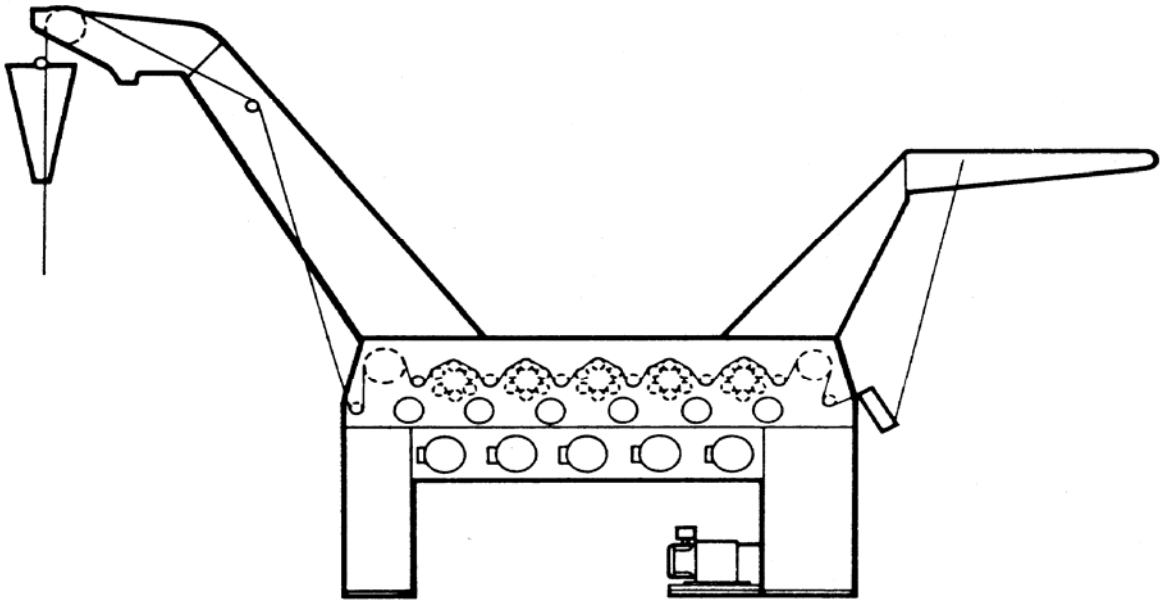
Using all of this information, a data bank can be created to improve the likelihood of creating or duplicating a successful suede. The effect of a change in one variable on the suede results of a particular fabric can give an insight into the probable effect on other fabrics.

MACHINE DESIGN - MULTI-CYLINDER SUEDERS

To raise a pile on fabric, the multi-roll sueder relies on tension to allow the abrasive to penetrate the fabric surface. The use of several (usually five) abrasive rolls to perform this task reduces the amount of tension by spreading the work over several rolls. Each roll is independently driven, and can be rotated in a clockwise or counterclockwise direction. Adjustable idler rolls between the abrasive rolls control the slack in the fabric between rolls. Entry and exit drive rolls transport the fabric and control tension.

Cylinder construction varies in accordance with the machinery manufacturer. For example, there are abrasive covered cylindrical rolls, fluted cylindrical rolls with the high portion of the flutes covered with abrasive material, and cylinders consisting of abrasive covered tubes mounted around the periphery of the cylinder shaft. The tubes are mounted six to a cylinder, and a segment of each abrasive tube is exposed to provide the sanding action. As the abrasive grit on the tubes becomes dull, they can be rotated to present a fresh abrasive surface. The principle of exposing the fabric to more than one abrasive action area permits the use of a finer grain abrasive.

Multi-Cylinder Sueding Machine Schematic



Source: Gessner Company

MACHINE VARIABLES - MULTI-CYLINDER SUEDERS

On a multi-cylinder sueder, there are only a few variables which can be altered to change suede results. In regard to abrasive selection, once a machine has been equipped with abrasive covered tubes of a particular grit, the expense and time required for a change can be considerable. Also, since a narrow range of abrasive grit sizes is used in most applications, the effect of a change would probably be minimal.

Other variables which can be altered include the number of abrasive rolls employed, the feed rate, the amount of tension applied, and the direction of rotation of the abrasive rolls.

TROUBLESHOOTING - MULTI-CYLINDER SUEDERS

Seams

Normally, properly made seams will pass through the multi-cylinder sueder without incident. But if the seams were not sewn to protect the connecting thread, or if they are too bulky, then they must be passed by releasing tension or by stopping the abrasive rolls.

Excessive Loss of Width

Tension must be regulated to prevent excessive draw-down, or loss of width.

DATA COLLECTION - MULTI-CYLINDER SUEDERS

Since the number of variables for multi-cylinder sueders is small, data collection is simplified. Detailed fabric construction information, as well as prior processing or chemical treatment information, should be recorded. Machine variables which should be recorded include abrasive type and size, the number of abrasive rolls used, direction of rotation of the rolls, the feed rate, and the amount of tension. All of this information can be used to establish a data bank for future reference.

SUEDING MACHINE INSTALLATION AND OPERATOR TRAINING

The first sueding machine installation at a particular site should be done by a factory representative. The representative can insure proper adjustment and operation of the equipment, and can assist with operator training, interpretation of the manuals, and the establishment of safe operating practices. Also, the representative provides a "hot line" contact for any questions or problems which may arise.

Complete instructions on foundation, erection of the machine, assembly of the abrasive, etc. are generally included in the manufacturer's manuals furnished with the sueding equipment.

FABRIC SELECTION AND DESIGN

With the exception of very fine materials (under 0.007" thickness), where loss of strength may be a factor, almost any cotton fabric can be sueded. Circular knits, warp knits, denims, twills, and plain weaves are some indication of the range of fabrics which can be sueded successfully. But to achieve the best results, fabrics should be designed and developed with consideration given to the ultimate effect that the sueding process will have on fabric appearance and performance.

When fabrics are sueded, there is normally a loss in fabric strength. As fibers are raised to the fabric surface, the strength these fibers would have contributed to the overall strength of the fabric construction is lost. Naturally, strength losses increase in direct proportion to the amount of pile created. Fabrics must be designed with adequate strength to compensate for the inevitable strength reduction after sueding.

Both the single cylinder and multi-cylinder sueders are capable of successfully processing a wide variety of sueded cotton products, but in some cases, one machine may be more effective than the other. For example, a fabric with knots or slubs, or one that has selvages which are thicker than the body of the fabric, is more susceptible to damage on a single cylinder sueder. Knot holes or over-sueded, weak selvages may occur. On certain styles, a non-directional pile may be desired, and the multi-cylinder sueder can be operated with the cylinders rotating in opposing directions, eliminating the directional effect. On the other hand, fabrics with yarn loops on the face which must

be broken, and extremely difficult styles which require shaving of the fabric surface to develop an effect, are better handled by the single roll sueder.

Special effects can be created by designing fabrics for sueding with high and low areas, such as satin stripes, bedford cords, and cavalry twills. The raised areas will have a heavier sueded effect than the low areas. If these fabrics are dyed after sueding, the raised areas will dye darker, creating a tonal effect.

Sueding can be done before or after a fabric is dyed, but either way, the shade will be affected. Sueding after a fabric is dyed will generally lighten the color, sometimes giving the fabric a frosted appearance. A fabric which is dyed after sueding will generally dye darker than the same fabric which has not been sueded.

ABRASIVES

General Information

Coated abrasives (sandpaper) are an important grinding tool for many industries, and are made in a multitude of different forms for special applications. There are three components of coated abrasives:

1. The Mineral Abrasive or Grain

   Aluminum oxide and silicon carbide are the two synthetic materials used, and of the two, aluminum oxide is favored. Brownish in color, as it wears, its edges become rounded. Silicon carbide is black in color, and as hard as aluminum oxide; however, as it wears, its grain fractures.

2. The Backing

   A paper based material is used for coated abrasive backing. Information on the type of grain used, size of the grain, and the weight of the paper backing is typically printed on the back of the paper. Two weights are common for surface finishing-"E" weight has a lighter paper back, and "F" weight is approximately 0.005" thicker and heavier.

3. The Bonding Agent

   The principal bonding agent is a heat-resistant resin glue. Two bonding coats hold the grain to the backing.

Sueding with Abrasives

Abrasives are graded by size of the abrasive grain. An abrasive with the designation "220 grit E" means that the abrasive grain was screened through a mesh with 220 openings per square inch on a backing of "E" weight paper. Because each grain size has a different thickness, and each backing is also different, it is essential that when an abrasive cover is changed, the sueder must be re-calibrated.

The FEPA, Federation of European Producers Association, employs different mineral grading standards than the United States. They are identified with a letter "P" preceding the grain size number (a chart follows).

Abrasive Life and Costs

The average life of an abrasive cover depends upon the application. For denims requiring a coarse abrasive, 5000 yards is not unusual. Because abrasive grain wear is gradual, the run of suede through the abrasive will dictate when a change is necessary. When the quality of suede begins to deviate from the standard, a change is necessary. In many finishing plants, the abrasive cover is changed with each change in shift operator so that quality control can be delegated to the current operator.

Overall, costs of abrasive are only a small factor per yard of finished material.

Source of Supply

The sueding equipment manufacturer is the best source of information on abrasive supply. Once a supply has been procured, care and storage requirements must be observed.

Care and Storage of Abrasives

Coated abrasive products are affected by humid conditions as the backings are hygroscopic. If allowed to absorb excess moisture, they will expand, distorting the grain side. A distorted abrasive cover is difficult to apply properly on a sueder cylinder. Ideal storage conditions call for a humidity level of 35-50%.

Edge damage of abrasive rolls and covers could render them useless. Whenever possible, rolls and covers should be left in their original packing until used.

Of all the variables present in the sueding process, the abrasive used has the greatest influence on the final product.

GRIT COMPARISON CHART
U.S. AND FEDERATION OF EUROPEAN PRODUCERS ASSOCIATION

MESH NUMBERS	
U.S.	FEPA "P" GRADES
GRIT SIZE	
600	P1200
500	P1000
400	P800
	P600
360	
	P500
320	P400
	P360
280	
	P320
240	P280
	P240
220	P220
180	P180
150	P150
120	P120
100	P100
80	P80
60	P60
50	P50
40	P40

APPROXIMATE THICKNESS OF ABRASIVE COVERS ("E" WEIGHT BACKING - FOR "F" WEIGHT ADD 0.005")

SYMBOL NUMBERS	GRIT NUMBERS	THICKNESS
10/0	400	0.013"
9/0	320	0.014"
8/0	280	0.015"
7/0	240	0.016"
6/0	220	0.018"
5/0	180	0.020"
4/0	150	0.022"
3/0	120	0.025"
2/0	100	0.028"
0	80	0.033"
½	60	0.039"
1	50	0.045"
1½	40	0.049"
2	36	0.056"
2½	30	0.062"
3	24	0.065"
3½	20	0.085"

RESEARCH AND TECHNICAL SERVICES

Cotton Incorporated is a research and promotion company representing cotton worldwide. Through research and technical services, our company has the capability to develop, evaluate, and then commercialize the latest technology to benefit cotton.

- Agricultural research leads to improved agronomic practices, pest control, and fiber variants with properties required by the most modern textile processes and consumer preferences. Ginning development provides efficient and effective machines for preservation of fiber characteristics. Cottonseed value is enhanced with biotechnology research to improve nutritional qualities and expand the animal food market.

- Research in fiber quality leads to improved fiber testing methodology and seasonal fiber analyses to bring better value both to growers and then mill customers.

- Computerized fiber management techniques result from in-depth fiber processing research.

- Product Development and Implementation operates programs leading to the commercialization of new finishes and improved energy and water conserving dyeing and finishing systems. New cotton fabrics are engineered -- wovens, circular knits, warp knits, and nonwovens -- that meet today's standards for performance.

- Technology Implementation provides comprehensive and customized professional assistance to the cotton industry and its customers -- textile mills and manufacturers.

- A fiber-to-yarn pilot spinning center allows full exploration of alternative methods of producing yarn for various products from cotton with specific fiber profiles.

- The Company operates its own dyeing and finishing laboratory, knitting laboratory, and a laboratory for physical testing of yarn, fabric, and fiber properties including High Volume Instrument testing capable of measuring micronaire, staple length, strength, uniformity, color, and trash content.

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