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EFFECTS OF LIGHT AND HEAT AGING ON SELECTED QUILTING PRODUCTS CONTAINING ADHESIVES

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JANET EVENSON AND PATRICIA COX CREWS

ABSTRACT—No published results concerning the long-term performance of adhesive-containing commercial products are available to quilt makers. Consequently, they cannot make informed choices. The purpose of this study was to carry out accelerated light and heat aging on selected quilt basting sprays, fusible webs, and fusible battings to determine whether or not they contribute to discoloration or degradation over time. Selected products were exposed to 40 or 80 AATCC Fading Units of light exposure and 6 or 36 hours of heat aging. Following light exposure and heat aging, changes in color, strength and stiffness were measured. Results of this research show that fusible battings are the only commercial product acceptable for quilts intended as heirlooms or for museum collections. All adhesive sprays except one were associated with significant yellowing or strength losses following both shorter and longer periods of light exposure and heat aging. Selected fusible webs are acceptable for quilts intended to last for a lifetime (less than 100 years) but are not recommended for quilts intended as heirlooms or art quilts offered for sale to collectors or museums. Museum curators and most knowledgeable collectors do not want to pay thousands of dollars for a quilt that has a life span of less than 100 years, and possibly only 20 to 50 years.

TITULO—INFLUENCIAS DEL ENVEJECIMIENTO Y EXPOSICIÓN A LA LUZ SOBRE LOS NUEVOS MATERIALES DE RELLENO INCORPORADOS EN LAS COLCHAS (*QUILTS*) CONTENPORÁNEAS. RESUMEN—El objetivo de este estudio es determinar si ciertos materiales de acolchado contemporáneo, particularmente *sprays* para hilvanar y tejidos y rellenos fusionables, contribuyen a la degradación o decoloración de las telas de las colchas a lo largo del tiempo, ya que los efectos a largo plazo de estos químicos son desconocidos. Los adhesivos temporales para hilvanar, así como los tejidos y rellenos fusionables son evaluados debido a los cambios en el amarillamiento, en la resistencia a la ruptura y en la rigidez que se producen luego de exponerlos a un acelerado proceso de envejecimiento y exposición a la luz. El envejecimiento acelerado simulando el envejecimiento natural se está realizando de acuerdo al AATCC 26-1999: Envejecimiento Acelerado de Textiles Teñidos por Sulfuro. Para ellos se está usando un horno VWR de aire forzado, modelo 1350M. La exposición solar a través de un vidrio se simulará por medio de una luz artificial con un Atlas Xenon-Arc Weather-Ometer. Para simular la exposición a la luz-día detrás de un vidrio se usará AATCC 16-1998: Luz para Decolorar, Opción E, usando un filtro de bicarbonato de soda. El índice de amarillamiento (envejecimiento) se medirá con un espectrofotómetro HunterLab UltraScan XE, antes y después del tratamiento especificado o de la combinación del tratamiento de envejecimiento y exposición a la luz. Se evaluarán los cambios en la resistencia a la ruptura de los conjuntos textiles (tejidos y rellenos), incorporando los *sprays* de hilván y los tejidos y rellenos fusionables. Se medirán los cambios en la resistencia de las urdimbres usando el modelo 4444 Instron de prueba simple de materiales, según ASTM D5035-95: Método de Prueba Estándar para Resistencia y Elongación Textil. Para determinar los cambios en la dureza o rigidez del textil que sigue a la exposición a la luz y envejecimiento acelerado, se usará un ASTM D1388-96: Método de Prueba Estándar de Rigidez

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Textil, prueba de cantilever o "modillón." Para medir la longitud de torsión del espécimen se usará un Drape-Flex Stiffness Tester. Esta investigación está en marcha, pero esperamos para Marzo de 2003 tener completa la recolección de datos. Los resultados prometen ser de utilidad para los profesionales que trabajan en museos. Estos proporcionarán una información de base científica muy útil para evaluar los desafíos y costos asociados que tendrán que enfrentar los conservadores, a medida que las actuales colchas que contienen estos innovadores materiales ya están siendo agregadas a las colecciones del próximo siglo.

1. INTRODUCTION

A quilt maker's choice of materials – including fabric, batting, thread and other components – influences the life span of the object. It is disappointing, and sometimes devastating, when components prematurely yellow, stiffen, or weaken with age. This is true for individual quilt makers and their families, as well as for serious collectors or museum curators who may spend thousands of dollars on art quilts for their collections.

Conservators and conservation scientists (Down 1984 and 1986; Horie 1987; Down et al. 1996; Tímár-Balázsy and Eastop 1998) have evaluated archival-quality adhesives and identified ones acceptable for use in conservation treatments. Unfortunately, no published results concerning the long-term performance of adhesive-containing commercial products are available to quilt makers and home sewers or to discerning collectors and curators. Consequently, they cannot not make informed choices. Textile scientists and conservators are, however, aware of these commercially available products and have expressed concerns about them. The conservation science literature is filled with reports about the deleterious effects of adhesives on paper and textiles (Himmelstein and Appelbaum 1977; Feller and Encke 1982; Smith 1983; Masschelein-Kleiner and Bergiers 1984; Feller 1994; Down et al. 1996; Tímár-Balázsy and Eastop 1998).

The purpose of this study was to carry out light and heat aging tests on three types of adhesives used in quilting. Products tested included three quilt basting sprays: Sullivans, Sulky KK2000, and Spray & Fix 505; three fusible webs: Stitch Witchery, Wonder-Under and HeatnBond; and three fusible battings: Stearns Mountain Mist White Gold (cotton), Hobbs Heirloom (cotton/polyester blend), and June Tailor low loft (polyester). The goal was to determine whether the selected adhesive-containing commercial products contribute to discoloration or promote degradation of fabrics over time.

2. MATERIALS AND EXPERIMENTAL METHODS

2.1 MATERIALS

Quilt basting sprays have been available for some time and are used to temporarily bond the top and backing layers to the batting in lieu of pin- or hand-basting. The adhesives in these sprays are dissolved in a solvent: when the solvent evaporates it leaves behind the solid adhesive which bonds fabric to batting with pressure. The chemical composition of these quilt basting sprays is proprietary.

Most brands proclaim their adhesives to be colorless, nontoxic, nonstaining, acid-free, and to have little or no odor.

Sulky brand claims "bonding disappears in two to five days." Sullivans' labeling information asserts the bond of their adhesive spray is temporary, repositionable, and can be reactivated with steam. The Spray & Fix label claims that it will not discolor fabric and that the bond dissipates after six months or when laundered. While the adhesive bond may dissipate over time, the adhesive compound will not disappear. In addition, the adhesives may be water-soluble during the first few months after application, as claimed, but it is unlikely that they will remain water-soluble indefinitely. Therefore, unless the quilt is laundered soon after completion, it seems likely that the adhesive spray may eventually cause discoloration of the fabrics.

Fusible webs have been available for more than 30 years and are used for appliqué techniques as well as for "basting" fabric to batting. The adhesives in fusible webs activate when heat is applied, thereby bonding fabric to batting. Stitch Witchery, developed and trademarked in 1969, is a polyamide polymer which patent records describe as a "thermally activatable adhesive in net form" (United States Patent and Trademark Office 1969). Pellon's Wonder-Under is another polyamide polymer commercially available since 1986 (United States Patent and Trademark Office 1987). Polyamide polymers are known to be particularly susceptible to photo-oxidation from ultraviolet light and heat (Smith 1983). HeatnBond, available since 1989, is a mixture of poly(vinyl alcohol) (PVAL) polymers, resin, and a tackifier (Scott 2002). PVAL in its pure form has been used for conservation treatments for many years. However, it is known to stiffen over time.

Fusible battings coated with a heat-activated resin "baste" the fabric to the batting when ironed in place and are another option for eliminating traditional basting. Fusible battings have been around for approximately two years. As with the quilt basting sprays, the adhesive resins used in fusible battings are proprietary.

2.2 EXPERIMENTAL METHODS

The resistance of temporary-bond quilt basting sprays, fusible webs, and fusible battings to light and heat was evaluated in this study. Fabric assemblies were constructed using the three categories of adhesive-containing products and cotton muslin as the top layer and cotton batting as the bottom layer. The two layers were bonded together with each of the quilt basting sprays or fusible webs. Fusible batting fabric assemblies differed from the others in that because adhesive is applied to both surfaces of the batting, the fusible batting was sandwiched between two layers of cotton fabric.

Two sets of controls were prepared without adhesive products. One set contained a top layer of cotton muslin stitched to Hobbs Heirloom bleached cotton nonfusible batting (Control C). This control was used for the quilt basting sprays and the fusible webs. The other set contained a layer of nonfusible batting sandwiched between two layers of cotton muslin and stitched together to provide controls for the fusible battings. Control C2 also

contained Hobbs Heirloom bleached cotton nonfusible batting and Control P2 Mountain Mist 100% polyester nonfusible batting (1). Three replicate sets of materials were prepared and evaluated.

2.3 ADHESIVES ANALYSIS

The University of Nebraska's Department of Chemistry Research Instrumentation Facility was enlisted to identify the chemical classification of the adhesives used in the products being tested. Fourier transform-infrared spectroscopy (FT-IR) was employed to determine the chemical classification of the adhesive sprays. All three quilt basting sprays were identified as poly(vinyl acetate) (PVAC) products. FT-IR spectra of the three showed similar curves (fig. 1). Spectral differences likely are due to differences in additives.

Archival quality PVAC is one of the most light stable of the solvent-based adhesives. In addition, it does not appreciably cross-link or degrade in air and in some formulations remains soluble in an alcohol/water mixture after more than 30 to 40 years (Horie 1987). It has been used in conservation treatments since the 1930s (Himmelstein and Appelbaum 1977; Smith 1983; Horie 1987). Nevertheless, it has a number of negative properties; it is "inflammable, toxic, foul-smelling and expensive since you … throw over half the bulk away by evaporation" (Smith 1983, 49). In addition, PVAC becomes brittle as it ages owing primarily to loss of solvent (Smith 1983).

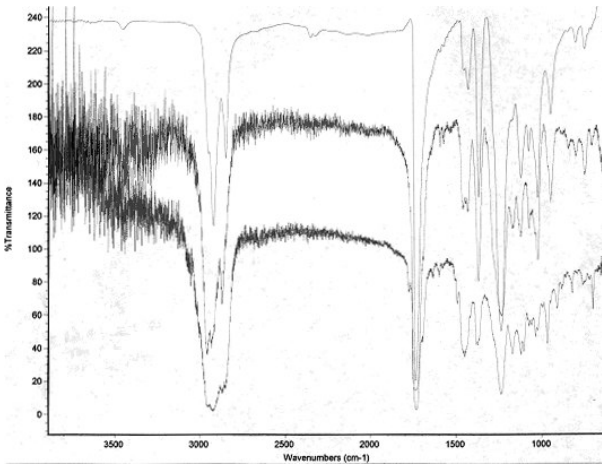

Figure 1. FT-IR spectra of the quilt basting sprays. Top to bottom Spray & Fix, Sulky, Sullivans.

Composition of the thermoplastic polymers comprising the fusible webs was corroborated using fiber solubility tests rather than IR or proton nuclear magnetic resonance (NMR) imagery. American Society of Testing and Materials (ASTM) standards were followed (2). Stitch Witchery and Wonder-Under were identified as polyamide products by the manufacturers; this was corroborated using ASTM fiber identification test procedures. Polyamides have been used in conservation treatments since the 1950s (Horie 1987). They are soluble in a mixture of water and alcohol but become less soluble as they age (Tímár-Balázsy and Eastop 1998) and are especially susceptible to photodegradation (Horie 1987). The manufacturer of HeatnBond described it as a web containing PVAL. PVAL also has been used since the 1950s as "a consolidant for textiles and as a heat-seal adhesive for paper" (Horie 1987, 99). The polymer is water soluble. Pure PVAL has been shown to be stable to ultraviolet/oxygen aging; however, it may become insoluble after light aging (Horie 1987).

Identification of the adhesives used in the fusible battings proved more challenging because they were applied in such a thin layer. NMR spectra revealed that the adhesives used on the fusible battings were similar and all contained peaks indicating the presence of epoxy and possibly ether groups, but each product varied somewhat depending upon additives present (fig. 2). Given the wide range of thermosetting resins available and constraints on resources, it was not possible to determine the exact chemical composition of the adhesives. We speculate that acrylic resins may have been used. Selected acrylic resins are used in thermosetting adhesives and are known to be extremely stable to degradation by heat and light (Horie 1987).

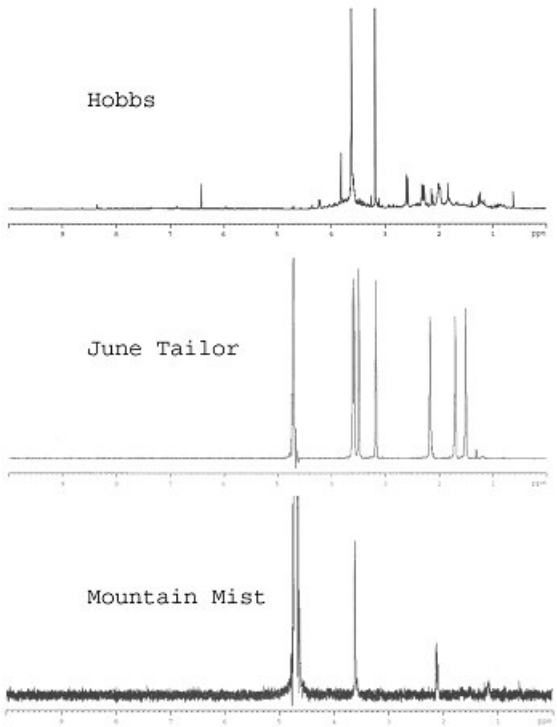

Figure 2. NMR spectra of adhesives in the fusible battings.

2.4 LIGHT EXPOSURE AND HEAT AGING

To determine whether or not quilting materials containing adhesives would yellow, weaken, or stiffen over time, specimens cut from the fabric assemblies were exposed to heat or light aging.

Light aging was conducted according to standards set by the American Association of Textile Chemists and Colorists (AATCC) (3). An Atlas Ci65A Xenon Weather-Ometer with soda lime filter was used to simulate sunlight through window glass. Specimens were exposed to 40 or 80 AATCC Fading Units (AFUs) of light because household textiles are expected to withstand 40 AFUs of accelerated xenon light exposure according to voluntary guidelines. Textiles capable of withstanding 80 AFUs of light without fading exceed most voluntary performance specifications.

Heat aging also was conducted according to AATCC standards (4). Specimens were aged in a VWR forced-air oven, model 1350M, at 135 ± 2°C using water to create steam for 6 or 36 hours because conservation scientists have equated 7 hours of aging at 140°C to a life span of approximately 20 years and 36 hours of aging at 140°C to a 100-year minimum life span, an expected life span for an heirloom (Feller 1994). This AATCC test method was selected as it is a proven protocol for accelerated aging of textiles; the conditions used in this study were similar to those described by Feller (1994) in his aging tests for conservation materials.

2.5 EVALUATION OF COLOR CHANGE, BREAKING STRENGTH, AND STIFFNESS

Following light exposure or heat aging, changes in color, strength, and stiffness were measured. Color change was evaluated using a HunterLab UltraScan XE spectrophotometer according to AATCC standards (5). Total color change (ΔE) was calculated using the CIE 1976 L*a*b* evaluation. Three measurements were performed per specimen. Because there were three replicate specimens, the mean color difference value for each adhesive product represents an average of nine measurements.

Warp breaking strength was measured using an MTS Qtest/10 materials testing system according to ASTM standards (6). Flexural rigidity of the fabric assemblies following light exposure and heat aging also was determined according to ASTM standards (7).

Color difference, percent change in breaking strength, and changes in flexural rigidity were assessed using analysis of variance (ANOVA) procedures. When ANOVA procedures showed that an independent variable had a significant effect, Tukey's post hoc test was performed to ascertain where statistically significant differences in means were located (8).

3. RESULTS AND DISCUSSION

3.1 QUILT BASTING SPRAYS

Results showed that one quilt basting spray yellowed more than the others (table 1). Specimens containing Sullivans' quilt basting spray yellowed significantly more than the control or other quilt basting sprays following both 40 or 80 AFUs of light exposure, as well as following 36 hours of heat aging. On the other hand, Sulky quilt basting spray specimens exhibited significantly greater strength losses (>30% loss) compared to the control (~5% loss) or other quilt basting spray specimens following 40 or 80 AFUs of light exposure and following 6 or 36 hours of heat aging (table 2). Despite the significant discoloration associated with Sullivans' quilt basting spray, it exhibited no more strength loss than the control. Spray & Fix was the only quilt basting spray for which there was no significant difference from the control in terms of yellowing, strength loss, and stiffness.

Except Sulky, all the quilt basting sprays stiffened following light exposure and heat aging but no more than the controls (table 3). Unexpectedly, Sulky specimens exhibited a significant loss of flexural rigidity following 40 AFUs of light exposure. This decrease in stiffness may be due to fiber degradation, as reflected in the significant strength losses Sulky specimens exhibited following light exposure. As light exposure lengthened to 80 AFUs, photo-oxidation-induced changes resulted in a stiffening of Sulky specimens.

The differences observed between quilt basting sprays probably were due to differences in additives (likely the emulsifiers or perfumes) incorporated in the product formulations. Since all three quilt basting sprays were PVAC-based adhesive products and yet they performed quite differently, it is apparent that knowing the basic chemical class of a quilt basting spray (as provided on the product

QUILT BASTING SPRAYS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Color difference (ΔE_{CIELAB})			
Control (C)	0.37A	0.51A	4.09A	10.43A
Sullivans	9.09B	9.93B	6.02A	14.93B
Sulky KK2000	0.90A	0.90A	5.35A	11.07A
Spray & Fix 505	0.53A	0.65A	4.71A	11.03A

Table 1. Mean color difference values for quilt basting sprays following light exposure and heat aging.

NOTE: Control (C) at 0 AFUs was used as the standard for calculating ΔE. Means with the same letter are not significantly different at $p \leq 0.05$.

QUILT BASTING SPRAYS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Breaking strength (% change)			
Control (C)	-5.30A	-8.23A	-1.33AB	-10.03A
Sullivans	-5.33A	-4.53A	+0.23B	-8.10A
Sulky KK2000	-35.37B	-37.63B	-32.23C	-38.00B
Spray & Fix 505	-3.17A	-12.37A	-8.40A	-7.17A

Table 2. Mean percent change in breaking load for quilt basting sprays following light exposure and heat aging.

NOTE: Means with the same letter are not significantly different at $p \leq 0.05$.

QUILT BASTING SPRAYS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Change in flexural rigidity (mg•cm)			
Control (C)	+914C	+727A	+504A	+870B
Sullivans	+1248C	+815A	+594A	+1093B
Sulky KK2000	-737A	+327A	+162A	+60A
Spray & Fix 505	+217B	+528A	+45A	+736B

Table 3. Mean change in flexural rigidity for quilt basting sprays following light exposure and heat aging.

NOTE: + = increase in stiffness. Means with the same letter are not significantly different at $p \leq 0.05$.

label) is insufficient information to make an informed decision. Quilt makers who wish to use a quilt basting spray in a quilt they intend to become an heirloom should select Spray & Fix. Collectors and curators may wish to avoid acquisition of quilts containing these quilt basting sprays. The makers of Sulky and Sullivans may wish to reevaluate and modify their product formulations.

3.2 FUSIBLE WEBS

In general, the fusible webs exhibited no more yellowing, stiffening, or strength losses than the control following 40 AFUs of light exposure or 6 hours of heat aging (table 4). This suggests that fusible webs may perform acceptably in quilts and household textiles intended for a life span of less than 100 years.

Following 36 hours of heat aging however, all of the fusible webs exhibited undesirable yellowing and bleed-through. Wonder-Under exhibited significantly greater amounts of color change than the control following 80 AFUs of light exposure, but this color change was not yellowing. Instead, Wonder-Under exhibited significant product bleed-through, making the appearance unacceptable. HeatnBond yellowed significantly more than the others. In addition, HeatnBond exhibited significantly greater strength losses after 36 hours of heat aging than did the control or any other fusible web (table 5). Wonder-Under exhibited significantly greater stiffening than the control following 36 hours of heat aging (table 6).

These findings suggest that fusible webs should not be incorporated into quilts that makers hope will become heirlooms. Because the two polyamide products (Stitch Witchery and Wonder-Under) behaved very differently from one another, it also is clear that knowing the general chemical class of an adhesive (as provided on a product label) is insufficient information to make an informed decision.

3.3 FUSIBLE BATTINGS

All fusible batting products exhibited more yellowing following heat aging than following light exposure (table 7). None, however, exhibited more yellowing than the controls. In terms of strength loss and stiffness, none of the fusible batting fabric assemblies were significantly different from the controls following 80 AFUs of light exposure or 36 hours of heat aging (tables 8, 9). When incorporated into fabric assemblies, fusible battings exhibited less color change than fabric assemblies containing quilt basting sprays or fusible webs. The adhesives used in the fusible battings proved to be the most stable to heat and light of any of the products evaluated.

4. CONCLUSIONS

Fusible battings were the only adhesive-containing products that appear acceptable for quilts intended as heirlooms. All of the quilt basting sprays except Spray & Fix were associated with significant yellowing or strength losses following both shorter and longer periods of light exposure and heat aging. Fusible webs, while acceptable for quilts intended to last for a lifetime, could not be recommended for quilts intended to be handed down from generation to generation or for studio art

FUSIBLE WEBS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Color difference (ΔE_{CIELAB})			
Control (C)	0.37A	0.51A	4.09AB	10.43A
Stitch Witchery	0.56A	0.87B	5.42B	13.95B
Wonder-Under	4.35C	4.32D	3.17A	18.95C
HeatnBond	1.24B	1.71C	5.90B	23.32D

Table 4. Mean color difference values for fusible webs following light exposure and heat aging.

NOTE: Control (C) at 0 AFUs was used as the standard for calculating ΔE. Means with the same letter are not significantly different at $p \leq 0.05$.

FUSIBLE WEBS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Breaking strength (% change)			
Control (C)	-5.30A	-8.23A	-1.33A	-10.03A
Stitch Witchery	+3.53A	-9.53A	+2.03A	-7.23A
Wonder-Under	-1.73A	-5.70A	+12.00A	-3.03A
HeatnBond	-0.53A	-10.20A	+11.47A	-34.10B

Table 5. Mean percent change in breaking load for fusible webs following light exposure and heat aging.

NOTE: Means with the same letter are not significantly different at $p \leq 0.05$.

FUSIBLE WEBS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Change in flexural rigidity (mg•cm)			
Control (C)	+914A	+727AB	+504AB	+870AB
Stitch Witchery	-370B	+116A	-572A	+55A
Wonder-Under	+365AB	+876AB	+1681BC	+2705C
HeatnBond	+764AB	+1155B	+2863C	+1182B

Table 6. Mean change in flexural rigidity for fusible webs following light exposure and heat aging.

NOTE: + = increase in stiffness. Means with the same letter are not significantly different at $p \leq 0.05$.

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FUSIBLE BATTINGS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Color difference (ΔE_{CIELAB})			
Control (C2)	0.37A	0.51A	4.09A	10.43A
Mountain Mist 100% cotton	0.72A	1.13AB	4.64A	10.99A
Hobbs Heirloom cotton/poly blend	0.98A	1.45B	5.23A	10.36A
Control (P2)	2.29B	3.01C	4.40A	11.79A
June Tailor 100% polyester	0.80A	1.29AB	4.62A	11.22A

Table 7. Mean color difference values for fusible battings following light exposure and heat aging.

NOTE: Control (C) or (P) at 0 AFUs was used as the standard for calculating ΔE. Means with the same letter are not significantly different at $p \leq 0.05$.

FUSIBLE BATTINGS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Breaking strength (% change)			
Control (C2)	-10.87A	-7.77A	-9.00A	-20.90A
Mountain Mist 100% cotton	-9.03A	-4.97A	-13.90A	-13.33A
Hobbs Heirloom cotton/poly blend	-4.87A	-11.43A	-3.77A	-7.93A
Control (P2)	-20.30A	-11.20A	-8.63A	-8.50A
June Tailor 100% polyester	-8.23A	-8.97A	-7.67A	-14.23A

Table 8. Mean percent change in breaking load for fusible battings following light exposure and heat aging.

Means with the same letter are not significantly different at $p \leq 0.05$.

FUSIBLE BATTINGS	LIGHT		HEAT AGING	
	40 AFUs	80 AFUs	6 hours	36 hours
	Change in flexural rigidity ($mg^{\bullet}cm$)			
Control (C2)	+1053A	+1568A	+856A	+986A
Mountain Mist 100% cotton	+2070A	+2045A	+1225A	+606A
Hobbs Heirloom cotton/poly blend	+2574A	+1598A	+2819AB	+3022A
Control (P2)	+1007A	+1812A	+1200A	+1142A
June Tailor 100% polyester	-82A	+700A	+3415B	+2390A

Table 9. Mean change in flexural rigidity for fusible battings following light exposure and heat aging.

NOTE: + = increase in stiffness. Means with the same letter are not significantly different at $p \leq 0.05$.

quilts intended for sale to serious collectors or museums. Most museum curators and knowledgeable collectors do not want to pay thousands of dollars for a quilt that has a projected life span of less than 100 years.

NOTES

1. Controls C and C2 both included Hobbs Heirloom bleached 100% cotton nonfusible batting. Control P2 included Mountain Mist 100% polyester nonfusible batting.

Specific AATCC and ASTM protocols used in this study are as follows:

2. ASTM D276-00a, Standard Test Methods for Identification of Textile Fibers.

3. AATCC 16-1998, Colorfastness to Light. Option E test procedure.

4. AATCC 26-1999, Aging of Sulfur-Dyed Textiles: Accelerated, Alternate Oven Test.

5. AATCC Evaluation Procedure 6, Instrumental Color Measurement.

6. ASTM D5035-95, Standard Test method for Breaking Force and Elongation of Textile Fabrics. The 2.5 cm (1") cut strip option was followed.

7. ASTM D1388-96, Standard Test Method for Stiffness of Fabrics, Option A, cantilever test using a Drape-Flex Stiffness Tester.

8. Tukey's post hoc mean comparison test is a statistical test used to compare means and identify which means are significantly different from another.

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SOURCES OF MATERIALS

Hobbs Heirloom® 80% cotton / 20% polyester fusible batting; bleached 100% cotton nonfusible batting
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Waco, TX 76710
Tel: (800) 433-3357
www.hobbsbondedfibers.com

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Fax: (770) 938-7018
www.htc-handler.com

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