ULTRASONICALLY AND CONVENTIONALLY QUILTED MATTRESS PADS--LAUNDERING, WEAR, AND CONSUMER SATISFACTION

by

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I. INTRODUCTION

Ultrasonically quilted fabrics first appeared on the market in 1973, and presently there are several sonically quilted items on the market. These items are mattress pads, bedspreads and draperies.

The process of ultrasonic quilting uses sonic energy to bond layers of fabric together instead of thread. In the quilting of the fabric a sonic horn is brought to bear against a patterned disc while the fabric that is to be quilted lies between the disc and the horn. As the fabric progresses through the disc and the horn, the horn, which is vibrating in the ultrasonic range, produces enough heat to weld or quilt the fabric together. There are no thread joinings on the fabric but tiny "weld" spots in the shape of a dot or line (6). Branson Power Company developed the first sonic sewing machine in 1970 (3).

Sonic quilting eliminates lengthwise and side-to-side tensioning problems, thread breakage and snags on the outer fabric. The snags and breaking of thread usually cause the batting to "lump" in the inner fabric of the mattress pad or bedspread (6,10).

Sonic quilting machines produce quilt fabric at a much faster rate than conventional thread quilting machines. For example, sonic machines produce fabric at ten yards per minute compared to thread quilting machines which produce fabric at one yard per minute. The difference in cost per linear yard is an important consideration. The total cost per linear yard (excluding raw materials) for thread quilting is 8.16 cents compared to 1.47 cents for ultrasonically quilted fabric.

Theoretical Framework

There has been little published research on the ultrasonically quilted fabric. At Ohio State University some testing was done on an ultrasonically quilted bedspread under home laundering and commercial drycleaning conditions. Separate sections of the bedspread were laundered and dry cleaned a total of three times. The laundered section was washed in warm water, using the permanent press cycle and tumbled dried in a dryer. Shrinkage of the bedspread after laundering amounted to a fraction of one percent. After drycleaning the bedspread stretched slightly in both directions. Some color loss was noted in both cases but more color loss was noted after dry cleanings than after launderings (10).

Prior to placing ultrasonically quilted nylon mattress pads on the market, a retail company test-washed some ultrasonic pads five times under home type laundry conditions. The company found the pads shrank to some degree but the quilting points did not pull apart and held firmly (12).

In the course of normal wear, most mattress pads and bedspreads will usually undergo more than three to five launderings. During this time they will also undergo some stress, abrasion and strain. One of the objectives of this study was to use an ultrasonically quilted product in an actual wear study and observe how the weld or quilted points held. As a comparison a conventionally stitched quilted product was also used. Considering availability and cost, mattress pads were used.

The quilting of the fabric is only one aspect of the mattress pad or other quilted fabric that must remain stable to insure a quality product. Other aspects of importance in the quality of a mattress pad or other quilted products are dimensional stability, strength, absorption, and thickness. Because a mattress pad must fit the bed properly to insure service to the user, dimensional stability of the pad is important. Strain occurs to the pad when in use. If, as a result of weakness from strain, the fabric split, the batting of the pad would eventually be lost and the product would no longer be serviceable. Along with strength and dimensional stability, thickness is also important in a mattress pad or other quilted product. The thickness of a mattress pad helps make the bed smoother and softer. Products such as quilted bedspreads or draperies must maintain their thickness throughout wear life of the product for warmth and pleasing appearance. A second objective of this study was to examine the wear qualities and consumer satisfaction of mattress pads after use and launderings.

Objectives

1. To use an ultrasonically quilted product in an actual wear study and observe how the weld or quilted points held.

2. To examine the wear qualities and consumer satisfaction of mattress pads after use and laundering.

Hypothesis

After laundering and wear there is no difference in the

1. number of quilt points that hold
2. consumer satisfaction
3. visual observations and physical test results

of three types of mattress pads, two which are ultrasonically quilted and one which is conventionally (stitch) quilted.

II. PROCEDURES

Characteristics of Test Mattress Pads

Three different types of twin size mattress pads were used. Two of the three types of pads were ultrasonically quilted and one stitch quilted. All the pads had polyester fiberfil for the "batting" or inner layer. The fibers used for outer fabric were nylon, polyproplylene, and a combination of a cotton face and a polyproplylene back. Types of construction used on outer fabrics included knit, woven and non-woven. Type B pads were quilted using two different size quilting patterns. The smaller size was approximately five inches by five and a half inches. A summary of the information on fiber content and method of quilting is in Table 1, and weight and dimensions in Table 2. Samples of fabrics are shown in Plate I.

Table 1. A Summary of Information on Fabric and Construction of Mattress Pads

Pad Type	Method of Constr. Outer Fabric	Outer Fabric Fiber Cont.	Inner Layer Fiber Cont.	Method of Quilt.
A	woven nonwoven	100% cotton " polypro-plylene	100% polyes-ter fiberfil	conventional
B	tricot knit	100% nylon	100% polyes-ter fiberfil	ultrasonic
C	nonwoven	100% polypro-plylene	100% polyes-ter fiberfil	ultrasonic

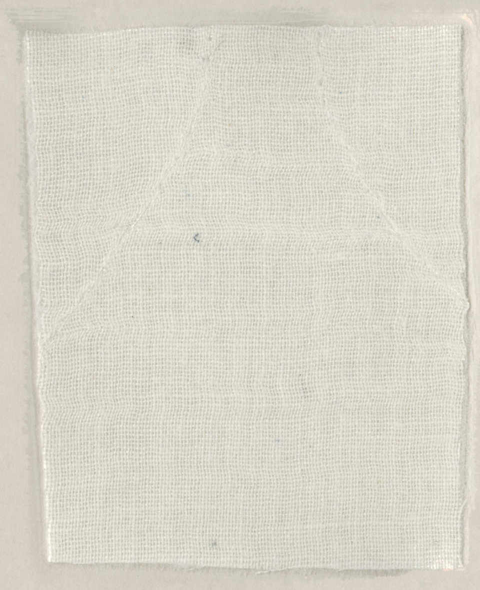
ILLEGIBLE DOCUMENT

THE FOLLOWING DOCUMENT(S) IS OF POOR LEGIBILITY IN THE ORIGINAL

THIS IS THE BEST COPY AVAILABLE

PLATE I

Sample Fabrics of Pad Types A, B, and C



TYPE A

TYPE B

TYPE C

Table 2. A Summary of Average Weight and Dimensions of Mattress Pads

Pad Type	Average Wt. oz./sq. yd.	Size Stated on Label	Average Meas. Size
A	8.74	36" x 75"	38.5" x 73.2"
B	6.0	39" x 76"	39.5" x 73.5"
C	5.4	38" x 75"	38.7" x 73.8"

The pads, which were used on the beds of children (ages from three to thirteen years) of the secretaries, students and faculty members in the College of Home Economics, were laundered a total of seven times. These users were selected as participants because it would be easier to do a follow up study and to control mattress pads. While one pad was being laundered the other pad was on the bed. Each pad remained on the bed a week at a time.

Laundering Procedure

Pads were laundered following the care instructions given on the label of the mattress pad. A home-type washer and dryer were used for the launderings. The permanent press cycle was used for all launderings. Three of the same type pads were washed in one load of wash. A commercially available detergent (Dash) was used because of its general similarity to the AA T CC Standard Detergent with fluorescent whitening agents. Drying times and temperatures for laundering pads followed specific label instructions also. Information given on the label for each pad is shown in Table 4. Specifics on laundering and drying conditions for pads are in Table 3. Information on machine functions during the wash is given in Table 5.

Table 3. Specific Information on Laundering Instructions for Mattress Pads

Laundry Factor	Specific Information
Wash Cycle	E--permanent press
Drying Cycle	Permanent press, medium and low temperature setting. Using the permanent press drying cycle the heat shuts off ten minutes before the end of the cycle.
Drying Time	Type A & B pads, twenty minutes Type C pad, ten minutes
Machines Used	Sears Kenmore 25779 35770 Series, home-type automatic washer Sears Kenmore 62611 72611 Model Series, home-type automatic dryer
Wash Load	Three pads of the same type per load of wash
Detergent	Dash, the recommended amount of 3/4 cup per load

Table 4. Information From Label of Each Type Pad

Type Pad	Label Information
A	Care Instructions: Fabric care--2. Machine wash and dry, using warm settings. Dry 15-20 minutes--remove immediately. Commercial dryers should not be used due to possible excessive heat which could melt the fabric. Do not iron. Caution, avoid excessive temperatures. Stretch to size before drying. Official Dupont Label Dacron 88 fiberfil Resilient, odorless, mat resistant, non-allergenic, surface resin bonded
B	Care Instructions: Machine wash, warm water. Tumble dry low heat. No iron.
C	Care Instructions: Machine wash using warm setting and regular or permanent press cycle. Tumble dry 10-20 minutes using low heat. Remove immediately. Commercial dryers should be avoided due to possible excessive heat which could melt the fabric. Caution: Avoid excessive temperatures.

Table 5. Machine Functions During Wash Cycle

Machine Function		Cycle Time (in minutes)
Fill for Wash	Water temperature-55 C.	
Wash	Normal Agitation	8
Cool Down-cold water	Alternate drain & fill	8
Drain	Drain hose	2
Spin-spray Four 5-second sprays	Slow speed-cold	2
Fill Rinse	Cold water temperature-28 C.	2
Drain	Drain hose	2
Spin	Slow speed-no spray	4

Coding Procedures

Each participant used one of the stitch quilted pads and one of the two types of ultrasonically quilted pads. Pads were coded so that participants used the same two pads throughout the study. For example, one participant might have used ultrasonically quilted Type B pad, lettered (A), and stitch quilted Type A pad, numbered (3) throughout the entire study. Ten or eleven of each type of ultrasonically quilted mattress pads and twenty-one conventionally quilted mattress pads were used.

Physical Test Procedures

Physical tests were performed to help evaluate the wear quality of the mattress pads. These tests aided in evaluating and comparing the strength, air permeability, dimensional stability, absorption and thickness of the three types of pads before and after launderings. Because samples had to be cut from pads for certain tests and the pad was then no longer serviceable only one pad of each type was tested before launderings. After seven launderings were completed, for all physical tests, except dimensional stability, six pads used in this study were selected from type A, B, and C for testing. Final observations of dimensional stability were on ten pads from each type of pads. The six pads used for all other physical tests were included in these ten pads. The following are test procedures for each test performed.

Air Permeability: ASTM D 737-69 Test Method procedure was followed for measuring air permeability. The Frazier air permeability machine was used for testing fabrics.

Absorption: AATCC Test Method 79-1972 procedures were used to test for absorption. Test fabrics were not tested under standard conditions.

Weight: The procedure used for determining weight of pads basically followed ASTM Test Method 1910-64. The fabric was not weighed under standard conditions.

Breaking Strength: The test method procedure that was followed for breaking strength was ASTM Test Method D 1682, Grab Method, on the Scott Tester, Model-J machine. Because of the stretchiness in the crosswise samples of type B fabric, it was impossible to obtain valid results for filling breaking strength. Although this method is usually for wovens the lengthwise direction of type B fabric was tested for breaking strength using the Scott Tester because the stretchiness of knit that makes the test invalid was not found in the lengthwise direction of the quilted type B fabric. With no other exceptions all pads were tested for warp and filling breaking strength.

Dimensional Stability: The procedure basically followed for dimensional stability was a modified version of AATCC Test Method 99-1972. The dimensions of the pads were measured after each laundering without being conditioned. Laundering procedures followed were those previously mentioned.

Thickness: Thickness of pads was tested using ASTM D 1777-64 Test Method and the one-inch diameter presser foot of the Frazier Compressometer machine.

Plan for cutting samples is shown in Plate II.

Visual Observation Procedures

Before pads were given to participants, each pad's dimensions were measured and recorded. The pads were also checked visually for loose quilt points, snagged or broken threads, pilling and holes or runs (i.e. a ravel in a knitted fabric caused by the breaking of one or more threads or stitches) in fabric. Any observations of these factors were recorded. Pads were again examined for the above items after each laundering and notes made accordingly. These results were tallied and examined at the end of the wear period.

Questionnaire Procedures

Upon completion of the seven launderings the participating faculty member, student or secretary answered a questionnaire. Along with questions pertaining to consumer satisfaction, acceptance and awareness of ultrasonically quilted mattress pads and other ultrasonically quilted products, questions pertaining to use and care of mattress pads used in the study were also used.

EXPLANATION OF PLATE II

Plan for Cutting Test Specimens

First digit = test

Second digit = # of replication of test per pad

W = warp

F = filling

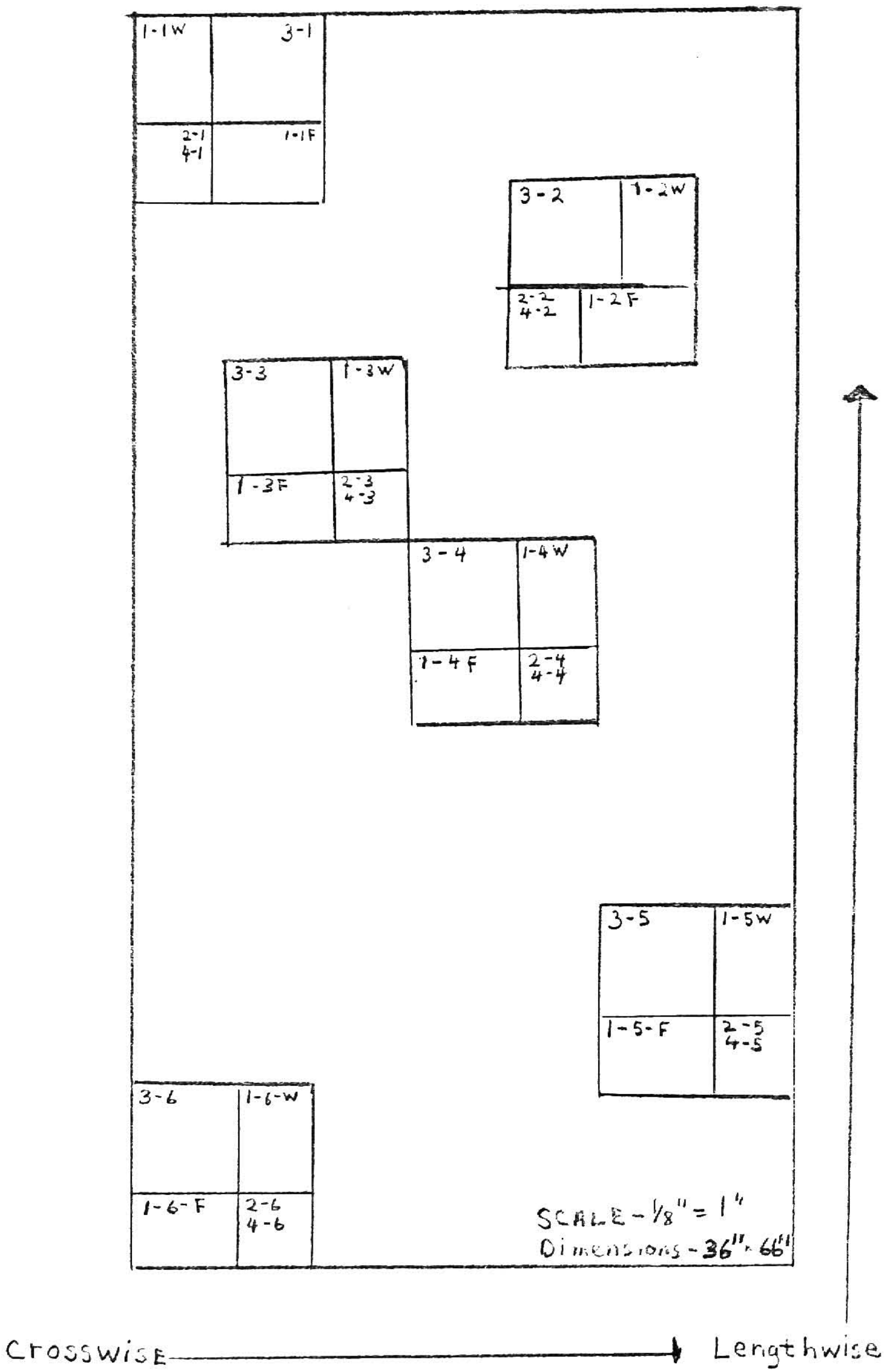
1 = Breaking strength

2 = Absorption

3 = Air permeability

4 = Thickness

PLATE II


1-1W
3-1
2-1
4-1
1-1F
3-2
1-2W
2-2
4-2
1-2F
3-3
1-3W
1-3F
2-3
4-3
3-4
1-4W
1-4F
2-4
4-4
3-5
1-5W
1-5-F
2-5
4-5
3-6
1-6-W
1-6-F
2-6
4-6
SCALE - 1/8" = 1"
Dimensions - 36" x 66"
Crosswise
Lengthwise

Originally, most of the test questions on the questionnaire were structured so that there was a choice of four possible responses. However due to the limited number of people (14) answering the questionnaire, as many questions as possible were re-written to illicit not more than two possible responses. The final revised questionnaire is in the Appendix, page

Questionnaires were coded so that responses could be tallied in two groups. Responses from people using the nylon ultrasonically quilted pad were in one group and responses from participants using the polyproplylene ultrasonically quilted pads were in the second group. The two groups were used so that any noticeable difference in the acceptance of the two types of ultrasonically quilted pads could be noted.

III. RESULTS AND DISCUSSION

Warp Breaking Strength

Means of warp breaking strengths before laundering are shown in Table 6. Mean warp breaking strength for the conventionally stitched pads was approximately 6.5 times greater than that of type B, the nylon ultrasonically quilted pad, and 2.0 times greater than that of the polyproplylene sonically quilted pads. Tests on type B pads were performed on a pad quilted with smaller of the two sizes quilting designs used on these type of pads (see page 4). Type C pad's readings differed significantly from sample to sample. This may have been due to the number of quilting points in the sample. As the number of quilting points decreased, the warp breaking strength decreased. This could be explained by the fact that when the ultrasonic method of quilting melts the fabric together it also weakens the fabric at the quilting points.

Table 6. Warp Breaking Strength Mean (in pounds) Before and After Laundering

	Type A	Type B	Type C
Before	96.2	14.2	46.5
After	95.99	19.91	29.98

Mean of warp breaking strengths after laundering showed that conventionally quilted pads warp strength had not changed significantly (Table 6). The mean after launderings was three tenths of a pound less. Type B's warp breaking strength, observing the means, became greater by four pounds. Examining the means within pads of type B, a considerable difference can be found. The mean warp breaking strength of pads after laundering ranged from 45.33 pounds to 3.6 pounds. These differences are due to the number of quilting points in the sample. Pads with the smaller quilting design had more quilt points visible in the sample. Pad samples with few quilting points located between the jaws of the machine had a higher mean warp breaking strength.

Type C mean warp breaking strength decreased by approximately 16 pounds after laundering. Examining the means of each pad showed one pad had a considerably low mean. The samples from this pad had shown many quilting points in them.

Filling Breaking Strength

Filling breaking strength mean for type A pads before laundering was 52.2 pounds. For type C pads, the mean was 38.4 pounds (Table 7). Samples within type A pad showed the filling breaking strength varied from 4 to 22 pounds. Samples within type C pads filling breaking strength varied from three to 19 pounds. The reason for variation in type C pads were the number of quilting points in the sample. The mean for type C pads filling breaking strength before laundering and wear was twenty-six percent lower than the means for the type A pads.

Comparison of filling breaking strength after launderings by type showed a considerable degree of variation between pads by type. Filling breaking strength mean for type A pad after laundering was 37.87 pounds (Table 7). For type C pads the mean was 34.23 pounds. The mean for type A pad after laundering and wear decreased by approximately 15 pounds. Filling breaking strength on type C pad decreased by approximately 4 pounds.

Table 7. Filling Breaking Strength Mean (in pounds) Before and After Laundering

	Type A	Type B	Type C
Before	52.2	--	38.4
After	37.87	--	34.24

Filling breaking strength means of pads after laundering were significantly different from the means of pads before laundering. Type A and C pads showed a decrease in the filling breaking strength after launderings. Difference was greater for type A pads than for type C pads. Type C pads mean for filling breaking strength after seven launderings was 9.5% lower than type A pad mean.

Filling breaking strength for type B pad was not examined as the tests for these samples, due to the type of construction of outer fabric, were void. Fabric was of a knit construction and stretched too much in the filling direction to get an accurate reading.

Absorption

Pad type A showed the highest rating for absorption before laundering. Type C pad was non-absorbent before laundering. Water beaded and remained on the surface of fabric. Essentially no absorption took place on type B pads. Observations showed water would drop below the first layer of fabric but was not absorbed. For type A pads, tests were conducted only with the cotton side up. The mean absorption rate before laundering was 11.2 seconds. Below five seconds is considered good absorbency for bleached woven cloth (AA T CC Test-79, 1972). None of the three types of pads met this standard before laundering and wear.

After laundering and wear, pad type C remained non-absorbent. Drops of water were left on the outer fabric for as long as two hours and no absorption took place. Fiber and type of fabric construction (nonwoven) of type C pad were the reason for no absorption. Type B pads after laundering displayed results similar to those before laundering. Drops of water gradually disappeared from the outer layer of fabric but were not absorbed. The drops of water dropped through to the inner layer of fabric and remained there.

The mean absorbency of type A pads tested after laundering was 1.71 seconds or by 84.7% more after laundering and wear. Type A pad before laundering was stiff with sizing. After launderings and with sizing the fabric was much more absorbent.

Thickness

Thickness means of pad samples tested before laundering showed type A pad to be the thickest quilted fabric, followed by type B and then type C pad. Type A pad before laundering was 5.6% thicker than type B pad and 7.3% thicker than type C pad. Visibly, little or no difference in thickness could be seen. Before laundering thickness means between type A and B pads differed by .096 thousandths of an inch and by .125 thousandths of an inch between type A and C pads (Table 8).

Means of thickness of the type A and C pad increased after laundering while means of type B pad decreased. Mean thickness increased by 5% for type A pad and by 13% for type C pad.

Type A pad was the thickest after laundering and wear. Thickness mean of type A pad after laundering and wear was 7.8% more than that of type B and 1.3% more than the mean of thickness for type C pad.

Type B pad decreased by 1.8% after laundering. Decrease in thickness may have been caused by the inner layer of fibers becoming more compact with laundering and wear. Or, holes and runs in type B pad (54% of pads after launderings, page 26) could have contributed to the decrease in thickness because some of the inner layer could have been lost through the holes and runs during laundering and wear.

Table 8. Thickness Mean (in .001") Before and After Launderings by Type

Launderings	Type A	Type B	Type C
0	.170	.161	.158
7	.171	.158	.169

Means of thickness within type A pads varied by as much as 21.8%. Type B pad means of thickness within types varied up to 9.4%. The greatest variance of means within pads was in type C pads where the variance was 23.9%. All pad measurements of thickness were taken on parts of the fabric that did not contain quilting stitches. The various degrees of closeness to the quilting stitches during testing may have been a contributing factor to the differences in means of thickness within types. Also, it may be hypothesized that the quilt stitch could have made the inner layer of fabric around it more compact, thus decreasing the amount of thickness in that area.

Analysis of variance of the thickness of pad using types as a variable, after launderings and wear showed the types of thickness of pads was significant at the .05 level (Table 9).

Table 9. Analysis of Variance of Thickness by Types of Mattress Pads

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F-value	Prob.
Types of Pads	2	.003	.001	6.14*	.003

*Significant at the .05 level

Dimensional Stability

Results showed that after one and seven launderings dimensional changes in length were greatest in type A. Dimensional change mean of length for pad type A after seven launderings was 63 percent more than that of type B and 69 percent more than that of type C (Table 10).

Table 10. Dimensional Stability Means of Length, Width and Area by Type After One and Seven Launderings

Type Pad	One Laundering			Seven Launderings		
	Length	Width	Area	Length	Width	Area
A	3.0	4.50	7.50	4.09	5.94	10.14
B	1.79	6.19	8.00	2.17	7.59	9.79
C	.69	1.59	2.39	1.84	3.64	5.59

Results of length after seven launderings in type B are questionable with one of the pads having had a considerably high negative mean result for dimensional stability of length (Table 1, Appendix B). It may be that additional tests should be performed to validate these results. Analysis of variance using the F-test for significance at the .05 level showed significant differences with variables; i.e. types of pads, one and seven launderings (Table 12). Analysis of length by pad type showed that dimensional change mean was significantly different among types.

Analysis of variance of length after one laundering and of length after seven launderings showed that the number of launderings had a significant effect on the dimensional change of length (Table 13).

Width. Dimensional stability mean of type B pad for width after seven launderings showed type B pad shrank 21.7 percent more than type A pad and 52.4 percent more than type C pad (Table 11). Dimensional stability mean of width for type B was greater after the first and seventh laundering than either type A or type C pad. Type C pad shrank the least in width before and after laundering (Table 11).

Table 11. Dimensional Stability Mean of Length, Width and Area After One and Seven Launderings

Laundry No.	Length	Width	Area
1	1.88	4.09	5.95
7	2.09	5.73	8.51

Analysis of variance of dimensional stability of width by interaction between number of launderings and by type of pad showed a significant difference in dimensional stability of type of pads (Tables 12, 13). A significant difference in dimensional stability of width was also shown between laundry one and laundry seven (Table 13). Mean of dimensional stability of width for all pads was 4.09 percent after one laundering compared to 5.73 percent after seven launderings (Table 10).

Area. A two-way analysis of variance of area dimensional stability of pads showed significant differences with variables; i.e. pad types and one and seven launderings (Tables 12, 13). Mean dimensional stability of area was least for pad C. Type A and B pad means showed both shrank more than type C pad (Table 10).

Table 12. Analysis of Variance of Dimensional Stability of Length, Width, and Area by Types After Laundering

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-value	Prob.
Length	2	27.154	19.127	19.11*	.000
Width	2	185.608	92.804	58.73*	.000
Area	2	315.308	157.654	65.70*	.000

*Significant at the .05 level

Table 13. Analysis of Variance of Dimensional Stability Mean After One and Seven Launderings of Length, Width, and Area

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F-value	Prob.
Length	1	11.266	11.266	7.93*	.011
Width	1	40.016	40.016	25.32*	.000
Area	1	97.537	97.537	40.65*	.000

*Significant at the .05 level

Air Permeability. Air permeability is expressed in cubic feet of air per square feet of fabric. Before laundering type B pad was twelve times more permeable than type A pad and six times more permeable than type C pad (Table 14).

After laundering type B pad's air permeability decreased but was still the most permeable of the three types of pads with a mean of 579.32. Construction of outer fabric contributed to the higher permeability of type B pad. Type B's yarns were not as compact as yarns and fibers in type A and C. Type A and C pad's mean for air permeability after 7 launderings increased. Type A's air permeability could have increased for pad A because as the fabric was laundered the sizing was removed and allowed more air to flow through the fabric. Type C's permeability was increased by a smaller amount. Abrasion of C's fabric during wear could have altered the construction of the fabric so that more air was able to penetrate after laundering.

Table 14. Means of Air Permeability Before and After Laundering*

	Type A	Type B	Type C
Before	47.13	587.05	92.94
After	178.36	579.32	123.5

*Expressed in cubic feet of air per square feet of fabric

Visual Observations

Before laundering, type A and type C pads showed no signs of pilling, threads snagged or broken, quilting points loose, or splits and holes in fabric. Several of type C pads did have some small holes at welding points.

Type B pads showed a few quilt points loose or missing on almost all pads before laundering. There were locations where quilt points should have been but were not and it looked as if the quilting machine had skipped stitches.

After the first laundering, type B and C pads each had one pad with loose quilt points. These points were in addition to the loose points observed before laundering. Type B also had one pad with a split or hole in the fabric. Type A pad had no snagged or broken threads but had one pad with a hole in the polyproplylene layer of fabric. All other pads were in good condition after the first laundering.

Forty percent of the type A pads exhibited loose quilting points or snagged and broken threads after seven launderings. None of these appeared until after the third laundering. The number of pads with broken threads or snags increased steadily after the third laundry cycle.

Loose quilting points were observed on forty-five percent of the type B mattress pads after the final laundering. As in type A pads, after the third laundry cycle the number of pads with loose quilting points increased steadily. From the fifth to the final laundering the number of pads with loose quilting points remained the same. Quilting points that came loose on type B pads tended to leave holes in the outer fabric. The reason for this could be that the fabric was too weak to hold around the quilting points. After the loose quilting points first became noticeable, and with each additional laundering, the number of loose quilt points in that particular area seemed to increase.

After the final laundering of type C pads, thirty percent of the pads had loose quilting points. Pads with loose quilting points usually had at least one whole design unquilted. The design is a diamond-shaped area approximately seven by five inches.

Approximately twenty percent (3 out of 11) of the type B pads exhibited pilling. The pilling was obvious, ranging from one-sixteenth of an inch to one-eighth inch in size.

Forty percent (4 out of 10) of the type C pads showed pilling after a total of seven launderings. Pilling was again obvious. Most of the pilling in type C pads occurred in the middle of the pad.

Type A pads which had holes, splits or runs in fabric at the end of the seven laundry cycles comprised twenty-eight percent of the type A pads. All the holes were observed in the polyproplylene layer of the outer fabric. This fabric was very thin in spots and it looked as if a hole had gradually worn in the fabric.

Fifty-four percent of the nylon ultrasonically quilted pads showed holes or runs in the outer fabric. Fabric with runs in it often had as many as six or seven runs on the particular layer of fabric. Runs frequently started at a quilting point in the fabric. Some runs developed into splits or holes in the fabric. None of the splits, once formed changed much in size. One pad in particular had a hole in which the batting was beginning to disintegrate. The size of the hole which was quite large (six inches) caused this to happen. No holes appeared in type C pads after launderings.

Lumping of batting seemed almost non-existent in all but type B pads. Upon final examination several of the type B pads showed a tendency to lump.

Comparing the over-all results, type B pads had the greatest percent of loose quilting points, followed by type A pad and then type C pad. Type B pads exhibited a higher percentage of loose quilt points than type C pads (45 percent, 5 out of 11 versus 30 percent, 3 out of 10) but the area where the quilting had come loose after the final laundering was greater in type C pads.

Type C fabric showed twice the amount of pilling as type A pads. However, pilling was more noticeable on type A pads because of the larger size of the pills. If fabric similar to that used in type B and type C pads were used for a purpose where the fabric would be exposed to considerable abrasion it would probably pill more readily.

Type B pad exhibited the greatest percentage of splits, runs or holes in outer fabric and in over all area the greatest number of loose quilt points. It would appear that type B fabric quilted under the same method and used for a product that will receive more abrasion during its wear life, would deteriorate more readily than the other two kinds of quilted fabric.

Visually, type C pads looked the least worn after launderings. Although type A pads did not pill at all and exhibited no holes in the upper outer fabric layer, several of the bindings on the pad began to fray and come loose. Also, type A's fabric had a softer and limper look after the final laundering (seventh laundering). Some of type B pads looked comparable to type C pads (i.e. least worn) others looked more worn. Type B pads had two different size quilting patterns. The pads quilted using the smaller size pattern looked limp and more worn and batting was slightly lumpy. A summary of visual observations appears in Table 15.

Questionnaire

Because there was no significant difference between the responses by the two separate groups (procedures, page 9) of tallies from the questionnaires, the data was combined into one group.

Sixty percent of those that responded indicated they used a mattress pad four years or more. Participants indicated they laundered a mattress pad anywhere from every day to every 12 months.

Lumping of batting was given by approximately half the people as the reason for discarding a pad. Discoloration and staining were also mentioned several times.

One-half of the participants indicated they had been dissatisfied with a mattress pad they purchased. Reasons given for dissatisfaction

Table 15. Summary of Visual Observations During Launderings

Type Pad	Factor	Number of Laundry Cycle 1	2	3	4	5	6	7	Percentage of Pads**
A . . .	Broken or snagged threads, loose quilt points	0	0	3	5	6	7	9	40
	Pilling	0	0	0	0	0	0	0	0
	Holes or runs in outer fabric*	1	1	1	2	2	5	6	26
	Lumping of batting	0	0	0	0	0	0	0	0
B . . .	Broken or snagged threads, loose quilt points	1	2	4	4	5	5	5	45
	Pilling	0	0	0	1	3	3	3	20
	Holes or runs in outer fabric	1	2	2	2	4	6	6	54
	Lumping of batting	0	0	0	0	0	0	0	0
C . . .	Broken or snagged threads, loose quilt points	1	2	2	2	3	3	3	30
	Pilling	0	0	0	1	3	4	4	40
	Holes or runs in outer fabric	0	0	0	0	0	0	0	0
	Lumping of batting	0	0	0	0	0	0	0	0

*Observed on polyproplylene fabric only
**Percentage is based on total number of pads exhibiting factor

included shrinkage, breaking of quilting thread, poor quality of elastic binding, and lumping of batting.

Eighty-four percent indicated the quality of mattress pads should be improved and that the participants would be willing to pay from ten to twenty percent more for improvements. Participants would like to see improvements in the quality of fabric and elastic used for mattress pads, in the stability of size, and in the stitching used for quilting. Remarks exemplifying responses were as follows:

> "better fabric to prevent splitting"
> "better elastic, less shrinkage"
> "thread problem improved"

Answers to questions on observations of wear on mattress pads used in the study showed nothing specific. Ratings of the wear qualities of the pad showed great variation, as did the ratings of specific qualities of importance in mattress pads. From observation it appears that most of the qualities as seen by individual participants fall generally into the same grade range or scale.

Less than half the people indicated they had heard of ultrasonic quilting. Those that had, learned about it from magazines, newspapers, shopping, or purchase of an ultrasonically quilted product. Responses showed participants were satisfied with the ultrasonically quilted mattress pad and that they would purchase an ultrasonically stitched product. A slight preference was shown for the ultrasonically stitched pad compared to the regularly stitched pad. Responses were equal as to a preference for the ultrasonically stitched pad compared to the regularly stitched pad. Responses were equal as to a preference for ultrasonic quilting versus stitch quilting. A summary of responses to yes-no questions in the questionnaires is given in Table 16.

Table 16. Responses to Yes-No Questions on Questionnaire

Factor	Question Number	No Response	Yes	No	% Yes*	% No*
Ultrasonic process awareness of	2		5	8	38	62
	4		--	13	--	100
	5		--	13	--	100
	15	3	5	5	50	50
Ultrasonic process satisfaction with	6		11	2	85	15
	7		7	6	53	47
	8	1	9	3	75	25
	9	3	8	2	80	20
	10	1	6	6	47	47
Producting testing Wear qualities	11	1	6	6	47	47
	13		5	8	38	62
	15	3	5	5	50	50
Improvement of product	20	3	5	5	50	50
	22	1	9	3	75	50
	23	2	7**a)		64	36
			4 b)		36	

*Percent is based on the number of people who responded to the question
**a) willing to pay 10% more
b) willing to pay 20% more

Rejection of Hypothesis

Using results from physical tests, questionnaires and visual observation after laundering the following hypothesis were rejected.

After laundering and wear there is no difference in the

1. number of quilt points that hold
2. consumer satisfaction
3. visual observations and physical tests results

of three types of mattress pads, two of which are ultrasonically quilted and one which is conventionally (stitch) quilted.

IV. SUMMARY AND CONCLUSIONS

A study of comparison was completed on the effect of laundering and wear upon two different types of ultrasonically quilted mattress pads and one type stitch quilted mattress pad. The ultrasonically quilted mattress pads outer fabrics were of a nylon tricot knit (type B) and a nonwoven polyproplylene (type C). The stitch quilted pad's outer fabrics were a woven cotton and a nonwoven polyproplylene (type A). All the pads inner layers were of a polyester fiberfil.

Consumer satisfaction with an ultrasonically quilted product, physical characteristics of ultrasonically and stitch quilted fabrics, and the ability of quilt points to hold were examined. Physical characteristics examined included dimensional stability, breaking strength, absorption, thickness, air permeability, pilling, and snagging of fabric. Consumer satisfaction was examined by means of a questionnaire.

All three types of mattress pads had quilt points loose at the end of seven launderings. Type B had the greatest number of pads with quilt points loose after launderings. Type C pads had the fewest number of pads with loose quilt points after seven launderings.

From the questionnaire it was found that consumers were almost equally satisfied with the ultrasonically and stitch quilted mattress pads. No preference was shown as to method of quilting preferred. Consumers were satisfied with and would consider purchasing other ultrasonically quilted products. However, respondents to the questionnaire were not satisfied with the quality of mattress pads and indicated they would be willing to pay from ten to twenty percent more to see this product improved.

Examination of physical characteristics of the three types of pads showed that all the types of pads were considerably different before and after laundering in physical characteristics. Warp breaking strength of type A pad was three to four times greater than that of type B or C before and after laundering. Filling breaking strength of type A and C were similar after laundering. Breaking strength tests showed that the ultrasonic quilting may have weakened the strength of the fabric. This was particularly evident in type B pad.

Tests for absorption before launderings of pads showed that type B and C pad fabrics were nonabsorbent and that type A pad was absorbent, but below the average for good absorption.

After laundering type A pad's absorbency was excellent. Removal of sizing during launderings may have been responsible for this change. Type B and C pads remained nonabsorbent after laundering.

Tests for thickness of fabrics showed that type B fabric had the highest reading for thickness before laundering, followed by type A and then by type C. After laundering, type A and C's thickness increased and type B's thickness decreased. The decrease in type B's thickness might have been caused by the loss of inner layer during launderings from splits and runs in the outer fabric.

Results from dimensional stability showed that type of pad's dimensional stability differed significantly. Type A pads shrank the most in length during laundering and type B pads shrank the most in width after launderings.

Although air permeability may have little effect on the wear qualities of mattress pads specifically, this test was performed since air permeability could be of importance in fabrics similar to mattress pads but used for other end uses (i.e. draperies). Results showed that type B fabric was most permeable both before and after laundering. Type C fabric was least permeable before and after laundering. Method of outer fabric construction (non-woven) may have been the reason for this occurrence. Both type A and C's air permeability increased after laundering while type B fabric's air permeability decreased.

Visual observations after launderings showed that type C fabric had the best appearance retention. Both type B and C outer fabrics had some pilling after launderings. Pilling was more noticeable on type B pad. Some of type B pads had splits and runs in the outer fabric. None of type C pads had holes or splits. The polyproplylene layer of type A fabric had holes after laundering. Type B pads, quilted with the smaller quilting pattern were the only pads which showed a tendency to lump.

Recommendations: Based on the outcomes from this study the following areas are recommended for further investigation.

1. Samples be cut for analysis containing identical quilting patterns.
2. Replication of studies on dimensional stability of mattress pads using a different and more appropriate procedure.
3. Further testing of the effect of ultrasonic quilting used on fabrics from other fibers (i.e. ultrasonically quilted cotton/polyester fabric).
4. Replication of wear tests with a larger sample size and fewer variables.

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APPENDIX

APPENDIX A

Directions: Please supply the needed information or place a check (√) by the appropriate answer.

1. What was the age(s) of the child (children) who used the mattress pad(s)?

   ___ ___

2. Had you heard of ultrasonic quilting before you were in this study?
   ___Yes ___No

3. If yes, from what source?
   ___magazines
   ___newspapers
   ___television
   ___window shopping & looking in stores
   ___other (please specify)______________________________

4. Did you notice any quilted points loose on the ultrasonically quilted pad when it was NEW?
   ___Yes ___No

5. Did you notice any THREADS loose or broken on the regularly stitched pad when it was NEW?
   ___Yes ___No

6. Have you been satisfied with the ultrasonically stitched pad?
   ___Yes ___No

7. Do you prefer the ultrasonically stitched pad to the regularly stitched mattress pad?
   ___Yes ___No

8. Would you purchase an ultrasonically stitched mattress pad?
   ___Yes ___No

9. Would you purchase another ultrasonically stitched product?
   ___Yes ___No

10. Do you think the ultrasonic quilting process is better than the conventional (thread) type of quilting?
    ___Yes ___No

11. Have you ever been dissatisfied with a mattress pad you purchased?
    ___Yes ___No

12. If so, why were you dissatisfied? Be specific.

13. Do you assume manufacturer's have sufficiently tested an item before putting it on the market?
___Yes ___No

14. During this study did you notice any of the following occurring in your:

	Ultrasonically stitched	Regularly stitched
Color change	___	___
Lumping of inner layer	___	___
Quilted points loose	___	___
Outer layer split	___	___
Shrinkage	___	___
Pilling (balls of fuzz on fabric)	___	___
Threads broken	___	___
Other (please specify)	___	___

15. If shrinkage occurred, do you think the regularly stitched mattress pad has shrunk more than the ultrasonically stitched mattress pad?
___Yes ___No

16. How do you decide when to replace a mattress pad?

17. Regarding the LAST mattress pad you discarded, how long was it used?
___1 year or less
___1 - 2 years
___2 - 4 years
___4 years or more

18. Where did the first signs of wear appear on your last mattress pad?

19. How often do you launder your mattress pad?
___3 weeks or less
___2 - 3 months
___3 - 6 months
___6 - 12 months

20. Do you think the quality of mattress pads could be improved?
___Yes ___No

21. If yes, how? (be specific)

22. Would you be willing to pay for improvement on this product?
___Yes ___No

23. How much more?

	YES	NO
Up to 10% more	___	___
Up to 20% more	___	___
Up to 30% more	___	___
Up to 50% more	___	___

24. List the following characteristics of a mattress pad in order of importance. Rate from 1 to 6,
1 being the most important characteristic
6 being the least important characteristic

___absorbency
___thickness
___easy care conditions
___safeguards against shrinkage
___fitted
___flat
___others (please specify)________________________________

25. Rate the following wear qualities of the pads you used in the study on a scale of 1-5, 1 being EXCELLENT and 5 being POOR.

	Ultrasonically stitched	Regularly stitched
Outer fabric appearance	___	___
Bulk-thickness	___	___
Signs of wear	___	___
Matting of INNER fabric	___	___
Quilted points loose	___	___
Puckering at binding or any other points	___	___
Color or whiteness	___	___
Shape retention (size)	___	___
Absorbency	___	___

Others (please specify)________________________________
____
____

APPENDIX B

Table 1. Means of Dimensional Stability of Length by Pads Within Type After Launderings

Pad Number	Type A	Type B	Type C
I	1.0	4.75	2.75
II	3.5	3.75	2.00
III	3.0	2.75	-0.25
IV	3.25	3.00	-0.25
V	2.75	4.75	1.50
VI	5.00	2.25	2.00
VII	4.00	2.25	.75
VIII	5.00	3.00	.50
IX	5.00	-6.00	1.75
X	3.00	-0.75	2.00

ULTRASONICALLY AND CONVENTIONALLY QUILTED MATTRESS PADS--
LAUNDERING, WEAR, AND CONSUMER SATISFACTION

by

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ABSTRACT

Physical properties and consumer satisfaction of ultrasonically and stitch quilted mattress pads were examined in this wear study. Three different types of mattress pads were used. Two types of pads were ultrasonically quilted and one type was conventionally (stitch) quilted. Outer layers of pad's fabrics were of nylon, polyproplylene, and a combination of cotton and polyproplylene. All types of pad's inner layers of fabric were of polyester fiberfil.

Pads were placed on the beds of children of secretaries, students and instructors in the College of Home Economics for a total of seven launderings on each pad. Pads were used for one week between launderings. Observation of physical properties of pads were visually examined and recorded before and after launderings.

Physical tests for breaking strength, absorption, thickness and air permeability were performed before and after launderings on all three types of pad. Dimensional stability of pads was tested after laundering.

Results from visual observations showed there was considerable difference in physical properties of all three types of pads. The questionnaire showed consumers were satisfied with the wear of the ultrasonically quilted mattress pads and showed a slight preference to the ultrasonically quilted pads compared with the stitch quilted pads. Physical test results showed differences in breaking strength, thickness, air permeability, absorption, and dimensional stability among types of pads.