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TRANSACTIONS

10—WEAK PLACES IN COTTON FABRICS

An effect produced by defective conditions during loom stoppage.

By Frank Kendall

During ordinary commercial routine testing of textile fabrics, particularly tests for tensile strength, the operator is usually concerned only with the results recorded by the machine, and, apart from obvious jaw breaks and tears, little or no attention is paid to the manner in which the rupture of the fabric takes place. In fact, with certain types of apparatus in common use, it is not possible for one person to operate the machine and observe the reactions of the test sample at the same time.

The writer having been concerned more with research problems than with mere routine testing, has paid attention to this aspect of testing and it has been the customary duty of the operator to notice the behaviour of all the test samples whilst undergoing strain. The same strict supervision obtains whether the tests are being made for research purposes or for Government routine testing. It is due to this fact that the existence of a most pernicious and widespread defect has been discovered which is being created daily in many factories producing cotton fabrics.

This defect takes the form of a weakness warp way in narrow bands across the full width of the fabric, the loss in strength at these positions often being so high as 40 per cent. of the normal fabric strength. It is all the more pernicious in that, with a large variety of fabrics, it is not easily seen even when its existence is suspected or known, and, in all cases up to now, it has passed the normal commercial examination to which fabric is subjected.

Manufacturers will realise the serious nature of such a state of affairs, particularly when these fabrics are required for Service use where a break-down in performance may have very serious consequences.

Fortunately it can be obviated quite easily and without additional cost to the manufacturer, and below is given a brief description of the cause, and the method of putting a stop to its continuance, or at least of reducing the effect to a negligible quantity.

The defect is produced by leaving the shafts in an open position whilst the loom is standing. Whilst the loom is in this position the threads forming either the top shed or the bottom shed are under greater strain than those forming the opposite shed. This difference in strain is of course greater or less according to the "setting-up" of the loom. The threads under strain are thus elongated, and when the loom is once more set into motion, these elongated threads do not have any share in setting the warp beam into motion, thus the whole weight of the warp beam is brought to bear on the unstretched threads which then weave into the fabric under excessive tension until the balance is restored. This may be from an eighth to half an inch according to type of fabric and loom setting. It will readily be appreciated that, in the case of a plain weave, the unstretched threads have to bear double their normal weaving tension. Thus a narrow band is produced across the fabric in which alternate threads are very tight and the complementary threads are very slack, so that any strain that is brought to bear warp way on this portion of the fabric is not borne equally by all the threads. A weak place is the result.

Before leaving the loom to stand at week-ends, overnight, at lunch times or during any other break, the shafts should be brought together at the neutral position.

The value of this point is illustrated by the appended results of a number of experiments which have been carried out by several manufacturers who have co-operated with us in order to provide sufficient evidence to convince the trade and, at the same time, to satisfy themselves as to the seriousness of the defect. Most of these experiments have been made on Government Service fabrics.

TENSILE STRENGTH TESTS (warp way only)

Size of sample tested : 7 ins. between the jaws × 2 ins. wide

These test results represent the tensile strength warp way on strips of fabric including a standing place.

Those marked (N) are the normal portions of the fabric and those marked (S) are the portions of the test strips including the standing places.

Where three lots of figures are given in the order (N) (S) (N), the (N) figures represent the normal fabric before and after the standing place, respectively.

All comparisons of (N) and (S) figures are along the same warp threads as illustrated in Fig. 2.

MANUFACTURER No. 1

Type of Fabric	Position of shafts and period of standing	Strength in lbs. Test results	Mean	Loss
16¾ oz. Cotton Duck *Loom A.*	Open Week-end	(N) 297, 320, 330, 338, 310 (S) 241, 249, 228, 215, 237	319 234	27%
16¾ oz. Cotton Duck *Loom B.*	Open Lunch-time	(N) 338, 358, 345, 352, 356 (S) 268, 275, 247, 254, 251	350 259	26%
16¾ oz. Cotton Duck *Loom B.*	Open Overnight	(N) 356, 320, 353, 364, 351 (S) 224, 232, 218, 247, 233	349 231	34%
16¾ oz. Cotton Duck *Loom B.*	Closed Overnight	(N) 341, 338, 309, 344, 320 (S) 316, 333, 327, 294, 322	330 318	4%

MANUFACTURER No. 2

Type of Fabric	Position of shafts and period of standing	Strength in lbs. Test results	Mean	Loss
16¾ oz. Cotton Duck	Open Week-end	(N) 352, 364, 358, 360, 362 (S) 265, 213, 246, 246, 239 (N) 340, 370, 360, 369, 380	359 242 364	33%
16¾ oz. Cotton Duck	Closed Week-end	(N) 345, 342, 357, 356, 340 (S) 333, 307, 327, 302, 316 (N) 321, 355, 366, 377, 374	348 317 359	10%

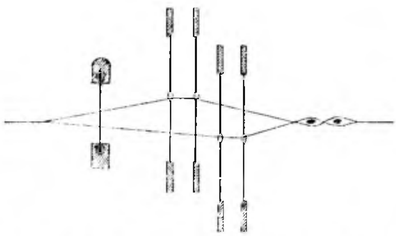
Type of Fabric	Position of shafts and period of standing	Strength in lbs. Test results	Mean	Loss
		Manufacturer No. 3		
Balloon type Cotton Cambric 1st experiment	Open Week-end	(N) 125, 119, 119, 128, 107	120	42½%
		(S) 72, 67, 68, 69, 68	69	
Fabric similar type to the above. 2nd experiment.	Open Week-end	(N) 110, 113, 111, 114, 107	111	39%
		(S) 69, 69, 66, 64, 66	67	
		(N) 110, 109, 109, 113, 109	110	
	Closed Week-end	(N) 120, 108, 109, 104, 122	113	8%
		(S) 105, 107, 111, 110, 98	106	
		(N) 120, 115, 118, 117, 115	117	
		Manufacturer No. 4		
16¾ oz. Cotton Duck	Open Week-end	(N) 386, 408, 366, 371, 383	383	29%
		(S) 267, 260, 286, 253, 273	268	
		(N) 376, 400, 346, 380, 360	372	
Cotton Sheeting.	Open Week-end	(N) 129, 127, 123, 130, 124	127	17%
		(S) 107, 105, 93, 105, 100	102	
		(N) 114, 123, 112, 121, 121	118	
Cotton Cambric.	Open Week-end	(N) 101, 110, 113, 109, 109	108	14%
		(S) 94, 96, 91, 95, 95	94	
		(N) 112, 110, 113, 106, 110	110	
Cotton Poplin.	Open Week-end	(N) 203, 213, 210, 220, 213	212	18%
		(S) 172, 170, 184, 178, 166	174	
		(N) 213, 211, 210, 215, 211	212	
		Tests made by Manufacturer (at his mill)		Difference
16¾ oz. Cotton Canvas	Closed Week-end	(S) 379, 445, 398, 395	404	23%
* 16¾ oz. Cotton Canvas	Open Week-end	(S) 308, 312, 323, 296	310	

* These two series of tests were made on fabric of the same quality but from two different looms. No tests were made on normal fabric clear of standing places.

Type of Fabric	Position of shafts and period of standing	Strength in lbs. Test results	Mean	Loss
		Manufacturer No. 5		
Coloured Striped Cotton Poplin Shirting	Closed Week-end	(N) 160, 173, 155, 159, 164	162	5%
		(S) 153, 158, 151, 156, 146	153	
		(N) 159, 167, 146, 167, 165	161	
	Open Week-end	(N) 162, 166, 174, 172, 167	168	20%
		(S) 135, 132, 140, 136, 120	133	
		(N) 161, 160, 161, 174, 170	165	

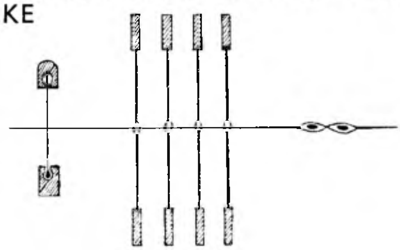
These experiments are in themselves sufficient evidence to show that the practice of leaving the shafts in the open position when the loom is standing is one that should be discontinued, and although the exact relative position of the shafts which would give an exactly equal balance of tension may be a little off the closed position and vary between one loom and another, due to lease rod positions, it is abundantly clear that the simple precaution of bringing the shafts to the closed position is usually sufficient to ensure that, from a practical commercial point of view, the defect is overcome. Where this is not sufficiently effective, a releasing of the warp beam tension will be required.

One of the manufacturers, whose experiments have been cited, after satisfying himself that our statements were well founded, had a number of cards printed which clearly illustrate the necessary precaution, and issued them to all his weavers. A reproduction of this card is given below.



DON'T LEAVE YOUR HEALDS OPEN LIKE THIS! IT MAKES VERY WEAK PLACES IN THE FABRIC.

AT LUNCH TIME, NIGHT, WEEK-END AND AT ALL TIMES LEAVE HEALDS LIKE THIS



STRAIGHT HEALDS
SAVE
FABRIC STRENGTH

In order to illustrate the form of the defect as it appears in the fabric, a sketched impression both of the surface and warp cross section is appended (see Fig. 1). From this it will be seen how alternate ends are tight and slack, varying to a considerable degree according to respective loom conditions.

A further sketch (Fig. 2) is also given, showing strips of fabric which have been subjected to tensile strength tests. This illustrates how the ruptures all fall in a straight line across the defective bar, whereas in the normal part of the fabric, the breaks occur at random positions and usually at an angle.

It has been possible, with a heavy cotton duck containing the defect in a severe form, to stop the testing machine at the first sign of rupture and to obtain a test piece showing alternate ends broken with the complementary ends intact.

It is hoped that this article will be of interest to all cotton manufacturers and result in preventing the continuation of this unnecessary defect.

Before concluding it is desired to draw attention to another defect which reduces the *general* strength of the fabric to an alarming extent. Although its existence has not been found to be widespread it should not be passed over without mention. This has occurred where, for reasons of convenience, two warp beams have been employed and a general unbalanced tension has been produced between the two sets of warp. This gives an all-over effect similar to the small bars which are the subject of this article, and this matter is mentioned as a warning that fabrics for Service use are not likely to meet specification standards when manufactured in this manner. It also opens up an avenue for research into the making of warps from back beams for if the maximum strength from any given yarn is to be obtained, the balance of tension between all the back beams is of paramount importance.

Figure 3 illustrates how such fabrics break under strain.

Thanks are due to those manufacturers who have been so helpful in producing samples according to suggestions made, and also to my assistants who have diligently helped in this research.

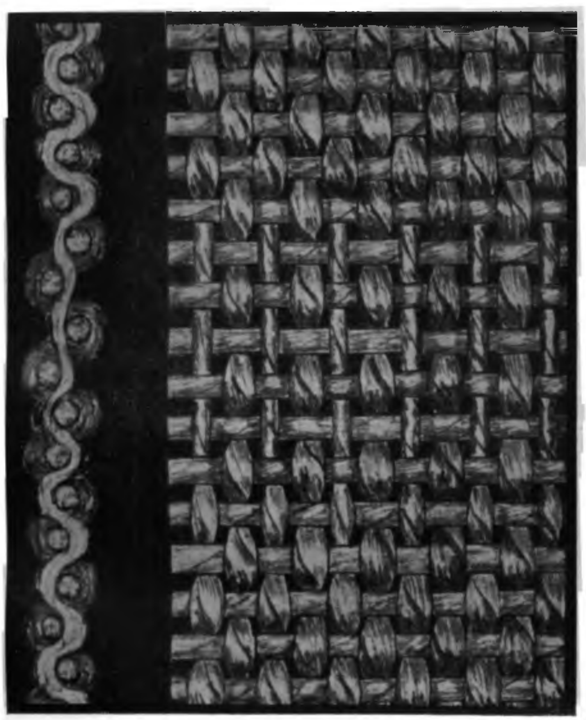


Fig. 1. Reproduction of sketch illustrating plan and warp way cross section of fabric containing standing place with shafts left open.

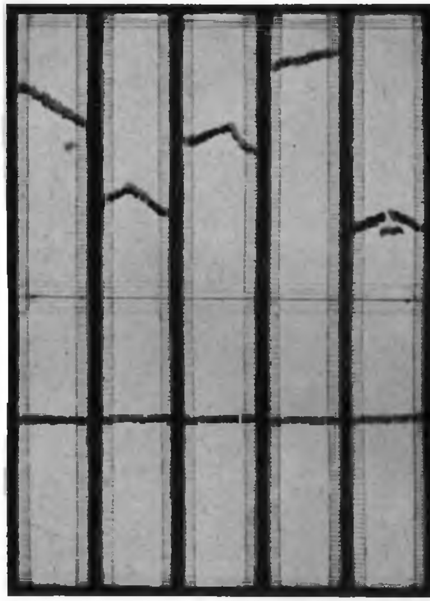


Fig. 2. Sketch illustrating tensile strength test strips of fabric containing standing place with shafts open. Where the defect occurs, the ruptures all take place along one line, whereas in the normal part they fall in random positions.

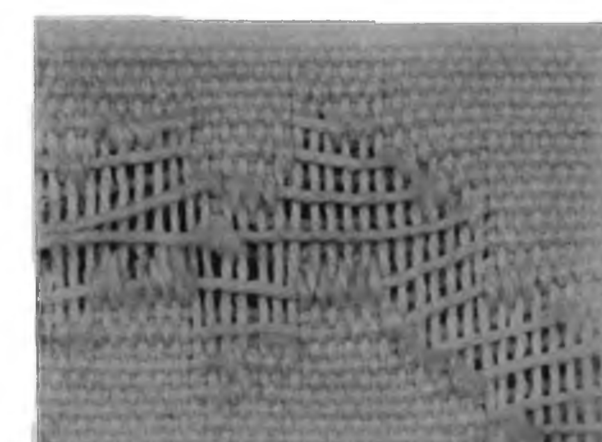


Fig. 3. Micrograph of tensile strength rupture of fabric made from two warp beams at different tensions. Alternate ends only are ruptured.