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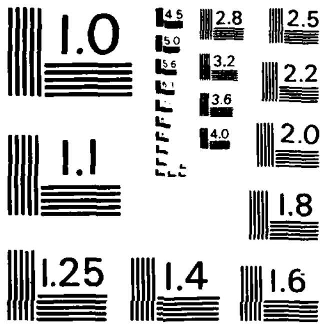
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ABSTRACT

A previous study by the authors on the effect of low temperatures on coated and uncoated fabrics raised certain points which were left unanswered. This study addresses these points. It was found that the load-elongation curve of a fabric is not necessarily the same as that of a yarn or a filament; differences in the percent elongation at break of a fabric and its yarn depend on the physical properties of the yarn; inconsistent differences in the percent change in the percent elongation at break for warps and wefts of the same fabric as the temperature is decreased is procedure-dependent and it is the fabric, yarn and filament working in concert which give each fabric its unique load-elongation curve.

RÉSUMÉ

Une étude menée antérieurement par les mêmes auteurs sur l'effet des basses températures sur les tissus enduits et non enduits avait laissée certaines questions sans réponse. La présente étude porte justement sur ces questions. On a découvert que le courbe force-allongement d'un tissu n'est pas nécessairement pareille à celle d'un fil ou d'un filament. Les différences dans le pourcentage d'allongement à la rupture d'un tissu et de son fil dépendent des propriétés physiques du fil. Les divergences dans les résultats, lesquels sont exprimés en pourcentage de l'allongement à la rupture des fils de chaîne et des fils de trame d'un même tissu en fonction de la température, dépendent de la façon dont les expérieces ont été menées. C'est l'action commune du tissu, du fil et du filament qui donne à chaque tissu sa propre courbe force-allongement.

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INTRODUCTION

A previous study of the effect of low temperatures on coated and uncoated fabrics (Crow and Dewar, 1982) was undertaken because some fabrics, especially coated ones, are known to become hard and brittle at low winter temperatures. Their usefulness at low temperatures will be determined by their ability to retain their room-temperature properties at these temperatures. The coated and uncoated fabrics were broken on a tensile tester at 20, 0, -20 and -40°C and the results analysed in terms of the load-elongation curves. Certain points were raised in that study and were left unanswered.

First, it was assumed that the load-elongation curves of the fabrics could be explained in terms of the load-elongation curves of yarns and fibres. This was done because only the curves for yarns and fibres could be found in the literature. Second, since the warp and weft of the fabrics studied were composed of the same fibre(s), and the coated fabrics were covered with a uniform polymeric film, it was expected that the warp and weft load-elongation characteristics would react similarly to temperature changes. However, in some cases, the warp of a fabric had a distinctly different behaviour and load-elongation curve than the weft of the same fabric. The study concluded that the differences due to yarn construction and fabric count between the warp and weft were sufficient to over-ride the effect of changing temperature on their physical properties. Finally it was hypothesised that, in explaining the presence of the yield point and secondary yield point for fabrics, gross changes in fabric and yarn structures contribute to the yield point and changes in the polymer-chain configuration cause the secondary yield points.

Therefore, this study was undertaken to determine if there are similarities between the load-elongation characteristics of a fabric and its yarn and fibres; if properties such as yarn construction and woven fabric count (the number of yarns per centimeter) contribute to the unlike behaviour of the warp and weft fabric at 20 and -40°C; and if fabric, yarn and fibre structures contribute individually to a fabric's yield points.

METHOD

Three plain-weave fabrics were selected for this study; a 100% nylon from the previous study (Crow and Dewar, 1982) and two 100% polyesters of differing mass. All fabrics had continuous-filament yarns. Their relevant properties are given in Table I.

The fabrics were broken in accordance with CAN 2-4.2 M77, Method 9.1, Breaking Strength of Fabrics - Strip Method (Constant-Time-to-Break Principle). Five-centimeter wide and 25 cm long strips were used for the nylon; 2.5 cm wide and 15 cm long strips were used for the polyesters. The reason for this is explained below. The warp and weft yarns were removed from the fabrics and broken in accordance with CAN 2-4.2 M77 Method 9.4 Breaking Strength of Yarns - Single Strand Method (Constant-Time-to-Break Principle). Sixty 25 cm lengths of yarn were broken at 20°C. The standard deviations of these results were used to calculate the number of specimens for test at -40°C (99% probability level). Six 15 cm lengths of yarn were broken at this lower temperature.

The discrepancies in the lengths and widths used were due to the demise of the Instron Tensile Tester, Model 1102 and the acquisition of the Instron Tensile Tester, Model 4201 during the study. Since we are not comparing fabrics, but rather the behaviour of each fabric relative to its yarn, the difference in widths of the nylon and polyester fabrics should make no difference to the interpretation of the results.

Differences in the lengths of the yarns when tested at 20 and -40°C may be significant. Yarns break at their weakest point and thus the chances of having a 'weaker' point in a 25 cm length of yarn are greater than that in a 15 cm length. However, since the coefficient of variation for the 60 specimens of any of the yarns was no greater than 6% for the breaking load and 10% for the percent elongation at break, the yarns are considered to be quite uniform. This diminishes the importance of inconsistent specimen length. The basic shape of the load-elongation curve for the yarns would not be altered by specimen length.

It was extremely difficult to extract a single filament of the required length from the yarns, in particular, the polyester yarns. Further, it was found that the sensitivity of the tensile tester was not sufficient to obtain a meaningful trace for the polyester filaments. Since the nylon filaments were stronger than the polyester filaments, their load-elongation curves were more accurate. Typical traces of a polyester filament and a nylon filament are given in Appendix A, Figure A-1. Six

TABLE 1

Relevant Physical Properties of the Fabrics

	Nylon	Polyester A	Polyester B
Mass (g/m^2)	183	121	67
Fabric Count (yarns/cm)			
Warp	21	60	36
Weft	17	27	35
Yarn Twist (turns/m)			
Warp	0	666(S)	0
Weft	59(Z)	668(S)	17(Z)
Number of Filaments/Yarn			
Warp	64	35	35
Weft	69	35	36

specimens of the nylon were broken at 20°C and one specimen at -40°C, according to CAN 2-4.2 M77, Method 9.4 Breaking Strength of Yarns - Single Strand Method (Constant-Time-to-Break Principle).

RESULTS AND DISCUSSION

The results are given and discussed in three parts. First, the load-elongation curve of each fabric in the warp and in the weft direction is compared with the curve of its component yarn and similarities or differences are explained. Second, detailed results of breaking load, percent elongation at break, initial modulus, yield point and secondary yield point are presented and these parameters for each fabric are compared with those of its component yarn. Finally, from the detailed results, the percent changes in the parameters from 20 to -40°C are summarized and discussed. Brief comments on the behaviour of the limited number of filaments tested will be included as appropriate.

COMPARISON OF THE SHAPES OF THE LOAD-ELONGATION CURVES

In order to compare the shapes of the load-elongation curve of the fabric with that of its component yarn, the curve of one was superimposed on that of the other. This was done by selecting an appropriate point near the breaking point of one curve and making it coincident with the point on the other curve having the same percent elongation. The two curves were then drawn using appropriate relative scales for the load. These are shown in Figures A-2 to A-13.

Attempts were made to compare statistically the loads on the fabric and on the yarn as recorded at regular intervals of percent elongation. However, t-tests did not accurately describe the relationships of the two curves in all instances and calculations of correlation coefficients, although they were very high, did not reflect the observed rankings of the curve pairs. This was because these two statistical analyses are based on plus and minus differences which, (i) are exaggerated by curves which snake back and forth over each other (Polyester B weft, Figure A-12); or (ii) do not reflect the similarity of the curves when one is slightly but consistently below the other one (Polyester A weft, 20°C, Figure A-8). In the latter case, a significant difference was found statistically to exist between the fabric and yarn curves, when in fact, these two curves are the most similar of all the pairs examined.

Therefore, this part of the study was reduced to a visual examination of the curves. The pairs of fabric and yarn curves which most nearly coincide are Nylon weft, Polyester A weft and Polyester B warp (Figure A-4 and A-5, A-8 and A-9, A-10 and A-11 respectively). These will be considered as one grouping. The remaining pairs of curves, or other grouping, differ because the yarns are more elastic than the fabrics at low loads and thus have yield points which do not coincide with those of the fabrics. This is less pronounced for Polyester B weft (Figures A-12 and A-13). The initial modulus, which was taken to be that part of the curve immediately below the yield point, is similar for these fabric-yarn pairs. The secondary yield points are also similar, but this may be influenced by the fact that the fabric and yarn were normalized in this region. The basic shapes of all fabric and yarn curves remained the same when the temperature was lowered to -40°C from 20°C.

Examination of the physical properties of the fabrics and yarns, given in Table 1, indicated no obvious reason for the distinctly different behaviour of the two groupings of fabrics and yarns. Each group had warp and weft directions, fabrics with low, medium and high yarn counts, yarns with low and high twists and yarns with the same or double the number of filaments per yarn.

In order to explain these results, it was reasoned that for the fabric to have the same shape of load-elongation curve as its yarn, the cross-wise yarns in the fabric must behave in such a manner so as not to interfere with the elongation of the longitudinal yarns in the fabric when these longitudinal yarns are stressed. It was found that the fabric-yarn combinations which had similar curves also had yarns which seemed to pull readily through the fabric. To quantify this subjective observation, specimens were made, as shown in Figure 1 and the "extraction load" of the yarn measured. The Instron Tensile Tester, Model 4201 was used, with the frayed yarn in the lower jaw and the upper jaw placed 2 cm below the slit in the fabric. The jaws were separated at 100 mm per minute and the peak force required to draw the yarn through the fabric recorded. The results are given in Table 2.

Nylon weft, Polyester A weft and Polyester B warp (the grouping with similar fabric and yarn curves), all required less force to pull their yarns through the fabric than the grouping with dissimilar fabric and yarn curves. This is particularly pronounced for the Nylon warp and Polyester A warp, the latter having warp yarns which would not pull through the fabric, but broke instead. The force required to pull the weft yarn through Polyester B is of the same magnitude, but slightly greater than that for the Polyester B warp yarns. This would account for the observed less-pronounced difference in the shapes of the fabric and yarn load-elongation curves of Polyester B weft.

The ease with which a yarn pulls through a fabric will depend on how easily the cross-wise yarns distort to allow this yarn to tend to become straight, rather than to maintain its "S" configuration in the fabric. This would reduce the degree of contact of the longitudinal yarn with the cross-wise ones, and so reduce the friction between these yarns.

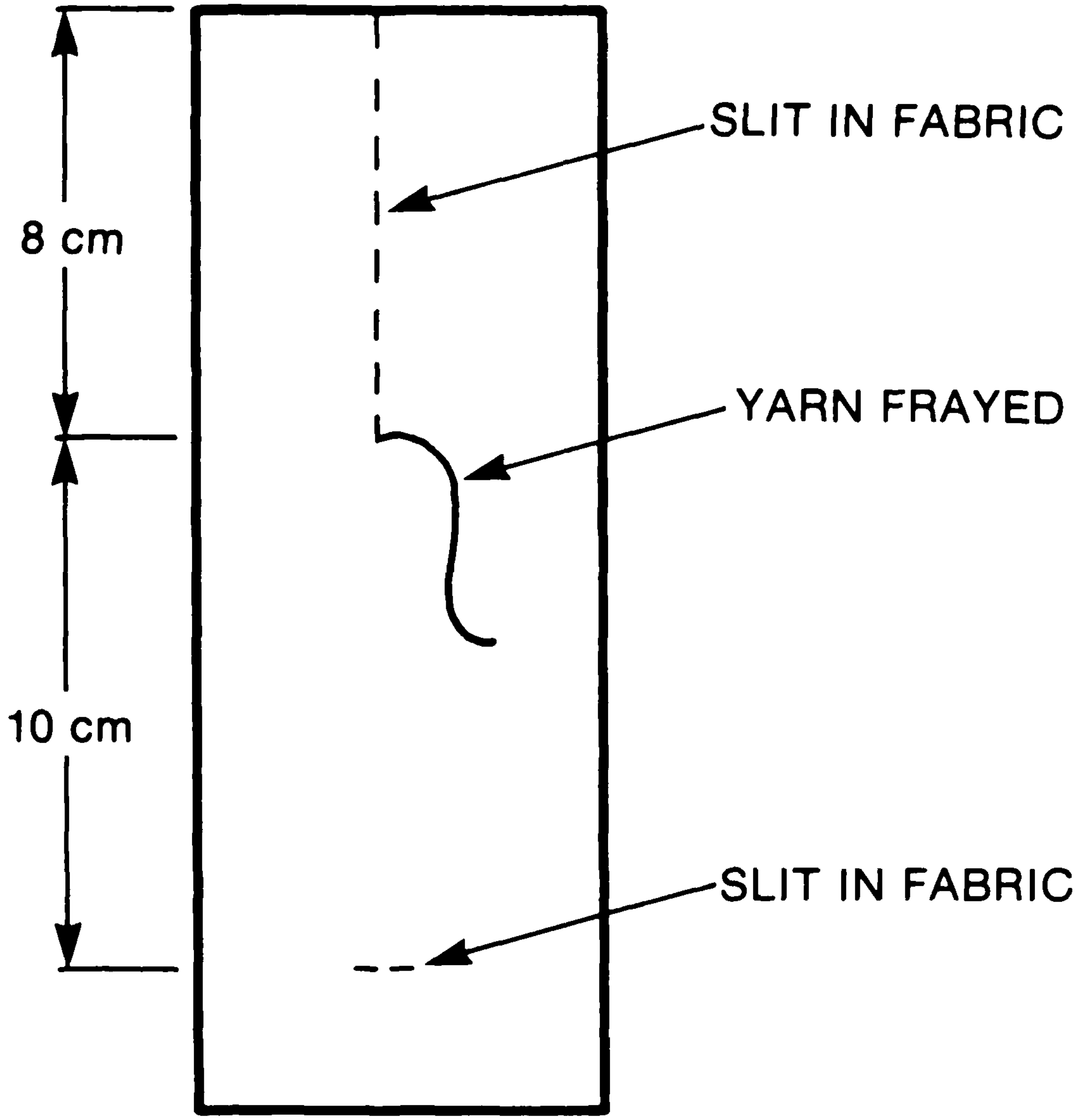

Figure 1: Specimen for Determining the Force Required to Draw a Yarn out of a Fabric.

TABLE 2

Maximum Force Required to Remove Yarn from Fabric

	Maximum Force (N)	Number of Specimens
Nylon Warp	14.5	2
Nylon Weft	3.7	2
Polyester A Warp	Yarn broke in fabric at 6.0	3
Polyester A Weft	2.0	3
Polyester B Warp	.74	8
Polyester B Weft	.85	9

Figure 2 shows two ways in which this is possible. Figure 2(a) shows a cross-section of a fabric in an unstressed and in a stressed state. The cross-wise yarns, such as those with low twist, can be easily deformed and so allow the stressed yarn to become straight. This decreases the area of contact of the yarn with the cross-wise yarns and as well, the magnitude of the frictional force which exists between the yarn and cross-wise yarns. This appears to be characteristic of the nil to low twist cross-wise yarns of the Nylon warp and Polyester A warp, and to a lesser extent to Polyester B weft. This causes the Nylon weft, Polyester A weft and Polyester B warp yarns to pull out of the fabrics easily.

Figure 2(b) shows fabrics with balanced and unbalanced counts. Although the weft yarns have the same number of points of contact with the warp yarns (per unit length of fabric) in both the unbalanced and the balanced count, there is more length of warp yarn between each weft yarn in the unbalanced count. Thus, the warp yarns in the unbalanced count are able to deform more easily when the weft yarns are stressed and so do not tend to 'lock' the weft yarns in place as they do in the balanced count. Therefore it would be easier to remove a weft yarn from the unbalanced-count fabric than it would be to remove a warp yarn. This would apply to Polyester A which has an unbalanced count with fewer yarns in the weft direction than in the warp direction. This allowed its weft yarn to be easily removed, whereas the warp yarn broke in the fabric.

The shapes of the load-elongation curves for all the filaments, be they Nylon or Polyester, are similar to those given in Figure A-1. At both 20 and -40°C they have a yield point and no secondary yield point. Thus, the shapes of the load-elongation curves of the filaments are not similar to those of the fabrics and yarns from which they were taken.

DETAILED RESULTS OF THE LOAD-ELONGATION CURVES

The detailed data on breaking load, percent elongation at break, initial modulus, yield point and secondary yield point are given in Appendix A.

None of the fabrics or yarns had a significant change of the yield point or secondary yield point when the temperature was lowered from 20 to -40°C. The limited number of filaments tested did not lose their yield points.

At both 20 and -40°C, the Nylon yarns generally had a greater percent elongation at break than the Nylon fabrics. Polyester B fabric had a greater percent elongation at break than its yarns and Polyester A fabric and yarns had similar percent elongations at break. These results may be explained in terms of yarn twist and yarn diameter.

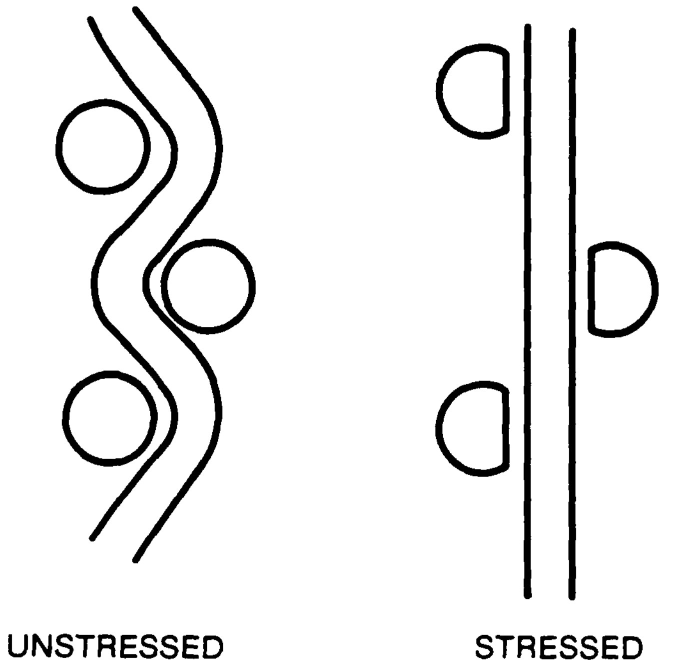

Figure 2a: Cross-Section of a Fabric in an Unstressed and Stressed State.

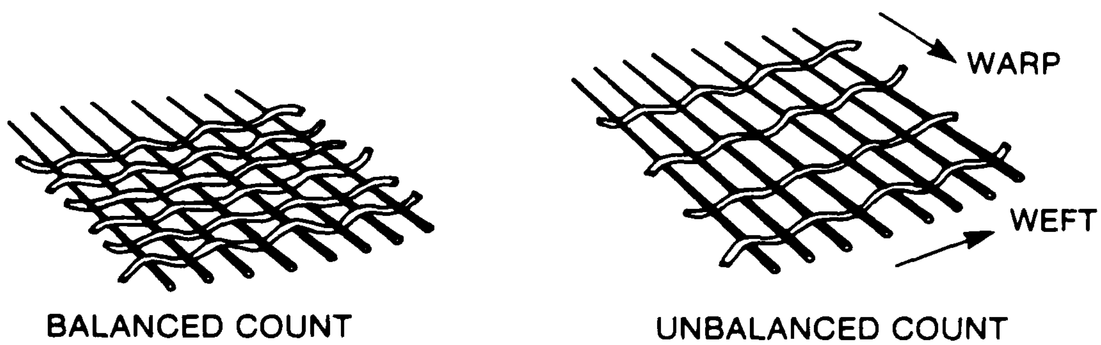

Figure 2b: Fabrics with Balanced and an Unbalanced Count.

The Nylon fabric has low twist yarns with double the number of filaments in each yarn than the two Polyesters have. Since most textile filaments in conventional yarns, such as used in the three fabrics here, are of the same diameter, it is safe to assume, without measurement, that the yarns in the Nylon fabric are about twice the diameter of those in the Polyester fabrics. This would result in a greater contact area between the warp and weft yarns and so a higher frictional force between the stressed Nylon yarns and their cross-wise yarns. Also, tubes of larger diameter can sustain greater bending loads, as it is harder to straighten them out. Thus, the Nylon yarns would tend to retain their 'S' formation on stressing and so result in a greater force and a lesser degree of elongation at break for the Nylon fabric than for its individual yarns which are free to deform when individually placed in the tensile tester.

For Polyester B, its low twist yarns in combination with a low number of filaments in the yarn (i.e. smaller yarn diameter and so less cross-wise friction than the Nylon) would allow the 'S' formation of the yarns in the Polyester fabric to stretch readily under stress. Since the yarns have nil to low twist, the filaments in the yarns will be more or less straight when they are placed in the tensile tester. Since there is no twist to be removed from the yarns, they will have less elongation when stressed to break than the fabric.

The opposite would be true for Polyester A. Its relatively fine, high twist yarns in both the warp and weft directions would impart the same degree of percent elongation at break whether the yarns are in the fabric or broken alone.

PERCENT CHANGES IN THE PARAMETERS FROM 20 TO -40°C

The percent change between tests at 20 and -40°C in breaking load, percent elongation at break and initial modulus are given in Table 3. The breaking loads of all three fabrics and their yarns increased as the temperature was lowered (from 20 to -40°C), the magnitude for each fabric being similar to that of its yarn. The percent elongation at break of all fabrics and their respective yarns decreased when the temperature was lowered except that of the Nylon fabric warp which increased. The magnitude of the decreases in percent elongation at break was relatively small and similar for the two polyester fabrics and their yarns (a range of -2 to -8%). The percent decrease in the percent elongation at break was considerably greater for the nylon yarns than for the nylon fabric. The breaking loads of the nylon filaments increased and the percent elongation at break decreased, reflecting the behaviour of the yarns. No conclusive comments may be made on the magnitude of these changes since only one filament was broken at -40°C.

No changes in initial modulus (from 20 to -40°C) are evident for the Nylon warp yarn or for the Polyester B fabrics or yarns since one of

TABLE 3

Percent Change in Parameters from 20°C to -40°C

	% Change					
	Warp			Weft		
Parameters	Fabric	Yarn	Filament	Fabric	Yarn	Filament
Nylon						
Breaking Load	+39	+42	+84	+29	+40	+88
% Elongation at Break	+11	-18	-34	-9	-29	-48
Initial Modulus	+33	-	-	+81	+81	-
Polyester A						
Breaking Load	+19	+27		+25	+24	
% Elongation at Break	-7	-2		-3	-6	
Initial Modulus	+9	+11		+28	+54	
Polyester B						
Breaking Load	+30	+25		+27	+23	
% Elongation at Break	-2	-8		-5	-8	
Initial Modulus	-	-		-	-	

the pairs had a S-shaped start to its load-elongation curve which made the determination of the slope of this initial part of the curve impossible. The initial modulus for the remaining fabrics and yarns increased with decreasing temperature. There are not sufficient data to comment conclusively about the magnitude of these changes.

The above results are similar to those of the earlier study, namely that there is always an increase in breaking load and initial modulus as the temperature is lowered and there is usually a decrease in the percent elongation at break between tests at 20 and -40°C. It was also found that the changes in percent elongation occurred independently of the breaking load, with the majority of the fabrics having their maximum increase at 0°C, and minimum decrease at -40°C. (In the previous study the fabrics were broken at 0 and -20°C, as well as at 20 and -40°C.) It had been hypothesized that the increase at 0°C was due to moisture in the specimens which made them more plastic and extensible at large loads. The magnitude of the percent changes in elongation were not as consistent as were the ones for the breaking loads, with variations between the warp and weft of the same fabric.

The present study did not reveal any obvious reason for this variation in percent elongation. However, with the acquisition and use of the new Instron tensile tester, it was found that the variation in percent elongation at break in the earlier study was procedure-dependent.

The standard test method used to break the fabric specimens is based on a constant-time-to-break principle, in particular, 20 seconds to break. In order to have the specimens break at 20 seconds, it is necessary to adjust the cross-head speed or the rate at which the specimen is elongated. The tensile tester used in the previous study had a fixed number of cross-head speeds from which to choose, i.e. 5, 10, 12.5 and 20 cm/min. The new tensile tester used in this study (for all but the Nylon fabric) has cross-head speeds which can be set at increments of 1 mm/min. Therefore, with the new tester, one is able to select a cross-head speed which will allow the specimen to be broken closer to 20 seconds than was previously possible. On examination of the records from the previous study, it was found that in many instances, it was not possible to select an appropriate cross-head speed. Thus, there were several instances where the specimens broke at, say, 15 seconds at one temperature and at 25 seconds at another, simply because there was no intermediate cross-head speed available to give the required 20 second breaking time. The time to break is directly proportional to the percent elongation at break for the same cross-head speed. Decreasing or increasing the cross-head speed generally decreased or increased the time to break and so the percent elongation to break. Variations which were obtained in the percent elongation at break were rate-dependent. This explains the inconsistent results in the previous study for percent elongation at break as the temperature was lowered for one fabric direction or between the warp and weft of the same fabric. This also explains why our inconsistent elongation results would agree with those of Russian workers, Bozov and Nikitin (1975) who presumably would also have used a tensile tester with a limited range of cross-head speeds.

A sufficient number of fabric specimens did break at 20 sec ±1 sec to show that the general trend of the results of the previous study is valid, i.e. that there is a decrease in percent elongation at break as the temperature is lowered and moisture may cause the increase in percent elongation at break at 0°C.

No satisfactory explanation has been found to account for the increase in percent elongation at break for the Nylon fabric warp as temperature decreases from 20 to -40°C. In the previous study, two similar 50% nylon, 50% cotton fabrics, designated N/C-G in the greige state and N/C-F in the finished state, also had increases in percent elongation at break in both the warp and weft direction as temperature was decreased from 20 to -40°C. Of the three fabrics, the Nylon warp and N/C-G weft had statistically significant increases at the 95% confidence level. Both were broken using the identical cross-head speed for the two temperatures. The N/C-G weft broke at average times of 20.8 seconds at 20°C and 23.2 seconds at -40°C. The Nylon warp broke at 19.7 seconds and 21.6 seconds for 20°C and -40°C respectively. Differing physical properties of these two fabrics cannot explain these results since N/C-G is almost identical to N/C-F, with similar mass, count, yarn composition and yarn twist. The N/C-F did not have a significant increase in percent elongation at break as temperature decreased from 20 to -40°C. Therefore, the only remaining plausible reason for this increase in percent elongation at break is experimental error.

SUMMARY AND CONCLUSIONS

This study has shown that:

1. The load-elongation curve of a fabric is not necessarily the same as that of a yarn or a filament, even when those yarns and filaments are taken from the parent fabric. Therefore, explaining the shape of the load-elongation curve of a fabric in terms of those of a yarn or a filament (fibre) is not always valid. The differences between the shape of a load-elongation curve of a fabric and the shape of that of its component yarn are due to yarn twist or fabric count;

2. Differences in the percent elongation at break of a fabric and its yarn depend on the physical properties of the yarn; i.e. yarn twist and yarn diameter;

3. The inconsistent differences in the percent changes in the percent elongation at break for warps and wefts of the same fabrics as the temperature is decreased is procedure dependent;

4. The load-elongation curves of the fabrics, the yarns and the limited number of filaments studied here retain their basic shape as temperature is changed from 20 to -40°C. Generally, the fabrics and yarns both have yield points and secondary yield points and their filaments have yield points only. It would appear that the presence or absence of yield points and secondary yield points is a function of the fabric, yarn and filament working in concert to give each fabric its unique load-elongation curve.

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TABLE A-I

Nylon

	Fabric				Yarn				Filament			
	Warp		Weft		Warp		Weft		Warp		Weft	
	20°C	-40°C	20°C	-40°C	20°C	-40°C	20°C	-40°C	20°C	-40°C	20°C	-40°C
Breaking Load												
x (N)	1488	2069	1377	1782	17.5	24.8	18.6	26.0	0.31	0.57	0.32	0.60
cv (%)	1	4	1	6	2	1	3	2	2		3	
Elongation at Break												
x (%)	27	30	34	31	34	28	42	30	38	25	50	26
cv (%)	2	2	2	7	6	2	10	6	7		7	
Initial Modulus	48	64	58	105	.5	S	.8	1.5				
Yield Point	None	vsl	8,360	6,450	8.2.6	8,6	6,3	6,6				
Secondary Yield Point	vsl	vsl	26,1300	27,1680	23,14	24,24	29,17	26,23.5				

vsl = very slight
S = S-shaped

TABLE A-II

Polyester A

	Fabric				Yarn			
	Warp		Weft		Warp		Weft	
	20°C	-40°C	20°C	-40°C	20°C	-40°C	20°C	-40°C
Breaking Load								
x (N)	655	781	317	397	4.9	6.2	4.9	6.1
cv (%)	9	6	3	2	4	3	4	6
Elongation at Break								
x (%)	45	42	33	32	43	42	32	30
cv (%)	7	6	4	4	8	3	8	9
Initial Modulus	32	35	18	23	.27(S)	.3(S)	.24	.37
Yield Point	4,64	5,164	4.5,72	5.5,116	7,1.3	12.5,1.7	5.5,1.3	5.5,1.9
Secondary Yield Point	40,636	slight	26,282	27,354	35,4.2	35,5.5	26,4.4	25,5.6

S = S-shaped

TABLE A-III

Polyester B

	Fabric				Yarn			
	Warp		Weft		Warp		Weft	
	20°C	-40°C	20°C	-40°C	20°C	-40°C	20°C	-40°C
Breaking Load x (N)	261	338	246	313	3.2	4.0	3.1	3.8
cv (%)	3	4	6	4	6	3	5	1
Elongation at Break x (%)	52	51	43	41	48	44	40	37
cv (%)	4	3	6	6	8	5	6	7
Initial Modulus	S	13	10	S	S	.19	.19(S)	S
Yield Point	11.5,54	15,112	12.5,78	7,82	11,0.5	16.5,1.5	8,0.6	8.8,1.0
Secondary Yield Point	43.5,242	45,312	29,228	35,282	43.5,2.2	36.5,3.6	28.5,2.5	24,3.1

S = S-shaped

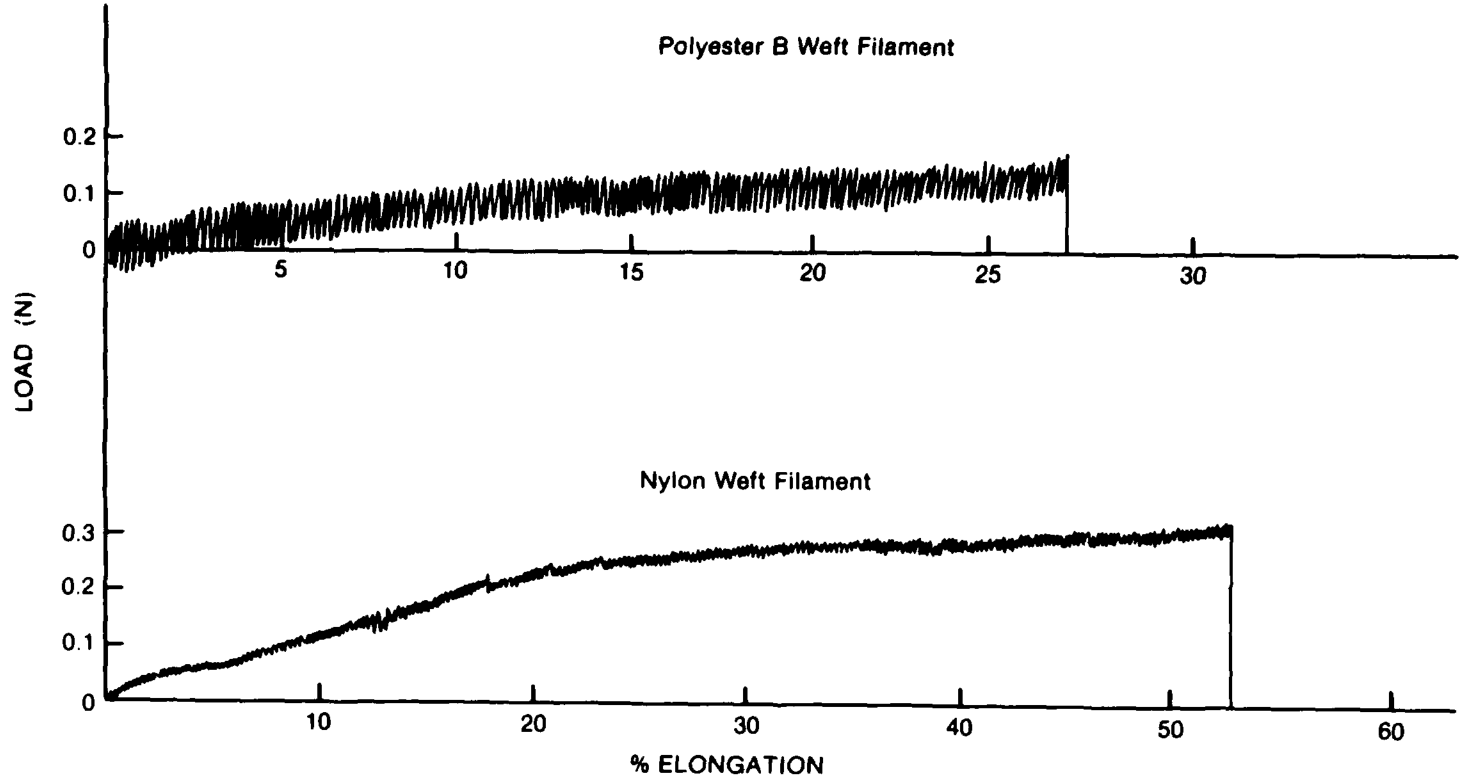

Figure A-1: Typical Traces of the Nylon and Polyester Filaments.

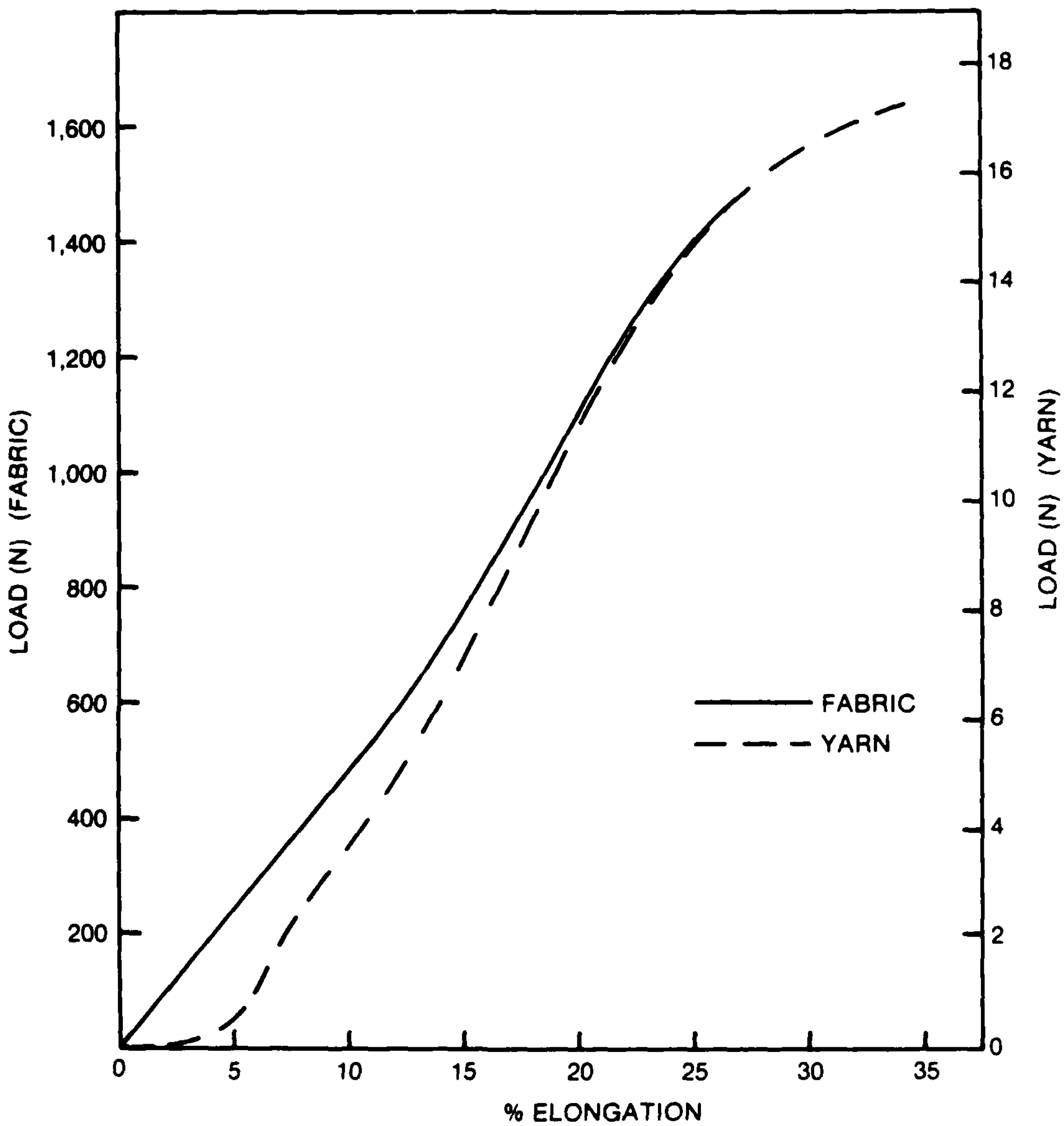

Figure A-2: The Load-Elongation Curves of Nylon Warp at 20°C.

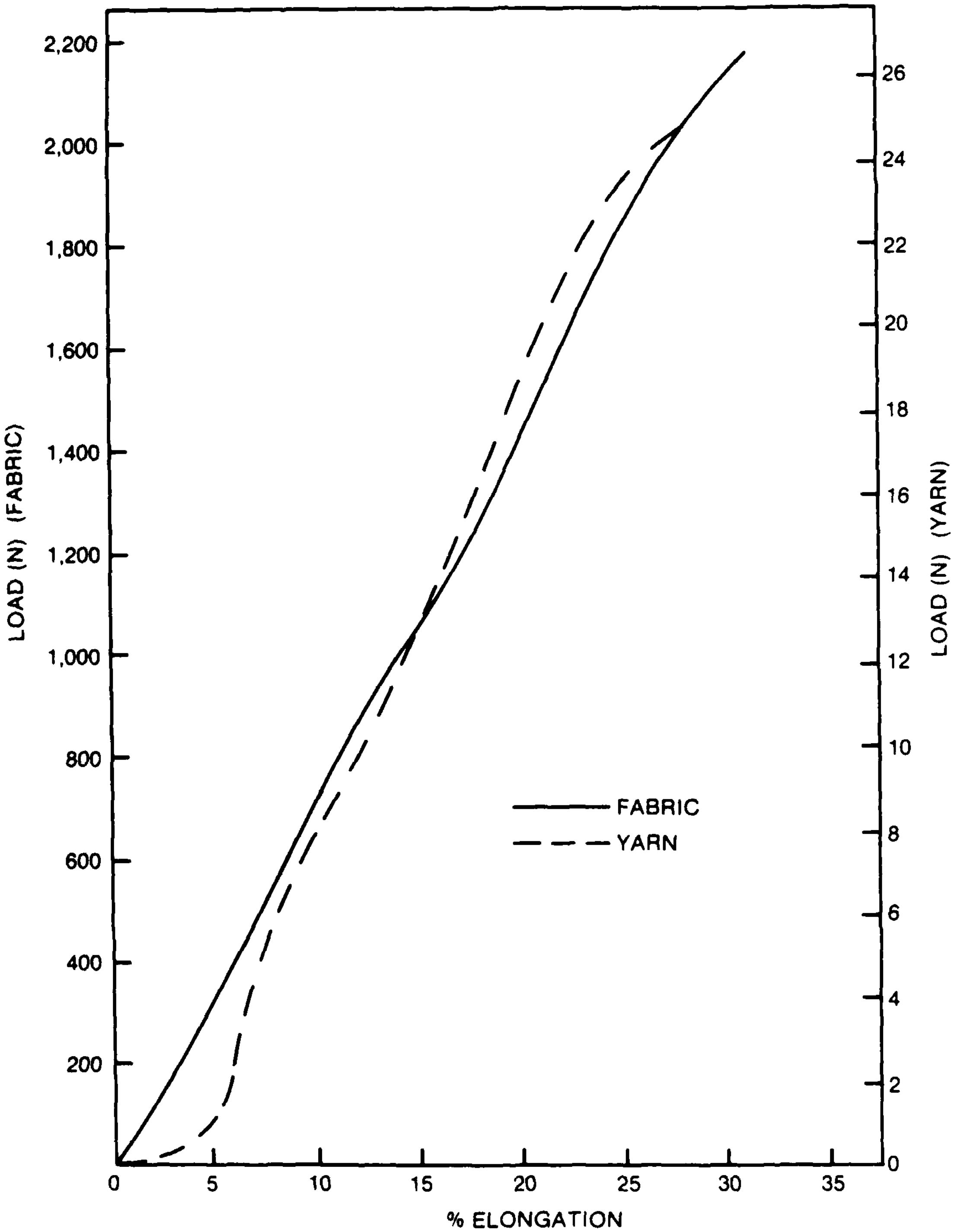

Figure A-3: The Load-Elongation Curves of Nylon Warp at -40°C.

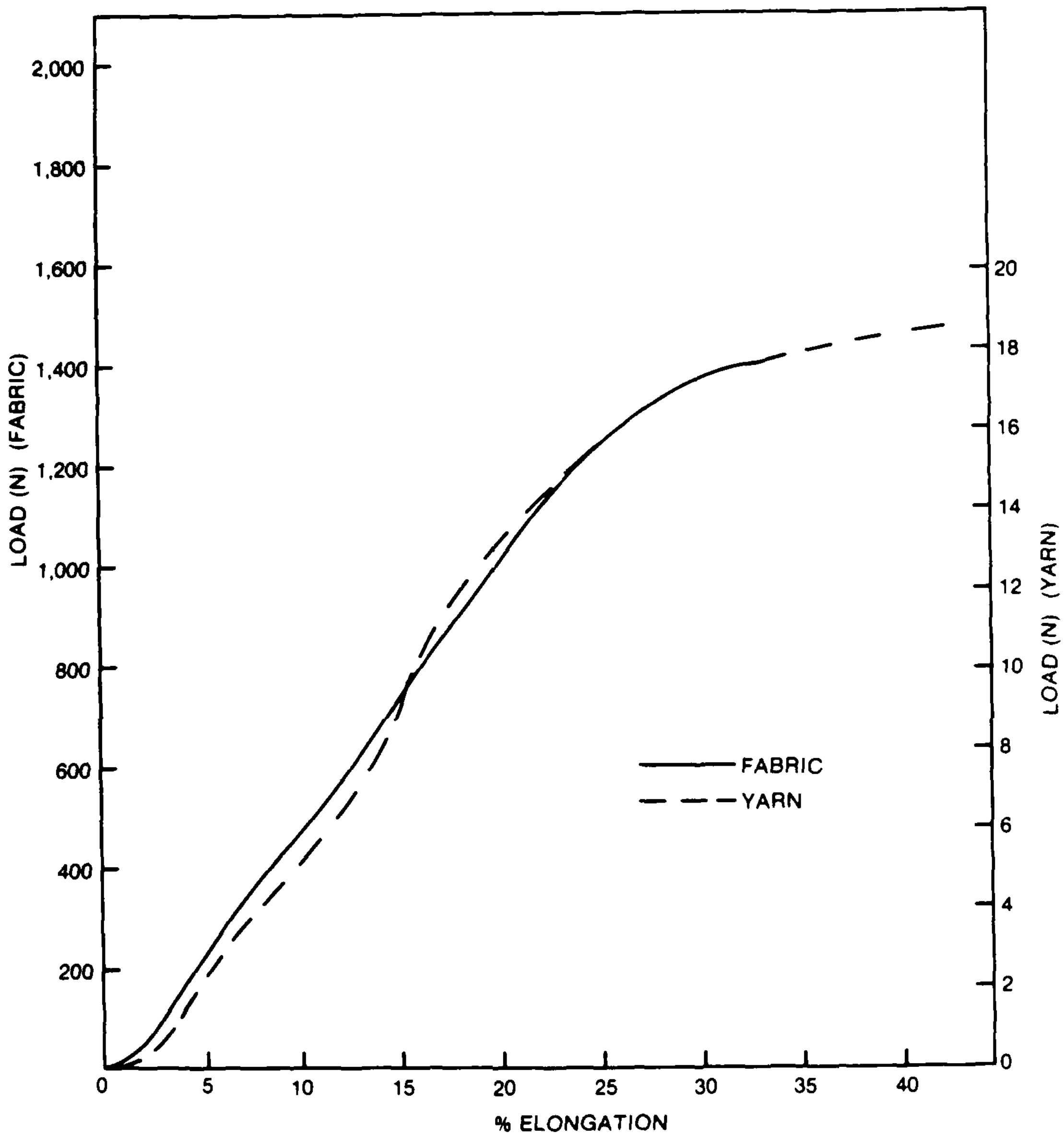

Figure A-4: The Load-Elongation Curves of Nylon Weft at 20°C.

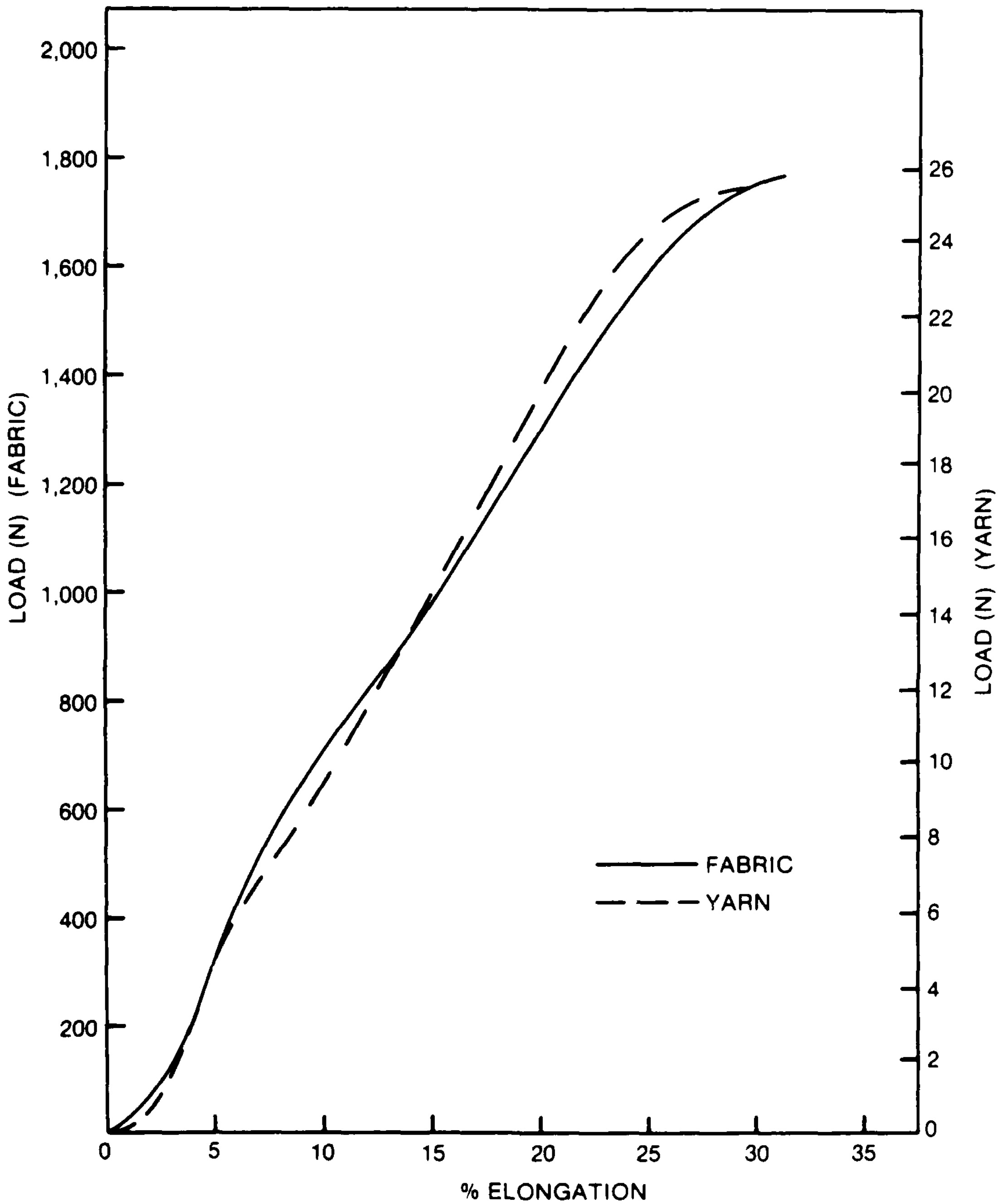

Figure A-5: The Load-Elongation [illegible] Weft at -40°[illegible].

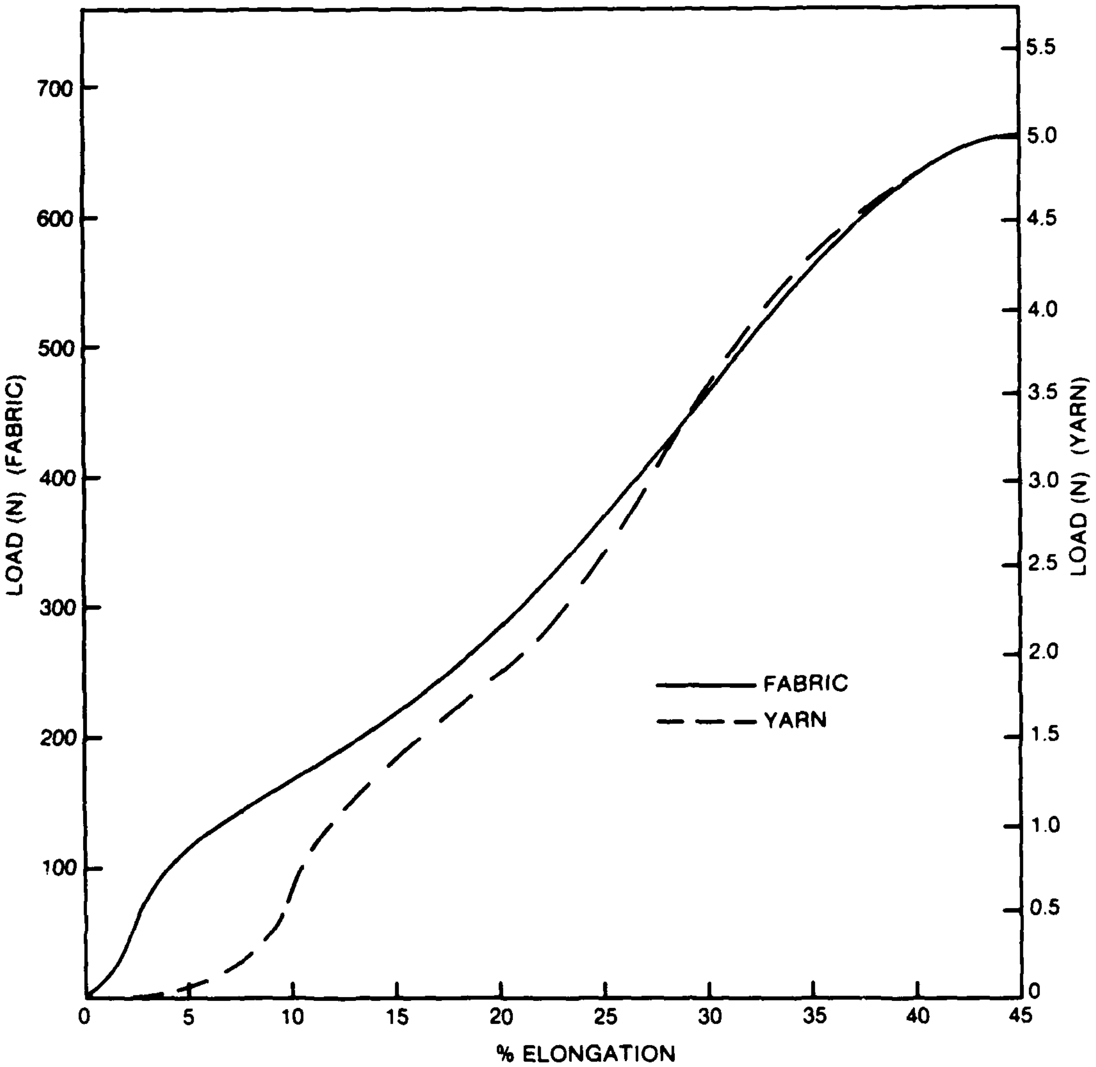

Figure A-6: The Load-Elongation Curves of Polyester A Warp at 20°C.

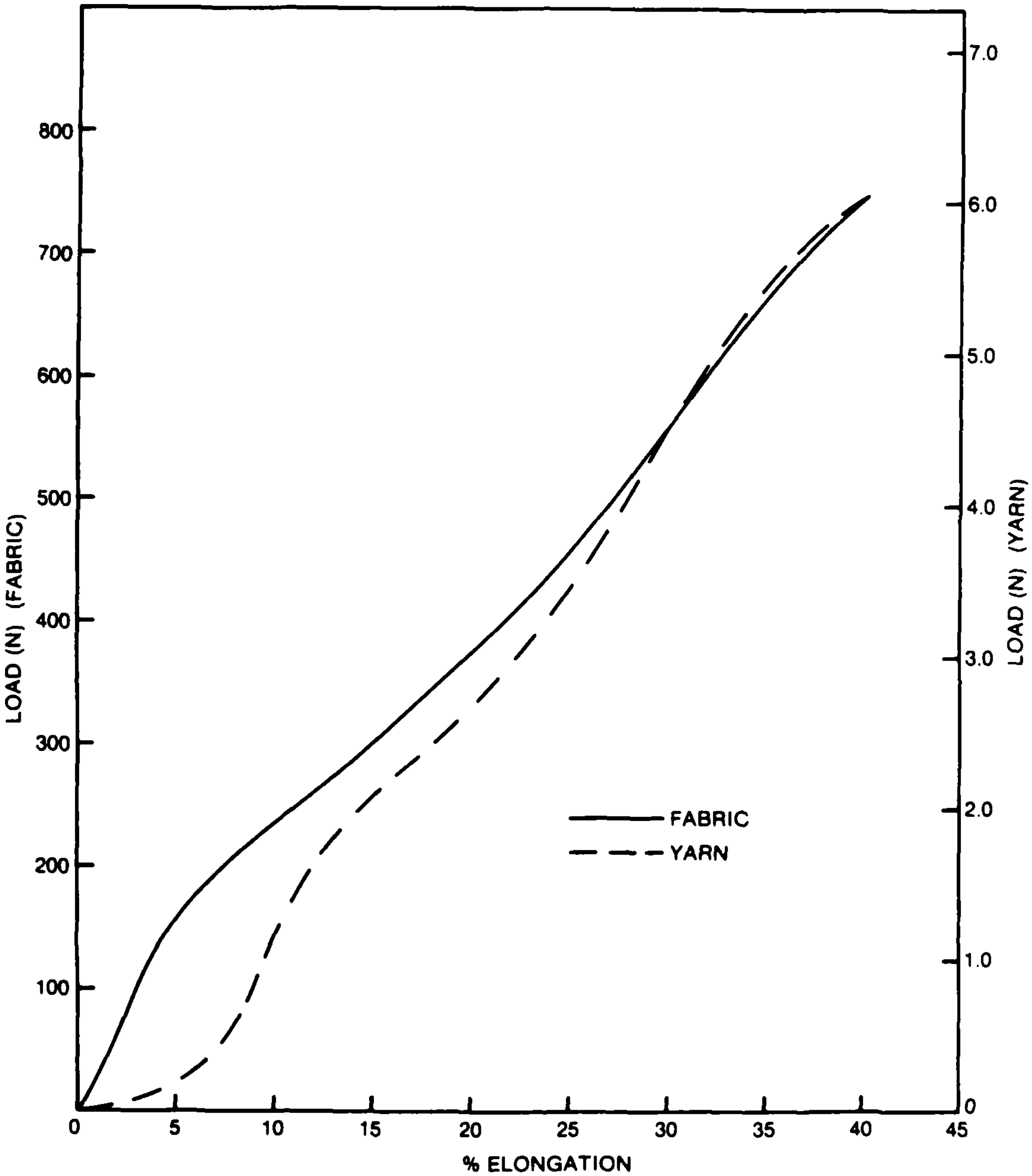

Figure A-7: The Load-Elongation Curves of Polyester A Warp at -40°C.

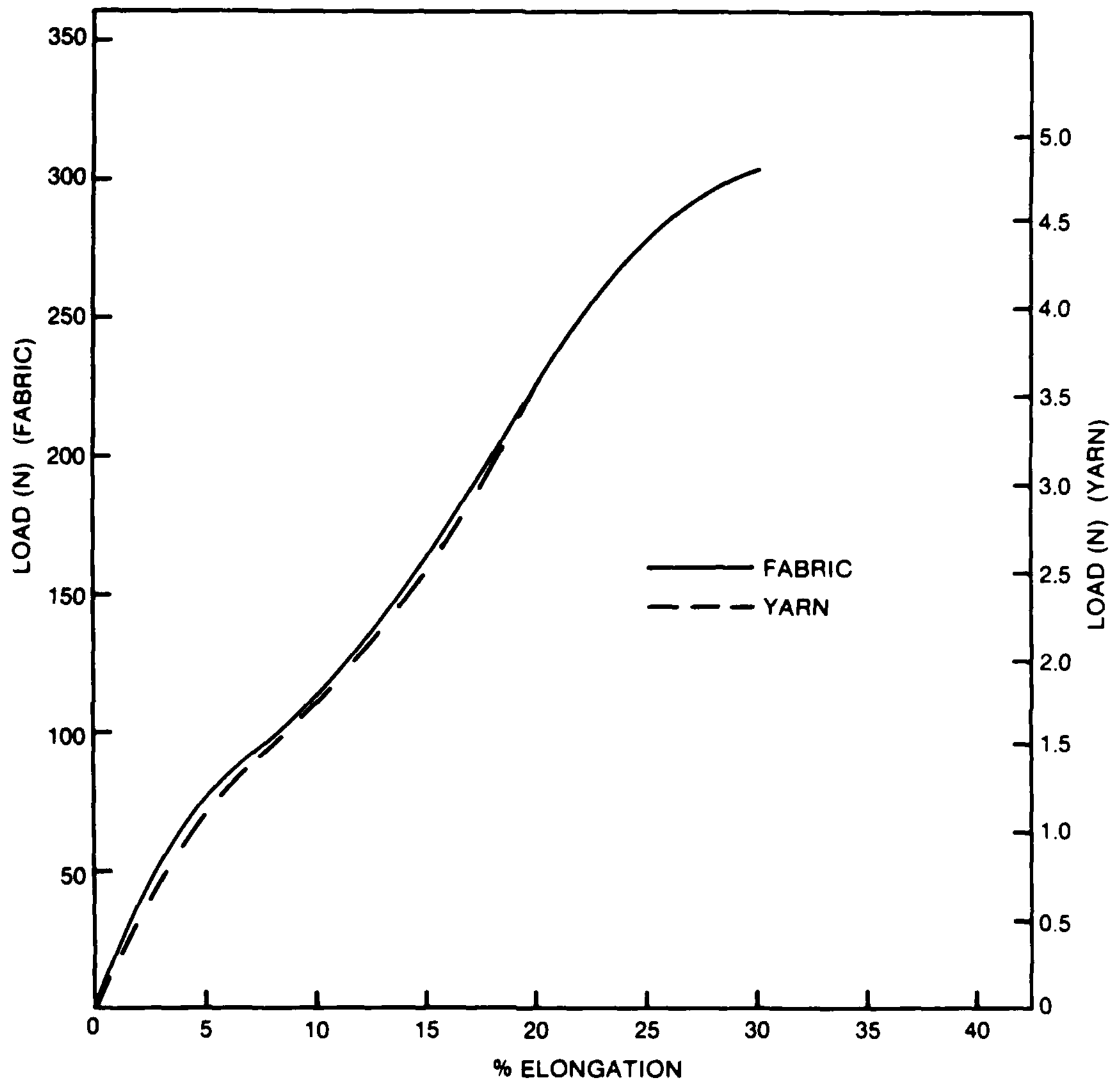

Figure A-8: The Load-Elongation Curves of Polyester A Weft at 20°C.

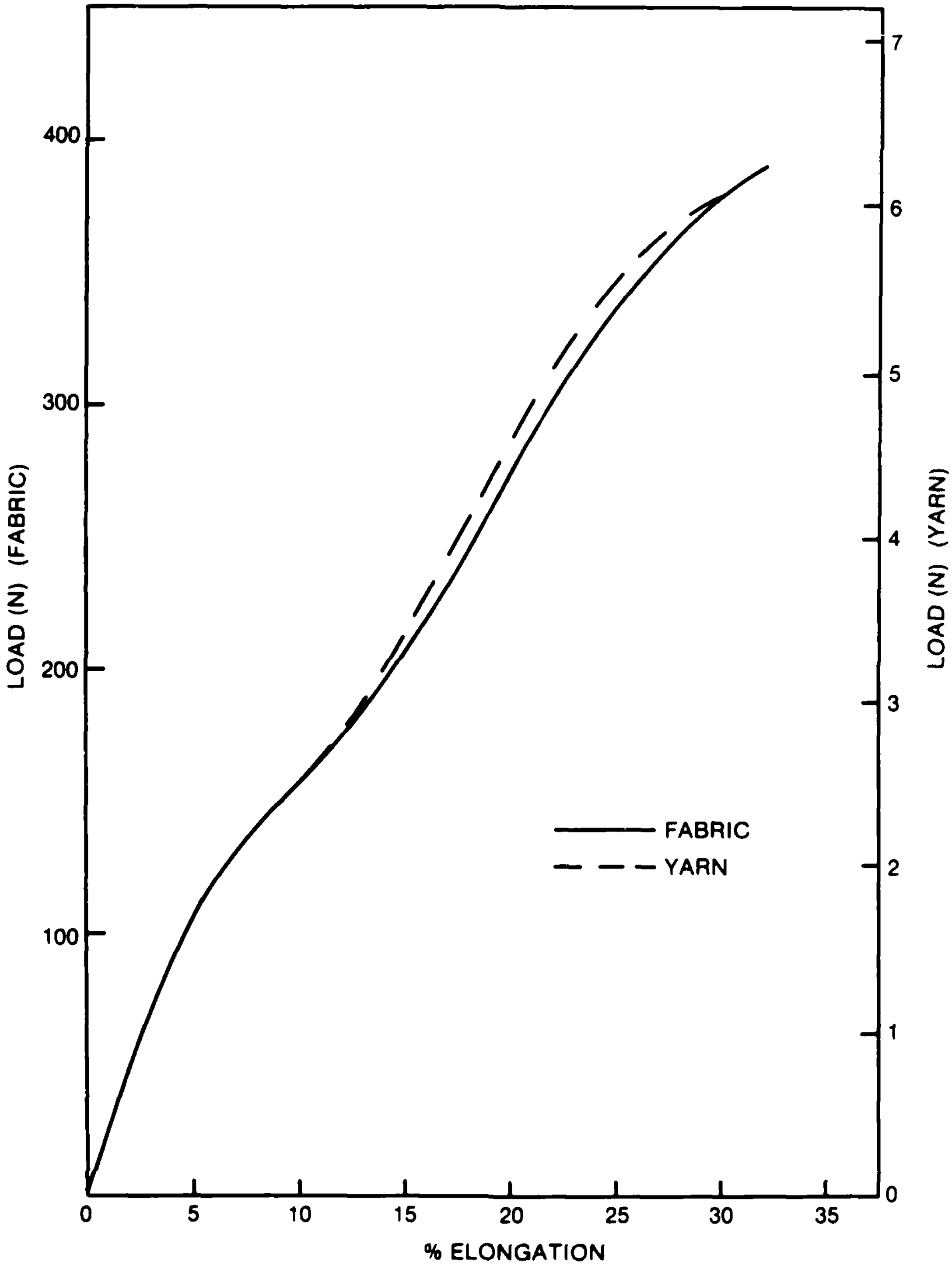

Figure A-9: The Load-Elongation Curves of Polyester A Weft at -40°C.

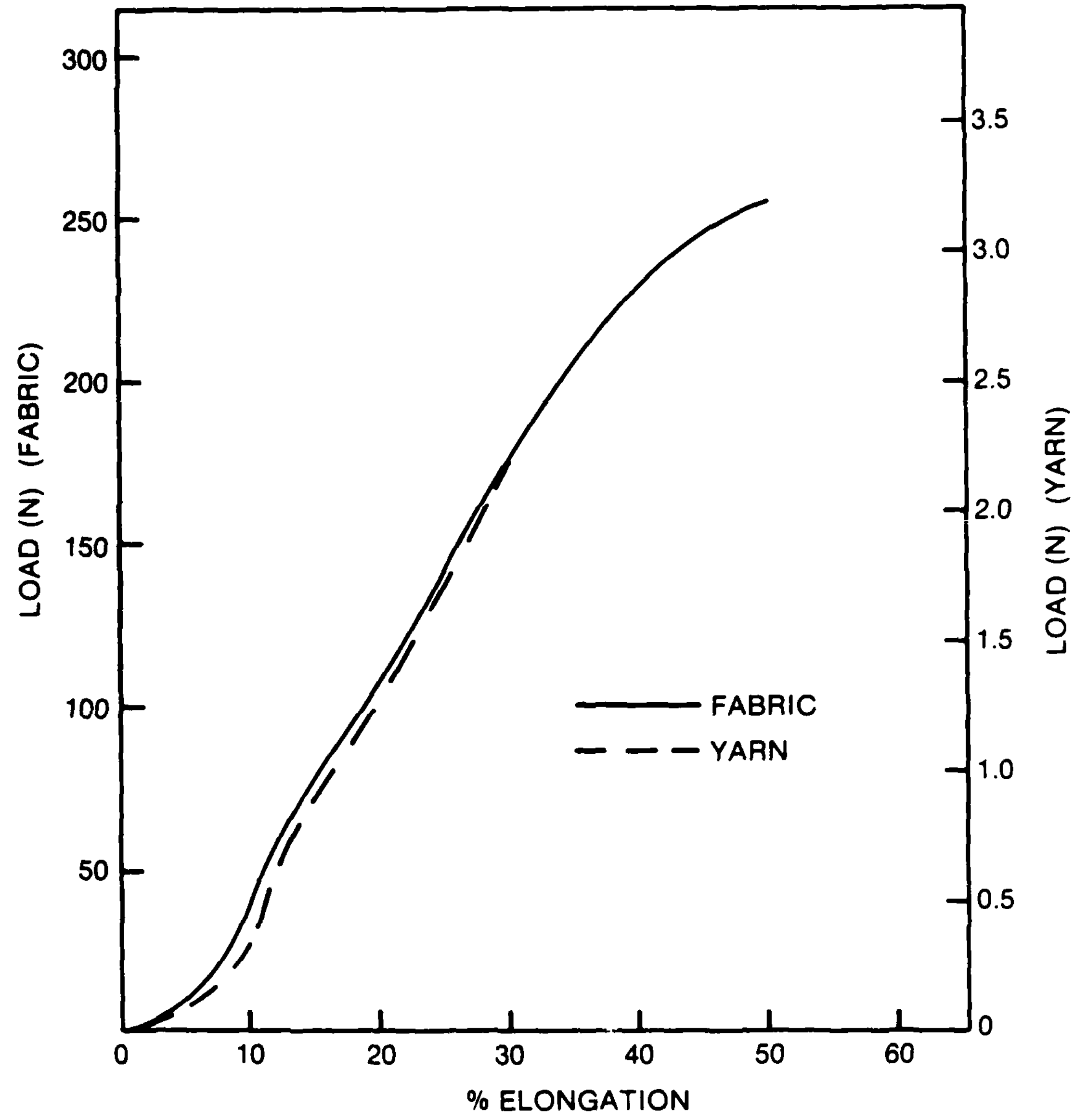

Figure A-10: The Load-Elongation Curves of Polyester B Warp at 20°C.

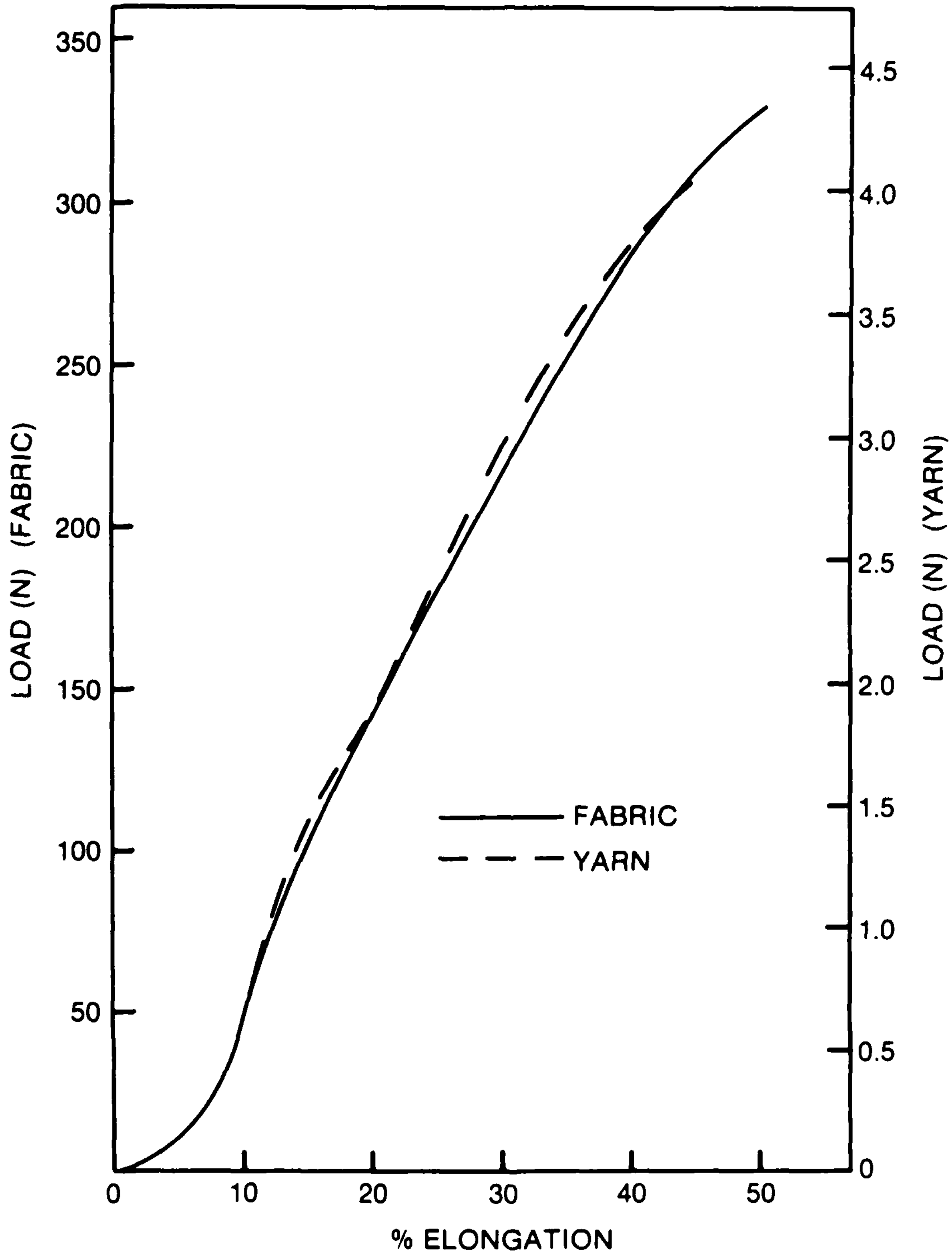

Figure A-11: The Load-Elongation Curves of Polyester B Warp at -40°C.

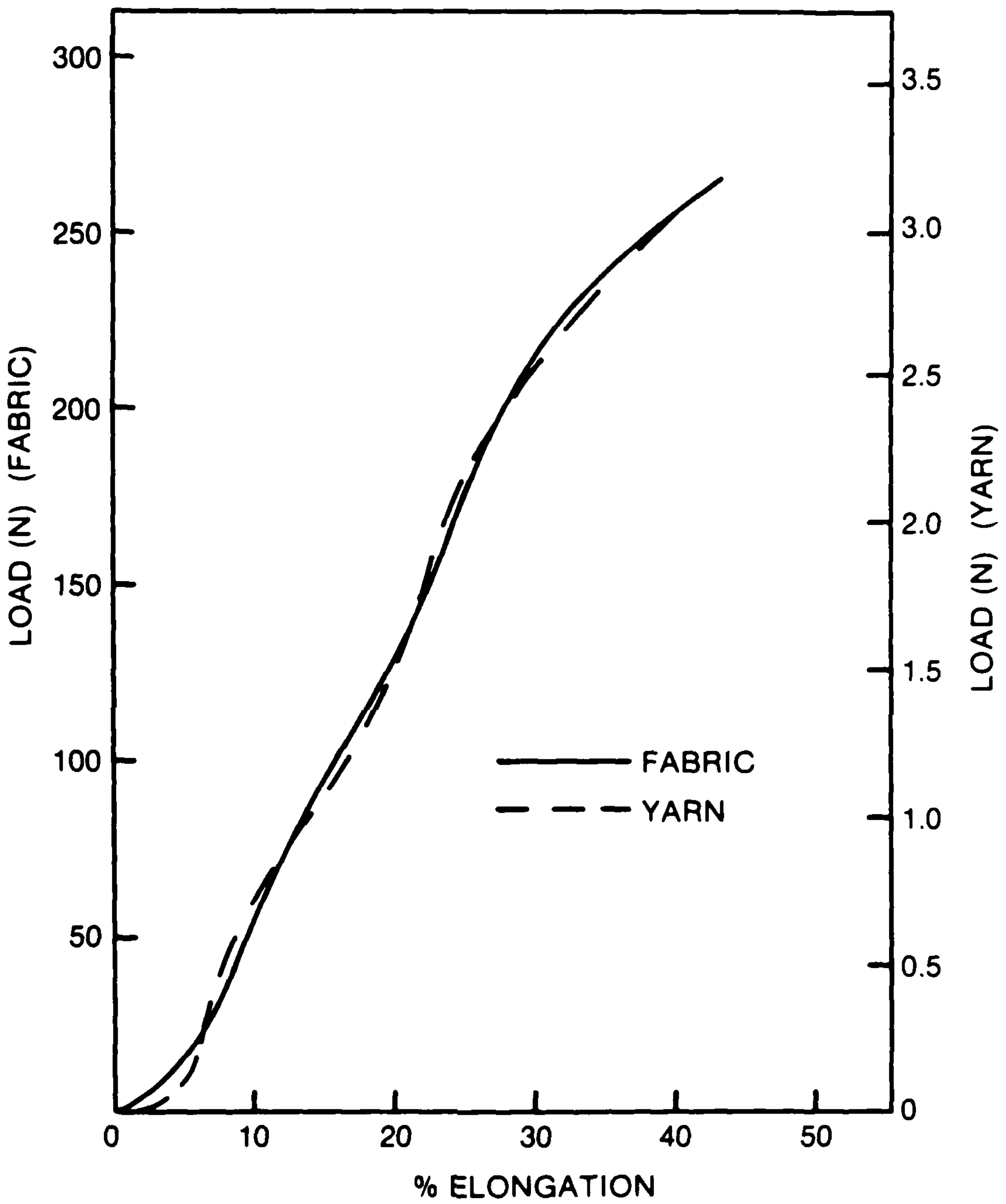

Figure A-12: The Load-Elongation Curves of Polyester B Weft at 20°C.

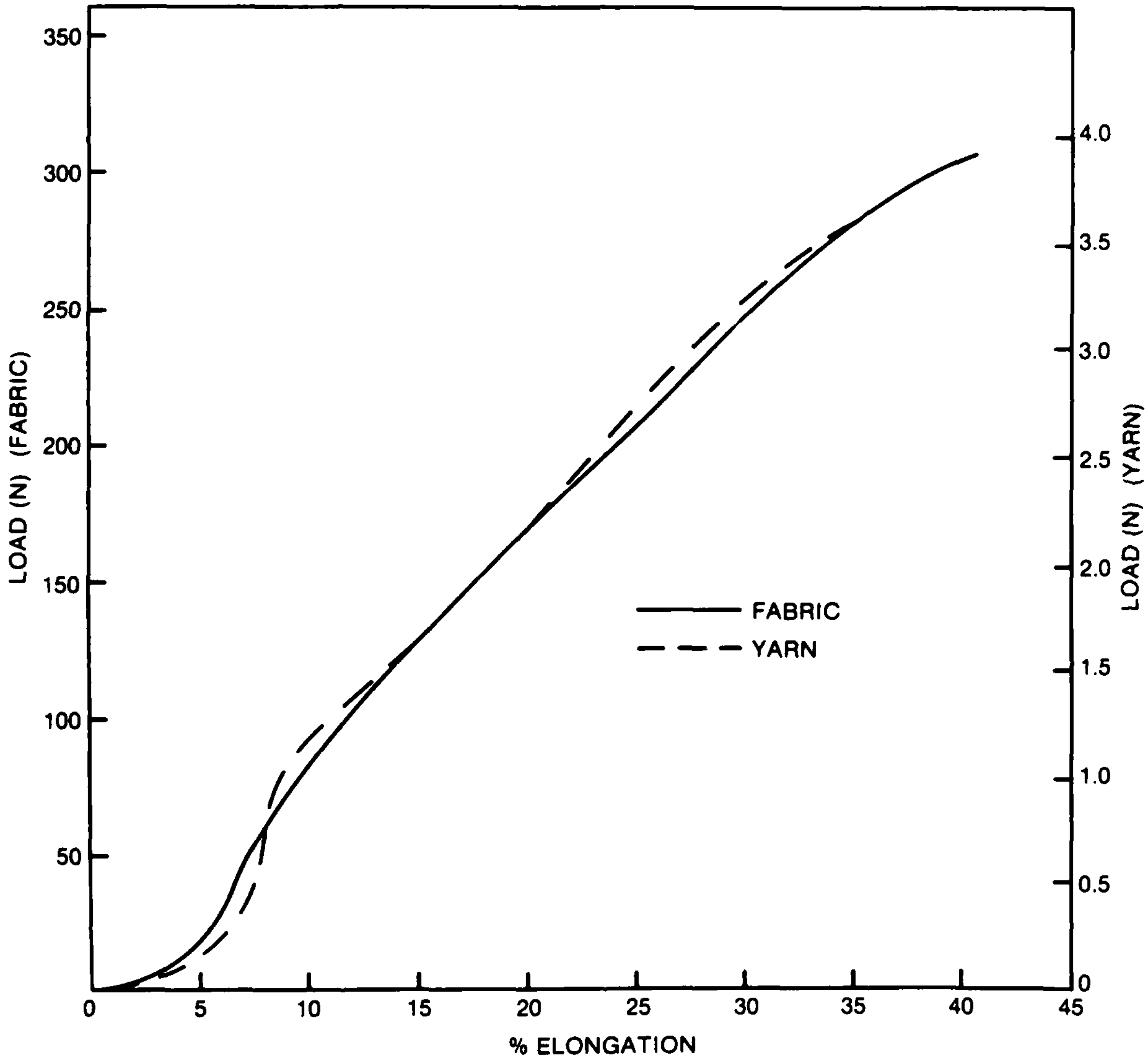

Figure A-13: The Load-Elongation Curves of Polyester B Weft at -40°C.

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13 ABSTRACT

A previous study by the authors on the effect of low temperatures on coated and uncoated fabrics raised certain points which were left unanswered. This study addresses these points. It was found that the load-elongation curve of a fabric is not necessarily the same as that of a yarn or a filament; differences in the percent elongation at break of a fabric and its yarn depend on the physical properties of the yarn; inconsistent differences in the percent change in the percent elongation at break for warps and wefts of the same fabric as the temperature is decreased is procedure-dependent and it is the fabric, yarn and filament working in concert which gives each fabric its unique load-elongation curve.

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TEXTILE FIBRES
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ELONGATION
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