THE EFFECT OF CHANGING WEFT COUNTS & DENSITY FOR THE SAME WEIGHT PER UNIT AREA ON SOME PROPERTIES OF PRODUCED FABRIC

تأثير تغيير نمر وكثافات خيوط اللحمة لنفس وزن النسيج على بعض خواص القماش الناتج

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الغرض من البحث:
يهدف هذا البحث إلى تثبيت وزن المتر المربع من الأقمشة البولي استر مع استخدام نمر مختلفة من خيوط اللحمة وتغيير تبعا لذلك كثافة هذه الخيوط وكانت النمر المختارة لاستخدامها لنوعين من خيوط اللحمة المبنطة والغير مبنطة هي١٠٠ و ١٥٠ و ٣٠٠ دنير وبالتالي كانت الكثافات المقابلة لهذه النمر هي ٣٦ و ٢٤ و ١٢ خيط لحمة لكل سنتيمتر على الترتيب مع استخدام سداء واحد فى جميع الحالات. وقد أظهرت النتائج المستخلصة من البحث أن استخدام النمر الأرفع (كثافة أعلى) لخيوط اللحمة تعطى أقمشة لها قدرة عالية على الرجوعية بعد التجعد بينما استخدام النمر الأسمك (كثافة أقل) تعطى أقمشة ذات متانة عالية وسمك اكبر ونفاذية أعلى للهواء.

ABSTRACT:
The aim of this work is to fix the weight per unit area of the polyester fabrics. This is happens by changing the weft density according to it's count. Three weft counts were chosen for this study 100, 150, 300 denier twisted / untwisted polyester yarns, where the warp was constant in all cases. The results obtained showed that the finer weft counts (higher density) give higher crease recovery fabrics, where the thicker weft counts (lower density) give fabrics that have more strength, air permeability and thickness.

INTRODUCTION:
The first use of polyester filaments was in knit shirts and blouses for women. The filaments were also used in glass curtains. Both smooth and textured filaments have had wide use in career apparel such as uniforms for nurses and waitresses. Where as the first use of staple polyester was in tropical suiting for men's summer suits. The suits were light in weight and machine washable. The very low absorbency of polyester fibres limited the comfort factors of these garments, a disadvantage that was overcome by blending with cotton and / or wool.

The polyester is noted for their ability to impart strength, wrinkle resistance, and ease of care to fabrics and garments. Strength and abrasion resistance of polyester are quite high and the wet strength is comparable to the dry strength. The high strength is developed by hot – drawing or stretching to develop crystallinity and also by increasing the molecular weight.

Accepted June 22, 2003.

A safe ironing temperature of 325° F may be used on filament polyester if the fabric has been properly heat – set. If the fabric is made of stable fibre, it should be pressed at lower temperature and the time of exposure and the pressure of the iron should be carefully controlled to prevent glazing or shining.

MATERIALS & METHODS:

Two different fabric constructions were chosen for this study plain& satin 5, they manufactured with the same warp in the laboratories of faculty of engineering , Mansoura University, but the weft were 100. 150. 300 denier twisted & untwisted yarns. The density of the weft was chosen in order to keep the weight per unit area still constant and the fabric specifications were as follows:

Fabric construction	Yarn count (Denier) Warp	Weft	Yarn density /cm Warp	Weft	Weight per unit area Gm/mt²
PLAIN	150	100	25	36	85
	150	150	25	24	85
	150	300	25	12	85
SATIN 5	150	100	25	36	85
	150	150	25	24	85
	150	300	25	12	85

Theoretical weight per unit area was calculated as follows:

Warp weigh $= (1 + 0.03) * 25 * 150 * 100 / 9000$ gm / mt²
≈ 43 gm / mt²

Weft weight $= (1 + 0.05) * 36 * 100 * 100 / 9000$ for fabric 1
$= (1 + 0.05) * 24 * 150 * 100 / 9000$ for fabric 2
$= (1 + 0.05) * 12 * 300 * 100 / 9000$ for fabric 3
$= 42$ gm / mt² for all fabrics.

Where Cw & Cf are the warp & weft crimp ratio, Dw & Df are the warp & weft counts in Denier, E.P.Cm. & P.P.Cm. are the warp & weft density per cm. respectively.

EXPERIMENAL WORK:

The obtained fabrics were taken to the laboratories (Mansoura University), in order to investigate the following properties according to ASTM [1] : tensile strength & breaking elongation ; bending length ; fabric thickness ; air permeability ; crease resistance ; fabric cover factor and the phase of fabric construction.

YARN COUNT (DENIER)		CRIMP RATIO %		YARN DENSITY (YARNS / CM)							
WARP	WEFT	WARP	WEFT	WARP	WEFT	Yw	Yf	Hw	Hf	Kr	Fr
150	100	3	5	25	36	0.251	0.329	0.0697	0.1316	0.5296	3.77
150	150	3	5	25	24	0.251	0.329	0.1046	0.1316	0.7948	4.54
150	300	3	5	25	12	0.251	0.329	0.2092	0.1316	1.5897	5.91

Where : **Yw & Yf** : empirical forms as a function in warp & weft crimp respectively;
Hw & Hf : empirical forms for calculating warp & weft height respectively ;
Kr : empirical form as a percentage between warp & weft wave heights;
Fr : the phase of fabric construction. [2]

$$\mathbf{Yw} = \sqrt{Cw\,(200 - Cw)}\,/\,(100 - Cw) \quad ; \quad \mathbf{Yf} = \sqrt{Cf\,(200 - Cf)}\,/\,(100 - Cf)$$
$$\mathbf{Hw} = 10\,Yw\,/\,P.P.Cm \quad ; \quad \mathbf{Hf} = 10\,Yf\,/\,E.P.Cm$$
$$\mathbf{Kr} = Hw\,/\,Hf$$
$$\mathbf{Fr} = (1 + 9\,Kr)\,/\,(1 + Kr)$$

RESULTS & DISCUSSION:

The obtained fabrics were taken to investigate their properties [1 , 3]: thickness, coefficient of crease resistance, tensile strength & extension and cloth cover factor. The figures (1 – 15) show the results obtained and trends of behavior for each sample.

From the results obtained we notice that :

- the fabric thickness increases by increasing the weft count / decreasing density , this is due to using coarser yarns. Coarser yarns leads to enlarge fabric thickness. This happens in cases of twisted / untwisted yarns. (fig. 1 – 2)

- the coefficient of crease resistance decreases by increasing the weft counts / decreasing density , this is due to using coarser yarns. This happens in cases of twisted / untwisted yarns. (fig. 3 – 4)

- by increasing the weft count / decreasing weft density , the fabric air permeability increases, while the fabric cover factor decreases. This is due to using coarser yarns. Using coarser yarns leads to enlarge yarns interspaces which leads to decrease fabric cover factor / increase air permeability. This happens in the cases of twisted / untwisted yams. (fig. 5 , 6 , 17)

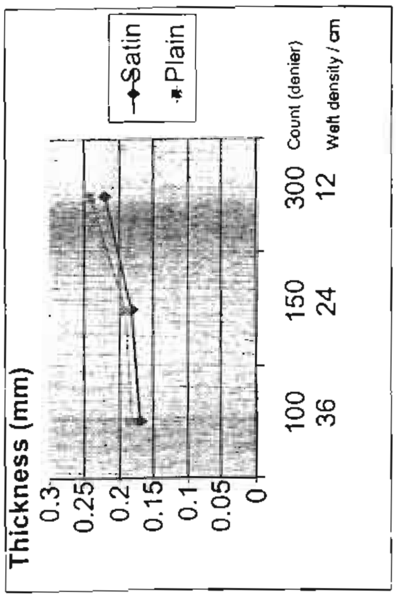

Fig (1) The relationship between fabric thickness & weft count / density for twisted yarns

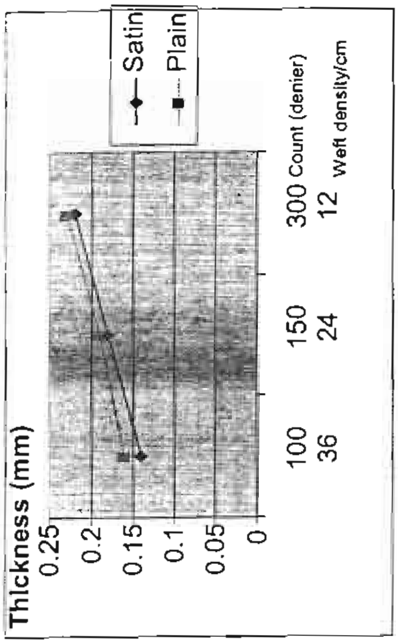

Fig (2) The relationship between fabric thickness & weft count / density for untwisted yarns

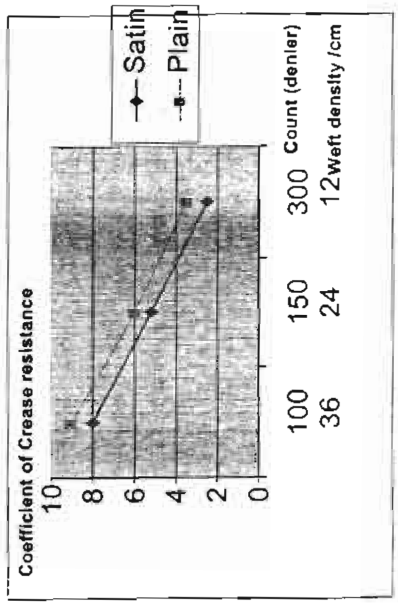

Fig (3) The relationship between coefficient of crease resistance & weft count/ density for twisted yarns

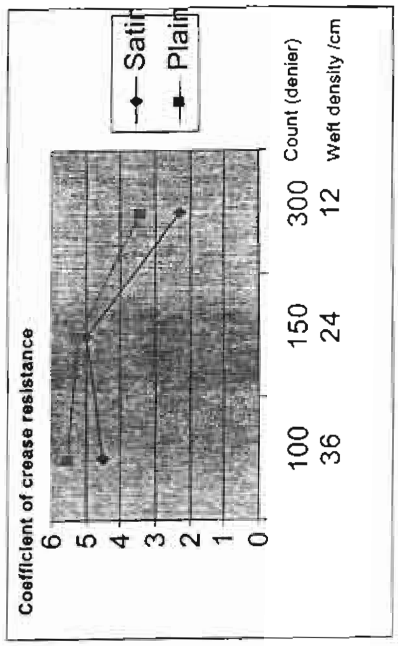

Fig (4) The relationship between coefficient of crease resistance & weft count / density for untwisted yarns

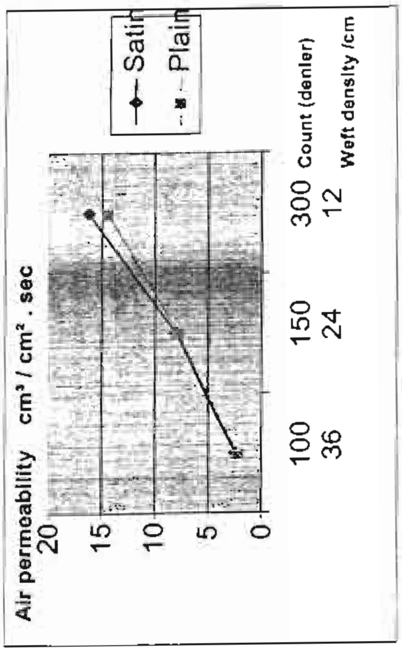

Fig (5) The relationship between fabric air permeability & weft count / density for twisted yarns

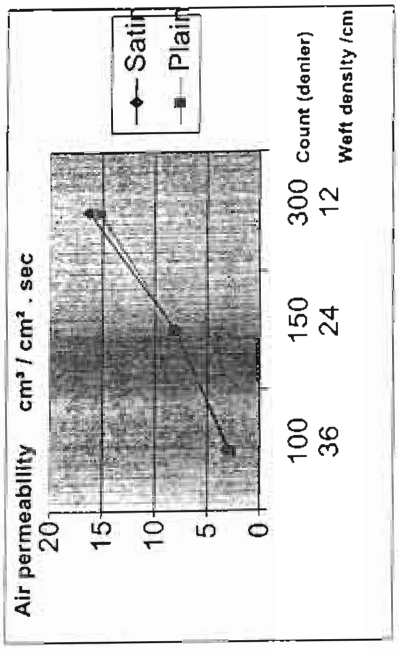

Fig (6) The relationship between fabric air permeability & weft count / density for untwisted yarns

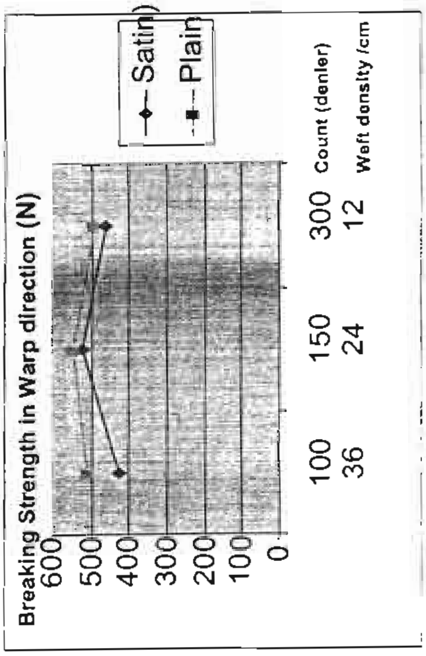

Fig (7) The relationship between fabric strength in warp direction & weft count / density for twisted yarns

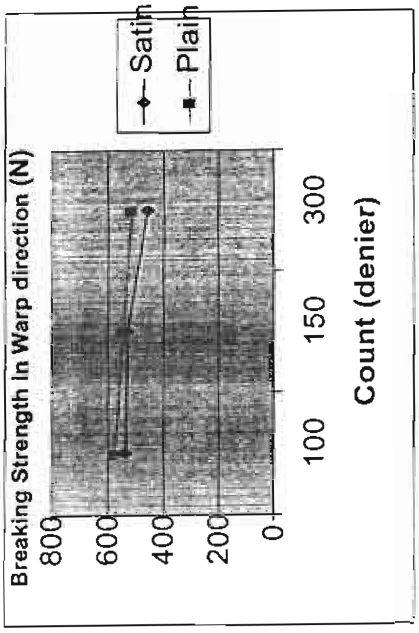

Fig (8) The relationship between fabric strength in warp direction & weft count / density or untwisted yarns

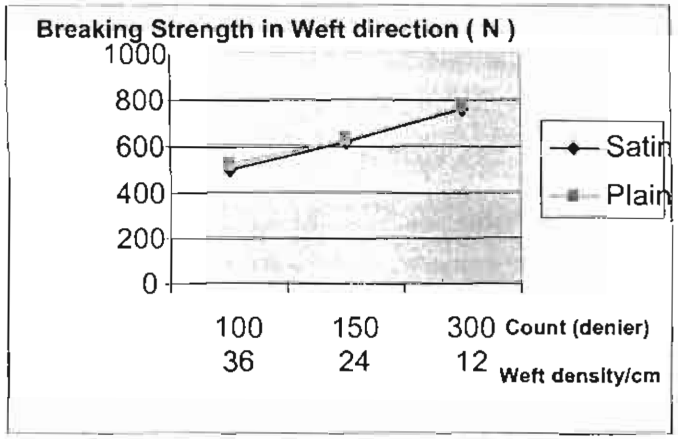

Fig (9) The relationship between fabric strength in weft direction & weft count / density for twisted yarns

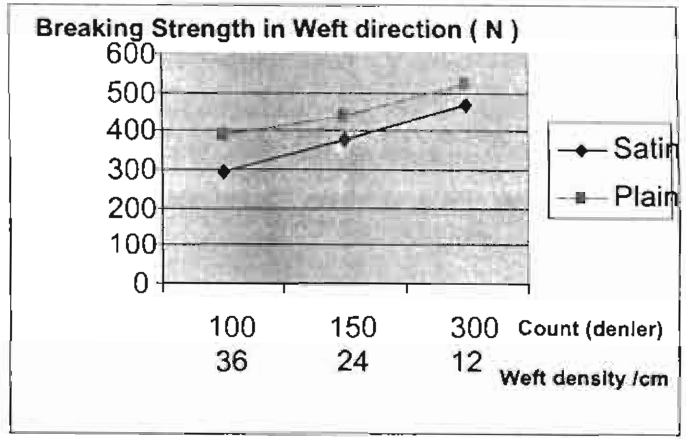

Fig (10) The relationship between fabric strength in weft direction & weft count / density for untwisted yarns

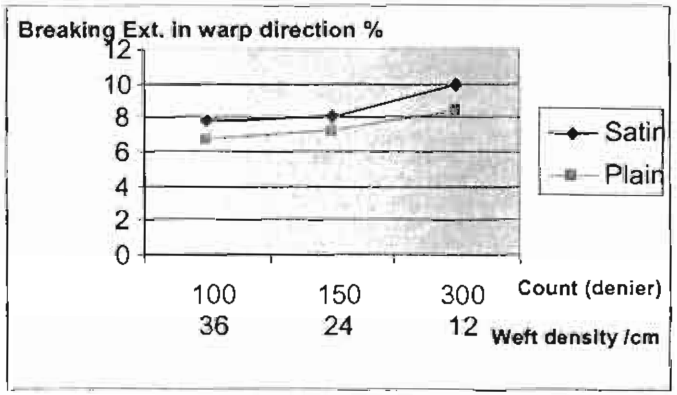

Fig (11) The relationship between fabric breaking extension in warp direction & weft count / density for twisted yarns

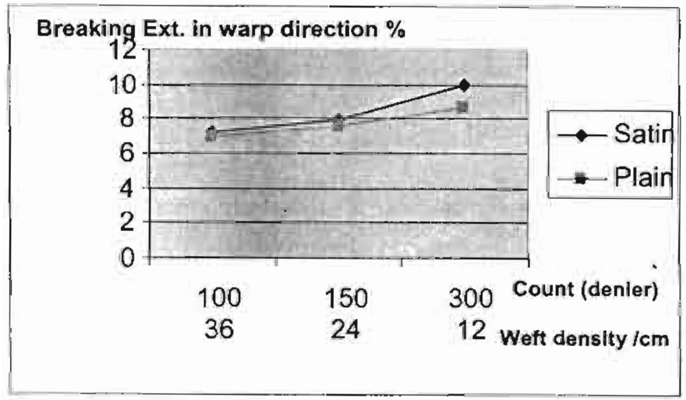

Fig (12) The relationship between fabric breaking extension in warp direction & weft count / density for untwisted yarns

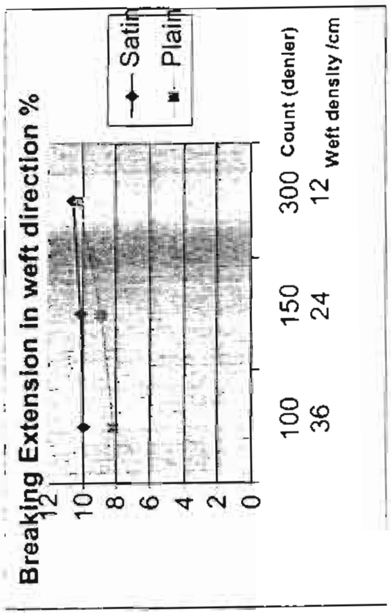

Fig (13) The relationship between fabric breaking extension in weft direction & weft count / density for twisted yarns

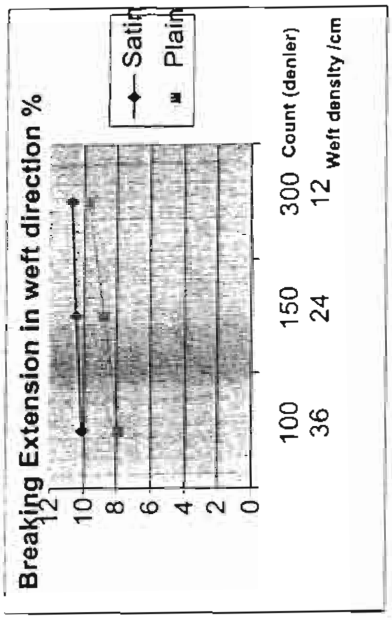

Fig (14) The relationship between fabric breaking extension in weft direction & weft count / density for untwisted yarns

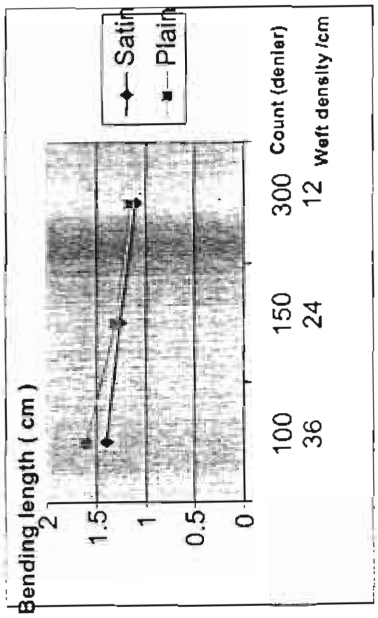

Fig (15) The relationship between the bending length in the warp direction & weft count / density for twisted yarns

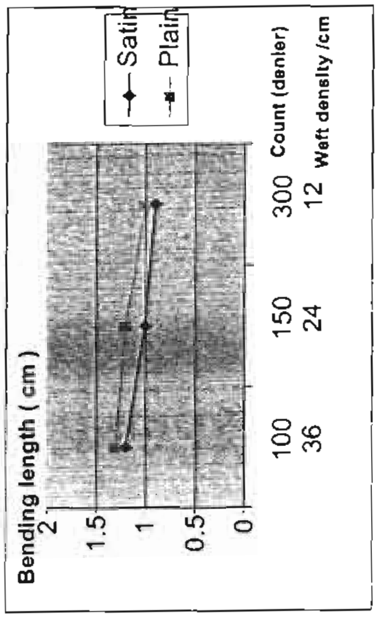

Fig (16) The relationship between the bending length in the warp direction & weft count / density for untwisted yarns

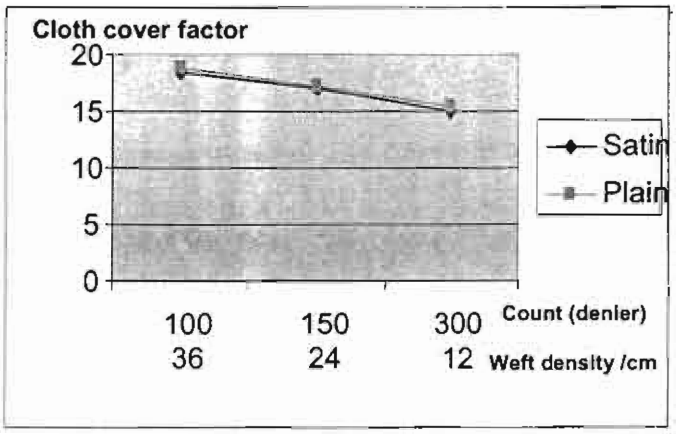

Fig (17) The relationship between fabric cover factor & weft count / density for twisted yarns

- the tensile strength in the warp direction increases by increasing the weft count / decreasing weft density for twisted yarns ,but in case of untwisted yarns it decreases by increasing the weft count / decreasing density. (fig. 7 , 8)

- the tensile strength in the weft direction increases by increasing the weft count / decreasing weft density .This is happens in the cases of twisted / untwisted yarns. (fig. 9 , 10)

- the breaking extension in the warp / weft direction increases by increasing the weft count / decreasing density , for the cases of twisted / untwisted yarns. (fig. 11 - 14)

- the bending length in the warp direction decreases by increasing the weft yarn count / decreasing density. The lower bending length means less stiffness for coarser yarn. More stiffness for higher density of yarns causing less mobility. This happens in the cases of twisted / untwisted yarns. (fig. 15-16)

- by increasing the weft count from 100 Denier to 300 Denier, the phase of fabric construction increases from 4^{th} degree to 6^{th} degree. This means that the degree of the displacement of warp & weft threads changes. And 5^{th} degree is the optimum degree that gives more suitable fabric [4]. This happens in case of using weft count 150 Denier and weft density of 24 P.P.Cm.

CONCLUSION:

By increasing weft count from 100 denier to 300 denier (decreasing weft density from 36 to 12 P.P.Cm.), we notice that bending length, crease recovery or fabric cover factor decreases while fabric thickness, fabric strength in both direction and also extension increases.

So, in order to obtain fabrics that have a higher cover factor, crease recovery or stiffness we must use a lower weft counts 100 denier (higher weft density 36 p.p.cm). But in order to obtain fabrics that have more strength, air permeability or thickness, we must use a higher weft counts 300 denier (lower weft density 12 p.p.cm).

In order to obtain more regular fabric in the phase of it's construction 5^{th} degree we must use medium weft count 150 denier / medium density 24 p.p.cm.

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