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THE EFFECT OF DEPTH OF SHADE ON KNITTED COTTON FABRIC PROPERTIES

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C O N T E N T S

A P P E N D I C E S

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1. INTRODUCTION

During the ongoing analysis work on the vast amount of data, amassed over the years in connection with the STARFISH project, it has been suggested that there may be slight differences in certain fabric properties which may, or may not be attributable to the amount of dyestuff which has been applied to the fabric. This on the face of it may be considered to be a feasible possibility, since the deposition of dyestuff into the fibres should in theory affect the weight and therefore count of the yarn. Yarn count is also one of the variables in the equations which are used to calculate for example, relaxed courses, relaxed wales, relaxed weight.

On a commercial level it is normal to class dyed fabric into one of three categories viz pale, medium, deep. The amount of dyestuff which needs to be applied to the fabric in order to acquire a certain depth of shade is highly variable dependent on class of dyestuff, colour and fabric pretreatment (e.g. mercerisation). The practical dyer normally refers to the depth of shade of a particular dyeing by reference to the actual amount of dyestuff which he has to place in the dyeing vessel. This is usually calculated by reference to the manufacturers shade cards and is based on the weight of fabric to be dyed.

The dyestuff supplied to the dyer is usually of consistent strength, but contains other components as well as the colouring agent. For example, dispersing agents, anticaking agents, anti-dusting agents etc. are usually added. The actual colouristic strength of the supplied dyestuff powder or liquid is seldom known by the dyer and is of little interest to him, provided that it is of consistent strength and corresponds with the dyestuff used to prepare the manufacturers shade cards.

Where variations in dyestuff strength are unavoidable in manufacture the manufacturer normally quotes a strength factor which enables the dyer to make corrections to his dyeing recipes.

The amount of dyestuff or colouring component which actually remains on the fabric after a dyeing is therefore dependent on a number of factors including:-

- depth of shade
- strength of original dyestuff
- degree of exhaustion

To try to determine whether the depth of shade does have an effect on fabric properties, it was decided to prepare a set of fabrics where the depth of shade was systematically altered and to measure a number of the more important properties to determine whether measureable differences are in fact detectable.

2. EXPERIMENTAL DETAILS

The number of variables in such an evaluation needs to be kept to a minimum, so that any detectable differences can be directly attributable to the amount of dyestuff remaining on the fabric.

The most important dyestuff class as far as cotton knitted outerwear is concerned is fibre reactive. Within this class of dyestuffs is a particular brand manufactured by ICI which is claimed to have a high degree of exhaustion and which is insensitive to liquor to goods ratio. A particular dyestuff from this range

was chosen for the initial investigation, this being Procion Red HE 3B.

Since fabric preparation can have a profound influence on fabric properties and in particular yarn count it was felt necessary to carry out the dyeing trials on fabric which had received standard preparation, rather than use ecru fabric and give individual preparation treatments prior to dyeing. The fabric used for these trials was therefore taken from a roll of interlock fabric, which was purchased from Meridian a few years ago, as a standard fabric for resin finishing trials.

This fabric was 20 gauge interlock, made from 1/38's Ne yarns, at a stitch length of 0.338 cms. It was bleached at Meridian in a winch using hydrogen peroxide, with optical brightening agent incorporated, but no softening agent was applied. The fabric was simply winch bleached, hydroextracted, slit and stenter dried.

A number of samples of size 24 cm x 36 cm were cut from this roll of fabric and wound onto individual perforated cylinders from the AHIBA laboratory dyeing machine. Each samples was weighed in turn, all the samples being approximately 14g.

A range of dyeings was produced using the recommended dyeing procedure at liquor ratios of 15 to 1. The dyeings were over the range 0% to 10% of dyestuff on weight of sample in steps of 1%. The 0% level was a blank dyeing with additions of salt and alkali, but without dyestuff. The dyeing cycle and the rinsing was the same as for the dyed samples.

The recommended quantity of salt is dependent on depth of shade and was 40g/l for the 0% and 1% levels and was raised proportionately to 100g/l for the 10% level. The alkali used was soda ash and the recommended level of 20g/l was used across the shade range. The dyeing procedure was as follows:-

1) dyebath set at 40°C
2) salt added portionwise over 30 mins
3) alkali added (predissolved) and dyeing continued for 10 mins.
4) temperature raised to 80°C
5) dyeing continued for 60 mins
6) samples rinsed until clear in running hot water
7) soaped off in 0.1g/l Synperonic NX at boil for 30 mins
8) hot rinse
9) cold rinse
10) line dried

The complete range of dyeings was repeated giving two replications in all.

The samples were submitted to the testing laboratory together with samples of the bleached only fabric for testing.

Testing was carried out after the samples had been restored to their reference state, using the IIC standard procedure. The samples were tested for Tex, stitch length, courses/3cm and wales/3cm. The test results are given in Table 1.

Samples of the dyed fabric were mounted and are attached to this report.

3. OBSERVATIONS

In the table and on the figures the bleached only fabric is designated CONTROL. The properties of Tex, stitch length, courses/3cm and wales/3cm are plotted against the depth of shade in Figures 1 to 4. Where applicable the 95% confidence intervals have been included. The average of the two replications has also been included. If each property in turn is evaluated the following picture emerges:

3.1. Tex (Figure 1)

Differences exist between the two replications but there is a distinct trend that Tex increases as the depth of shade increases. If the average line is considered this increases from a Tex of 14.75 up to a maximum of 15.0. In percentage terms this is an increase of 1.7%.

Clearly more replications need to be done in order to obtain a more precise figure but it would appear that over a wide range of depth of shade such as this, the Tex increase would not be expected to be higher than say 2.5% which with all other factors equal should be seen as a corresponding change in fabric weight.

3.2. Stitch Length (Figure 2)

There is no evidence to suggest that depth of shade has any effect on the relaxed stitch length.

3.3. Courses (Figure 3)

Here again there is no evidence to suggest that depth of shade has any influence on the reference courses given that the dyeing procedure is standardised.

3.4. Wales (Figure 4)

The same conclusion applies to the relaxed wales. The overall variation of the average of the two replications is within the confidence intervals of the individual means.

4. CONCLUSIONS

This somewhat limited study has shown that over a wide range of depths of shade, the only property which shows a measureable differnce is yarn Tex, which will be transmitted to fabric weight. The stitch length and the dimensional properties remain the same. The changes in Tex which were measured in this exercise were rather small with a maximum increase of perhaps 2.5% which, when considering

the normal variation in tex of the delivered yarn is not very large.

When considering depth of shade, however, there may be other factors which influence the situation. In this investigation fabric pretreatment and dyeing methods were kept the same. In the commercial world, this may not necessarily be the case. For instance, fabrics being dyed to a pale shade may be pre-bleached in order to obtain brightness, whereas deep-dyed fabrics or indeed those dyed to a medium shade may simply be given a mild scour. This in itself may have an effect on Tex or indeed structure. The depth of shade may very well influence the choice of dyeing machine to be used. Deep shades for example may be dyed in jets where the liquor to goods ratio is considerably lower than for winches. So, the depth of shade to which a fabric has been dyed is not a clear cut case of simply the amount of dyestuff which was added to the dyeing vessel and unless a clear history of that fabric is known it would be difficult to make precise allowances for Tex changes due to depth of shade for example when setting specifications.

With this in mind, however, it would appear that differences in yarn tex are detectable and are due to the weight of dyestuff being applied to the fabric.

DEPTH OF SHADE	YARN TEX	REPLICATION 1						YARN TEX	REPLICATION 2					
		STITCH LENGTH*		COURSES/3CM		WALES/3CM			STITCH LENGTH*		COURSES/3CM		WALES/3CM	
		Mean	95%CL	Mean	95%CL	Mean	95%CL		Mean	95%CL	Mean	95%CL	Mean	95%CL
CONTROL	14.5	3.339	0.01	45.8	0.3	44.0	0.3	15.0	3.359	0.01	45.3	0.4	46.0	0.5
0%	14.6	3.331	0.01	46.3	0.4	44.6	0.4	14.9	3.376	0.004	45.6	0.4	45.8	0.5
1%	14.8	3.341	0.01	46.3	0.4	44.5	0.4	14.9	3.373	0.003	46.3	0.5	45.6	0.4
2%	14.7	3.348	0.01	45.7	0.4	44.7	0.4	15.1	3.366	0.004	46.3	0.5	45.5	0.4
3%	14.8	3.347	0.01	45.5	0.4	43.8	0.3	15.0	3.363	0.003	45.3	0.4	44.9	0.4
4%	14.9	3.343	0.01	45.4	0.4	44.1	0.4	15.2	3.365	0.004	45.1	0.4	45.1	0.4
5%	14.9	3.338	0.01	45.6	0.4	44.3	0.5	15.1	3.361	0.002	45,4	0.4	45.2	0.3
6%	15.0	3.348	0.01	45.6	0.5	44.1	0.2	15.1	3.362	0.003	45.3	0.4	45.2	0.3
7%	15.3	3.342	0.01	45.6	0.4	44.4	0.4	14.9	3.358	0.01	45.4	0.4	44.9	0.2
8%	15.1	3.345	0.01	45.4	0.4	44.6	0.4	15.0	3.362	0.003	46.5	0.4	44.9	0.5
9%	15.0	3.336	0.01	45.8	0.3	44.6	0.4	15.0	3.357	0.003	45.0	0.5	44.7	0.6
10%	15.0	3.356	0.01	45.2	0.3	44.1	0.4	15.0	3.350	0.01	45.6	0.4	45.2	0.5

* Stitch Length in mm.

TABLE 1

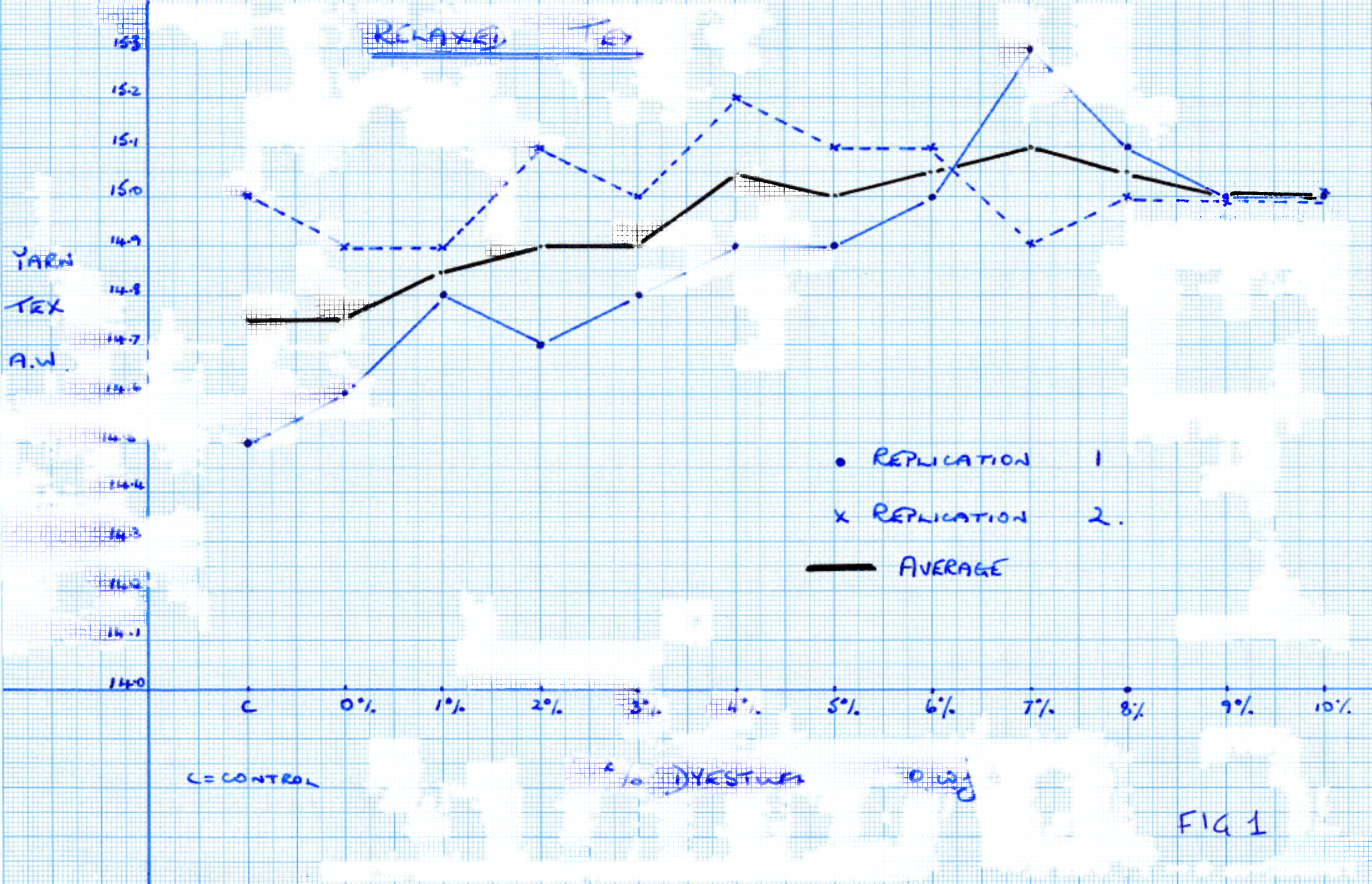

RELAXED
YARN TEX
A.W.
15.3
15.2
15.1
15.0
14.9
14.8
14.7
14.6
14.5
14.4
14.3
14.2
14.1
14.0
• REPLICATION 1
x REPLICATION 2.
AVERAGE
C
0%
1%
2%
3%
4%
5%
6%
7%
8%
9%
10%
C = CONTROL
% DYESTUFF

FIG 1

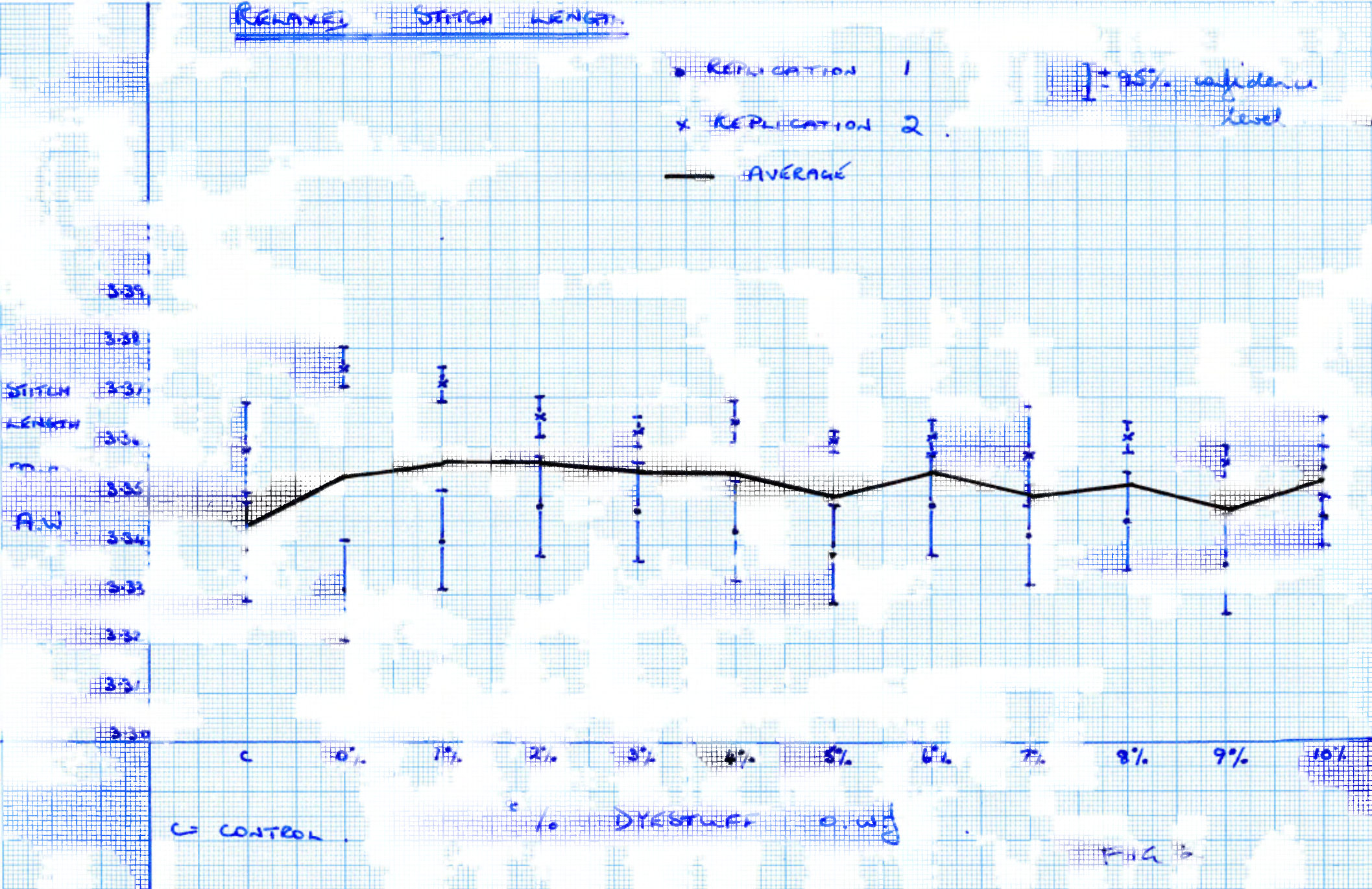

RELAXED STITCH LENGTH
• REPLICATION 1
× REPLICATION 2
— AVERAGE
± 95% confidence level
STITCH LENGTH
A.W
3.35
3.34
3.33
3.32
3.31
3.30
C
0%
1%
2%
3%
4%
5%
6%
7%
8%
9%
10%
C = CONTROL
% DYESTUFF o.w.f.

FIG 6

RELAXED COURSES.

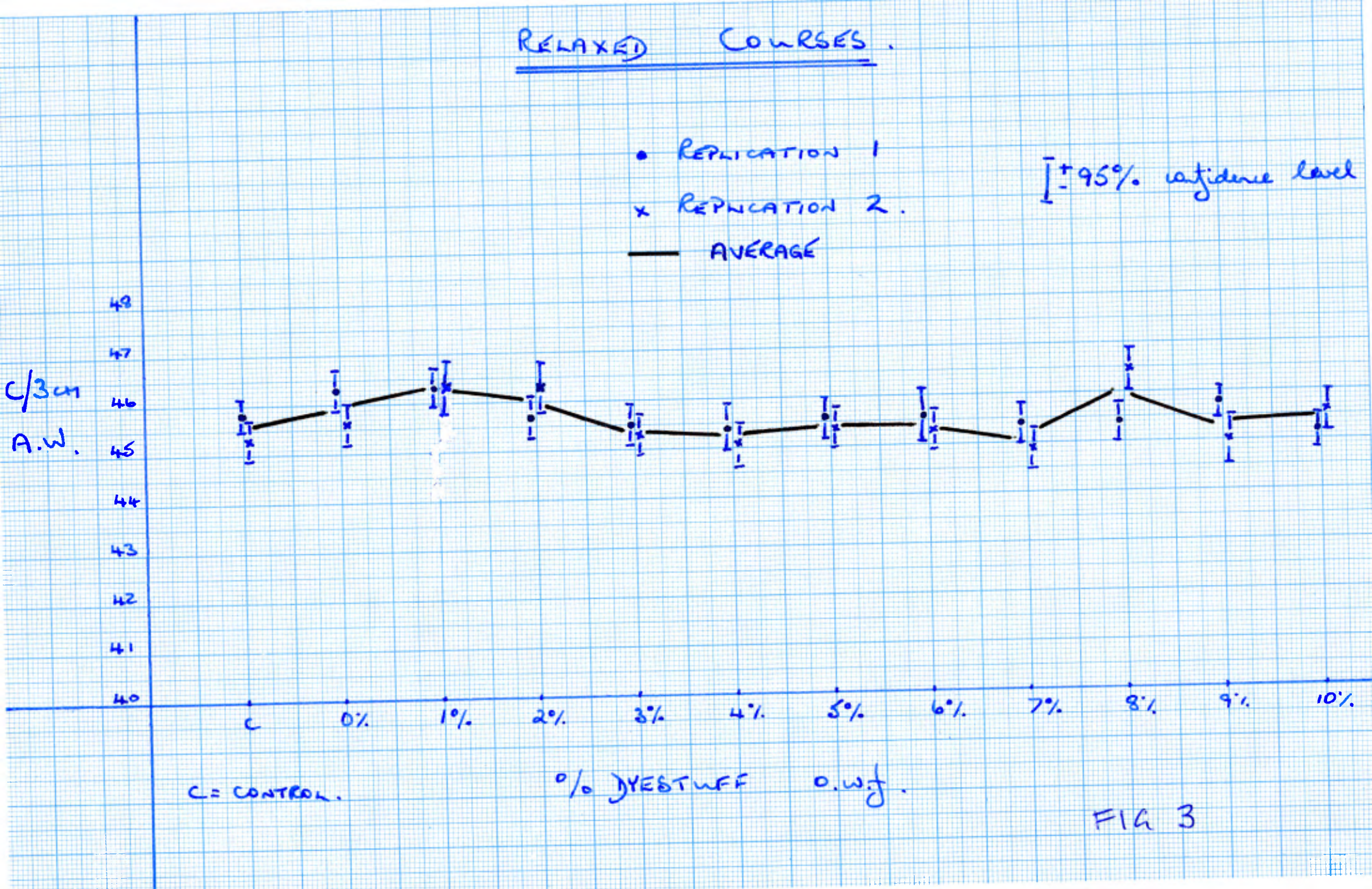
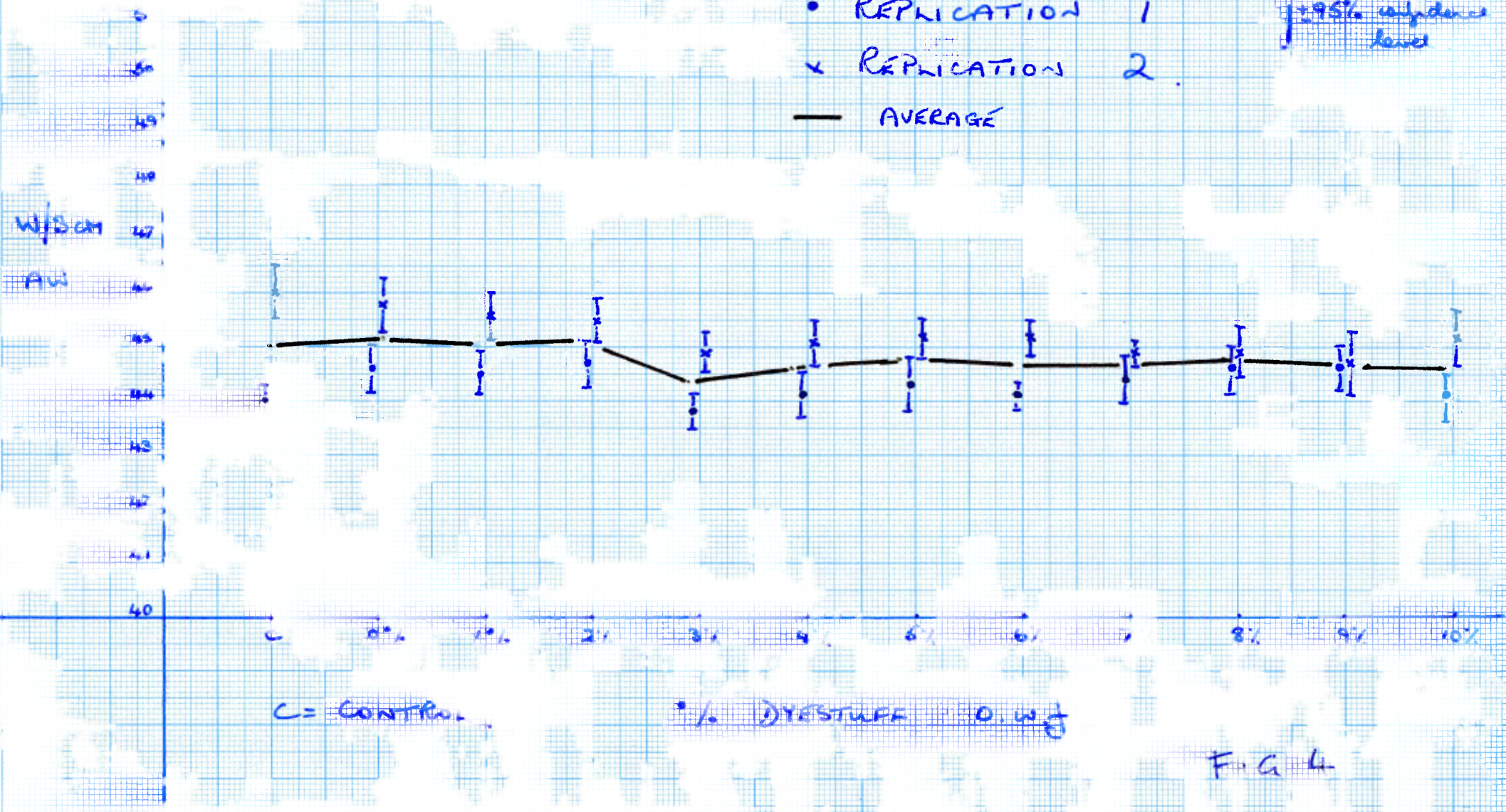


FIG 3

RELAXED WALES



C = CONTROL

% DYESTUFF O.W.S

FIG 4

DEPTH OF SHADE % o.w.f.

REPLICATION 1. REPLICATION 2.

1%

2%

3%

4%

5%

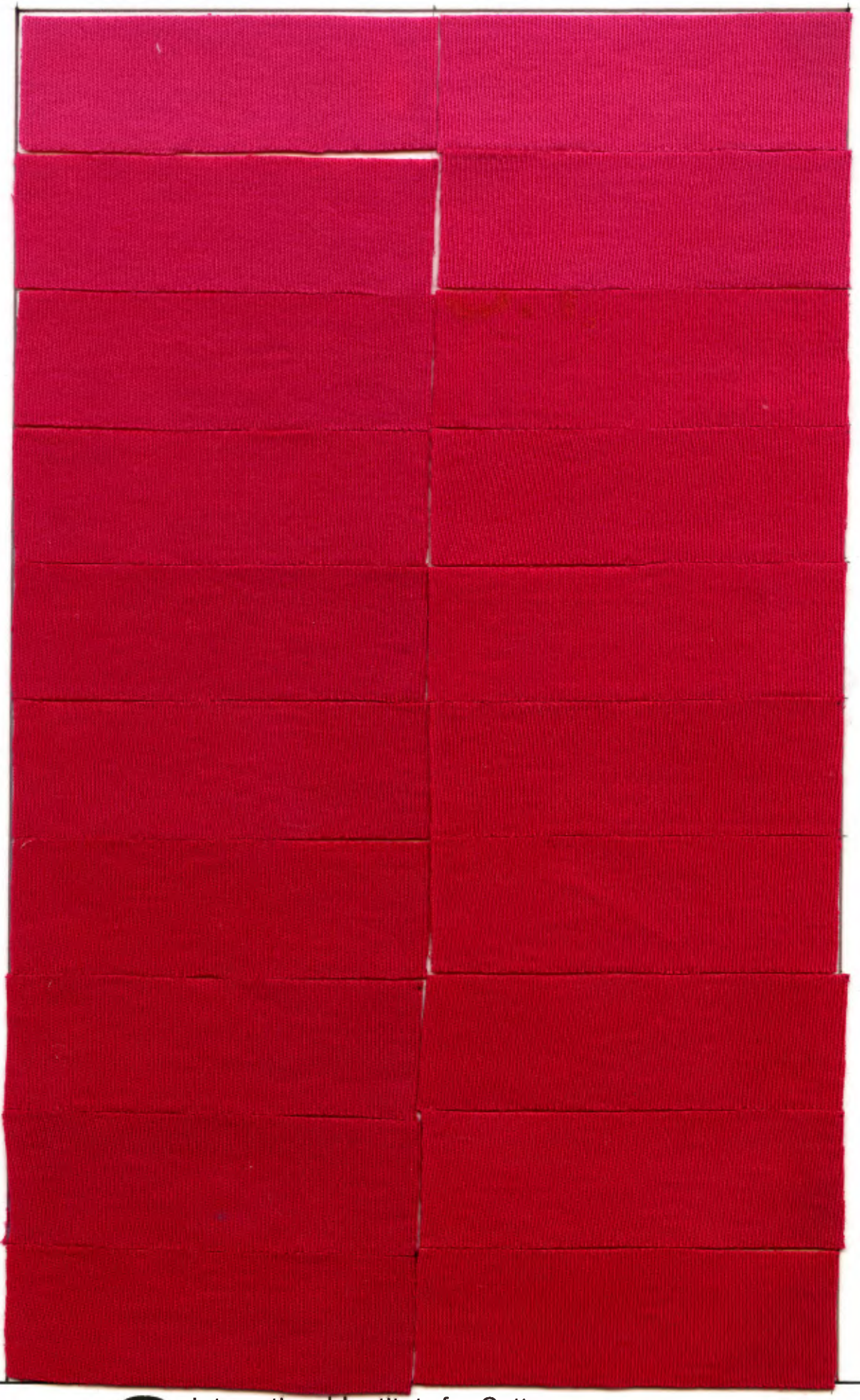
6%

7%

8%

9%

10%



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