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OBJECTIVE MEASUREMENT OF "OBJECTIONABLE" MEDULLATED FIBRES IN COMMERCIAL MOHAIR TOPS USING AN OPTICAL FIBRE DIAMETER ANALYSER (OFDA) - AN INTRODUCTORY STUDY

by

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SUMMARY:

In a quest to find an objective measure of those medullated fibres which "stand out" as being "optically different" and "objectionable" to the naked eye when viewed against their surrounding fibres in commercial mohair tops (including good quality tops containing relatively few such fibres), researchers at Gubb & Inggs have carried out exploratory studies using Cape, Texas and Turkish mohair spanning a wide range of diameter and "objectionable" medullated fibre count.

The results have indicated that there is a good statistical fit between the number of "objectionable" medullated fibres counted visually at Gubb & Inggs and the number of medullated fibres (excluding "flat" fibres) counted on the OFDA, the statistical fit passing through a peak at an opacity threshold level of approximately 92 percent.

This technique of measurement could, for the first time ever, offer a rapid, practical and cost-effective means for the objective measurement of objectionable medullated fibres in mohair, even at relatively low count levels down to 0,01 percent.

It is hoped that this introductory study will stimulate further work and lead to the establishment of a commercially viable Test Method within the near future.

INTRODUCTION

Medullated fibres are present to a greater or lesser extent in the hair of virtually all animals. Such medullated fibres vary in their degree of medullation, as well as in their fibre diameter. Some of these medullated fibres "stand out" as being "optically different" and "objectionable" to the naked eye when viewed against the background of the surrounding fibres, and can be a source of problems and faults, especially to the worsted industry. Even in very small numbers, they can spoil the appearance of the dyed and finished fabric since they appear lighter. These "objectionable" fibres are sometimes referred to as "kemp". Finer and/or less medullated fibres can pass virtually unnoticed and not present a problem. Hunter and co-workers[1,2,3] have in fact proposed a bivariate analysis (involving fibre diameter and medulla ratio) to distinguish "objectionable" medullated fibres from "non-objectionable" fibres.

One of the most authoritative reviews on mohair, containing over 100 references, has been recently written by Hunter[1], and this contains important and up-to-date information on medullation and kemp. Briefly, the amount of medullated fibre in mohair can be controlled by selective breeding, a practice which has been particularly successful in South Africa, whose mohair is now rated as the best in the world. Also, a certain percentage of medullated fibres is removed during mechanical processing, particularly during carding and combing. Nevertheless, a small number of "objectionable" medullated fibres generally persist into the finished top and play an important role in determining its quality and price in the market place. It is extremely important, therefore, that an objective measure of these fibres be established which is accurate at low count levels.

The distinction between the "objectionable" and the "non-objectionable" medullated fibres has been the subject of much research and debate, but to date has not been satisfactorily resolved. In fact, a recent Round Trial[2,3], conducted specifically to compare the subjective assessments of "objectionable" medullated fibres by laboratories from various different countries, showed that although the ranking of the various samples used in the trial was fairly similar between laboratories, assessments differed widely. This confirms the subjective nature of visually classifying a fibre as "objectionable" or not, and the associated errors involved.

Test Methods already exist for the determination of the percentage of medullated fibres in wool and other animal fibres by projection microscope[4], but these do not make a distinction between "objectionable" and "non-objectionable" fibres as viewed by the naked eye, except that fibres with a medulla to diameter ratio exceeding 0,60 are generally classified as "kemp". Estimates of the degree of medullation can also be obtained by various other means such as photo-electric devices[5], by multi-angular light scattering techniques[6] and Near-Infra-Red techniques[7]. None of these, however, measure "objectionable" fibres specifically, but rather "total medullation", and although it has been claimed that total

medullation is highly correlated with the "objectionable" medullated fibre levels, we believe that a much more direct method is highly desirable. The possibility of staining to facilitate the identification of "objectionable" fibres, when counting these by hand, has also been suggested[8] but did not prove successful in Round Trials[2,3].

Recently, laser-beam technology has been used for the routine and rapid measurement of fibre diameter in mohair[9] and also for the measurement of the so-called "coarse edge"[1,2,3] of the diameter distribution which, it is claimed, could be correlated with the "objectionable" medullated fibre count[2,3,10]. A much more recent development has been the development of the Optical Fibre Diameter Analyser (OFDA)[11] and enhancement of the OFDA hardware and software to enable the opacity of fibres to be measured rapidly and automatically[12].

The fibre opacity has been defined as the ability of a fibre to transmit light perpendicular to the fibre's length. (A fibre is regarded as 0% opaque when the amount of light transmitted by the fibre is the same as that transmitted by a glass fibre of the same diameter, while a metal wire, which allows no light through, is regarded as 100% opaque.) The opacity histogram of a mohair sample clearly illustrates the existence of two populations, and two distinct peaks[12]. The second of the two populations appears to commence at about 80% opacity, and peaks between 80% and 100%. It is this latter population which is regarded as representative of the usual medullated fibres, and the opacity threshold above which a fibre is regarded as medullated is generally set at 80%[12]. Hunter[3] carried out some preliminary studies on the correlation between OFDA opacity readings and subjectively measured "objectionable" medullated fibres, for both undyed and dyed mohair tops, using an earlier version of the OFDA software. He found that the mean opacity was correlated with the mean fibre diameter of the samples, and the visual count of "objectionable" fibres was correlated with the standard deviation of opacity as measured by the OFDA. For the limited number of samples examined, he did not find a significant correlation between the number of medullated fibres counted (which included "flat" fibres) at an opacity threshold of 80% and the visual count of the "objectionable" fibres.

Gubb & Inggs has been privileged to be one of the first laboratories to have been able to carry out experiments with the OFDA medullation measurement facility (with the latest version of the software) and has attempted to use it to determine whether opacity can be utilised to determine the "objectionable" medullated fibre count as determined manually by Gubb & Inggs. Since the aforementioned company is probably the largest processor of mohair in the world, has records and samples relating to its mohair processing dating back several years, and is involved daily in assessment of "objectionable" medullated fibre counts of its combed mohair tops, it is considered that it could play an important role in establishing a suitable international standard for the objective measurement of "objectionable" medullated fibres. This has stimulated the work

reported here and, in turn, it is hoped that this will lead to further important work by the international community and eventually to the establishment of a commercially viable official Test Method.

EXPERIMENTAL

A total of 50 samples of combed mohair tops were obtained from the Gubb & Inggs stock of reference samples, deliberately spanning a wide range of mean fibre diameter and "objectionable" medullated fibre count. The samples comprised 23 lots from Texas, USA and 27 lots from the Cape, South Africa. Fortynine of these ranged in their "objectionable" medullated fibre count from three to 583 per 5 g (equivalent to from one to 54 per 10000 total fibres, or from 0,01% to 0,54% by number), while the fiftieth sample had a relatively high count, namely 1183 per 5 g, equivalent to 291 per 10000 total fibres, or 2,9%. Subsequently, a sample of Turkish mohair, also having a relatively high "objectionable" medullated fibre count of 1760 per 5 g, equivalent to about 197 per 10000 fibres or 2,0%, was added to the data base. The latter two samples were far above the normal commercial range encountered at Gubb & Inggs but were included to provide a more complete picture.

An OFDA instrument equipped to measure medullation, and containing a ring of five LED's about the standard LED to provide dark field illumination, was used for all tests, using Software Version 2, Update 1[10]. The dark field flash length was set by the manufacturer at 92,0 microseconds. The fibre opacity is calculated by summing the light transmitted in the dark field mode and normalising this by dividing by the fibre diameter. The normalised figure is then converted to a percentage opacity by calculating its ratio to the calibrated sum from a glass fibre. While the software allows for a division of fibres into three classes, depending on their dark field image, namely medullated, non-medullated and "collapsed medullated" or "flat", the flat fibres were not taken into account as "objectionable" in this study.

The reason for ignoring the "flat" fibre counting facility was as follows: Firstly, the present software does not discriminate a flat fibre according to the relative size of its medulla or its wall thickness, or the relative size of the central light band produced under dark field illumination in relation to the diameter of the specific fibre being measured, but only on a fixed, pre-selected, width of the central light band, together with a limitation that the fibre's opacity must also be below the opacity threshold selected for the test. It was felt that under these circumstances many non-medullated fibres in a mohair fibre population could be erroneously classed as medullated. Secondly, some trial runs on several of the very best mohair tops used in this study showed that the instrument counted a relatively large number of flat fibres when the width of the central light band was set at the recommended 40 microns at opacity threshold levels of from 80% to 94%, whereas the total visual count of "objectionable" fibres was close to zero per

10000 total fibres counted. Flat fibre recognition has also been admitted to be a problem[12], and will probably necessitate further software enhancement.

Opacity thresholds, above which all fibres were regarded as "objectionable" (provided their diameter was also above the diameter threshold) were set at 80%, 86%, 90%, 92% and 94% The diameter threshold was set, in the case of each sample, at the nominal mean fibre diameter of that sample.

Six successive tests on the same slide were carried out on forty occasions, covering 8 of the above lots at five different settings of opacity, in order to determine the "within-slide" variance. Tests were also carried out on three sub-samples of nineteen of the above lots to determine the "within-laboratory" variance. Of the remaining lots, two sub-samples were tested on four of the lots and the remainder were tested only once.

In the case of each test, a slide was prepared in a modified spreader using guillotined snippets, the slide density generally varying between about 25 and 35 percent, and the instrument was set to conduct a total of 10000 counts per test. All tests were carried out in a standard laboratory atmosphere.

RESULTS AND DISCUSSION

1. General

The results of the experiment are given in Table 1. This table has been arranged in increasing order of "objectionable" count per 10000 fibres (as determined visually). At the base of the table grand mean values and their standard deviations are given for both 49 lots and 51 lots (the latter including the two very extreme cases of "objectionable" medullated fibres). Tables 2 and 3 provide exactly the same information, but the data has been sorted, for the sake of convenience, in order of increasing mean fibre diameter and increasing lot number, respectively. The lot numbers have been so allocated that this provides a convenient grouping of hair from the Cape, Texas and Turkey, respectively.

From the point of view of sample selection it is clear from Table 3 that the Cape mohair lots are generally in the lower range of "objectionable" count, whereas the Texas and Turkish hair are in the higher range.

2. Opacity values

There appears to be very little difference in the mean opacity values for all these samples, the grand mean being 48.3 with a standard deviation of only slightly more than one unit. On the other hand, as one progressed from an opacity threshold of 80% to one of 94%, the

number of medullated fibres counted by the OFDA decreased significantly. Fig 1 illustrates this trend for a selection of six of the lots.

3. Relation between opacity results and visual counts

Regression analyses carried out on the OFDA medullated fibre counts (y) and visual counts (x) of "objectionable" fibres per 10000 fibres counted, gave the following best fit equations:

On 49 samples:

Opacity threshold	Best fit equation	%Fit	Std Error for "y"
80	y = 1.515 x + 23.2	66	10.9
86	y = 1.237 x + 10.0	66	9 0
90	y = 1.299 x -0.012 x^2 + 1.9	75	4.8
92	y = 0.782 x -0.004 x^2 + 1.6	79	3.2
94	y = 0.586 x -0.007 x^2 + 0.1	55	3.0

On 51 samples:

Opacity threshold	Best fit equation	%Fit	Std Error for "y"
80	y = 1.091 x + 27.2	94	13.4
86	y = 0.544 x + 7.3	94	6.4
90	y = 0.873 x - 0.001 x^2 + 4.2	96	5.1
92	y = 0.781 x - 0.002 x^2 + 1.2	96	3.5
94	y = 0.461 x - 0.001 x^2 + 0.3	90	3.5

It is clear from the above that, within the normal commercial ranges encountered in mohair tops, as represented by the results on the 49 samples, the correlation between OFDA medullated fibre count and visual count at different opacity threshold levels peaked at a threshold of about 92 percent opacity with a fit of 79 percent, the relationship being quadratic. The standard error of the y estimate at a threshold of 92 % opacity was about three fibres. When the two extreme cases were included in the data set, the fit improved to around 96 percent for both 90 and 92 percent opacity thresholds, the relationship also being quadratic. At 92 percent opacity threshold the offset was closer to the origin than at 90 percent opacity threshold and the standard error was also lower at about 3 fibres. It is clear from the above results that a good estimate of the "objectionable" medullated fibre count of a sample of mohair (as counted by Gubb & Inggs) can be obtained on the OFDA by measuring the number of medullated fibres at a threshold of 92% opacity. Figs 2 and 3 illustrate the correlations in the normal commercial range, and also the wider range, graphically.

4. Diameter of medullated fibres

The mean fibre diameters of the medullated fibres at the various selected values of opacity threshold are shown in the tables, together with the standard deviations of those measurements and the ratios of the mean fibre diameters of the medullated fibres to those of the sample means (the "diameter ratio"). It is interesting that the general picture is that of a fairly wide spread of medullated fibre diameter within the sample, with the mean value situated at a point about 1.6 times above the mean of the sample itself. It is interesting to note that Hunter and co-workers[1,2,3,10] reported similar mean values (actually ranging from about 1,6 to 2,0). The spread of values does not seem to be influenced by the mean fibre diameter of the sample, or by the amount of medullated fibre present, but the standard deviation of the diameter of the medullated fibres is, nevertheless, relatively high and appeared to be much lower in the Cape hair than the other sources. The single example from Turkey definitely appears to differ significantly from the other sources in having very coarse kemp fibres for such a fine base material. Individual results for the diameter ratio also varied considerably.

5. Variance in results

A statistical analysis was carried out on the "within-slide" and "within-laboratory" results to determine the variances.

The "within-slide" analysis gave the following best-fit equation:

$$\sigma_s = 0.0731 \text{ Visual Count} - 0.00011 \text{ Visual Count}^2 + 2.47$$

$$n = 40;\ r = 0.80;\ \text{Std. Error} = 2.55$$

The within-slide variability appeared to be relatively high, and some attention could perhaps be paid to this point by the manufacturers since it may be related to the discrimination parameters used in the software programme, and an improvement in the within-slide variability could be of significant benefit.

The "within-laboratory" analysis gave the following best fit equation:

$$\sigma_w = 0.1782 \text{ Visual Count} - 0.00031 \text{ Visual Count}^2 + 1.09$$

$$n = 95;\ r = 0.86;\ \text{Std. Error} = 3.21$$

Since the above variance includes the within-slide variance, a reduction in the latter should reduce the within laboratory variance significantly.

An analysis was also carried out on a selection of visual count "within-laboratory" results taken from previous records, but these only ranged from visual counts of from 0 to 15 per 10000 fibres. (Above this the samples are classed as "kempy" and very few actual count records have been made.) The result was as follows:

σ_v = 0.1180 Visual Count + 0.56

n = 27; r = 0,58; Std. Error = 0.65

All the above results are graphically illustrated in Fig 4.

6. 95% Confidence level

If, from a consignment of 50 bales, ten bales are each tested twice, then the following calculation applies:

Within-lab variance, $v = (\sigma_w)^2/20$

95% Confidence limit of the "within-lab" mean = $2 * v^{0.5}$

"Objectionable" count per 10000 fibres	95% Confidence Limit Within-lab
2	+/- 0.7
5	+/- 0.9
10	+/- 1.3
15	+/- 1.7
20	+/- 2.0
30	+/- 2.8
40	+/- 3.5
50	+/- 4.1
100	+/- 7.1
200	+/- 10.9
300	+/- 11.9

Inter-laboratory Round Trials are now necessary to establish the "between-laboratory" variance.

6.Relation between results at opacity threshold levels of 92 percent and 80 percent

A number of statistical analyses were carried out to try and ascertain what parameter(s) were mainly responsible for the relation between the results at opacity threshold levels of 92 percent and 80 percent. The best of these gave an excellent fit and was as follows:

OFDA Count at 92% opacity threshold = 0.099*(OFDA Count at 80% opacity threshold)*(Mean result for MFD ratio)^2 -1.40.

F = 2425.38; n = 51; r = 0.99; Std.Error = 2.53

The above equation illustrates a very important point, namely that the relative number of "objectionable" medullated fibres to other medullated fibres for a specific level of total medullation increases with the square of the diameter ratio . It would seem worthwhile, from a breeding point of view, therefore, to select for a low diameter ratio of the medullated fibres as well as a low spread of medullated fibre diameter.

SUMMARY AND CONCLUSIONS

In a quest to find a totally objective measure of those medullated fibres which "stand out" as being "optically different" and "objectionable" to the naked eye when viewed against their surrounding fibres in commercial mohair tops (including good quality tops containing relatively few such fibres), researchers at Gubb & Inggs have carried out exploratory studies using an Optical Fibre Diameter Analyser (OFDA). This work involved fortynine tops from both the Cape and from Texas, spanning a wide range of diameter, from approximately 25 to 40 microns, which included samples of Kids, Young Goats and Adult hair, and which varied in "objectionable" medullated fibre count from one to 54 in a total count of 10000 fibres i.e. from 0,01% to 0,5%. Two extreme cases of "objectionable" count, far above normal commercial levels, namely 197 and 291 per 10000 fibres, i.e. 2% and 2,9%, were added to the data base from samples of Turkish and Texas mohair, respectively, to provide additional information and to provide a more complete picture.

The results have indicated that there is a good quadratic relationship between the number of "objectionable" medullated fibres counted visually and the number of medullated fibres counted on the OFDA, the statistical fit passing through a peak at an opacity threshold value of approximately 92 percent. For a specific level of total medullation the number of "objectionable" fibres increased according to the square of the diameter ratio, and this finding could have important implications for breeders. The results at 92% opacity threshold were found to be correlated with the Gubb & Inggs manual counts, more particularly in the lower, practical range of counts, where it approached a 1:1 relationship. A change-over to this objective system of counting, based on a threshold level of 92% opacity, should therefore pose no serious commercial problem to traders presently using the old system.

The OFDA medullated fibre counts referred to above specifically excluded the so-called "flat" fibres, but it is important that further work look into the role played by these "flat" fibres in arriving at an accurate estimate of the "objectionable" medullated fibre count, particularly if improved software discrimination becomes available.

On the question of variance, the OFDA method rates similarly to the manual method, but one must remember that in the latter case an examination is made of five grams by the operator (i.e. somewhere around 40000 to 100000 fibres), and this is subjective and extremely time-consuming, tedious and costly. In the case of the OFDA a single test of 10000 fibres on a 386 PC only takes about 5 minutes. The OFDA technique of measurement could, therefore, offer a rapid and practical low-cost solution to the dilemma in which topmakers and spinners of mohair from various parts of the world have found themselves in the past i.e. not being able to reproduce "objectionable" medullated fibre counts counted at other laboratories with any reliable accuracy. Furthermore, it is able to count the "objectionable" fibres relatively accurately at very low count levels, which is of significant advantage to mohair topmakers.

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COMMENTS BY DR.LAWRANCE HUNTER

"The authors are to be congratulated on their paper since it represents an important step towards developing an operator-independent, rapid and cost-effective objective test for the level of "objectionable" medullated fibres in mohair.

"It is now important to extend the work to cover

(i) a wider range of mohair from the various producing countries

(ii) different laboratories, each using their own criteria for visually "objectionable" fibres

(iii) dyed as well as undyed mohair

(iv) a bivariate approach involving the effects of both fibre diameter and medulla to diameter ratio on determining whether or not a fibre is regarded as visually "objectionable"

"More fundamental studies, to establish the importance of "flat" fibres, and the effects of fibre diameter and medulla to diameter ratio on opacity are also required.

"Ideally, work should also be done, both on OFDA and other image analysis systems (preferably where the medulla diameter and fibre diameter and, therefore, the medulla to diameter ratio can be measured directly) on populations from which the "objectionable" fibres have been removed manually, as well as on the "objectionable" fibres themselves. In so doing, a far clearer

"picture will be gained of the parameters (probably involving both the fibre diameter as well as the medulla to fibre ratio) which determine whether a fibre is considered to be "objectionable", and the criteria which need therefore to be used in formulating a standard method for measuring "objectionable" medullated fibres objectively."

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FIGURE 1

OFDA MED. FIBRE COUNT VS. OPACITY THRESHOLD

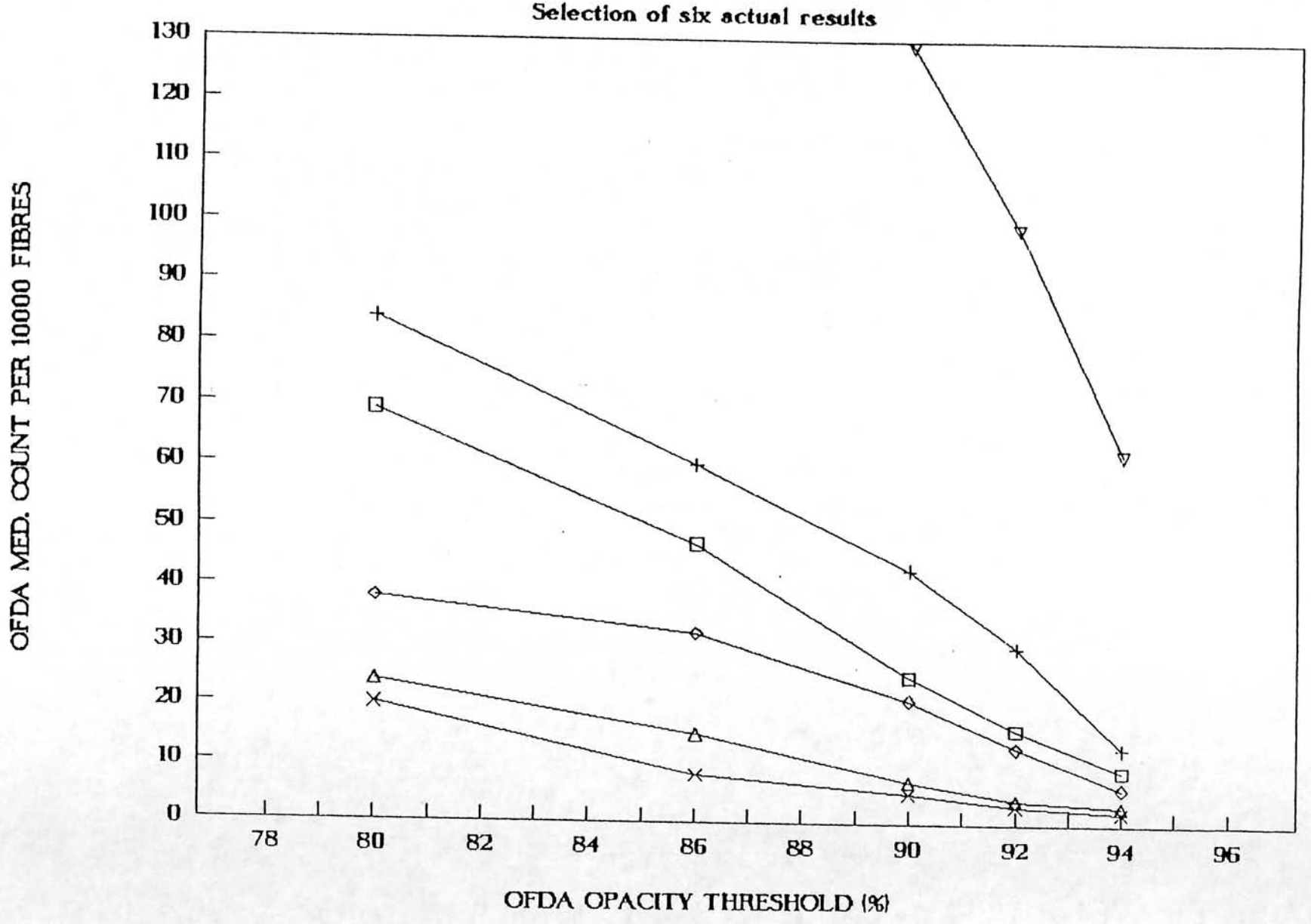

FIGURE 3

VISUAL "OBJECTIONABLE" COUNT VS. OFDA COUNT

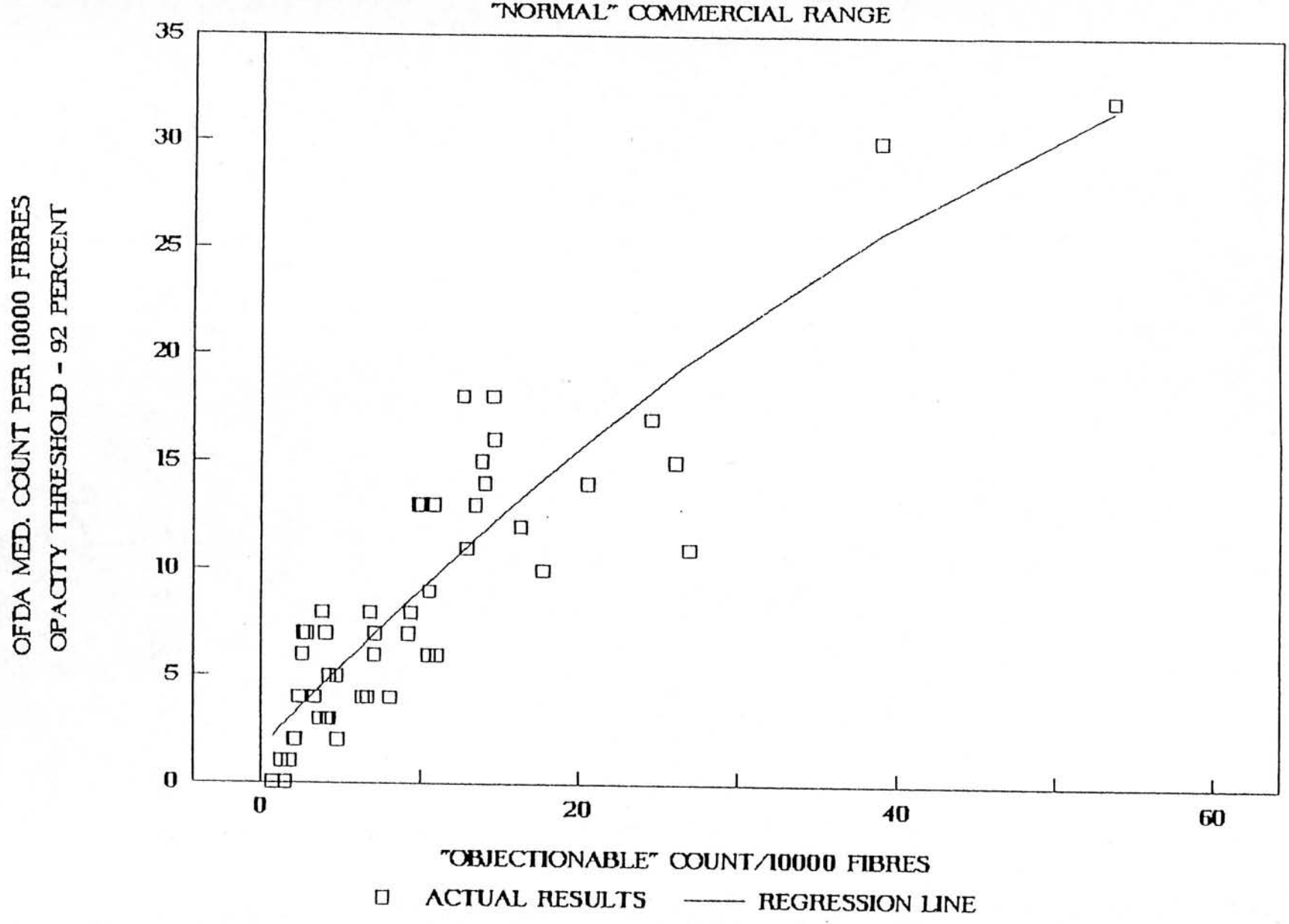

FIGURE 3

VISUAL "OBJECTIONABLE" COUNT VS. OFDA COUNT

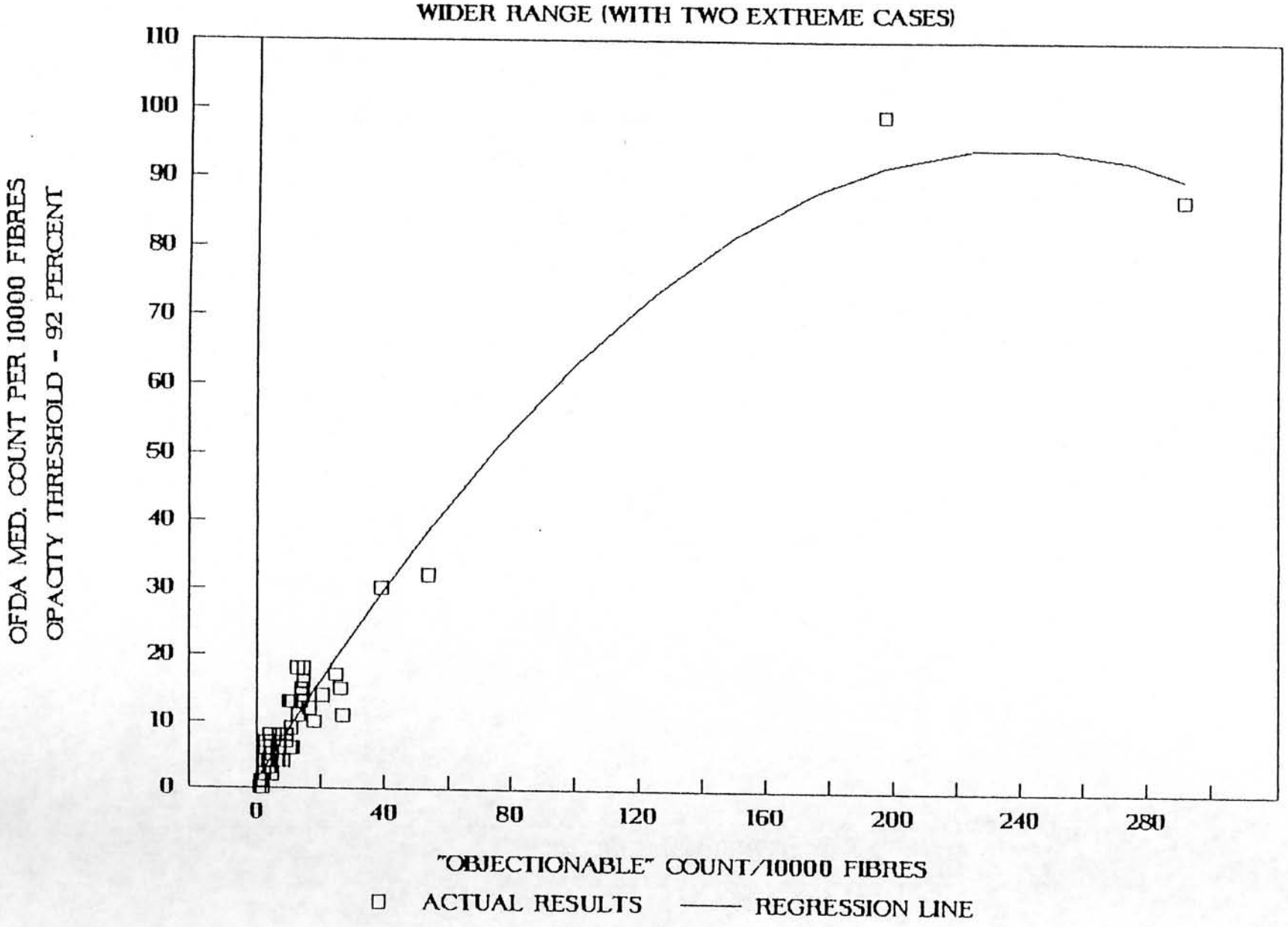

FIGURE 4

VARIANCE IN RESULTS

(REGRESSION LINES)

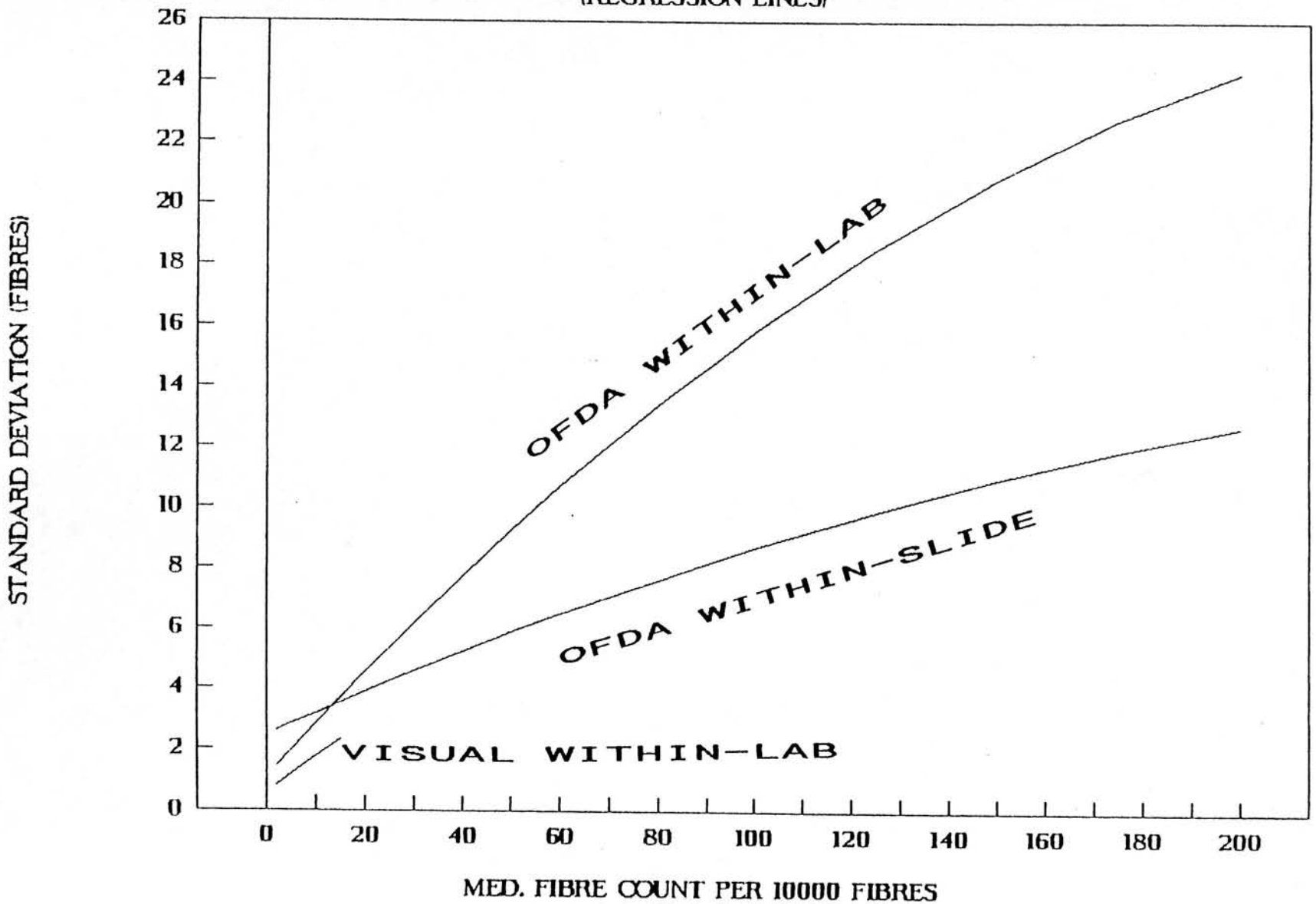

TABLE_1 (Left-side)

"OBJECTIONABLE" MEDULLAT

SOURCE	LOT	MFL (mm)	CV (%)	MFD (u)	SD (u)	OBJECTIONABLE MEDULLATED FIBRES COUNTED BY GUBB & INGGS ---- Per 5 grams --- Long	Short	Total	Per 10000 fibres
CAPE	24	104.5	33.9	32.6	7.7	2	1	3	1
CAPE	23	114.1	37.1	36.0	9.0	2	2	4	1
CAPE	26	104.0	37.6	29.5	7.0	5	3	8	1
CAPE	22	101.3	41.3	30.4	7.4	5	4	9	2
CAPE	25	115.7	35.6	35.2	9.3	4	3	7	2
CAPE	19	107.4	36.5	34.9	8.6	3	5	8	2
CAPE	8	82.7	47.6	31.3	7.9	7	7	14	2
TEXAS	42	85.0	52.4	33.6	9.1	5	8	13	3
CAPE	11	85.3	41.7	32.7	8.4	7	7	14	3
CAPE	5	92.1	41.2	35.0	9.1	6	6	12	3
CAPE	21	96.5	39.8	33.6	8.7	8	7	15	3
CAPE	9	87.3	45.3	26.4	6.7	13	16	29	4
TEXAS	40	86.0	54.1	28.2	7.9	11	16	27	4
CAPE	6	84.2	44.5	25.8	6.8	17	18	35	4
CAPE	14	82.0	49.0	30.1	8.3	14	13	27	4
CAPE	1	78.1	52.4	29.6	7.9	8	22	30	4
CAPE	13	83.4	49.2	36.1	10.1	15	4	19	4
CAPE	7	88.1	42.4	36.1	10.1	13	7	20	5
CAPE	27	102.0	40.7	33.7	8.8	11	9	20	5
CAPE	20	95.4	39.8	27.2	6.9	21	23	44	6
CAPE	15	94.9	44.9	28.8	7.4	22	19	41	7
CAPE	18	113.8	36.4	37.2	9.6	12	9	21	7
CAPE	2	90.8	44.5	36.8	10.3	14	14	28	7
CAPE	10	81.5	45.6	25.0	6.7	27	41	68	7
TEXAS	30	81.6	52.1	27.0	8.3	31	35	66	8
TEXAS	33	82.2	53.2	26.8	8.0	21	55	76	9
CAPE	4	90.6	45.2	39.0	11.4	16	17	33	9
TEXAS	39	84.7	52.4	35.5	9.8	15	30	45	10
TEXAS	41	87.5	49.0	35.4	10.1	18	26	44	10
TEXAS	49	86.4	49.0	35.1	9.9	20	26	46	10
CAPE	16	98.9	40.1	27.6	7.7	23	45	68	11
TEXAS	48	86.8	44.9	35.1	9.8	15	33	48	11
TEXAS	47	80.9	46.9	35.1	10.0	21	32	53	11
CAPE	17	93.0	40.0	25.6	7.2	37	51	88	11
TEXAS	45	79.6	45.1	34.8	9.9	30	34	64	13
TEXAS	36	82.8	48.7	35.0	9.3	23	39	62	13
TEXAS	38	85.2	43.5	32.5	8.6	37	36	73	13
TEXAS	37	84.6	51.3	35.6	9.7	28	35	63	14
CAPE	12	76.8	40.7	25.0	7.4	83	60	143	14
CAPE	3	78.3	39.7	25.5	7.8	69	70	139	15
TEXAS	46	80.1	51.9	30.3	8.4	44	53	97	15
TEXAS	34	86.4	49.7	36.1	10.1	24	47	71	16
TEXAS	44	83.4	50.6	30.4	8.6	44	68	112	18
TEXAS	29	90.1	42.0	35.9	10.0	47	39	86	21
TEXAS	43	83.0	48.1	35.1	10.3	45	72	117	25
TEXAS	35	85.2	49.1	26.6	7.5	74	137	211	26
TEXAS	31	85.0	49.8	32.7	8.0	59	85	144	27
TEXAS	28	89.0	44.7	35.3	10.7	66	105	171	39
TEXAS	32	74.2	47.1	24.6	7.8	218	365	583	54
TURKEY	51	80.6	51.7	26.0	9.6	890	870	1760	197
TEXAS	50	75.1	51.3	40.0	13.3	933	250	1183	291
GR.MEAN-49 LOTS		89.2	45.1	31.9	8.7	27.8	37.9	65.7	10.4
STD.DEV.		9.8	5.2	4.0	1.2	33.8	55.0	88.0	9.9
GR.MEAN-51 LOTS		88.8	45.3	31.9	8.8	62.4	58.4	120.8	19.6
STD.DEV.		9.9	5.3	4.2	1.3	174.8	130.2	291.8	47.3

TABLE 1 (Middle)

ED FIBRES AS MANUALLY COUNTED ON GUBB & INGGS MOHAIR TOPS VERSUS OBJECTIV

(PRINTED IN ORDER OF INCREASING OBJECTIONABLE MEDULLATED FIBRE

RESULTS OBTAINED ON OFDA :

MEAN OPACITY (%)	NUMBER OF MEDULLATED FIBRES AT OPACITY THRESHOLDS OF: 80 %	86 %	90 %	92 %	94 %	M.F.D.OF MED.FIBRES (um) AT OPACITY THRESHOLDS OF: 80 %	86 %	90 %	92 %	94 %
48.5	22	2	0	0	0	44	42			
49.7	14	2	4	1	0	52	41	47	36	
48.7	18	3	1	0	1	39	64	41		34
48.3	21	14	2	1	0	40	44	43	43	
49.2	30	10	3	2	0	48	57	55	49	
49.3	30	8	5	2	1	49	52	56	47	36
47.9	28	16	8	4	2	46	48	44	45	41
48.3	38	21	6	6	1	51	51	57	55	54
48.6	29	6	4	7	0	49	71	39	48	
48.4	41	10	5	7	2	53	45	48	47	49
49.7	30	10	5	4	0	49	65	43	50	
47.5	20	8	5	3	2	38	45	40	39	36
46.7	29	23	15	8	5	45	50	43	44	46
46.7	33	14	12	7	2	38	45	41	43	41
47.5	25	11	3	3	0	51	47	45	53	
47.8	24	13	7	3	1	47	44	56	51	34
47.9	24	10	10	5	4	58	71	51	46	80
47.5	19	6	3	5	3	53	55	54	49	48
47.7	24	10	4	2	1	50	61	53	60	66
47.8	24	15	7	4	3	45	47	43	43	47
46.7	20	16	8	4	2	54	49	49	60	54
48.1	26	26	11	8	3	57	72	60	57	56
49	27	12	8	6	1	55	52	58	52	49
45.8	21	13	8	7	3	40	43	42	44	37
49.4	19	16	4	4	2	47	50	43	39	46
49.9	28	20	12	7	2	43	42	45	43	39
48.9	48	22	13	8	4	58	60	60	62	56
48.8	61	26	16	13	10	58	56	53	67	61
49.2	59	35	23	13	12	52	53	53	62	62
48.6	38	32	21	13	6	59	63	57	55	64
45.9	31	14	8	6	3	40	43	43	41	43
49.8	43	38	18	9	4	56	58	57	56	54
48.7	51	31	21	13	10	54	63	57	64	58
49	37	21	10	6	5	39	45	39	38	39
49.3	53	45	21	18	15	61	65	61	70	61
49.1	49	34	22	11	8	52	54	56	53	57
47.3	34	24	12	13	10	49	61	53	55	54
49.7	65	45	20	15	11	53	59	58	58	54
46	48	44	28	14	11	45	45	44	50	47
47.8	69	40	23	18	10	41	42	42	46	45
47.2	69	47	25	16	9	47	49	47	51	48
48.3	56	33	18	12	9	61	62	64	68	62
48.4	49	20	17	10	3	49	51	49	50	51
48.8	43	26	19	14	11	57	61	59	60	66
50.7	62	40	24	17	5	59	67	67	69	70
47.1	54	39	18	15	4	43	45	43	43	51
47.5	43	23	20	11	7	47	48	46	46	48
49	84	60	43	30	13	58	58	63	62	60
46.7	100	69	37	32	15	42	45	44	46	44
46.9	199	171	129	99	62	55	57	57	57	60
53.4	366	252	152	87	51	62	64	65	66	66
48.3	39.0	22.9	13.0	8.9	4.8	49.4	53.1	50.2	51.3	51.1
1.1	18.4	15.1	9.3	6.7	4.4	6.6	8.7	7.5	8.6	10.4
48.3	48.5	30.3	18.0	12.2	6.8	49.7	53.4	50.6	51.7	51.7
1.3	53.2	40.3	26.5	17.6	11.0	6.7	8.7	7.7	8.8	10.5

TABLE 1 (Right-side)

E MEASUREMENT OF MEDULLATED FIBRES ON THE OFDA

COUNT)

S.D. OF M.F.D. OF MED. FIBRES (um) AT OPACITY THRESHOLDS OF:					MEAN RESULT	RATIO: M.F.D. MED. TO M.F.D. SAMPLE AT OPAC. THRESHOLDS OF:					MEAN RESULT
80 %	86 %	90 %	92 %	94 %		80 %	86 %	90 %	92 %	94 %	
4.0	0.8				2.4	1.35	1.29				1.3
7.8	0.4	2.8	0.0		2.8	1.43	1.14	1.31	1.00		1.2
4.4	19.2	0.0		0.0	5.9	1.32	2.17	1.39		1.15	1.5
2.9	9.9	0.0	0.0		3.2	1.33	1.45	1.41	1.41		1.4
3.5	14.7	0.9			6.4	1.35	1.63	1.57	1.39		1.5
4.6	11.4	4.6	1.6	0.0	4.4	1.40	1.50	1.62	1.33	1.03	1.4
6.4	7.0	5.2	4.2	1.5	4.9	1.47	1.54	1.42	1.44	1.31	1.4
5.6	4.8	6.2	6.0	0.0	4.5	1.53	1.51	1.69	1.64	1.61	1.6
7.3	19.6	1.8	5.7		8.6	1.49	2.18	1.19	1.47		1.6
8.0	2.0	3.4	2.5	0.5	3.3	1.51	1.29	1.38	1.33	1.40	1.4
9.0	21.3	3.2	4.2		9.4	1.45	1.93	1.28	1.49		1.5
4.5	8.0	2.3	1.0	1.2	3.4	1.44	1.71	1.52	1.48	1.36	1.5
5.9	7.6	3.3	2.9	4.4	4.8	1.60	1.78	1.53	1.56	1.63	1.6
3.4	9.0	7.2	7.0	1.6	5.6	1.48	1.75	1.60	1.66	1.59	1.6
9.9	1.5	2.6	9.3		5.8	1.68	1.55	1.48	1.77		1.6
7.9	5.3	13.4	1.1	0.0	5.5	1.60	1.48	1.89	1.72	1.15	1.6
10.2	17.8	7.1	5.4	3.3	8.8	1.61	1.96	1.41	1.28	2.22	1.7
9.2	5.0	1.3	2.8	5.2	4.7	1.46	1.51	1.49	1.36	1.34	1.4
9.0	16.2	7.5	0.3	0.0	6.6	1.48	1.80	1.57	1.77	1.96	1.7
8.5	6.3	2.0	2.2	1.1	4.0	1.64	1.73	1.58	1.58	1.73	1.7
12.0	5.9	5.2	3.0	0.0	5.2	1.87	1.69	1.69	2.07	1.87	1.8
6.7	18.7	7.7	11.9	1.4	9.3	1.53	1.93	1.61	1.52	1.50	1.6
8.1	9.9	5.0	4.0		6.8	1.49	1.42	1.56	1.41	1.32	1.4
3.4	3.5	3.8	3.7	1.7	3.2	1.60	1.71	1.70	1.76	1.49	1.7
9.4	13.2	3.3	1.1	1.4	5.7	1.76	1.84	1.59	1.45	1.70	1.7
7.1	3.7	5.1	4.1	1.3	4.3	1.61	1.55	1.67	1.60	1.44	1.6
10.0	9.8	9.8	11.4	6.4	9.5	1.49	1.54	1.54	1.59	1.43	1.5
11.8	10.8	5.8	18.4	17.1	12.8	1.63	1.58	1.49	1.87	1.73	1.7
8.5	7.5	7.9	13.1	15.4	10.5	1.48	1.49	1.50	1.75	1.76	1.6
11.6	15.2	11.1	5.4	6.7	10.0	1.68	1.80	1.62	1.57	1.82	1.7
4.6	5.0	2.8	2.1	2.1	3.3	1.45	1.56	1.56	1.48	1.56	1.5
10.7	11.2	9.5	6.3	5.7	8.7	1.61	1.65	1.62	1.59	1.54	1.6
7.5	13.3	7.1	10.2	3.7	8.4	1.54	1.80	1.63	1.83	1.65	1.7
4.0	6.3	2.2	1.5	1.6	3.1	1.52	1.76	1.52	1.48	1.51	1.6
12.1	12.9	8.3	13.6	12.3	11.8	1.75	1.87	1.74	2.00	1.75	1.8
6.4	8.9	7.7	5.9	7.5	7.3	1.48	1.54	1.60	1.51	1.63	1.6
5.6	16.2	4.7	9.1	4.6	8.0	1.50	1.87	1.63	1.70	1.66	1.7
5.5	7.9	9.5	9.0	10.0	8.4	1.48	1.65	1.63	1.64	1.53	1.6
6.3	6.3	3.3	2.8	2.4	4.2	1.79	1.82	1.76	2.02	1.87	1.8
5.0	4.7	3.2	5.0	4.4	4.5	1.61	1.65	1.63	1.80	1.76	1.7
7.2	8.4	5.7	7.8	7.2	7.3	1.55	1.60	1.55	1.68	1.58	1.6
12.4	12.9	12.9	16.5	11.5	13.2	1.69	1.72	1.78	1.89	1.72	1.8
9.2	9.3	4.9	5.3	2.0	6.1	1.62	1.68	1.61	1.64	1.68	1.6
8.8	11.1	9.1	10.4	12.5	10.4	1.59	1.70	1.64	1.67	1.84	1.7
9.7	14.0	13.4	18.2	17.9	14.6	1.68	1.91	1.91	1.96	2.00	1.9
5.3	5.3	4.3	3.5	6.3	4.9	1.62	1.68	1.62	1.62	1.92	1.7
6.2	8.6	3.8	3.6	4.4	5.3	1.44	1.47	1.40	1.41	1.47	1.4
11.7	13.9	14.2	14.5	13.0	13.5	1.64	1.64	1.78	1.76	1.70	1.7
4.8	5.5	3.9	4.2	3.5	4.4	1.71	1.83	1.79	1.85	1.79	1.8
11.4	11.4	10.6	9.3	12.3	11.0	2.12	2.19	2.21	2.19	2.31	2.2
8.2	8.7	9.1	9.0	8.7	8.7	1.55	1.60	1.62	1.65	1.65	1.6
7.4	9.5	5.6	6.1	4.9	6.7	1.6	1.7	1.6	1.6	1.6	1.6
2.6	5.1	3.5	4.8	4.9	3.1	0.1	0.2	0.1	0.2	0.2	0.1
7.5	9.6	5.8	6.3	5.2	6.9	1.6	1.7	1.6	1.6	1.6	1.6
2.6	5.0	3.6	4.7	5.0	3.1	0.1	0.2	0.2	0.2	0.3	0.2

TABLE 2 (Left-side)

"OBJECTIONABLE" MEDULLAT

SOURCE	LOT	MFL (mm)	CV (%)	MFD (u)	SD (u)	OBJECTIONABLE MEDULLATED FIBRES COUNTED BY GUBB & INGGS ---- Per 5 grams --- Per 10000 fibres			
						Long	Short	Total	
TEXAS	32	74.2	47.1	24.6	7.8	218	365	583	54
CAPE	12	76.8	40.7	25.0	7.4	83	60	143	14
CAPE	10	81.5	45.6	25.0	6.7	27	41	68	7
CAPE	3	78.3	39.7	25.5	7.8	69	70	139	15
CAPE	17	93.0	40.0	25.6	7.2	37	51	88	11
CAPE	6	84.2	44.5	25.8	6.8	17	18	35	4
TURKEY	51	80.6	51.7	26.0	9.6	890	870	1760	197
CAPE	9	87.3	45.3	26.4	6.7	13	16	29	4
TEXAS	35	85.2	49.1	26.6	7.5	74	137	211	26
TEXAS	33	82.2	53.2	26.8	8.0	21	55	76	9
TEXAS	30	81.6	52.1	27.0	8.3	31	35	66	8
CAPE	20	95.4	39.8	27.2	6.9	21	23	44	6
CAPE	16	98.9	40.1	27.6	7.7	23	45	68	11
TEXAS	40	86.0	54.1	28.2	7.9	11	16	27	4
CAPE	15	94.9	44.9	28.8	7.4	22	19	41	7
CAPE	26	104.0	37.6	29.5	7.0	5	3	8	1
CAPE	1	78.1	52.4	29.6	7.9	8	22	30	4
CAPE	14	82.0	49.0	30.1	8.3	14	13	27	4
TEXAS	46	80.1	51.9	30.3	8.4	44	53	97	15
CAPE	22	101.3	41.3	30.4	7.4	5	4	9	2
TEXAS	44	83.4	50.6	30.4	8.6	44	68	112	18
CAPE	8	82.7	47.6	31.3	7.9	7	7	14	2
TEXAS	38	85.2	43.5	32.5	8.6	37	36	73	13
CAPE	24	104.5	33.9	32.6	7.7	2	1	3	1
CAPE	11	85.3	41.7	32.7	8.4	7	7	14	3
TEXAS	31	85.0	49.8	32.7	8.0	59	85	144	27
TEXAS	42	85.0	52.4	33.6	9.1	5	8	13	3
CAPE	21	96.5	39.8	33.6	8.7	8	7	15	3
CAPE	27	102.0	40.7	33.7	8.8	11	9	20	5
TEXAS	45	79.6	45.1	34.8	9.9	30	34	64	13
CAPE	19	107.4	36.5	34.9	8.6	3	5	8	2
CAPE	5	92.1	41.2	35.0	9.1	6	6	12	3
TEXAS	36	82.8	48.7	35.0	9.3	23	39	62	13
TEXAS	47	80.9	46.9	35.1	10.0	21	32	53	11
TEXAS	43	83.0	48.1	35.1	10.3	45	72	117	25
TEXAS	49	86.4	49.0	35.1	9.9	20	26	46	10
TEXAS	48	86.8	44.9	35.1	9.8	15	33	48	11
CAPE	25	115.7	35.6	35.2	9.3	4	3	7	2
TEXAS	28	89.0	44.7	35.3	10.7	66	105	171	39
TEXAS	41	87.5	49.0	35.4	10.1	18	26	44	10
TEXAS	39	84.7	52.4	35.5	9.8	15	30	45	10
TEXAS	37	84.6	51.3	35.6	9.7	28	35	63	14
TEXAS	29	90.1	42.0	35.9	10.0	47	39	86	21
CAPE	23	114.1	37.1	36.0	9.0	2	2	4	1
TEXAS	34	86.4	49.7	36.1	10.1	24	47	71	16
CAPE	13	83.4	49.2	36.1	10.1	15	4	19	4
CAPE	7	88.1	42.4	36.1	10.1	13	7	20	5
CAPE	2	90.8	44.5	36.8	10.3	14	14	28	7
CAPE	18	113.8	36.4	37.2	9.6	12	9	21	7
CAPE	4	90.6	45.2	39.0	11.4	16	17	33	9
TEXAS	50	75.1	51.3	40.0	13.3	933	250	1183	291
GR.MEAN-49 LOTS		89.0	45.2	31.6	8.7	45.6	55.3	100.9	14.2
STD.DEV.		9.9	5.3	4.0	1.1	126.5	129.8	255.1	28.1
GR.MEAN-51 LOTS		88.8	45.3	31.9	8.8	62.4	58.4	120.8	19.6
STD.DEV.		9.9	5.3	4.2	1.3	174.8	130.2	291.8	47.3

TABLE 2 (Middle)

ED FIBRES AS MANUALLY COUNTED ON GUBB & INGGS MOHAIR TOPS VERSUS OBJECTIV

(PRINTED IN ORDER OF INCREASING FIBRE DIAMETER)

RESULTS OBTAINED ON OFDA :

MEAN OPACITY (%)	NUMBER OF MEDULLATED FIBRES AT OPACITY THRESHOLDS OF: 80 %	86 %	90 %	92 %	94 %	M.F.D.OF MED.FIBRES (um) AT OPACITY THRESHOLDS OF: 80 %	86 %	90 %	92 %	94 %
46.7	100	69	37	32	15	42	45	44	46	44
46	48	44	28	14	11	45	45	44	50	47
45.8	21	13	8	7	3	40	43	42	44	37
47.8	69	40	23	18	10	41	42	42	46	45
49	37	21	10	6	5	39	45	39	38	39
46.7	33	14	12	7	2	38	45	41	43	41
46.9	199	171	129	99	62	55	57	57	57	60
47.5	20	8	5	3	2	38	45	40	39	36
47.1	54	39	18	15	4	43	45	43	43	51
49.9	28	20	12	7	2	43	42	45	43	39
49.4	19	16	4	4	2	47	50	43	39	46
47.8	24	15	7	4	3	45	47	43	43	47
45.9	31	14	8	6	3	40	43	43	41	43
46.7	29	23	15	8	5	45	50	43	44	46
46.7	20	16	8	4	2	54	49	49	60	54
48.7	18	3	1	0	1	39	64	41		34
47.8	24	13	7	3	1	47	44	56	51	34
47.5	25	11	3	3	0	51	47	45	53	
47.2	69	47	25	16	9	47	49	47	51	48
48.3	21	14	2	1	0	40	44	43	43	
48.4	49	20	17	10	3	49	51	49	50	51
47.9	28	16	8	4	2	46	48	44	45	41
47.3	34	24	12	13	10	49	61	53	55	54
48.5	22	2	0	0	0	44	42			
48.6	29	6	4	7	0	49	71	39	48	
47.5	43	23	20	11	7	47	48	46	46	48
48.3	38	21	6	6	1	51	51	57	55	54
49.7	30	10	5	4	0	49	65	43	50	
47.7	24	10	4	2	1	50	61	53	60	66
49.3	53	45	21	18	15	61	65	61	70	61
49.3	30	8	5	2	1	49	52	56	47	36
48.4	41	10	5	7	2	53	45	48	47	49
49.1	49	34	22	11	8	52	54	56	53	57
48.7	51	31	21	13	10	54	63	57	64	58
50.7	62	40	24	17	5	59	67	67	69	70
48.6	38	32	21	13	6	59	63	57	55	64
49.8	43	38	18	9	4	56	58	57	56	54
49.2	30	10	3	2	0	48	57	55	49	
49	84	60	43	30	13	58	58	63	62	60
49.2	59	35	23	13	12	52	53	53	62	62
48.8	61	26	16	13	10	58	56	53	67	61
49.7	65	45	20	15	11	53	59	58	58	54
48.8	43	26	19	14	11	57	61	59	60	66
49.7	14	2	4	1	0	52	41	47	36	
48.3	56	33	18	12	9	61	62	64	68	62
47.9	24	10	10	5	4	58	71	51	46	80
47.5	19	6	3	5	3	53	55	54	49	48
49	27	12	8	6	1	55	52	58	52	49
48.1	26	26	11	8	3	57	72	60	57	56
48.9	48	22	13	8	4	58	60	60	62	56
53.4	366	252	152	87	51	62	64	65	66	66
48.2	42.1	26.0	15.4	10.8	6.0	49.3	53.1	50.2	51.2	51.2
1.1	29.2	25.8	18.9	14.4	9.2	6.5	8.7	7.5	8.5	10.5
48.3	48.5	30.3	18.0	12.2	6.8	49.7	53.4	50.6	51.7	51.7
1.3	53.2	40.3	26.5	17.6	11.0	6.7	8.7	7.7	8.8	10.5

TABLE 2 (Right-side)

E MEASUREMENT OF MEDULLATED FIBRES ON THE OFDA

S.D. OF M.F.D. OF MED. FIBRES (um) AT OPACITY THRESHOLDS OF:					MEAN RESULT
80 %	86 %	90 %	92 %	94 %	
4.8	5.5	3.9	4.2	3.5	4.4
6.3	6.3	3.3	2.8	2.4	4.2
3.4	3.5	3.8	3.7	1.7	3.2
5.0	4.7	3.2	5.0	4.4	4.5
4.0	6.3	2.2	1.5	1.6	3.1
3.4	9.0	7.2	7.0	1.6	5.6
11.4	11.4	10.6	9.3	12.3	11.0
4.5	8.0	2.3	1.0	1.2	3.4
5.3	5.3	4.3	3.5	6.3	4.9
7.1	3.7	5.1	4.1	1.3	4.3
9.4	13.2	3.3	1.1	1.4	5.7
8.5	6.3	2.0	2.2	1.1	4.0
4.6	5.0	2.8	2.1	2.1	3.3
5.9	7.6	3.3	2.9	4.4	4.8
12.0	5.9	5.2	3.0	0.0	5.2
4.4	19.2	0.0		0.0	5.9
7.9	5.3	13.4	1.1	0.0	5.5
9.9	1.5	2.6	9.3		5.8
7.2	8.4	5.7	7.8	7.2	7.3
2.9	9.9	0.0	0.0		3.2
9.2	9.3	4.9	5.3	2.0	6.1
6.4	7.0	5.2	4.2	1.5	4.9
5.6	16.2	4.7	9.1	4.6	8.0
4.0	0.8				2.4
7.3	19.6	1.8	5.7		8.6
6.2	8.6	3.8	3.6	4.4	5.3
5.6	4.8	6.2	6.0	0.0	4.5
9.0	21.3	3.2	4.2		9.4
9.0	16.2	7.5	0.3	0.0	6.6
12.1	12.9	8.3	13.6	12.3	11.8
4.6	11.4	4.6	1.6	0.0	4.4
8.0	2.0	3.4	2.5	0.5	3.3
6.4	8.9	7.7	5.9	7.5	7.3
7.5	13.3	7.1	10.2	3.7	8.4
9.7	14.0	13.4	18.2	17.9	14.6
11.6	15.2	11.1	5.4	6.7	10.0
10.7	11.2	9.5	6.3	5.7	8.7
3.5	14.7	0.9			6.4
11.7	13.9	14.2	14.5	13.0	13.5
8.5	7.5	7.9	13.1	15.4	10.5
11.8	10.8	5.8	18.4	17.1	12.8
5.5	7.9	9.5	9.0	10.0	8.4
8.8	11.1	9.1	10.4	12.5	10.4
7.8	0.4	2.8	0.0		2.8
12.4	12.9	12.9	16.5	11.5	13.2
10.2	17.8	7.1	5.4	3.3	8.8
9.2	5.0	1.3	2.8	5.2	4.7
8.1	9.9	5.0	4.0		6.8
6.7	18.7	7.7	11.9	1.4	9.3
10.0	9.8	9.8	11.4	6.4	9.5
8.2	8.7	9.1	9.0	8.7	8.7
7.4	9.6	5.6	6.1	5.1	6.8
2.7	5.1	3.5	4.8	5.1	3.1
7.5	9.6	5.8	6.3	5.2	6.9
2.6	5.0	3.6	4.7	5.0	3.1

RATIO: M.F.D. MED. TO M.F.D. SAMPLE AT OPAC. THRESHOLDS OF:					MEAN RESUL
80 %	86 %	90 %	92 %	94 %	
1.71	1.83	1.79	1.85	1.79	1.8
1.79	1.82	1.76	2.02	1.87	1.8
1.60	1.71	1.70	1.76	1.49	1.7
1.61	1.65	1.63	1.80	1.76	1.7
1.52	1.76	1.52	1.48	1.51	1.6
1.48	1.75	1.60	1.66	1.59	1.6
2.12	2.19	2.21	2.19	2.31	2.2
1.44	1.71	1.52	1.48	1.36	1.5
1.62	1.68	1.62	1.62	1.92	1.7
1.61	1.55	1.67	1.60	1.44	1.6
1.76	1.84	1.59	1.45	1.70	1.7
1.64	1.73	1.58	1.58	1.73	1.7
1.45	1.56	1.56	1.48	1.56	1.5
1.60	1.78	1.53	1.56	1.63	1.6
1.87	1.69	1.69	2.07	1.87	1.8
1.32	2.17	1.39		1.15	1.5
1.60	1.48	1.89	1.72	1.15	1.6
1.68	1.55	1.48	1.77		1.6
1.55	1.60	1.55	1.68	1.58	1.6
1.33	1.45	1.41	1.41		1.4
1.62	1.68	1.61	1.64	1.68	1.6
1.47	1.54	1.42	1.44	1.31	1.4
1.50	1.87	1.63	1.70	1.66	1.7
1.35	1.29				1.3
1.49	2.18	1.19	1.47		1.6
1.44	1.47	1.40	1.41	1.47	1.4
1.53	1.51	1.69	1.64	1.61	1.6
1.45	1.93	1.28	1.49		1.5
1.48	1.80	1.57	1.77	1.96	1.7
1.75	1.87	1.74	2.00	1.75	1.8
1.40	1.50	1.62	1.33	1.03	1.4
1.51	1.29	1.38	1.33	1.40	1.4
1.48	1.54	1.60	1.51	1.63	1.6
1.54	1.80	1.63	1.83	1.65	1.7
1.68	1.91	1.91	1.96	2.00	1.9
1.68	1.80	1.62	1.57	1.82	1.7
1.61	1.65	1.62	1.59	1.54	1.6
1.35	1.63	1.57	1.39		1.5
1.64	1.64	1.78	1.76	1.70	1.7
1.48	1.49	1.50	1.75	1.76	1.6
1.63	1.58	1.49	1.87	1.73	1.7
1.48	1.65	1.63	1.64	1.53	1.6
1.59	1.70	1.64	1.67	1.84	1.7
1.43	1.14	1.31	1.00		1.2
1.69	1.72	1.78	1.89	1.72	1.8
1.61	1.96	1.41	1.28	2.22	1.7
1.46	1.51	1.49	1.36	1.34	1.4
1.49	1.42	1.56	1.41	1.32	1.4
1.53	1.93	1.61	1.52	1.50	1.6
1.49	1.54	1.54	1.59	1.43	1.5
1.55	1.60	1.62	1.65	1.65	1.6
1.6	1.7	1.6	1.6	1.6	1.6
0.1	0.2	0.2	0.2	0.3	0.2
1.6	1.7	1.6	1.6	1.6	1.6
0.1	0.2	0.2	0.2	0.3	0.2

TABLE 3 (Left-side)

"OBJECTIONABLE" MEDULLAT

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SOURCE	LOT	MFL (mm)	CV (%)	MFD (u)	SD (u)	OBJECTIONABLE MEDULLATED FIBRES COUNTED BY GUBB & INGGS ---- Per 5 grams --- Long	Short	Total	Per 10000 fibres
CAPE	1	78.1	52.4	29.6	7.9	8	22	30	4
CAPE	2	90.8	44.5	36.8	10.3	14	14	28	7
CAPE	3	78.3	39.7	25.5	7.8	69	70	139	15
CAPE	4	90.6	45.2	39.0	11.4	16	17	33	9
CAPE	5	92.1	41.2	35.0	9.1	6	6	12	3
CAPE	6	84.2	44.5	25.8	6.8	17	18	35	4
CAPE	7	88.1	42.4	36.1	10.1	13	7	20	5
CAPE	8	82.7	47.6	31.3	7.9	7	7	14	2
CAPE	9	87.3	45.3	26.4	6.7	13	16	29	4
CAPE	10	81.5	45.6	25.0	6.7	27	41	68	7
CAPE	11	85.3	41.7	32.7	8.4	7	7	14	3
CAPE	12	76.8	40.7	25.0	7.4	83	60	143	14
CAPE	13	83.4	49.2	36.1	10.1	15	4	19	4
CAPE	14	82.0	49.0	30.1	8.3	14	13	27	4
CAPE	15	94.9	44.9	28.8	7.4	22	19	41	7
CAPE	16	98.9	40.1	27.6	7.7	23	45	68	11
CAPE	17	93.0	40.0	25.6	7.2	37	51	88	11
CAPE	18	113.8	36.4	37.2	9.6	12	9	21	7
CAPE	19	107.4	36.5	34.9	8.6	3	5	8	2
CAPE	20	95.4	39.8	27.2	6.9	21	23	44	6
CAPE	21	96.5	39.8	33.6	8.7	8	7	15	3
CAPE	22	101.3	41.3	30.4	7.4	5	4	9	2
CAPE	23	114.1	37.1	36.0	9.0	2	2	4	1
CAPE	24	104.5	33.9	32.6	7.7	2	1	3	1
CAPE	25	115.7	35.6	35.2	9.3	4	3	7	2
CAPE	26	104.0	37.6	29.5	7.0	5	3	8	1
CAPE	27	102.0	40.7	33.7	8.8	11	9	20	5
TEXAS	28	89.0	44.7	35.3	10.7	66	105	171	39
TEXAS	29	90.1	42.0	35.9	10.0	47	39	86	21
TEXAS	30	81.6	52.1	27.0	8.3	31	35	66	8
TEXAS	31	85.0	49.8	32.7	8.0	59	85	144	27
TEXAS	32	74.2	47.1	24.6	7.8	218	365	583	54
TEXAS	33	82.2	53.2	26.8	8.0	21	55	76	9
TEXAS	34	86.4	49.7	36.1	10.1	24	47	71	16
TEXAS	35	85.2	49.1	26.6	7.5	74	137	211	26
TEXAS	36	82.8	48.7	35.0	9.3	23	39	62	13
TEXAS	37	84.6	51.3	35.6	9.7	28	35	63	14
TEXAS	38	85.2	43.5	32.5	8.6	37	36	73	13
TEXAS	39	84.7	52.4	35.5	9.8	15	30	45	10
TEXAS	40	86.0	54.1	28.2	7.9	11	16	27	4
TEXAS	41	87.5	49.0	35.4	10.1	18	26	44	10
TEXAS	42	85.0	52.4	33.6	9.1	5	8	13	3
TEXAS	43	83.0	48.1	35.1	10.3	45	72	117	25
TEXAS	44	83.4	50.6	30.4	8.6	44	68	112	18
TEXAS	45	79.6	45.1	34.8	9.9	30	34	64	13
TEXAS	46	80.1	51.9	30.3	8.4	44	53	97	15
TEXAS	47	80.9	46.9	35.1	10.0	21	32	53	11
TEXAS	48	86.8	44.9	35.1	9.8	15	33	48	11
TEXAS	49	86.4	49.0	35.1	9.9	20	26	46	10
TEXAS	50	75.1	51.3	40.0	13.3	933	250	1183	291
TURKEY	51	80.6	51.7	26.0	9.6	890	870	1760	197
GR.MEAN-49 LOTS		89.2	45.1	31.9	8.7	27.8	37.9	65.7	10.4
STD.DEV.		9.8	5.2	4.0	1.2	33.8	55.0	88.0	9.9
GR.MEAN-51 LOTS		88.8	45.3	31.9	8.8	62.4	58.4	120.8	19.6
STD.DEV.		9.9	5.3	4.2	1.3	174.8	130.2	291.8	47.3

TABLE 3 (Middle)

ED FIBRES AS MANUALLY COUNTED ON GUBB & INGGS MOHAIR TOPS VERSUS OBJECTIV

RINTED IN ORDER OF INCREASING LOT NUMBER, THUS GROUPING TOGETHER HAIR FRO

RESULTS OBTAINED ON OFDA :

MEAN OPACITY (%)	NUMBER OF MEDULLATED FIBRES AT OPACITY THRESHOLDS OF: 80 %	86 %	90 %	92 %	94 %	M.F.D.OF MED.FIBRES (um) AT OPACITY THRESHOLDS OF: 80 %	86 %	90 %	92 %	94 %
47.8	24	13	7	3	1	47	44	56	51	34
49	27	12	8	6	1	55	52	58	52	49
47.8	69	40	23	18	10	41	42	42	46	45
48.9	48	22	13	8	4	58	60	60	62	56
48.4	41	10	5	7	2	53	45	48	47	49
46.7	33	14	12	7	2	38	45	41	43	41
47.5	19	6	3	5	3	53	55	54	49	48
47.9	28	16	8	4	2	46	48	44	45	41
47.5	20	8	5	3	2	38	45	40	39	36
45.8	21	13	8	7	3	40	43	42	44	37
48.6	29	6	4	7	0	49	71	39	48	
46	48	44	28	14	11	45	45	44	50	47
47.9	24	10	10	5	4	58	71	51	46	80
47.5	25	11	3	3	0	51	47	45	53	
46.7	20	16	8	4	2	54	49	49	60	54
45.9	31	14	8	6	3	40	43	43	41	43
49	37	21	10	6	5	39	45	39	38	39
48.1	26	26	11	8	3	57	72	60	57	56
49.3	30	8	5	2	1	49	52	56	47	36
47.8	24	15	7	4	3	45	47	43	43	47
49.7	30	10	5	4	0	49	65	43	50	
48.3	21	14	2	1	0	40	44	43	43	
49.7	14	2	4	1	0	52	41	47	36	
48.5	22	2	0	0	0	44	42			
49.2	30	10	3	2	0	48	57	55	49	
48.7	18	3	1	0	1	39	64	41		34
47.7	24	10	4	2	1	50	61	53	60	66
49	84	60	43	30	13	58	58	63	62	60
48.8	43	26	19	14	11	57	61	59	60	66
49.4	19	16	4	4	2	47	50	43	39	46
47.5	43	23	20	11	7	47	48	46	46	48
46.7	100	69	37	32	15	42	45	44	46	44
49.9	28	20	12	7	2	43	42	45	43	39
48.3	56	33	18	12	9	61	62	64	68	62
47.1	54	39	18	15	4	43	45	43	43	51
49.1	49	34	22	11	8	52	54	56	53	57
49.7	65	45	20	15	11	53	59	58	58	54
47.3	34	24	12	13	10	49	61	53	55	54
48.8	61	26	16	13	10	58	56	53	67	61
46.7	29	23	15	8	5	45	50	43	44	46
49.2	59	35	23	13	12	52	53	53	62	62
48.3	38	21	6	6	1	51	51	57	55	54
50.7	62	40	24	17	5	59	67	67	69	70
48.4	49	20	17	10	3	49	51	49	50	51
49.3	53	45	21	18	15	61	65	61	70	61
47.2	69	47	25	16	9	47	49	47	51	48
48.7	51	31	21	13	10	54	63	57	64	58
49.8	43	38	18	9	4	56	58	57	56	54
48.6	38	32	21	13	6	59	63	57	55	64
53.4	366	252	152	87	51	62	64	65	66	66
46.9	199	171	129	99	62	55	57	57	57	60
48.3	39.0	22.9	13.0	8.9	4.8	49.4	53.1	50.2	51.3	51.1
1.1	18.4	15.1	9.3	6.7	4.4	6.6	8.7	7.5	8.6	10.4
48.3	48.5	30.3	18.0	12.2	6.8	49.7	53.4	50.6	51.7	51.7
1.3	53.2	40.3	26.5	17.6	11.0	6.7	8.7	7.7	8.8	10.5

TABLE 3 (Right-side)

E MEASUREMENT OF MEDULLATED FIBRES ON THE OFDA

M THE CAPE, TEXAS AND TURKEY)

S.D. OF M.F.D. OF MED. FIBRES (um) AT OPACITY THRESHOLDS OF:					MEAN RESULT	RATIO: M.F.D. MED. TO M.F.D. SAMPLE AT OPAC. THRESHOLDS OF:					MEAN RESULT
80 %	86 %	90 %	92 %	94 %		80 %	86 %	90 %	92 %	94 %	
7.9	5.3	13.4	1.1	0.0	5.5	1.60	1.48	1.89	1.72	1.15	1.6
8.1	9.9	5.0	4.0		6.8	1.49	1.42	1.56	1.41	1.32	1.4
5.0	4.7	3.2	5.0	4.4	4.5	1.61	1.65	1.63	1.80	1.76	1.7
10.0	9.8	9.8	11.4	6.4	9.5	1.49	1.54	1.54	1.59	1.43	1.5
8.0	2.0	3.4	2.5	0.5	3.3	1.51	1.29	1.38	1.33	1.40	1.4
3.4	9.0	7.2	7.0	1.6	5.6	1.48	1.75	1.60	1.66	1.59	1.6
9.2	5.0	1.3	2.8	5.2	4.7	1.46	1.51	1.49	1.36	1.34	1.4
6.4	7.0	5.2	4.2	1.5	4.9	1.47	1.54	1.42	1.44	1.31	1.4
4.5	8.0	2.3	1.0	1.2	3.4	1.44	1.71	1.52	1.48	1.36	1.5
3.4	3.5	3.8	3.7	1.7	3.2	1.60	1.71	1.70	1.76	1.49	1.7
7.3	19.6	1.8	5.7		8.6	1.49	2.18	1.19	1.47		1.6
6.3	6.3	3.3	2.8	2.4	4.2	1.79	1.82	1.76	2.02	1.87	1.8
10.2	17.8	7.1	5.4	3.3	8.8	1.61	1.96	1.41	1.28	2.22	1.7
9.9	1.5	2.6	9.3		5.8	1.68	1.55	1.48	1.77		1.6
12.0	5.9	5.2	3.0	0.0	5.2	1.87	1.69	1.69	2.07	1.87	1.8
4.6	5.0	2.8	2.1	2.1	3.3	1.45	1.56	1.56	1.48	1.56	1.5
4.0	6.3	2.2	1.5	1.6	3.1	1.52	1.76	1.52	1.48	1.51	1.6
6.7	18.7	7.7	11.9	1.4	9.3	1.53	1.93	1.61	1.52	1.50	1.6
4.6	11.4	4.6	1.6	0.0	4.4	1.40	1.50	1.62	1.33	1.03	1.4
8.5	6.3	2.0	2.2	1.1	4.0	1.64	1.73	1.58	1.58	1.73	1.7
9.0	21.3	3.2	4.2		9.4	1.45	1.93	1.28	1.49		1.5
2.9	9.9	0.0	0.0		3.2	1.33	1.45	1.41	1.41		1.4
7.8	0.4	2.8	0.0		2.8	1.43	1.14	1.31	1.00		1.2
4.0	0.8				2.4	1.35	1.29				1.3
3.5	14.7	0.9			6.4	1.35	1.63	1.57	1.39		1.5
4.4	19.2	0.0		0.0	5.9	1.32	2.17	1.39		1.15	1.5
9.0	16.2	7.5	0.3	0.0	6.6	1.48	1.80	1.57	1.77	1.96	1.7
11.7	13.9	14.2	14.5	13.0	13.5	1.64	1.64	1.78	1.76	1.70	1.7
8.8	11.1	9.1	10.4	12.5	10.4	1.59	1.70	1.64	1.67	1.84	1.7
9.4	13.2	3.3	1.1	1.4	5.7	1.76	1.84	1.59	1.45	1.70	1.7
6.2	8.6	3.8	3.6	4.4	5.3	1.44	1.47	1.40	1.41	1.47	1.4
4.8	5.5	3.9	4.2	3.5	4.4	1.71	1.83	1.79	1.85	1.79	1.8
7.1	3.7	5.1	4.1	1.3	4.3	1.61	1.55	1.67	1.60	1.44	1.6
12.4	12.9	12.9	16.5	11.5	13.2	1.69	1.72	1.78	1.89	1.72	1.8
5.3	5.3	4.3	3.5	6.3	4.9	1.62	1.68	1.62	1.62	1.92	1.7
6.4	8.9	7.7	5.9	7.5	7.3	1.48	1.54	1.60	1.51	1.63	1.6
5.5	7.9	9.5	9.0	10.0	8.4	1.48	1.65	1.63	1.64	1.53	1.6
5.6	16.2	4.7	9.1	4.6	8.0	1.50	1.87	1.63	1.70	1.66	1.7
11.8	10.8	5.8	18.4	17.1	12.8	1.63	1.58	1.49	1.87	1.73	1.7
5.9	7.6	3.3	2.9	4.4	4.8	1.60	1.78	1.53	1.56	1.63	1.6
8.5	7.5	7.9	13.1	15.4	10.5	1.48	1.49	1.50	1.75	1.76	1.6
5.6	4.8	6.2	6.0	0.0	4.5	1.53	1.51	1.69	1.64	1.61	1.6
9.7	14.0	13.4	18.2	17.9	14.6	1.68	1.91	1.91	1.96	2.00	1.9
9.2	9.3	4.9	5.3	2.0	6.1	1.62	1.68	1.61	1.64	1.68	1.6
12.1	12.9	8.3	13.6	12.3	11.8	1.75	1.87	1.74	2.00	1.75	1.8
7.2	8.4	5.7	7.8	7.2	7.3	1.55	1.60	1.55	1.68	1.58	1.6
7.5	13.3	7.1	10.2	3.7	8.4	1.54	1.80	1.63	1.83	1.65	1.7
10.7	11.2	9.5	6.3	5.7	8.7	1.61	1.65	1.62	1.59	1.54	1.6
11.6	15.2	11.1	5.4	6.7	10.0	1.68	1.80	1.62	1.57	1.82	1.7
8.2	8.7	9.1	9.0	8.7	8.7	1.55	1.60	1.62	1.65	1.65	1.6
11.4	11.4	10.6	9.3	12.3	11.0	2.12	2.19	2.21	2.19	2.31	2.2
7.4	9.5	5.6	6.1	4.9	6.7	1.6	1.7	1.6	1.6	1.6	1.6
2.6	5.1	3.5	4.8	4.9	3.1	0.1	0.2	0.1	0.2	0.2	0.1
7.5	9.6	5.8	6.3	5.2	6.9	1.6	1.7	1.6	1.6	1.6	1.6
2.6	5.0	3.6	4.7	5.0	3.1	0.1	0.2	0.2	0.2	0.3	0.2