INTERNATIONAL WOOL TEXTILE ORGANISATION

TECHNOLOGY & STANDARDS COMMITTEE **BUENOS ARIES MEETING**

Sliver Group **May 2003**

Chairman: J. TURK (Australia) **SG Submission No: SG 01**

Effect of Application of a Raw Signal Filter on the Precision and Accuracy of the Almeter AL2ooo

By

R C Couchman1 & P.Holmes2

1. The Woolmark Company, Melbourne 2. Fopet Electronic Solutions, Reeth (UK)

BRIEFING PAPER

SUMMARY OF FINDINGS

Couchman & Holmes (IWTO Nice SG-02) provided information on the accuracy and precision of the new Almeter (*AL2ooo*) that showed differences between the AL100 and *AL2ooo* distribution statistics. Following further preliminary work they indicated that modification of the raw signal of the *AL2ooo* was required to filter the pre and post measuring activity of the measuring head (Couchman & Holmes [SG-01 Annexure to the Minutes]).

This paper provides confirmation of that preliminary work and clearly demonstrates that the filter is operating correctly and that the values obtained from the *AL2ooo* are equivalent to the AL100. Further work is reported on the operation AL100's and 2 other *AL2ooo* instruments, in relation to trapeziums and additional work is currently in progress on commercial wool top samples in order that trade interests are able to observe that the new *AL2ooo* instrument treats wool in the same manner as the original AL100. In their earlier paper, the authors argued that equivalence should be determined on the basis of measurements on the solid trapezium values as it eliminates a significant degree of variation caused by the wool medium due to both sample and sample preparation, common to both instruments. They argue that the issue is one of the measurements per se rather than the measuring system, which encompasses the sample and sample preparation variation and this, is borne out in the provisions of IWTO 0.

To confirm the effects of the application of a filter to the measuring head of the *AL2ooo* to remove pre and post measuring interference replicate sets of measurements were taken on the original 4 trapeziums studied. These are compared under IWTO 0 provisions and demonstrate that the original bias shown has been eliminated and the readings, especially for those of the distribution statistics, are now in line with the AL100 and the new instrument is demonstrating equivalence. These findings lead to the conclusion that the *AL2ooo* measuring system is equivalent to the AL100 as a suitable instrument to undertake measurement of top length and distribution attributes under IWTO 17.

COMMERCIAL IMPLICATIONS – CURRENT AND FUTURE

These studies show that the *AL2ooo* is equivalent to the AL100 in the measurement of top length and length distribution parameters allowing the wool trade to accept either measurement in trading.

The findings will require an editorial alteration to the text of IWTO 17 to identify the equivalence status of the *AL2ooo* instrument.

NOTE

This submission will be discussed in the Sliver Group meeting commencing 1630pm Friday 9th May, 2003.

INTERNATIONAL WOOL TEXTILE ORGANISATION

TECHNOLOGY & STANDARDS COMMITTEE **BUENOS ARIES MEETING**

Sliver Group **May 2003**

Chairman: J. TURK (Australia) **SG Submission No: SG 01**

Effect of Application of a Raw Signal Filter on the Precision and Accuracy of the Almeter AL2ooo

By

R C Couchman1 & P.Holmes2

1. The Woolmark Company, Melbourne 2. Fopet Electronic Solutions, Reeth (UK)

SUMMARY

This paper provides confirmation of preliminary work reported to IWTO Nice, 2002, on the equivalence of the Almeter *AL2ooo* and the effect of the application of a filter to raw signal results. Details clearly demonstrate that the filter is operating correctly and that the values obtained from the *AL2ooo* are equivalent to the AL100. The paper further presents data on the operation of 2 AL100's and 2 further *AL2ooo* instruments in 2 separate laboratories in relation to trapeziums. Additional work is underway on commercial wool top samples in order that trade interests are able to observe that the new *AL2ooo* instrument treats wool in the same manner as the original AL100 and results will be presented at the meeting in Buenos Aries.

The findings lead to recommendations to alter text in IWTO 17 to allow for inclusion of the *AL2ooo* instrument as a suitable instrument for providing fibre length and distribution measurement results in that Specification.

BACKGROUND

Couchman & Holmes (IWTO Nice 02) provided information on the accuracy and precision of the new Almeter (*AL2ooo)* that showed differences between the AL100 and *AL2ooo* distribution statistics. Following further preliminary work they indicated that modification of the raw signal of the *AL2ooo* was required to filter the pre and post measuring activity of the measuring head (Couchman & Holmes - Additional Information (SG 02- Annexure to the Minutes).

In their earlier paper, the authors argued that equivalence should be determined on the basis of measurements on the solid trapezium values as it eliminates a significant degree of variation caused by the wool medium due to both sample and sample preparation. They argue that the issue is one of the measurements per se rather than the measuring system, which encompasses the sample and sample preparation variation and this, is borne out in the provisions of IWTO 0.

IWTO 0 Appendix B states in paragraph 4, page 1… qoute...

"*Data is collected by measuring samples by both methods. The samples may be:*

(a) stable or completely homogenous substances (e.g. ceramic tiles used as colour standards);
(b) homoginised wool (e.g. blended wool top);
(c) etc. etc."

The use of trapeziums to show equivalence is a parallel situation to point (a).

IWTO 0 clearly classifies the level of variation in the above sampling cases.

"The sample categories as listed from (a) to (d) represent examples where the sampling variation is increasing from (a) to (d)" .

In addition, this section of Appendix B goes on to state....

"Where practicable, material with the least sampling variation should be used for testing method (or instrument) differences."

This once again is a similar situation whereby the use of trapeziums removes the additional sample and sample preparation variation that is introduced through the use of wool and the sample preparation procedures of the Fibroliner. These procedures are exactly the same for both the AL100 and the *AL2ooo* instruments and thus the trial design has followed IWTO 0 to the letter and its intent, i.e. to reduce unwarranted variation wherever possible in comparing test methods or instruments.. This is an instrument metrology issue not wool metrology hence the approach taken is correct under IWTO 0.

This work arises as a consequence of differences observed in an earlier study of the AL100 and the *AL2ooo* and reported to IWTO Nice 2002. These differences related primarily to the distribution statistics and a supplementary report presented during the Nice Meeting indicated that the reason for this was due to the sensing head of the new *AL2ooo* recording pre and post measuring information. The effects of this are overcome by the addition of a filter and this paper provides further evidence of the effectiveness of that filter.

The work comprises 2 studies:-

Part 1a was designed to demonstrate the improvement in compatibility of results between the AL100 and the *AL2ooo* as a consequence of the application of the signal filter. It had the added benefit of providing machine measuring precision limits.

To confirm the effects of the application of a filter to the measuring head of the *AL2ooo* to remove pre and post measuring interference 4 replicate sets of measurements were taken on the original 4 trapeziums studied. These are compared under IWTO 0 provisions and demonstrate that the original bias shown has been eliminated and the readings, especially for those of the distribution statistics, are now in line with the AL100 and the new instrument is demonstrating equivalence.

Part 1b provided a more extensive study of the earlier trapezium work undertaken in Part 1a for equivalence testing under procedures outlined in IWTO 0.

Part 2. In addition, a supplementary study has been commenced to demonstrate the repeatability of results between *AL2ooo* machines using commercial wool top samples in different laboratories and machines. Due to time constraints and un-availability of the round trial data from the commercial wool tops, at the time of writing this report, results will be reported at the Buenos Aries meeting.

PART 1A. TRAPEZIUM MEASUREMENTS – FILTER

To confirm the effects of the application of a filter to the measuring head of the *AL2ooo* to remove pre and post measuring interference 4 replicate sets of measurements were taken on the original 4 trapeziums studied. These are compared under IWTO 0 provisions and demonstrate that the original bias shown has been eliminated and the readings, especially for those of the distribution statistics, are now in line with the AL100 and the new instrument is demonstrating equivalence

HAUTEUR & HAUTEUR DISTRIBUTIONS

Table 1 shows the mean and sd values for Hauteur.

SUMMARY Hauteur		Mean Values AL100 A	AL2000F B	AL2000R C	AL100 - AL2ooo(F) A-B	Confidence Limit Tests F ratio A/B	P Value	t Tests for Mean Differences t Value A/B	t Value A/C	P Value A/B	P Value A/C
60mm Trapezium											
723/5	**Average**	59.8	59.8	59.8				0.4	0.4	0.7	0.7
724/5	**Average**	60.1	60.3	60.3				1.3	0.2	0.2	0.8
Sub-Total	**Average**	60.0	60.0	60.1	-0.1			0.6	0.3	0.5	0.8
	95% CLT	0.3	0.8	0.6		2.9	0.1				
120mm Trapezium											
723/7	**Average**	118.9	119.5	118.6				3.0	4.3	0.0	0.0
724/7	**Average**	120.0	120.6	120.3				4.5	2.1	0.0	0.1
Sub-Total	**Average**	119.5	120.0	119.4	-0.6			2.4	2.0	0.0	0.1
	95% CLT	1.1	1.4	1.8		1.3	0.4				
Combined											
OVERALL	**Average**	89.7	90.0	89.8	-0.3			2.4	1.7	0.0	0.1
	95% CLT	0.8	1.2	1.3		2.1	0.2				

Table 1 demonstrates that there are no significant differences between the AL100 and *AL2ooo* mean values for the Trapeziums either with or without the signal filter. Importantly, there are no significant differences in the 95% confidence limits for the AL100 and *AL2ooo* filtered data. This shows an overall average difference of 0.3mm Hauteur for the 4 trapeziums measured.

Table 2 shows the mean values, differences and probability statistics for means and confidence limit calculations for CV Hauteur. The 95% confidence limit tests are the within trapezium values and include the between replication variance component.

SUMMARY CVHa		Mean Values AL100 A	AL2000F B	AL2000R C	AL100 - AL2ooo(F) A-B	Confidence Limit Tes F ratio A/B	P Value	t Tests for Mean Differences t Value A/B	t Value A/C	P Value A/B	P Value A/C
60mm Trapezium											
723/5	**Average**	**47.9**	**47.7**	**51.2**	**0.1**			**1.8**	**40.8**	**0.1**	**0.0**
724/5	**Average**	**47.5**	**47.4**	**50.5**	**0.1**			**0.9**	**18.0**	**0.4**	**0.0**
Sub-Total	**Average**	**47.7**	**47.5**	**50.8**	**0.1**			**1.4**	**22.9**	**0.2**	**0.0**
	95% CLT	**0.4**	**0.7**	**0.9**		**2.0**	**0.2**				
120mm Trapezium											
723/7	**Average**	**52.1**	**52.3**	**54.4**	**-0.2**			**4.8**	**11.9**	**0.0**	**0.0**
724/7	**Average**	**52.0**	**51.2**	**53.0**	**0.8**			**11.0**	**15.5**	**0.0**	**0.0**
Sub-Total	**Average**	**52.5**	**51.7**	**53.7**	**0.8**			**3.6**	**7.8**	**0.0**	**0.0**
	95% CLT	**1.1**	**1.3**	**1.5**		**1.5**	**0.3**				
Combined											
OVERALL	**Average**	**50.1**	**49.6**	**52.3**	**0.5**			**3.8**	**18.1**	**0.0**	**0.0**
	95% CLT	**0.8**	**1.1**	**1.2**		**1.7**	**0.2**				

It is clear that the application of the raw signal filter has addressed the issue of pre and post sensing and the CVHa readings are now much better aligned to the AL100 values. The differences in Confidence Limit values between the AL100 and *AL2ooo* (A/B) are not significant.

The differences in the mean values of the 60mm Ha Trapeziums 723/5 and 724/5 are not significant for the AL100 and the filtered signal values for the *AL2ooo* (A/B), whereas the differences between the AL100 and the raw signal values of the *AL2ooo* (A/C above) are as reported in Nice 2002, significantly different.

The values have risen for the 120mm Ha Trapeziums where all values are still statistically significantly different from the AL100 however the level of difference for the filtered data for the AL2ooo is now only 0.5% CVHa. The statistical significance and it's level of significance needs to be taken in context together with the magnitude of the absolute value differences which are in reality very similar. Statistical significance in this instance is due to the high precision of the measurement because we are dealing with a stable medium to measure, the trapeziums. This highlights the strength of the analytical tests and procedures used.

In this particular instance, the absolute difference in CVHa is only 0.5% CVHa, for a trapezium measuring 120mm Hauteur, albeit a lower value than the AL100. It is therefore insignificant in respect to a 120mm Ha value when the maximum Ha value one is likely to encounter, in practice, is approx. 95mm. Such a small difference is therefore commercially irrelevant.

Hauteur Distribution Values

The distribution statistics for K (% fibres < x mm) and L (length of fibres @ x%) values are commercially important values, particularly the K20 – K30 and the L1 and L5 values. Whilst not as critical as the Hauteur or CVHa values they are important none the less.

The application of the filter has restored those values to be equivalent to the AL100. Details are provided in figures 1 and 2 (below). The result of the filter has reduced all the K values and has resulted in an increase in the higher L values (L75-L95) and decreased the lower L values (L1 and L10) to equivalent values to the AL100.

Figure 1 K Values (Hauteur)

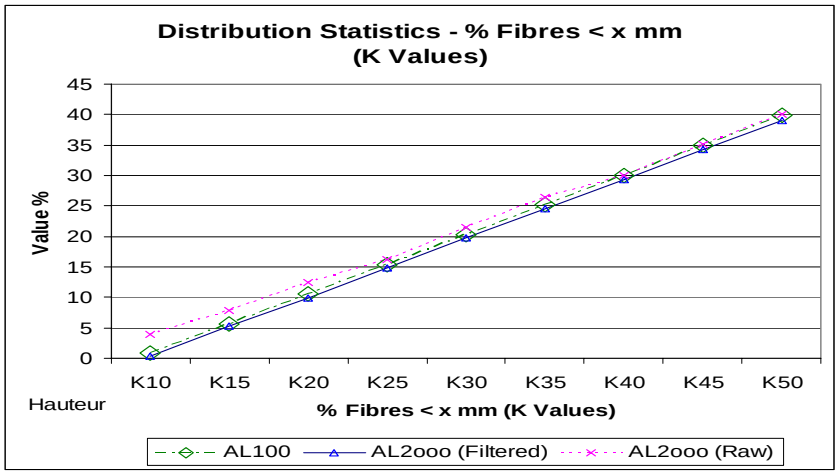
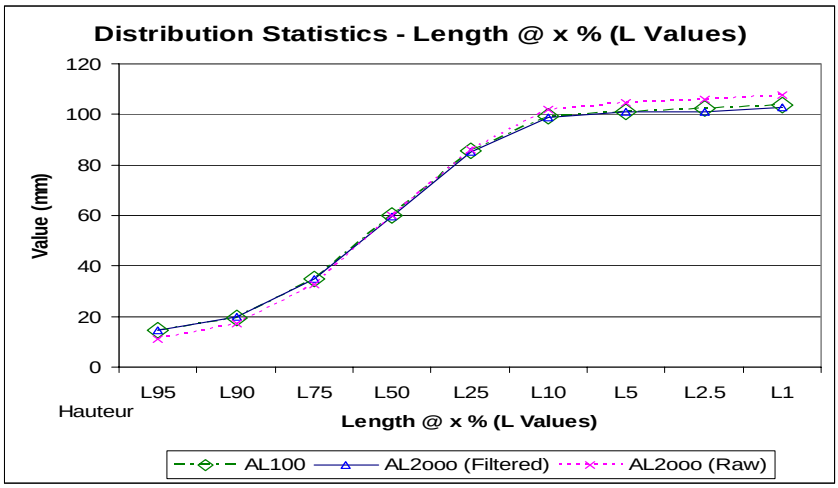


Figure 2. L Values (Hauteur)



Similar results have been obtained for the Barbe and Barbe distributions and these are presented below.

BARBE & BARBE DISTRIBUTIONS

Whilst Barbe and Barbe distribution statistics have limited use throughout the world for worsted processing with the exception of their use in China these statistics are used in the Length After Carding tests undertaken on scoured wool destined for the woollen trade. They therefore need to be reported.

Barbe

SUMMARY Barbe		Mean Values				Confidence Limit Tests		t Tests for Mean Differences			
		A	B	C	A-B	A/B		AL100 v's AL2ooo(F)		AL100 v's AL2ooo(R)	
		AL100	AL2000F	AL2000R	AL100 - AL2ooo(F)	F ratio	P Value	t Value	P Value	t Value	P Value
60mm Trapezium											
723/5	Average	73.4	73.3	75.5				5.7	0.1	20.4	0.0
724/5	Average	73.6	73.6	75.7				0.3	0.7	14.5	0.0
Sub-Total	Average	73.5	73.4	75.6	0.1			1.1	0.3	24.3	0.0
	95% CLT	0.2	0.6	0.3		3.1	0.1				
120mm Trapezium											
723/7	Average	152.3	151.8	153.7				5.7	0.0	20.4	0.0
724/7	Average	152.4	152.0	154.1				3.7	0.0	17.6	0.0
Sub-Total	Average	152.3	151.9	153.9	0.5			6.2	0.0	22.3	0.0
	95% CLT	0.1	0.6	0.4		4.0	0.0				
Combined											
OVERALL	Average	112.9	112.6	114.8	0.3			5.1	0.0	33.0	0.0
	95% CLT	0.2	0.6	0.4		12.1	0.0				

Despite the mean Barbe values for the 120mm (Ha) Trapezium for the AL100 and *AL2ooo* being significantly different, as are the 95% confidence limits, it is important to note that the absolute differences between the AL100 values and the *AL2ooo* values are only different by 0.3mm Barbe and thus would have no commercial impact. The comments regarding significance and magnitude of differences are also relevant to Barbe and CV of Barbe.

CV Barbe.

SUMMARY CV Barbe		Mean Values AL100 A	AL2000F B	AL2000R C	AL100 - AL2ooo(F) A-B	Confidence Limit Tests F ratio A/B	P Value	t Tests for Mean Differences t Value A/B	P Value A/B	t Value A/C	P Value A/C
60mm Trapezium											
723/5	Average	33.5	33.4	34.0				9.7	0.0	3.9	0.0
724/5	Average	33.4	33.3	33.9				2.6	0.0	10.4	0.0
Sub-Total	Average	33.5	33.3	33.9	0.1			3.3	0.0	15.4	0.0
	95% CLT	0.1	0.3	0.1		2.6	0.1				
120mm Trapezium											
723/7	Average	34.4	34.1	34.2				9.7	0.0	3.9	0.0
724/7	Average	34.1	33.9	34.1				17.2	0.0	17.2	0.0
Sub-Total	Average	34.3	34.0	34.2	0.2			5.1	0.0	5.0	0.0
	95% CLT	0.3	0.2	0.1		0.6	0.7				
Combined											
OVERALL	Average	33.9	33.7	34.1	0.2			6.0	0.0	15.3	0.0
	95% CLT	0.2	0.2	0.1		1.0	0.5				

Similarly, the mean values for CV of Barbe for the AL100 and *AL2ooo* are also significantly different, but the 95% confidence limits are not. It is important to note that the absolute differences between the AL100 values and the *AL2ooo* values are only different by 0.2% CV Barbe and thus would have no commercial impact. In addition Barbe as a value is not recommended for use commercially particularly as small differences in the lower K distribution statistics are small in relation to the similar statistic for Hauteur and thus have a scaling effect.

Barbe Distribution Statistics.

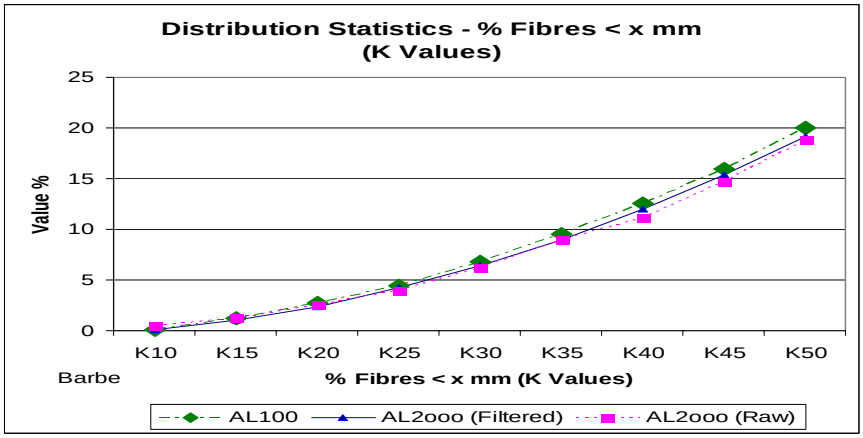


Figure 3. Barbe K Values

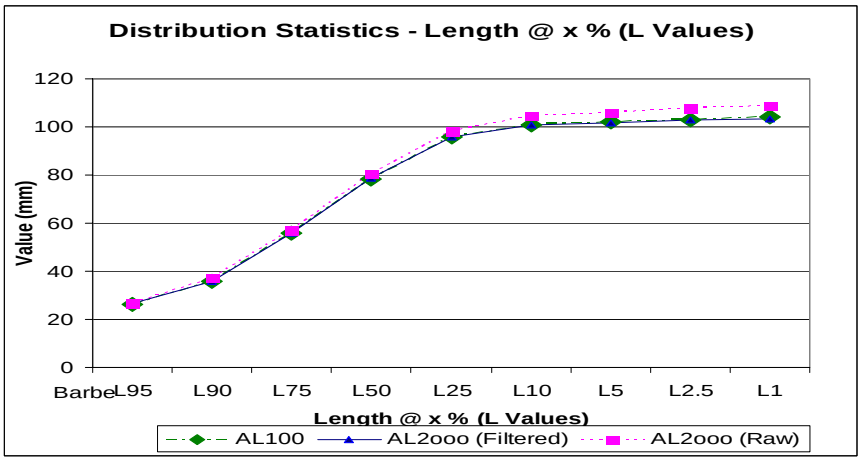


Figure 4. Barbe L Values

Details in both figures 3 & 4 (above) clearly illustrate that the Barbe distribution statistics now are very closely aligned to the original AL100 values as a result of the application of the filter to the original *AL2ooo* raw signals.

Part 1B – BETWEEN INSTRUMENT / LAB. TRAPEZIUM STUDY

The earlier work was undertaken on the *AL2ooo* prototype and an AL100 in a commercial testing laboratory. Subsequent development and manufacture of commercial machines has allowed the testing of two (2) additional *AL2ooo* machines in between machine/lab trials.

A single trapezium was measured in each machine, in two (2) labs with 8 replicates to obtain between machine variation values. Values recorded for the *AL2ooo* were the filtered values discussed in Part 1 of this report.

Results.

Results for the different machines and labs are presented in summary in table 6 with means and sd values. The between machine 95% confidence limits for the measurement of Ha and CVHa are presented in table 7.

The mean differences outlined in table 6 (below) again are statistically different (P=0.02) but the absolute differences are less than -0.04mm for a trapezium with an assigned value of 103.5mm. From a practical point of view such a level of difference is irrelevant and is well below any commercially significant level.

There was no significant differences shown between laboratories.

Table 6. Mean differences (mm Hauteur) for between machine and laboratory values for the measurement of Perspex Trapeziums in the AL100 and *AL2ooo*.

Trapezium Hauteur (Between Labs)				
	AL100		***AL2ooo***	
Test	Lab A	Lab B	Lab A	Lab B
1	60.2	59.8	61.2	59.8
2	60.2	59.9	57.9	59.9
3	60.2	59.8	59.9	59.9
4	60.2	59.9	59.9	59.9
5	60.2	59.9	60.0	59.9
6	60.2	59.6	60.1	59.7
7	60.2	59.8	60.1	59.7
8	60.2	59.8	60.0	59.8
mean	60.20	59.81	59.90	59.83
sd	0.00	0.10	0.90	0.08
95% CLT	0.002		0.144	

note 95% confidence limit for a single trapezium test.*

The differences in the AL100 values are significant due to zero variation in Lab A results but the absolute differences are negligible. No significant differences exist between the 2 *AL2ooo* machines.

It is pointed out that these values represent the differences between the AL100 and *AL2ooo* machines, in the measurement of perspex trapeziums. Whilst they are statistically significantly different from each other the absolute difference in 2 machines in 2 labs is only 0.14mm and thus these differences in both the measurements, or the 2 machines tested, are considered inconsequential. The significances arise due to the power of the analytical techniques used and the low level of overall variation in results.

The 95% confidence limits relate specifically to the measurement unit per.se., as the test specimen is a fixed perspex medium as opposed to a variable product such as wool, where there are components of variance associated with sampling and sample preparation of a variable medium like a wool top.

Table 7.

ANOVA	**Hauteur**							
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	*Lab I.D.*	*Mean*
Labs	0.417985488	1	0.417985	2.00	0.17	4.20		
Instruments	0.163632712	1	0.163633	0.78	0.38	4.20		
Interaction	0.202048037	1	0.202048	0.97	0.33	4.20		
Within	5.843101656	28	0.208682				Lab A	60.01
							Lab B	59.86
Total	6.626767894	31					Diff	-0.14

CV Ha

CVHa values are presented in Table 8 and 9 below.

There is an absolute difference between instrument types with the AL2ooo giving a slightly lower value (-0.84%). The 95% confidence limits are provided in Table 9

Trapezium CV Hauteur (Between Labs)				
	AL100		***AL2ooo***	
Test	Lab A	Lab B	Lab A	Lab B
1	47.7	47.7	47.3	46.7
2	47.7	47.8	48.0	46.8
3	47.7	47.3	46.4	47.3
4	47.7	47.7	46.4	46.5
5	47.7	47.5	46.4	47.2
6	47.7	47.7	46.6	47.0
7	47.7	47.7	46.7	46.8
8	47.7	47.7	46.2	47.0
mean	47.70	47.64	46.74	46.92
sd	0.00	0.16	0.62	0.26
95% CLT	0.005		0.079	

Table 9. CVHa

ANOVA								
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	*Lab I.D.*	*Mean*
Sample	0.030145412	1	0.030145	0.25	0.62	4.20		
Columns	5.658930463	1	5.65893	47.41	0.00	4.20		
Interaction	0.122780886	1	0.122781	1.03	0.32	4.20		
Within	3.341853745	28	0.119352				Lab A	47.67
							Lab B	46.83
Total	9.153710505	31					Diff	-0.84

Details of Comparative differences for Barbe and CV of Barbe are provided in Tables 10 and 11.

There are no significant differences in Barbe but statistical significances are apparent for CV of Barbe. It is however important to note that the absolute differences in CV of Barbe are negligible.

Table 10. Between Lab differences for Barbe & CV of Barbe.

Trapezium Barbe (Between Labs)				
	AL100		***AL2ooo***	
Test	Lab A	Lab B	Lab A	Lab B
1	73.80	73.30	75.06	73.19
2	73.80	73.40	71.26	73.16
3	73.80	73.20	72.91	73.15
4	73.80	73.40	72.93	73.27
5	73.80	73.40	72.97	73.13
6	73.80	73.10	73.22	73.11
7	73.80	73.40	73.18	72.98
8	73.80	73.40	72.90	73.13
mean	73.80	73.33	73.05	73.14
sd	0.00	0.12	1.02	0.08
95% CLT	0.003		0.081	

Trapezium CV Barbe (Between Labs)				
	AL100		***AL2ooo***	
Test	Lab A	Lab B	Lab A	Lab B
1	33.40	33.50	33.30	33.28
2	33.40	33.60	33.52	33.35
3	33.40	33.50	33.11	33.49
4	33.40	33.60	33.17	33.21
5	33.40	33.60	33.09	33.47
6	33.40	33.80	33.30	33.45
7	33.40	33.60	33.41	33.42
8	33.40	33.60	33.10	33.45
mean	33.40	33.60	33.25	33.39
sd	0.00	0.09	0.16	0.10
95% CLT	0.001		0.007	

Table 11.

ANOVA **Barbe**

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	*Lab I.D.*	*Mean*
Sample	0.301618	1	0.301618	1.13	0.30	4.20		
Columns	1.731149	1	1.731149	6.47	0.02	4.20		
Interaction	0.630921	1	0.630921	2.36	0.14	4.20		
Within	7.486435	28	0.267373				Lab A	73.56
							Lab B	73.10
Total	10.15012	31					Diff	-0.47

Table 12. CV of Barbe

ANOVA **CV of Barbe**

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	*Lab I.D.*	*Mean*
Sample	0.23384	1	0.23384	21.292	0.000	4.196		
Columns	0.260069	1	0.260069	23.680	0.000	4.196		
Interaction	0.006743	1	0.006743	0.614	0.440	4.196		
Within	0.307513	28	0.010983				Lab A	33.50
							Lab B	33.32
Total	0.808165	31					Diff	-0.18

Distribution Statistics (K & L Values)

The comparison of K & L values is provided in figures X & Y (below)

Figure 5

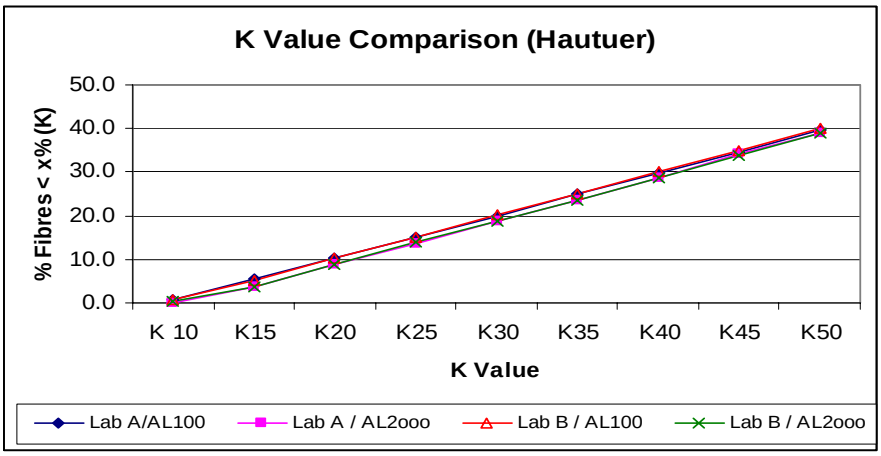
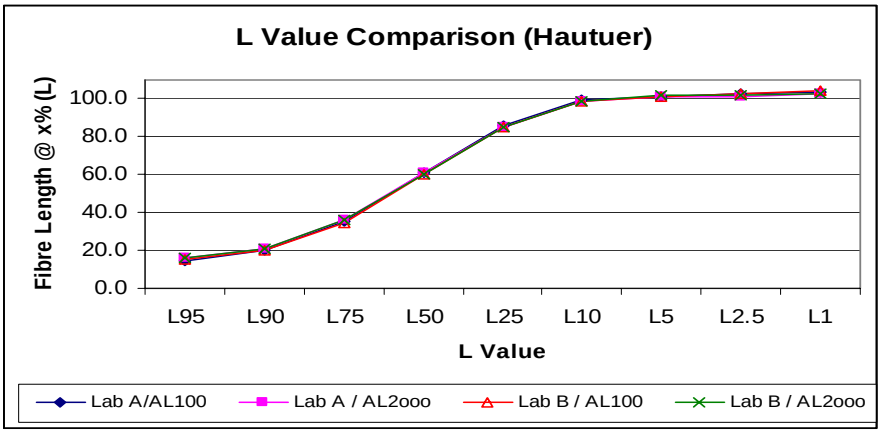


Figure 6



Similar results to those presented in Figures 5 & 6 were obtained for the Barbe distributions.

Part 1. Discussion

In the earlier paper, the authors argued that equivalence should be determined on the basis of measurements on the solid trapezium values as it eliminates a significant degree of variation caused by the wool medium due to both sample and sample preparation. They continue to argue that the issue is one of the measurements per se rather than the measuring system, which encompasses the sample and sample preparation variation and this, is borne out in the provisions of IWTO 0.

These procedures are exactly the same for both the AL100 and the *AL2ooo* instruments. This is an instrument metrology issue not wool metrology hence the approach taken is correct under IWTO 0.

This study provides confirmation of that preliminary work reported to IWTO Nice, 2002 on the application of a filter to raw signals from the *AL2ooo* instrument clearly corrects for pre and post sensing effects that had previously shown differences between the distribution statistics of the AL100 and *AL2ooo* instruments when raw signal values were used. The results demonstrate that the filter is operating correctly and that the values obtained from the *AL2ooo* are now equivalent to the AL100.

Whilst there were in some cases, statistically significant differences in the results obtained from the two machines for parameters such as CVHa, Barbe and CV Barbe and specifically for trapezium lengths relating to the 120mm Ha material, the absolute differences were very small and commercially irrelevant. The statistical differences relate as much to the strength of the analytical tests and procedures used and the high precision in the measurement due to measuring a stable finite medium; plastic trapeziums.

In Part 1B of the study, equivalence is shown for the 2 additional instruments and provides precision data for the *AL2ooo*. In addition, it shows no between instrument bias, and thus recommends alteration of the text to IWTO 17 to allow for the use of the *AL2ooo* in that Specification.

PART 2. COMMERCIAL WOOL TOP TRIALS

Background.

To supplement the trapezium information, a series of round trials has commenced using a number of commercial wool tops. At the time of writing this report the complete data set was unavailable and supplementary information on these trials will be presented at the Buenos Aries meeting as a result.

The aim, of this additional work, is to provide further data on the operation of both the AL100 and *AL2ooo* in relation to commercial wool top samples in order that trade interests are able to observe that the new *AL2ooo* instrument treats wool in the same manner as the original AL100.

Trial Design

Two commercial *AL2ooo* machines are being tested in 2 laboratories the UK and 3 in Australia.

Lab 1	2 (UK) *AL2ooo* machines*,	1 AL100	Commercial Testing Lab & Mill Lab
Lab 2	2 (UK) *AL2ooo* machines,	1 AL100	Commercial Testing Lab & Mill Lab
Lab 3	1 (Aust.) *AL2ooo* machine,	1 AL100	Commercial Testing Lab
Lab 4	1 (Aust.) *AL2ooo* machine,	1 AL100	Mill Lab
Lab 5	1 (Aust.) *AL2ooo* machine,	1 AL100	Research Lab

To this extent, any differences in, sample preparation in the various Fibroliners, or operator differences will add to any variation resulting from the measuring system per se. Results therefore will relate to the full testing and measurement system as opposed to the measuring system differences identified in Part 1 of this report on measurement of stable Trapeziums.

Tops have been sourced from a commercial topmaker and no attempt has been made to minimise any within batch variation in top length or its distribution through any additional processing or preparation of the top samples. The commercial top samples were selected to obtain Hauteur values across the Hauteur range from 55mm to 93mm. The number and range of tops used in these trials is similar to that used in the original Almeter round trials (46 – 94mm tops), as reported in Appendix 1 of IWTO 17.

Conclusions

These studies confirm the effects of the application of a filter to the measuring head of the *AL2ooo* to remove pre and post measuring interference.

Additional trapezium trials with two (2) other *AL2ooo*'s being compared to AL100's in two (2) different labs. confirm the earlier trapezium studies. These are compared under IWTO 0 provisions and demonstrate that the original bias shown has been eliminated and the readings, especially for those of the distribution statistics, are now in line with the AL100 and the new instrument is demonstrating equivalence.

In addition, the work being undertaken with wool samples is aimed at demonstrating that such results are transferable to wool and there are no appreciable between machine and laboratory influences.

These findings are likely to lead to the following recommendations:-

- to include the *AL2ooo* as a suitable instrument to undertake IWTO testing and certification of top length and distribution attributes under IWTO 17.
- to substitute the text "AL-100" with the text "AL-100/*AL2ooo*", throughout IWTO 17, to accommodate this.
- that the above text substitution is not applied to sections A6.1 – A6.6 of Appendix 6. These sections of Appendix 6 provide, what amounts to, a user's manual for the AL-100 instrument.
- that no such Appendix be inserted for the *AL2ooo* but a user's manual be provided with the instrument, independent of IWTO 17.

REFERENCES

Couchman, R.C., and Holmes, P. (2001) *Investigations Into the Repeatability and Precision of the Re-configured Almeter - AL2ooo.* IWTO T&S Committee, Nice, SG 02 (plus supplementary paper appended to the Sliver Group Minutes).

IWTO -17-85-(E) *Determination of Fibre Length Distribution Parameters by Means of the Almeter*.

IWTO -0– 98 *Introduction to IWTO Specifications. Procedures for the Development, Review, Progression or Relegation of IWTO Test Methods & Draft Test Methods Referencing Other Publications.*

Errata

A number of errors and omissions were identified between the submission of the paper and presentation at IWTO Buenos Aries.

These details, provided below, were presented to the Silver Group in Buenos Aries and appended to the minutes of that meeting.

	Hauteur				***CVHauteur***			
	AL100		*AL2ooo*		*AL100*		*AL2ooo*	
ReportSG01 sd's	*0*	*0.1*	*0.09*	*0.08*	*0*	*0.16*	*0.18*	*0.26*
Var	*0.005*		*0.007*		*0.013*		*0.050*	
Sd	*0.071*		*0.085*		*0.113*		*0.224*	
Con Limit	***0.139***		***0.167***		***0.222***		***0.438***	
F ratio			*1.45*				*3.91*	

	Barbe				***CVBarbe***			
	AL100		*AL2ooo*		*AL100*		*AL2ooo*	
Rep SDs	*0*	*0.12*	*0.14*	*0.08*	*0*	*0.09*	*0.13*	*0.1*
Var	*0.007*		*0.013*		*0.004*		*0.013*	
Sd	*0.085*		*0.114*		*0.064*		*0.116*	
Con Limit	***0.166***		***0.223***		***0.125***		***0.227***	
F ratio			*1.81*				*3.32*	

Further examination of the data revealed the presence of 2 outlier values in Lab A. Details and the effects are provided below:-

Lab A

Hauteur	*CvH*	*Barbe*	*CV Barbe*
61.2	*47.3*	*75.06*	*33.3*
57.9	*48*	*71.26*	*33.52*
59.9	*46.4*	*72.91*	*33.11*
59.9	*46.4*	*72.93*	*33.17*
60	*46.4*	*72.97*	*33.09*
60.1	*46.6*	*73.22*	*33.3*
60.1	*46.7*	*73.18*	*33.41*
60	*46.2*	*72.9*	*33.1*

The first 2 sets of values were tested and identified as outliers. Removing those alters the standard deviations and thus the 95% Confidence levels:-

	Ha	*CVH*	*Barbe*	*CVB*
All Data - mean	*59.89*	*46.75*	*73.05*	*33.25*
sd	*0.91*	*0.60*	*1.02*	*0.16*
Excl First 2 points	***60.00***	***46.45***	***73.02***	***33.20***
sd	***0.09***	***0.18***	***0.14***	***0.13***