INTERNATIONAL WOOL TEXTILE ORGANISATION

TECHNOLOGY & STANDARDS COMMITTEE **BIELLA MEETING**

Sliver Group **November 2005**

Chairman: G.S. SINGH (India) **Report No: SG 03**

Comparisons Between OFDA4000 and IWTO Standardised Methods for Measurement Made on Wool Tops: Part 2 Length Characteristics

By

A. Balasingam, V.E.Fish, T.J.Mahar and J.W.Marler

Australian Wool Testing Authority Limited PO Box 190, Guildford, NSW 2161 Australia

SUMMARY

A comparison has been conducted of the measurements of OFDA4000 and the IWTO Standard, Almeter on 601 commercial tops from the TEAM-3 project and 301 research tops from processing single sale lots. Results show statistically significant differences between OFDA4000 and Almeter for both average and level-dependent bias for most of the 40 parameters which characterise a top fibre length distribution, supporting previous work by Baxter.

This report uses the estimated the precision of a test for each parameter as a basis for interpretation of the magnitude of the average differences. The Table below sets out average differences (OFDA4000 – Almeter) for Hauteur and 5 other length parameters of interest:

	Hauteur	CV(Hauteur) %	Barbe	CV(Barbe) %	K25H (%)	L5H (mm)
TEAM	-0.8	0.7	-0.4	0.4	1.3	0.1
Sale Lots	0.3	0.3	0.7	0.1	0.5	1.6
Precision	±1.2	±1.9	±1.7	±1.0	±1.3	±1.3

With the exception of L5H for the Sale Lots data, all average differences for these parameters are within the precision limits for a test.

Results also indicate that, on average, the OFDA4000 has estimated the Almeter values of Hauteur and CVH, for the more extreme Sale Lots tops with similar accuracy as the TEAM-3 tops. There are results for a very small number of individual tops which show greater than expected differences between OFDA4000 and Almeter.

For any individual top the OFDA4000 can systematically over-estimate or under-estimate “K” and “L” parameters compared with the Almeter. These biases can range up to the equivalent of the precision of a test.

BACKGROUND

This report summarises the results of a comparison between OFDA4000 and Almeter measurements of a large number (approximately 900) of tops drawn from two independent sources, TEAM-3 (TEAM Final Report, 2004) and individual Sale Lots (Fish et al., 2003).

The OFDA4000 has been developed recently as described in a series of reports (Brims 2002, 2003, 2004, Brims and Baxter, 2004, Baxter, 2005), whereas the Almeter was developed over 40 years ago and is accepted as the industry standard for measurement of fibre length parameters in wool slivers and top, through IWTO-17-03. In order to determine, in part, the equivalence of the two technologies, OFDA4000, software version 5.18, and Almeter, a round trial comparing their performance was reported at the previous IWTO Congress (Baxter, 1, 2005). This round trial was conducted between 3 laboratories and included testing replicate samples from 40 tops. This trial provided estimates of the

measurement precision of each method for a comprehensive range of Hauteur and Barbe parameters, as well as highlighting small, statistically significant biases for 60% of these parameters.

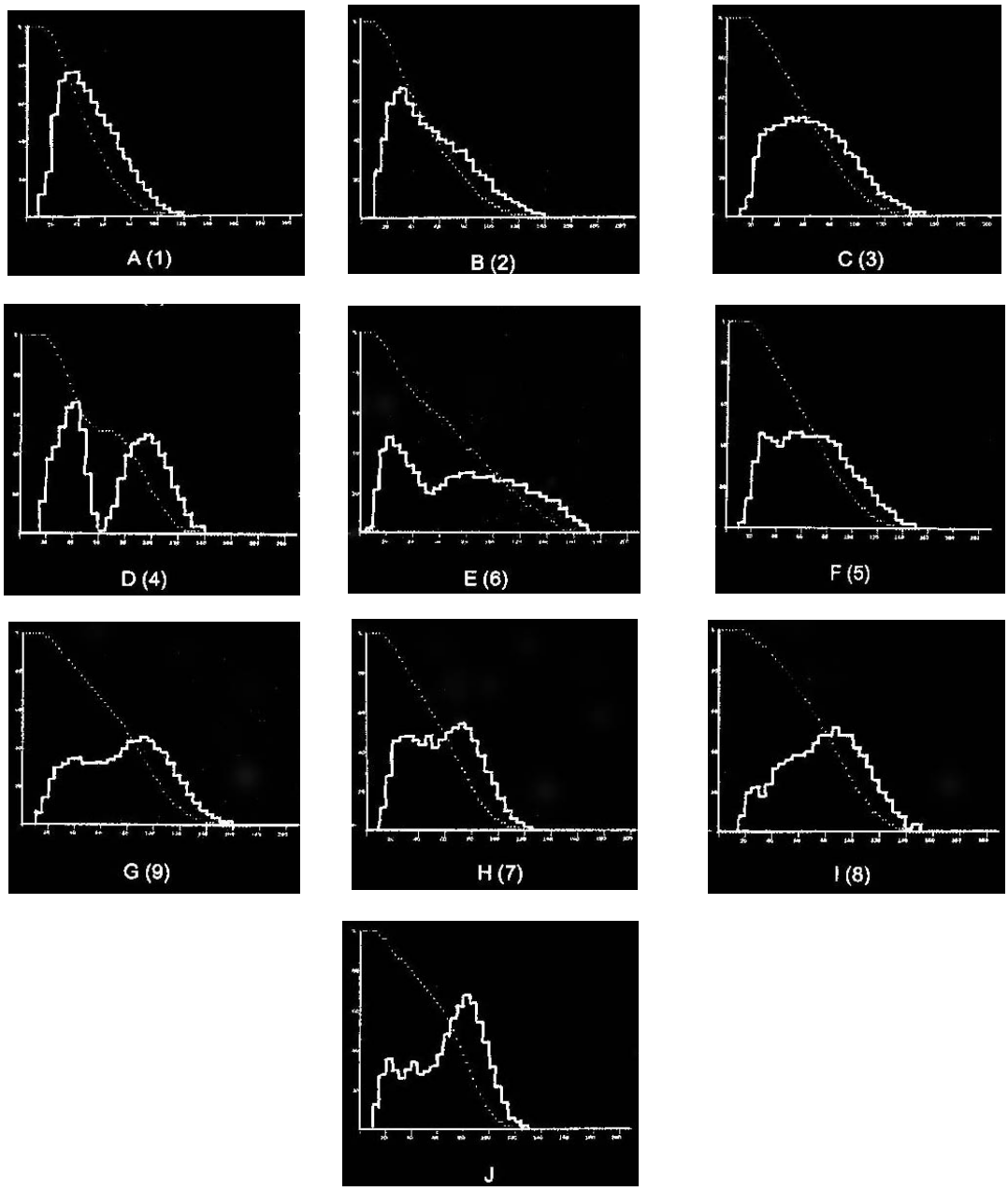


Figure 1. Almeter histograms with appropriate alphabetic codes used as the basis for assignment of shapes by Fish (2005). The numbers in brackets refer to the shape codes assigned by Allen, 1991.

Further evidence of the equivalence of the two technologies was also required for a much wider range of wool tops than could be represented by the 40 in the round trial. TEAM-3 was able to provide an ideal set of samples from which to establish equivalence for a wide range of over 600 commercial tops; while the Sale Lots trial (Fish et al., 2003) provided a set of tops with more extreme wool properties, typical of individual sale lots. Because commercial processing consignments are composed of many sale lots (an average of 40 sale lots/consignment in TEAM-3), the extremes of wool properties of individual sale lots are removed in the blending during processing of a consignment. The more extreme nature of wool properties in a sale lot was highlighted for Hauteur length distributions by Allen (1991) and more recently, for the two datasets used in this trial, by Fish (2005). As noted in the latter report, the Sale Lots tops in this trial are characterised in the main by either a “double humped”, or “single humped” fibre length

distribution, shapes “D” and “J” in Figure 1, or by the heavily skewed shape “B”. These shapes contrast with the more “featureless” distributions of shapes “H”, “F” and “C” which characterise most (56%) of the TEAM-3 tops.

These two comprehensive data sets, i.e. TEAM-3 and Sale Lots, were specifically chosen to provide a challenge to the algorithms which have been developed to transform the measured OFDA4000 length distribution into estimated Hauteur and Barbe distributions. This trial was not designed to re-address the precision of measurement, but to focus on measurement accuracy compared to Almeter. All measurements were made on one Almeter in one lab and on one OFDA4000 in one lab.

Specifically, the aims of this trial were:

- to quantify any biases which may exist between OFDA4000, software version 5.18, and Almeter for a series of Hauteur and Barbe parameters over a wide range of wool tops; and,
- to determine the ranges of differences in individual top measurements between OFDA4000, software version 5.18, and Almeter for the nominated Hauteur and Barbe parameters over the same range of tops.

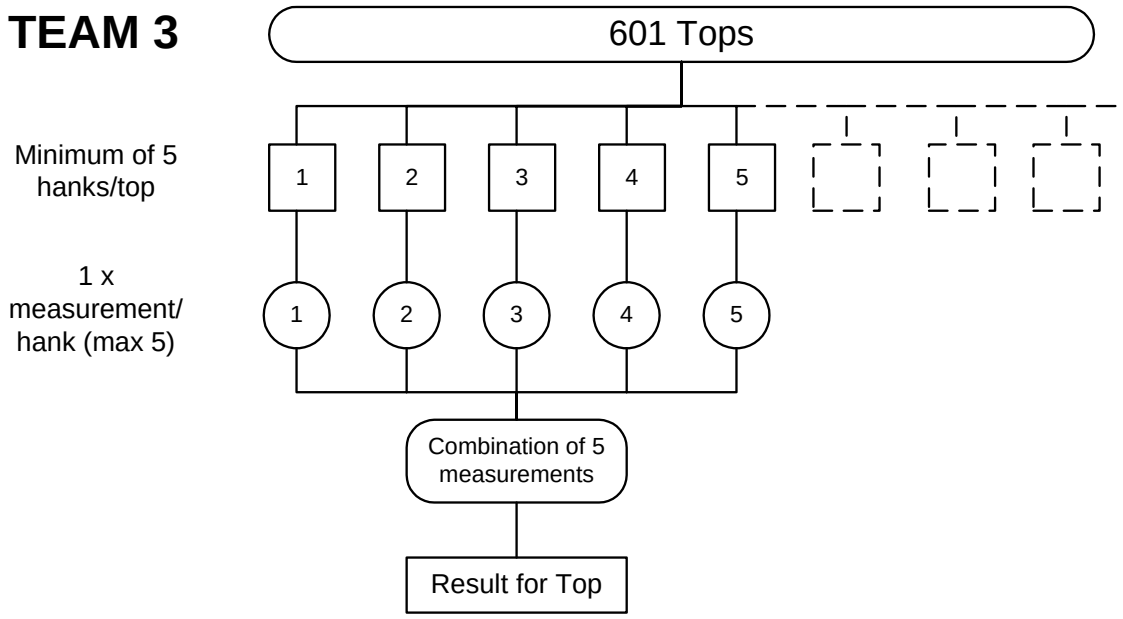
METHOD

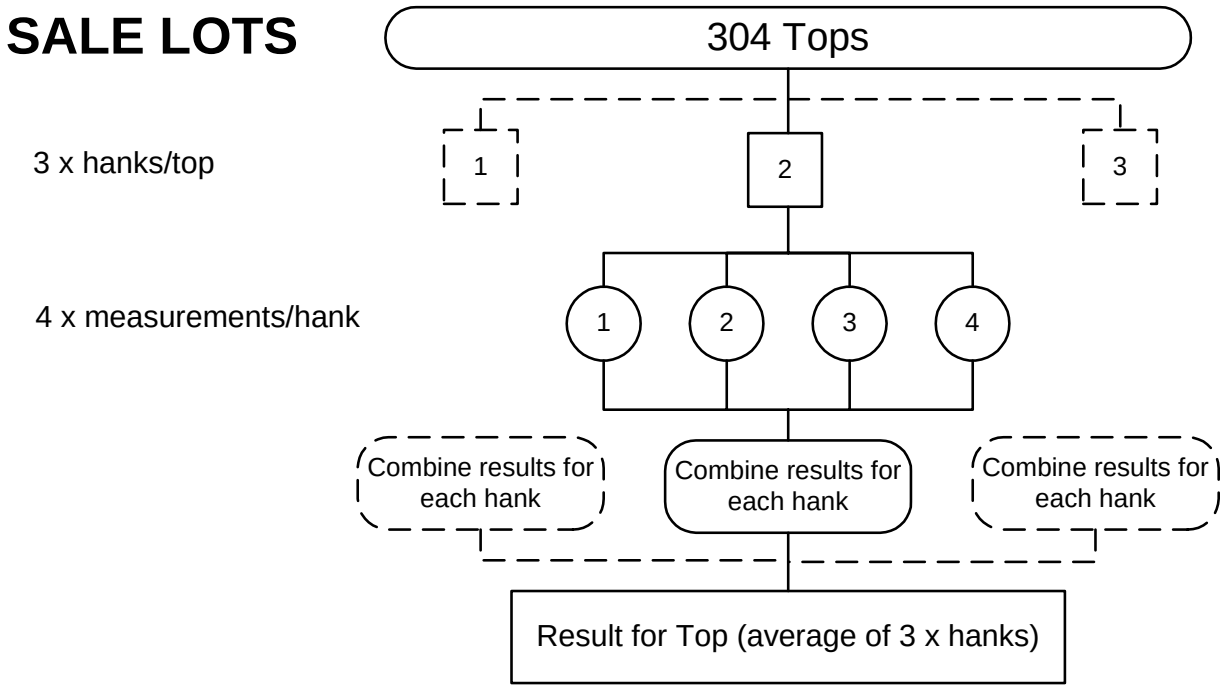
All Laboratory Samples of top were taken in accordance with IWTO-17-03, such that a 1.2m length of top was converted into a hank with 30 turns/m.

Almeter

All Almeter testing was performed by AWTA Ltd for both the TEAM-3 and Sale Lots tops. TEAM-3 tops were supplied as hanks (Laboratory Samples) by commercial mills. Five measurements were made for each TEAM-3 consignment as per the IWTO Regulations. One measurement was made from each of five hanks and results of these measurements were combined by the Almeter software to provide an overall result for that consignment. In cases where more than 5 hanks were submitted, 5 hanks were randomly selected for measurement.

For the Sale Lots tops, each sale lot produced one ball of top, and three Laboratory Samples, or hanks, were taken from each top at the beginning, middle and end of the ball. Each hank was measured four (4) times. The four (4) individual results were combined using the Almeter software. The results of the three (3) hanks were averaged to produce the overall result for each batch.



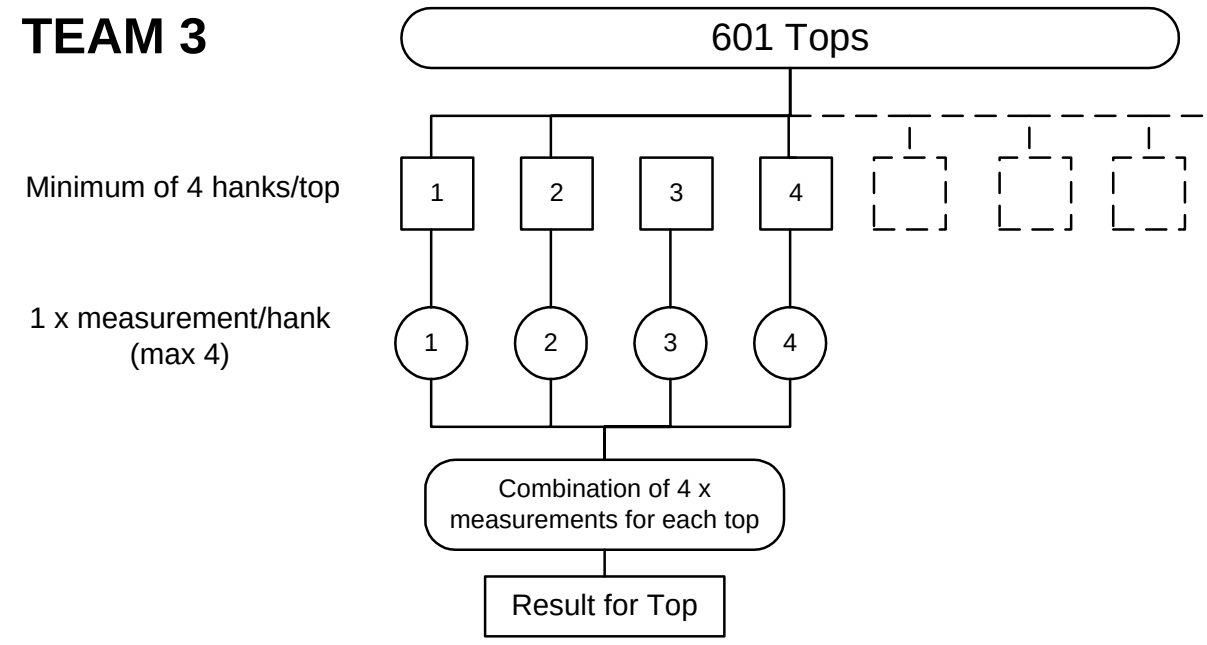


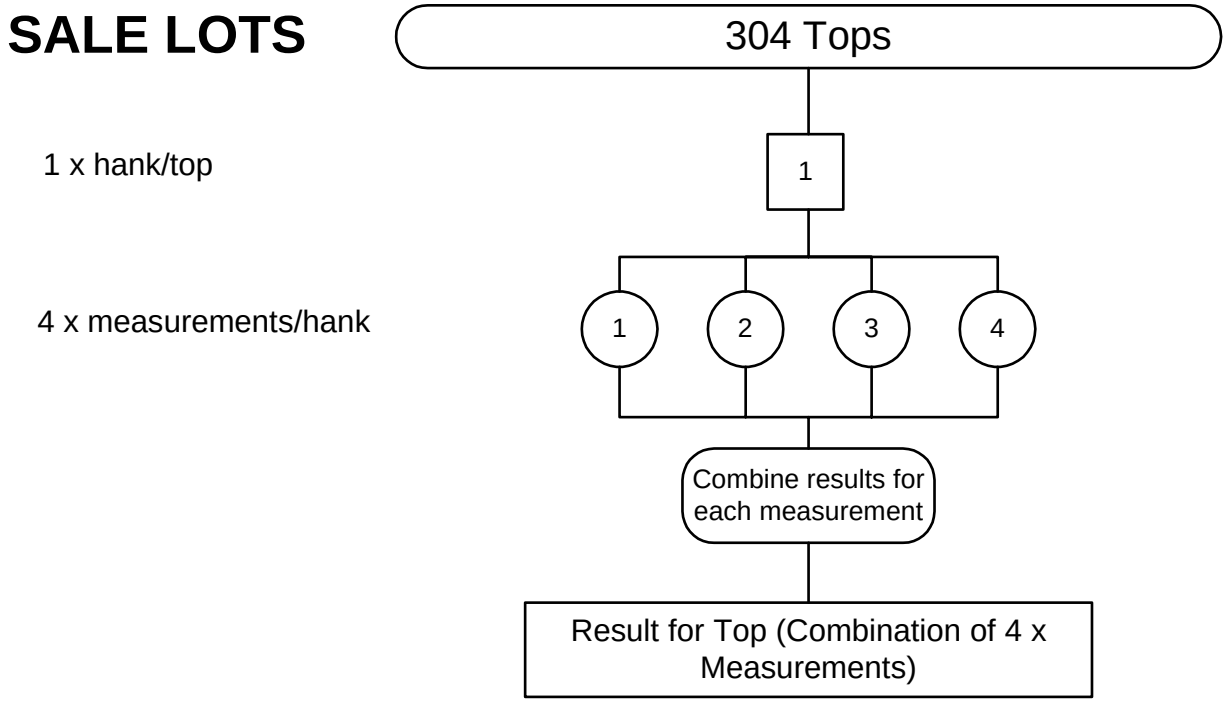
OFDA4000

All OFDA4000 measurements were made using software version 5.18. One feature of this version that differs from earlier versions is that the size of the step between adjacent scans of the top was 5mm from 0mm (0mm is equivalent to the base end of the Almeter beard) to 60mm and then 10mm from 60mm to the end of the fibre draw.

OFDA4000 testing was preformed by CSIRO, Textile and Fibre, for both TEAM-3 and Sale Lots tops. The testing ensured that four (4) measurements were taken from each processing consignment or batch.

For TEAM-3, this meant taking one Test Specimen from each Laboratory Sample, or hank, where four hanks were available. In cases where fewer than four (4) hanks were available due to insufficient material remaining after Almeter testing, multiple measurements were made on the available hanks such that a total of four (4) measurements were made for each consignment top. These four (4) measurements were combined by the OFDA4000 software to provide the result for analysis.





For the Sale Lots tops one hank was supplied for each batch, and so four (4) Test Specimens were measured from the hank. The four (4) measurements were combined by the OFDA4000 software to provide the results for analysis.

Datasets used for analysis

The Almeter and OFDA4000 testing for the two datasets used in these analyses was conducted at different times in different locations; the Almeter testing was conducted at AWTA Ltd Textiles between late 2001 and 2004, while the OFDA4000 testing occurred between March and August, 2005. These differences have meant that some original data from the earlier testing is no longer available. Also, because of a lack of sufficient sample for OFDA4000 testing the full 647 TEAM-3 and 311 Sale Lots datasets were not available for this analysis. Results were available for the vast majority of the tops in the original datasets, though different numbers of results were available for different parameters as shown in Table 1.

Table 1. The numbers of comparisons available for analysis for the TEAM-3 and Sale Lots datasets

	Numbers of Comparisons	
Parameter	TEAM	Sale Lots
Hauteur, CVH	601	304
Barbe, CVB	553	304
Hauteur and Barbe distribution parameters	553	287

Another aspect of testing a large number of samples in this manner is the propensity for labelling and transcribing errors to occur. Retesting has taken place, where possible, on a number of samples where large differences were noted for particular parameters. Of the 15 results which have been nominated for retesting, 10 were found to have errors, for 2 there was insufficient sample for retesting, and 3 have confirmed the original differences. In the case of the 2 tops from the TEAM dataset, for which insufficient

sample was available for retesting, there was an unusually high difference between Almeter and OFDA4000 in CVH. The isolated occurrences of these large differences have negligible effect on the average difference between the instruments because of the very high numbers of samples in the trial. However, examination of the extremes of differences between the instruments will be influenced by individual results for which retesting may be desired but may not have occurred. In the case of CVH, two analyses are reported for the TEAM dataset, one for all 601 tops and the other for the same dataset following removal of the 2 samples nominated for retesting, i.e. 599 tops.

Statistical Analyses

All comparisons between measurements were conducted using the procedures defined in IWTO-0. The convention for reporting statistical significance throughout this report is as follows:

- NS denotes not statistically significant at a probability level of 0.05;
- * denotes statistically significant at a probability level of 0.05;
- ** denotes not statistically significant at a probability level of 0.01; and,
- *** denotes not statistically significant at a probability level of 0.001.

RESULTS

Overall comparisons

Results of the comparisons of selected Hauteur and Barbe parameters using the analysis prescribed in IWTO-0-01 are presented in Appendix 1 of this report. Details are shown in Appendix 1 of the IWTO-0 nominated statistics for paired comparisons, difference versus average and geometric regressions, and plots of the difference versus average and Almeter versus OFDA4000 results for each of the 40 Hauteur and Barbe parameters shown in Table1. In the Geometric Regression (GM) between the Control (Almeter) and Treatment (OFDA4000), the solid line is the 1:1 relationship, and the dotted line is the GM relationship and the equation in Table (C) is the GM equation. In the Difference versus Average (DVA) plot, the dashed line is the GM relationship, the equation for which is shown in Table (C), and the dotted line represent the 95% CL lines about zero. The Appendix provides 16 comparisons in total, 8 for the TEAM tops and 8 for the Sale Lots tops. The full set of comparisons for each parameter list in Tables 2 and 3 will be included in a full report of this trial to AWI.

Summaries of the most important results of these analyses are shown in Tables 2 (a) and (b), separately for the Hauteur parameters of the TEAM-3, and Sale Lots, tops, respectively, and in Table 3 (a) and (b), for the Barbe parameters of the TEAM-3, and Sale Lots tops, respectively. These results are the average values of the Almeter and OFDA4000 measurements for each parameter, the difference between these average values, the statistical significance of this difference and the statistical significance of the slope of the differences versus average relationship.

Table 2 (a). Summary of comparisons according to IWTO-0 of Hauteur parameters for TEAM tops.

TEAM 3 Tops					
Parameter	Almeter	OFDA4000	Difference (OFDA4000-Almeter)	Significance of Difference	Significance of Slope of Differences versus Average Relationship
Hauteur	72.0	71.1	-0.8	***	*
CVH	44.9	45.7	0.8	***	***
K10H	0.0	0.2	0.1(rounding)	***	***
K15H	1.0	1.6	0.6	***	***
K20H	2.9	4.3	1.3	***	***
K25H	6.4	7.6	1.3	***	***
K30H	10.8	11.7	0.8	***	***
K35H	15.8	16.1	0.3	***	***
K40H	20.6	20.7	0.1	NS	***
K45H	25.6	25.4	-0.2	*	**
K50H	30.4	30.2	-0.2	*	NS
L95H	23.7	21.6	-2.1	***	***
L90H	29.7	28.6	-1.1	***	***
L75H	45.2	45.4	0.2	*	*
L50H	70.9	69.9	-0.9	***	NS
L25H	96.3	95.1	-1.1	***	***
L10H	115.2	115.1	-0.1	NS	***
L5H	125.5	125.6	0.1	NS	***
L2.5H	134.1	134.2	0.1	NS	***
L1H	144.2	144.3	0.1	NS	***

Table 2 (b). Summary of comparisons according to IWTO-0 of Hauteur parameters for Sale Lots tops

Sale Lots Tops					
Parameter	Almeter	OFDA4000	Difference (OFDA4000-Almeter)	Significance of Difference	Significance of Slope of Differences versus Average Relationship
Hauteur	66.1	66.5	0.4	***	NS
CVH	45.0	45.3	0.3	**	***
K10H	0.2	0.1	-0.1	***	***
K15H	1.4	1.8	0.4	***	***
K20H	4.0	4.9	0.9	***	***
K25H	8.5	9.0	0.5	***	***
K30H	14.2	13.8	-0.3	*	***
K35H	20.0	19.1	-0.9	***	***
K40H	25.7	24.5	-1.2	***	***
K45H	31.2	29.8	-1.4	***	***
K50H	36.5	35.2	-1.3	***	NS
L95H	22.5	21.3	-1.2	***	**
L90H	27.8	27.4	-0.4	***	NS
L75H	41.1	42.2	1.1	***	**
L50H	64.6	65.2	0.7	***	***
L25H	89.0	89.3	0.3	**	*
L10H	106.3	107.6	1.3	***	***
L5H	115.5	117.1	1.6	***	***
L2.5H	123.1	124.8	1.7	***	***
L1H	132.0	133.8	1.9	***	***

Table 3 (a). Summary of comparisons according to IWTO-0 of Barbe parameters for TEAM tops

TEAM 3 Tops					
Parameter	Almeter	OFDA4000	Difference (OFDA4000-Almeter)	Significance of Difference	Significance of Slope of Differences versus Average Relationship
Barbe	86.5	86.0	-0.4(rounding)	***	***
CVB	35.4	35.8	0.4	***	NS
K10B	0.0	0.0	0.0	***	***
K15B	0.2	0.3	0.1	***	***
K20B	0.7	1.0	0.3	***	**
K25B	1.8	2.1	0.2(rounding)	***	***
K30B	3.6	3.6	0.1(rounding)	*	***
K35B	5.9	5.7	-0.2	***	***
K40B	8.5	8.2	-0.3	***	**
K45B	11.5	11.1	-0.4	***	NS
K50B	14.7	14.3	-0.4	***	***
L95B	34.0	34.1	0.1	NS	NS
L90B	43.5	44.1	0.6	***	NS
L75B	64.3	64.0	-0.3	***	NS
L50B	88.3	86.9	-1.4	***	***
L25B	108.5	108.4	-0.1	NS	***
L10B	124.8	125.2	0.4	***	***
L5B	134.2	134.5	0.3	***	***
L2.5B	142.2	142.7	0.5	***	***
L1B	151.5	153.5	2.1(rounding)	***	***

Table 3 (b). Summary of comparisons according to IWTO-0 of Barbe parameters for Sale Lots tops

Sale Lots Tops					
Parameter	Almeter	OFDA4000	Difference (OFDA4000-Almeter)	Significance of Difference	Significance of Slope of Differences versus Average Relationship
Barbe	79.7	80.3	0.7	***	**
CVB	35.5	35.6	0.1	*	**
K10B	0.0	0.0	0.0	***	***
K15B	0.3	0.4	0.1	***	***
K20B	1.1	1.2	0.2(rounding)	***	***
K25B	2.7	2.7	0.0	NS	***
K30B	5.3	4.8	-0.4	***	***
K35B	8.3	7.6	-0.8	***	***
K40B	11.7	10.8	-1.0	***	***
K45B	15.5	14.4	-1.1	***	**
K50B	19.5	18.5	-1.1	***	NS
L95B	31.3	31.9	0.6	***	NS
L90B	39.6	41.0	1.3	***	NS
L75B	58.9	59.9	0.9	***	***
L50B	82.0	81.9	-0.1	NS	NS
L25B	101.6	100.5	0.1	***	***
L10B	114.9	116.7	1.7	***	***
L5B	123.2	125.0	1.9	***	***
L2.5B	130.3	132.4	2.1	***	***
L1B	138.9	142.3	3.4	***	***

DISCUSSION

Hauteur is the most important of the 40 parameters in these comparisons as it is the only parameter which may be certified under IWTO-17-03 and the IWTO Regulations 'For the Testing of Wool Slivers for Mean Fibre Diameter and Mean Fibre Length'. Some other parameters are also more commercially significant than others as they are used by combing and spinning industries to monitor top quality and/or setup spinning equipment. The more significant parameters include CVH, Barbe, CVB and parameters which specify the percentage of short fibre, (e.g. K15 or K20 or K25 or K30 or K35 or K40) and the length of the longest 1% (L1) or 2.5% (L2.5) or 5% (L5) of fibres in the top.

Because of the extremely large amount of information contained in the 80 analyses summarised in Tables 2 and 3, a smaller subset of parameters will discussed in detail in this report. The selection of which of the "K" and "L" parameters is the most widely used, is difficult to determine and may involve the intellectual property of individual organisations. Each of the "K" parameters nominated provides an estimate of the percentage of relatively short fibre in a top. They represent alternatives, rather than estimates of substantially different information, and so only K15H and K25H have been selected for further analysis. In a similar way, only L5H and L1H are discussed further in this report. These are the length distribution parameters chosen by Couchman et al. (2003) and Baxter (1, 2005) in previous reports on the evaluation of the OFDA4000.

Precision of measurement by Almeter

In order to provide a statistical context for evaluation of the average differences between OFDA4000 and Almeter results, the 95% Confidence Limits (CL's) for an Almeter test are used. In this context, the following model was adopted with reference to Baxter (2), 2005, as it is thought to best represent current commercial practice:

$$95\% \text{ Confidence Limit} = \pm 1.96 \times (\text{Between Lab variance} + (\text{Within Lab variance}/10))^{0.5}$$

This model was applied to the Almeter results from the Round Trial reported earlier (Baxter (1), 2005). Analysis of the resulting CL's showed that many exhibited level dependencies in a similar manner to those outlined subsequently (Baxter(2), 2005) and proposed for amendments to IWTO-17-03. The advantage of the data from the earlier Round Trial (Baxter (1)) was that these data included all the parameters which are being analysed in this report, whereas there is a restricted set of parameters for which precision data are available in the amendments to IWTO-17-03. In cases where both sets of precision data were available, the estimates in the proposed amendment to IWTO-17-03 were used.

In cases where the CL was level dependent this fact is noted in the text and the CL for the average value of the parameter in the analysis is used in the comparisons in this report.

Hauteur

Average differences between Almeter and OFDA4000

The results summarised in Tables 2 and 3 show were statistically significant differences (OFDA4000 – Almeter) in average Hauteur between the two technologies of -0.8mm and 0.3mm for the TEAM and Sale Lots tops, respectively. The values are somewhat larger, though comparable, to the difference found in a previously reported Round Trial (Baxter (1), 2005), viz. 0.2mm. The average differences are smaller than the published Confidence Limits (Baxter (2, 2005) for an individual test by Almeter, ±1.2mm, as shown in Table 4. The CL for Hauteur is level dependent in the data from Baxter (2, 2005).

Table 4. Average differences in Hauteur between OFDA4000 and Almeter, and the Confidence Limit* for an individual test of Hauteur.

Average Hauteur Difference (OFDA4000 – Almeter) (mm)			Confidence Limit* for an individual test (mm)
TEAM	Sale Lots	Baxter, 2005	
-0.8	0.3	0.1	±1.2

* As per Baxter (2, 2005).

Variability of differences between AImeter and OFDA4000

As well as the average differences, or biases, it is appropriate to examine the differences for individual tops measured in the trial. Table 5 presents different measures of the variation in differences between OFDA4000 and Almeter of Hauteur and CVH for the individual tops in this trial. Although the average difference in Hauteur between Almeter and OFDA4000 for the TEAM tops was -0.8mm, differences ranged from -3.9mm to 7.3mm for individual tops. The ranges for individual tops are slightly lower for the Sale Lots than for the TEAM tops, i.e. from -3.9mm to 5.1mm.

Table 5. Parameters showing the variation in individual values of differences between OFDA4000 and Almeter in Hauteur and CVH for 601 TEAM tops and 304 Sale Lots tops.

	TEAM		Sale Lots	
Parameter	Hauteur (mm)	CVH (%)	Hauteur (mm)	CVH (%)
SD	1.8	1.8	1.5	1.8
3 x SD	4.8	5.4	4.6	5.4
95% CL (Baxter (2), 2005)	±1.2	±1.9	±1.2	±1.9
Mean + 3 x SD	4.0	6.1	4.9	5.7
Mean - 3 x SD	-5.6	-4.7	-4.3	-5.1
Min	-7.3	-8.8	-3.9	-8.9
Max	5.5	5.0	5.1	5.6

The similar SD's of differences shown in Table 5 for the TEAM and Sale Lots data sets indicate that, on average, the OFDA4000 has estimated the Almeter values of Hauteur and CVH, for the more extreme Sale Lots tops with similar accuracy as for the TEAM tops. On average, the more extreme fibre length distributions of the Sale Lots tops provided no more problems of prediction for the OFDA4000 than did the TEAM tops with their more conventional fibre length distributions.

The 3 x SD value in Table 5 indicates that approximately 99.9% of differences in Hauteur for these tops would be expected to lie within 4.8mm of the mean difference for the TEAM tops, i.e. between -4.0mm and 5.6mm, if the differences were normally distributed. Similarly, the value of 3 x SD for the Sale Lots, 4.6mm, implies that 99.9% of differences would lie between -4.3mm and 4.9mm.

The wider than expected (assuming normality) range between the minimum and maximum differences for the 839 TEAM and Sale Lots tops indicates that there may be isolated examples of tops (8/601 tops from the TEAM and 0/304 from the Sale Lots datasets) for which unexpectedly high (>6.0mm) differences will occur in Hauteur.

In order to determine if there was any pattern to the fibre length distributions which were associated with (OFDA4000 – Almeter) differences greater than the 3 x SD limits, the shapes of the Almeter Hauteur distributions of these tops were examined. Of the eight (8) tops outside the 3 x SD limits, OFDA4000 under-predicted four (4) and over-predicted four (4). Three (3) of the four (4) under-predicted tops were shape "I"; the final top (difference -7.3mm) was shape "G". The high proportion, i.e. 75%, of tops with shape "I" in this set of four (4) tops contrasts with the much lower, 8% of all TEAM tops which have shape "I". This result indicates that tops with shape "I" may have a higher than normal chance of a significantly low Hauteur measurement on OFDA4000 compared with Almeter. Indeed, five (5) of the lowest ten (10) under-predicted tops were shape "I".

Two (2) of the four (4) over-predicted tops were shape "F", with one (1) shape "E" and the forth shape was undefined. Similar shapes "E" and "F" account for 75% of the over-predicted tops outside the 3 x SD limits, while accounting for only 40% of all TEAM tops. Seven of the highest ten (10) over-predicted tops were shapes "E" and "F". This result indicates that tops with shapes "E" and "F" may have a higher than normal chance of a significantly high Hauteur measurement on OFDA4000 compared with Almeter.

Coefficient of Variation of Hauteur (CVH), Barbe and Coefficient of Variation of Barbe (CVB)

Average differences

As was the case for Hauteur, there were statistically significant differences (OFDA4000 – Almeter) of 0.7% and 0.3% in average CVH; -0.4mm and 0.7mm for Barbe; and, 0.4% and 0.1%, for CVB for TEAM and Sale Lots tops, respectively. These average differences between OFDA4000 and Almeter are small compared to the Confidence Limits for an individual test as shown in Table 6.

Table 6. Average differences in CVH, Barbe and CVB between OFDA4000 and Almeter, and the Confidence Limits* for an individual test.

Parameter	Average Hauteur Difference (OFDA4000 – Almeter) (mm)			Confidence Limit for an individual test (mm)
	TEAM	Sale Lots	Baxter, 2005	
CVH	0.7	0.3	0.1	±1.9*
Barbe	-0.4	0.7	-0.1	±1.7*
CVB	0.4	0.1	0.1	±1.0#

* As per Baxter (2), 2005.
# As per Baxter (1), 2005.

Variability of differences

The variability of differences between OFDA4000 and Almeter for CVH of the individual tops in this trial is shown in Table 5. Although the average difference in CVH between Almeter and OFDA4000 for the TEAM tops was 0.7mm, differences ranged from -8.8mm to 5.0 mm for individual tops. The range for individual tops is similar for the Sale Lots, i.e. from -8.9mm to 5.6mm.

Table 7 presents different measures of the variation in differences between OFDA4000 and Almeter of Barbe and CVB for the individual tops in this trial. As Barbe values can be determined from Hauteur and CVH values, the differences between the two (2) instruments for Barbe follow similar patterns to those

already discussed for Hauteur and CVH and are not discussed separately in this report for reason of brevity.

Table 7. Parameters showing the variation in individual values of differences between OFDA4000 and Almeter in Hauteur and CVH for 553 TEAM tops and 304 Sale Lots tops.

	TEAM		Sale Lots	
Parameter	Barbe (mm)	CVB (%)	Barbe (mm)	CVB (%)
SD	1.5	0.9	1.3	1.0
3 x SD	4.5	2.6	4.0	3.0
Min	-6.3	-2.2	-3.1	-4.1
Max	6.3	3.0	4.9	2.7

The wider than expected range (assuming a normal distribution of differences) in CVH between the minimum and maximum differences for the 839 TEAM and Sale Lots tops indicates that there may be isolated examples of tops (7/601 tops from the TEAM and 5/304 from the Sale Lots datasets) for which unexpectedly high (>5.0%) differences will occur in CVH.

As with the extreme differences in Hauteur, an analysis was performed to determine if there was any pattern in the shapes of the Almeter Hauteur distributions, which were associated with (OFDA4000 – Almeter) differences greater than the 3 x SD limits in the CVH of the 12 'extreme' tops. Eleven (11) of the 12 tops outside the 3 x SD limits were under-predicted. Shape information was available for seven (7) of the 11 tops though no strong pattern of shapes was discernable in this case.

This result indicates that there may be isolated occurrences (approximately 1 in 100) of OFDA4000 under-predictions of CVH which are greater than 4.5% different from the Almeter value. These extreme differences appear not to be related to the shape of the Hauteur distribution.

Hauteur Distribution Parameters

Average differences

Two different sets of parameters are commonly reported to characterise the shape of the Hauteur distribution. In the recent lexicon these two sets are termed the "K" and "L" series, where K10H refers to the percentage of fibres in the Hauteur distribution which had a length < 10mm (%<10mm), and L95H refers to the length (in mm) of the longest 95% of fibres in the Hauteur distribution. The "K" parameters for lengths <35mm, e.g. K15, K25H, K30H or K35H, are used to characterise the proportion of 'short' fibres a top, while the L5H, L2.5H or L1H can be used to estimate the length of the longest fibres in the top.

Table 8 shows the (OFDA4000 – Almeter) differences for the four (4) selected Hauteur distribution parameters along with measures of the variability of these differences to assist in the evaluation of these differences. The differences were similar to the expected measurement precision for either the TEAM or Sale Lots tops or both.

For K15H and K25H the maximum values were generally within the 'Mean + 3 x SD' limits, while the minimum values well outside the 'Mean – 3 x SD' limits. This result indicates that there may be isolated cases in which OFDA4000 underestimates K15H or K25H by more than 1.8% or 3.9%, respectively.

For L5H and L1H both maxima and minima were beyond the 'Mean ± 3 x SD' limits for TEAM and Sale Lots tops.

Table 8. The Mean, Minimum and Maximum differences between OFDA4000 and Almeter results for K15H, K25H, L5H and L1H, together with the estimated precision and '3 x SD' limits for these parameters.

	TEAM *				Sale Lots			
Parameters	K15H (%)	K25H (%)	L5H (mm)	L1H (mm)	K15H (%)	K25H (%)	L5H (mm)	L1H (mm)
Mean Difference	0.62 (0.65)	1.3 (1.3)	0.1	0.1	0.4	0.5	1.6	1.9
Precision of an individual test (Baxter, 2005)	±0.6	±1.3	±1.3	±2.3	±0.6	±1.3	±1.3	±2.3
SD	0.87 (0.77)	1.6 (1.5)	1.9	2.6	1.1	1.8	1.6	2.6
3 x SD	2.6 (2.3)	4.7 (4.5)	5.7	7.7	3.4	5.4	4.8	7.7
Mean + 3 x SD	3.2 (3.0)	6.0 (5.8)	5.8	7.8	3.8	5.9	6.4	9.6
Mean - 3 x SD	-1.9 (-1.6)	-3.4 (-3.2)	-5.6	-5.6	-3.0	-4.9	-3.2	-5.1
Min	-7.1 (-4.1)	-8.1 (-5.0)	-7.4	-16.0	-8.4	-9.8	-2.4	-10.4
Max	2.3 (2.3)	5.2 (5.2)	8.0	14.4	3.8	6.2	8.6	8.1

* Values in brackets refer to results with 2 tops removed. There was insufficient material to conduct a retest of these two tops, so there is uncertainty about the validity of their extreme values for these parameters.

Figure 2 shows the average differences between OFDA4000 and Almeter for the "K" series parameters, not only for the TEAM and Sale Lots tops but also for the previously published Round Trial data (Baxter(1), 2005). There is a clear pattern of similarity amongst the three (3) datasets in Figure 2. This repeated pattern of differences implies that there are, on average, real differences between the "K" parameters measured by OFDA4000 and Almeter, and that there is a structure to these differences, i.e. on average, K20H will measure 0.5% to 1.3% higher using OFDA4000 than using Almeter.

Equivalent differences for the three (3) datasets are shown in Figure 3 for the "L" series parameters. As in Figure 2 a pattern is observed of the differences between OFDA4000 and Almeter results. In this case differences for the L5H, L2.5H and L1H parameters are <0.5mm for the TEAM and Round Trial datasets, while there is a 1.6mm to 1.9mm difference for the Sale Lots tops.

Precision estimates (95%CL's) for the distribution parameters, calculated according to the model discussed in the Section 'Precision of measurement by Almeter' are shown in Table 9, along with indications of level dependency of the CL. These values are included in Figures 2 and 3 to provide a statistical context for interpretation of the size of the average differences between OFDA4000 and Almeter for the three (3) data sets.

In trying to match the Almeter Hauteur distributions, the OFDA4000 systematically over- and under-estimates parameters as shown in Figures 2 and 3. In some cases the scale of these biases is similar to the precision of an individual test; in particular, the K20H, K25H, K30H for the TEAM data, and K35H for the Sale Lots, and K40H, K45H and K50H for the Sale Lots and Round Trial data sets have average differences of similar magnitude as the precision of an individual test.

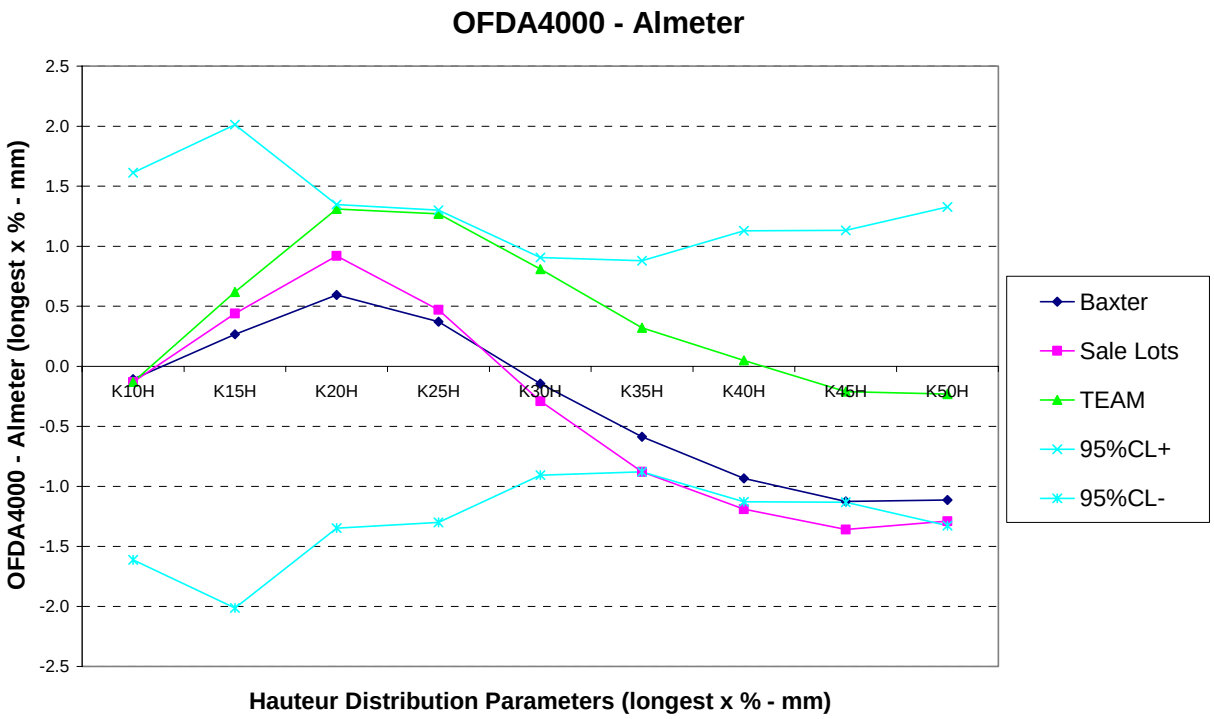


Figure 2. (OFDA4000 – Almeter) differences for the "K series" of Hauteur parameters for the TEAM and Sale Lots tops and the 40 tops recently reported by Baxter (1, 2005).

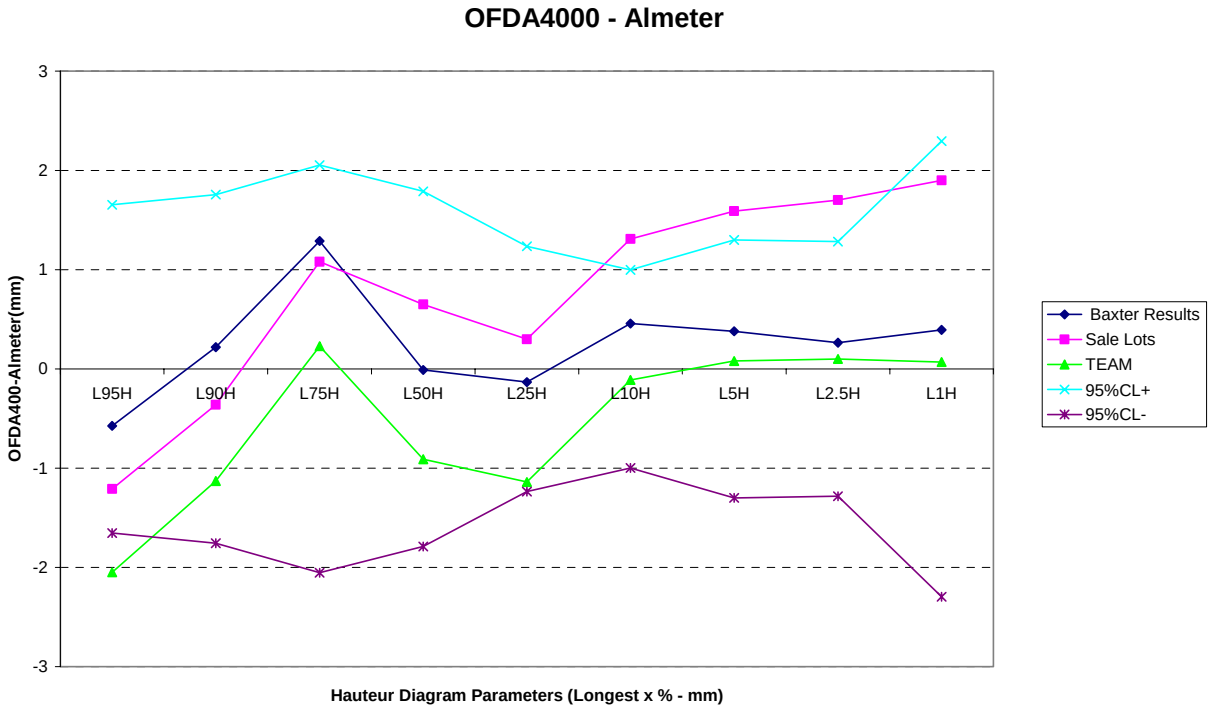


Figure 3. (OFDA4000 – Almeter) differences for the "L series" of Hauteur parameters for the TEAM and Sale Lots tops and the 40 tops recently reported by Baxter (1, 2005).

Table 9. Confidence Limits for Hauteur histogram parameters.

Parameter	Confidence Limit - ± (% for "K" parameters, mm for "L" parameters)	Level Dependent*
K10H	0.1	Y
K15H	0.6	Y
K20H	0.9	Y
K25H	1.3#	Y
K30H	1.5	Y
K35H	1.7	Y
K40H	2.0	Y
K45H	1.9	Y
K50H	1.9	Y
L95H	1.7	Y
L90H	1.8	Y
L75H	2.1	Y
L50H	1.8	N
L25H	1.2	N
L10H	1.0	N
L5H	1.3#	N
L2.5H	1.3	N
L1H	2.3	N

* CL calculated using the average value of the parameter from the TEAM data set if the CL was considered to be level dependent.
# Values obtained from Baxter(2), 2005.

Variability of differences

The maximum and minimum differences between OFDA4000 and Almeter were calculated for each of the "KH" and "LH" distribution parameters for both the TEAM and Sale Lots datasets. Figures 4 and 5 show these differences graphically together with the ±3 x SD range for each "KH" parameter for the TEAM and Sale Lots data sets, respectively. Note the increase in scale from ±2.5 to ±10 for the ordinate in Figures 4 and 5 compared to Figure 2, which indicates the relative sizes of the average and maximum differences for the "KH" parameters. There is a clear pattern for the minimum differences to extend beyond the -3 x SD line for both the TEAM and Sale Lots data, whereas the maximum differences either approximately match the +3 x SD values (Sale Lots) or are well within these values, (TEAM).

The consistent pattern between the two (2) data sets for the extreme negative values to exceed the -3 x SD value for each "KH" parameter indicates that there may be a higher than expected chance (assuming normality of differences) of OFDA4000 producing an occasional very low (8% - 10%) estimate of the "KH" parameters from K15H to K50H.

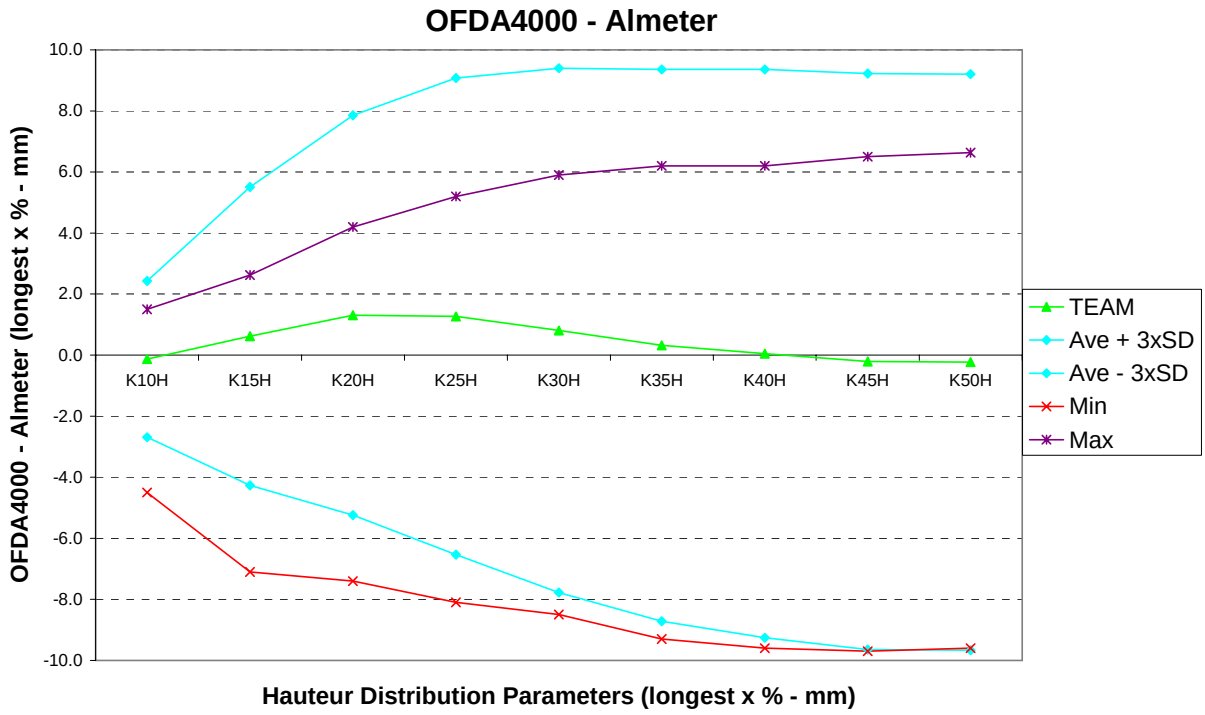


Figure 4. (OFDA4000 – Almeter) differences for "KH" series parameters from the TEAM tops.

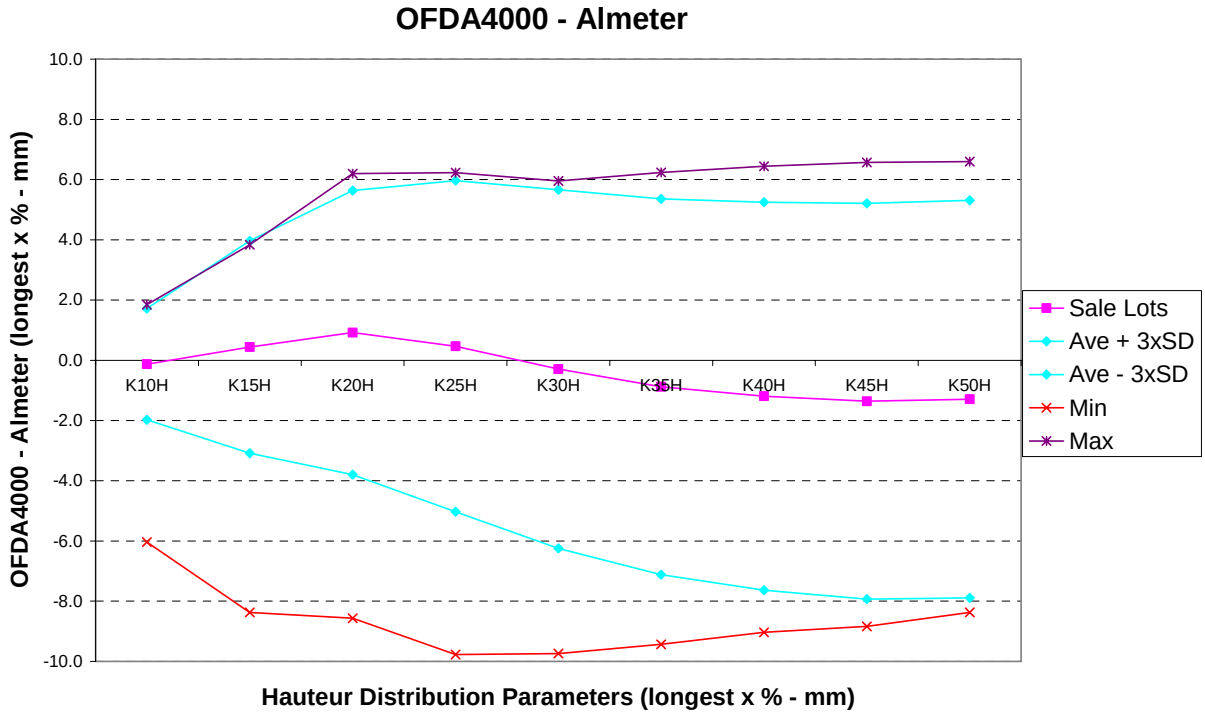


Figure 5. (OFDA4000 – Almeter) differences for "KH" series parameters from the Sale Lots tops.

Figures 6 and 7 show results equivalent to those in Figures 4 and 5 for the "LH" parameters. In this case the extremes for the TEAM data approximate the ±3 x SD range, as does the maxima data match the +3 x SD values for the Sale Lots data set. The minima for the Sale Lots data exceed the -3 x SD line as in the case of the "KH" parameters. This result indicates that there may be some tops for which there is a higher than expected chance of OFDA4000 producing an occasional very low (10mm<Almeter) estimate of the "LH" parameters from L90H to L1H.

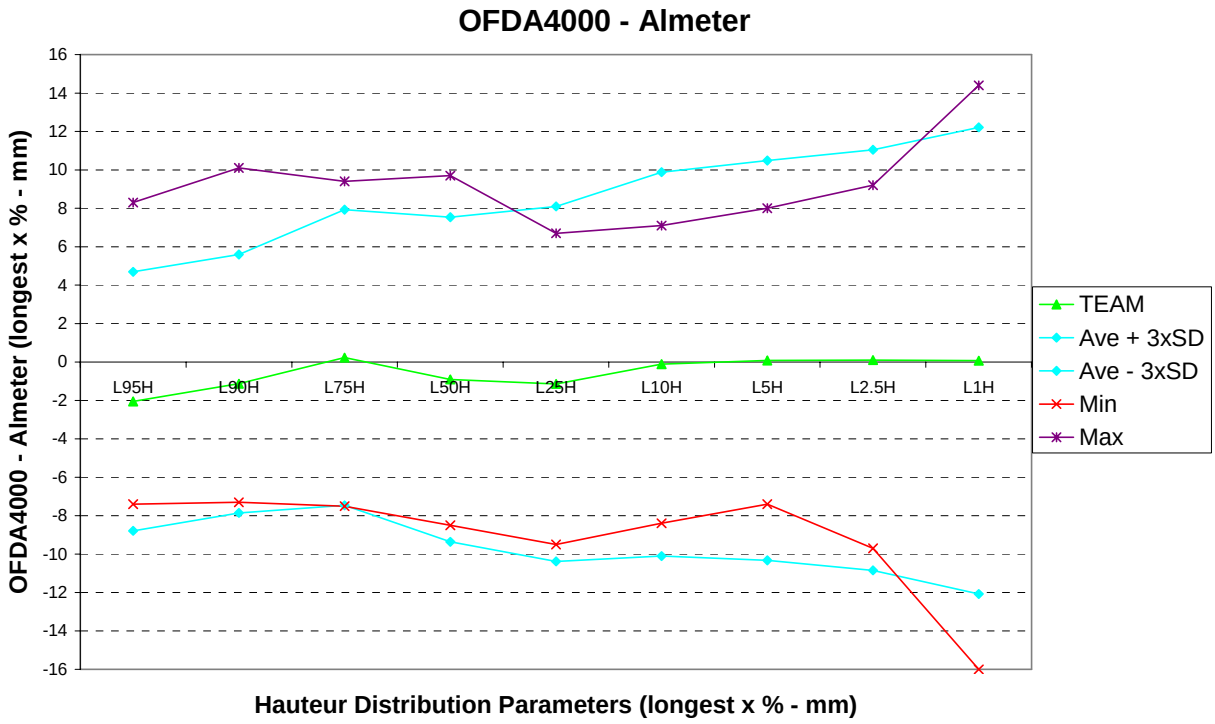


Figure 6. (OFDA4000 – Almeter) differences for "LH" series parameters from the TEAM tops

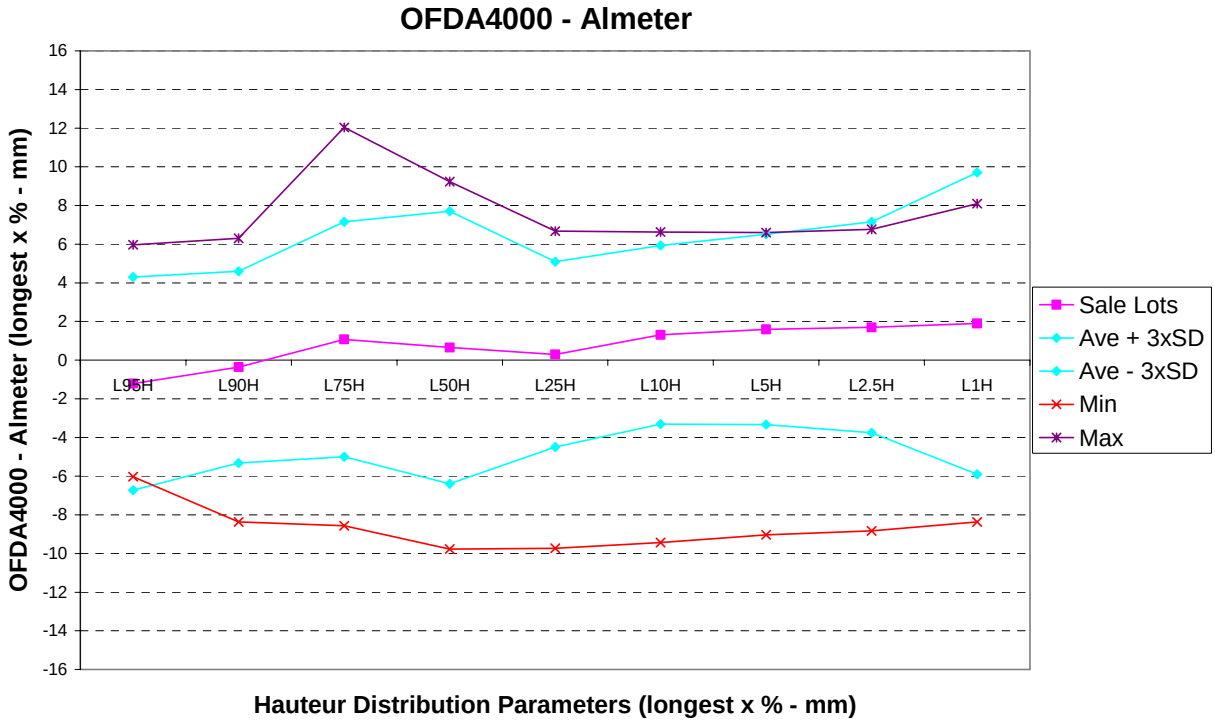


Figure 7. (OFDA4000 – Almeter) differences for "LH" series parameters from the Sale Lots tops

Shapes of Hauteur histogram

Figure 8 shows a comparison of the histogram plots from Almeter and OFDA4000 for a series of 6 tops from one mill. The tops were chosen based on the successive reduction in the relative proportion of

short fibre (<40mm) in the Almeter histogram. It can be observed that, when the Almeter histogram has a distinct local maximum in the short fibre end of the distribution, the extent of the maximum peak is underestimated by OFDA4000. When the local maximum peak does not appear in the Almeter histogram, there is very good agreement about the shapes of histograms between the two instruments.

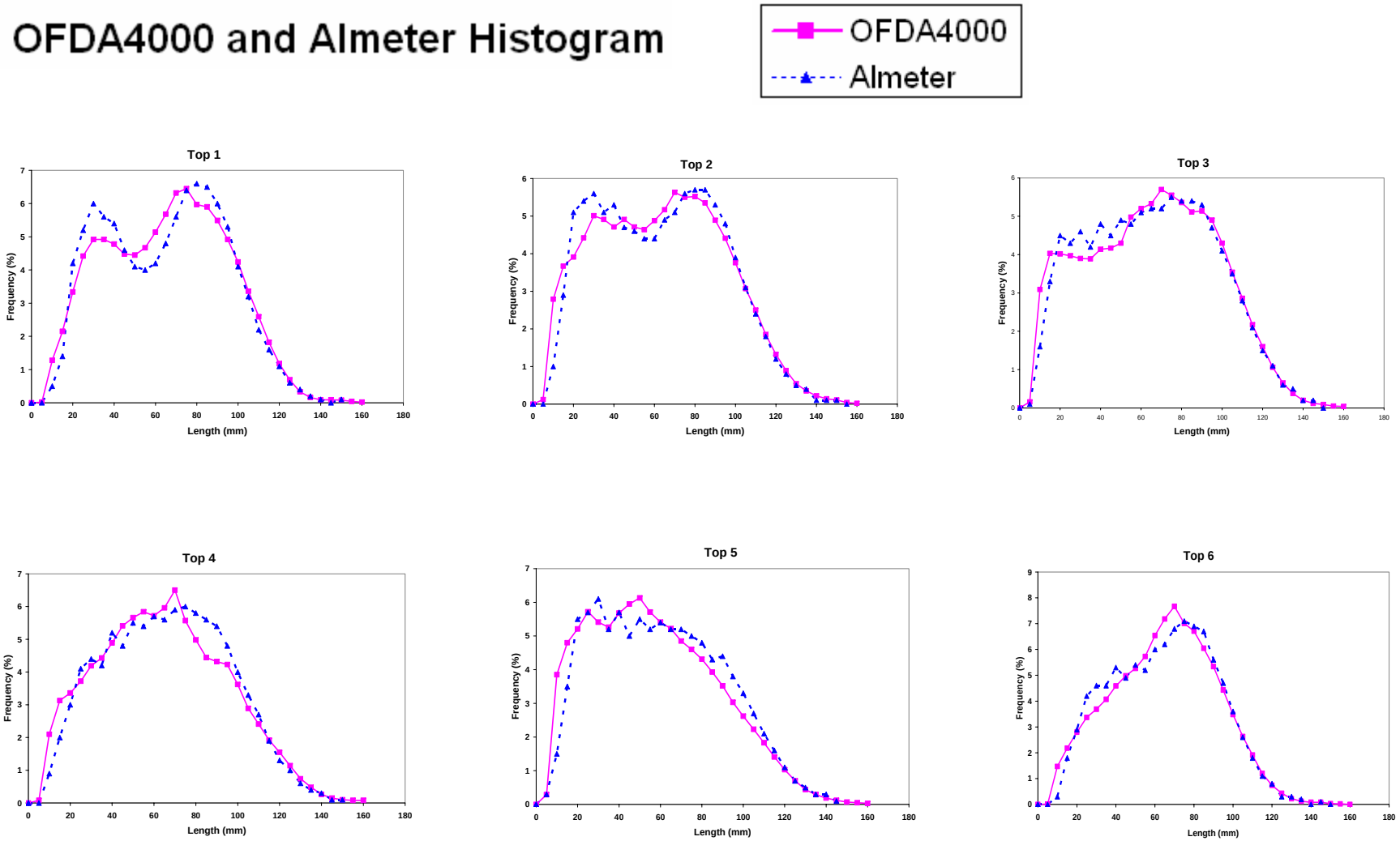


Figure 8. A comparison of the histogram plots from Almeter and OFDA4000 for a series of 6 tops from one mill.

CONCLUSIONS

The trial reported here was designed to provide information about the equivalence (accuracy) of the OFDA4000 prediction of Almeter measurement for over 900 tops - 601 commercial tops from the TEAM-3 project and 301 research tops from processing single sale lots.

As would be expected from measurement systems which use different principles testing a large number of wool samples, results from the OFDA4000 and Almeter are not exactly the same:

- Statistically significant differences have been observed between OFDA4000 and Almeter for most of the 40 parameters which characterise a top fibre length distribution as previously reported by Baxter.

- As reported by Baxter, consistent systematic differences were also observed between “KH” and “LH” parameters for each of the two (2) data sets, TEAM-3 and Sale Lots.

- Analysis of the shapes of the Hauteur distribution histograms of the individual tops with the greatest differences in Hauteur between OFDA4000 and Almeter highlighted particular shapes being over–represented, i.e. the occurrence of relatively high differences between the two (2) systems in Hauteur appeared to be related to the shapes of the Hauteur distributions.

- There was a higher than expected frequency (assuming normality of differences) of individual tops which had high differences between OFDA40000 and Almeter for most parameters.

However, OFDA4000 and Almeter produced similar results on average:

- The magnitude of differences is generally less than the precision, or 95% Confidence Limit, for a test.

- The biases in results for the most important length parameter, Hauteur, were a small positive value for one data set (TEAM) and a small negative value for the other data set (Sale Lots), indicating that average differences appear to be related to wool-specific characteristics, and that it is incorrect to assert that OFDA4000 typically measures Hauteur either longer or shorter than does Almeter.

- Results also indicate that, on average, the OFDA4000 has estimated the Almeter values of Hauteur and CVH, for the more extreme Sale Lots tops with similar accuracy as for the TEAM tops.

- The results and analysis reported here are consistent with those from the Round Trial of these two (2) measurement systems reported by Baxter.

- Biases between the two (2) systems are now documented based on testing a wide range of tops on one Almeter and one OFDA4000.

No attempt is made in this report to assign a commercial significance to the reported differences.

ACKNOWLEDGEMENTS

The authors acknowledge the financial support of Australian Wool Innovation Limited for funding the measurement of the TEAM tops and Single Sale Lot tops on an OFDA4000 and the analysis and preparation of this report. We also express our gratitude to Peter Baxter for supplying the data for the previously reported Round Trial from which the 95% Confidence Limits were calculated.

REFERENCES

Fish, V.E., Balasingam, A., Marler, J.W. & Mahar, T.J. (2005) *Comparisons Between OFDA4000 and Standardised IWTO Test Methods. Part 2: Diameter Characteristics.* T&S Committee, Biella, November 2005, RWG 02.

Brims, M.A. (2002) *Introducing OFDA4000: A new instrument for simultaneous measurement of fibre length and diameter in tops*, Barcelona, Report SG02.

Brims, M.A. (2003) *Progress of the OFDA4000 and comparison with Almeter*, Buenos Aires, Report SG02.

Brims, M.A. (2004) *Improving Agreement on Hauteur Measurement between OFDA4000 and Almeter*, Shanghai, Report SG01.

Baxter, P. (1, 2005) *Report on the 2004/05 OFDA4000 and Almeter/OFDA100/Laserscan Round Trial.* IWTO T&S Committee, Hobart, SG02.

Baxter, P. (2, 2005) *Proposed amendments to IWTO-17 to remove reference to manual grip, clarify sampling regime, and update precision statistics*, T&S Committee, Submission to Sliver Group, Biella, November 2005,

Couchman, R.C. and Holmes, P.J. (2003) *Report on equivalence round trials for the AL2000*, Dubrovnic, Report SG03 and supplements.

Fish, V.E., Marler, J.W. & Mahar, T.J. (2004) *Predicting Processing Results of Sale Lots. Part 1: Performance of TEAM Equations.* T&S Committee, Shanghai, November 2004, RWG 03.

Harig, H. (1995) *Report of the 1995 IWTO Round Trial. Part II: Wool Tops*. IWTO T&S Committee, Harrogate, June 2005, Report 16.

IWTO-0-01: *Introduction to IWTO Specifications. Procedures for the Development, Review, Progression or Relegation of IWTO Test Methods and Draft Test Methods.*

IWTO-17-03: *Determination of Fibre Length Distribution Parameters by Means of the Almeter.*

Smith, L.J. & Hoschke, B.N. (1982) *Mini-processing as an Assessment Technique.* J. Text. Inst., 6(264).

TEAM-3 Steering Committee (2004) *TEAM-3 Final Report June 2004*.

APPENDIX 1

DO NOT EDIT OR DELETE the above heading. NOTE: This message is formatted as hidden text and will not appear in your published document. It may be deleted at any time once the message is heeded.

The following pages present the detail of the IWTO-0 analyses conducted.

Hauteur Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	601	601	601
Average	71.9556	71.1369	**-0.8186**
SD	5.7414	5.9157	1.7886
SE	0.2342	0.2413	0.0730
t value	307.2431	294.7985	-11.2209
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	601
DF	599
R	0.9534
t-value	77.2994
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

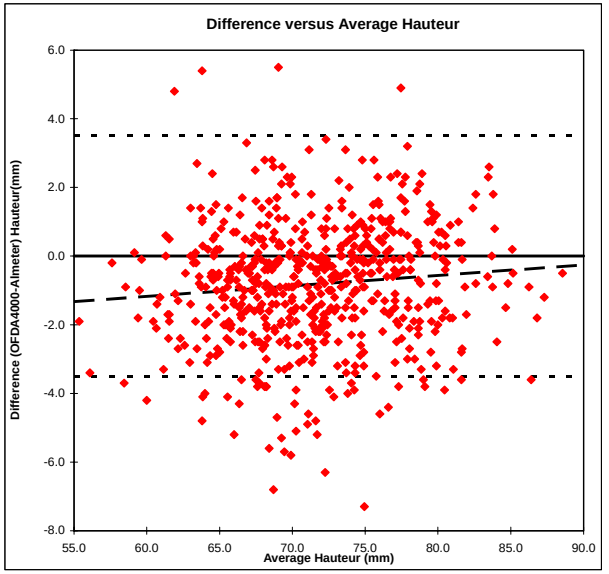
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0304	*	0.0127	2.3888	0.0172	0.9089
DVA	0.0306	*	0.0126	2.4251	0.0156	
Intercept(GM)	-3.0030					STEYX
Intercept(DVA)	-3.0091					1.7345

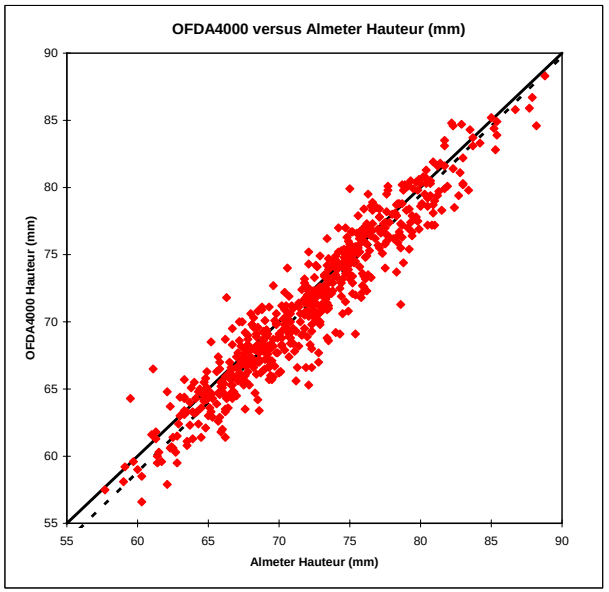
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
55	53.67	-1.33
65	63.97	-1.03
75	74.27	-0.73
85	84.58	-0.42
95	94.88	-0.12
105	105.18	0.18

Max/Mins.

Control	max	88.80
	min	56.30
Treatment	max	88.30
	min	54.40
average	max	88.55
	min	55.35
difference	max	5.50
	min	-7.30





Hauteur Comparison - Sale Lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	304	304	304
Average	66.1312	66.4793	**0.3481**
SD	10.2793	10.3752	1.5318
SE	0.5896	0.5951	0.0879
t value	112.1710	111.7188	3.9618
p value	0.0000	0.0000	0.0001
Significance			***

(B) Test for Correlation.

Number	304
DF	302
R	0.9890
t-value	116.4258
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

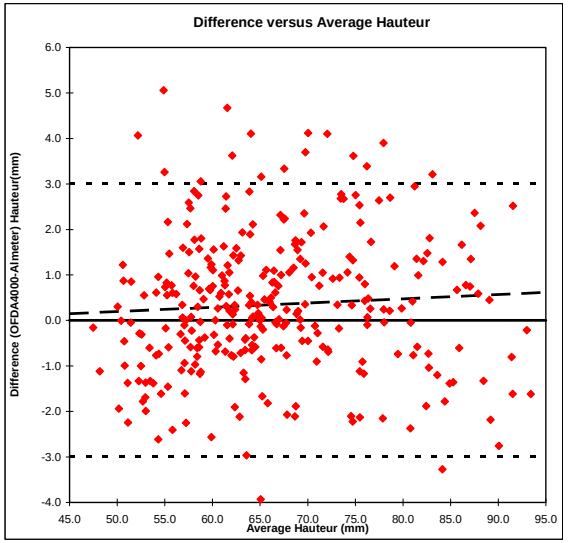
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0093	**NS**	0.0086	1.0884	0.2773	0.9782
DVA	0.0093	**NS**	0.0085	1.0935	0.2751	
Intercept(GM)	-0.2691					STEYX
Intercept(DVA)	-0.2712					1.5200

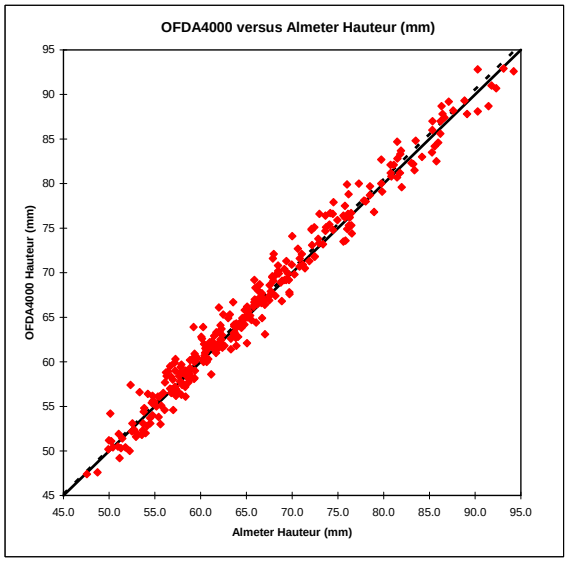
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
45	45.15	0.15
55	55.24	0.24
65	65.34	0.34
75	75.43	0.43
85	85.52	0.52
95	95.62	0.62

Max/Mins.

Control	max	94.22
	min	43.85
Treatment	max	92.90
	min	41.20
average	max	93.41
	min	42.53
difference	max	5.06
	min	-3.93





Coefficient of Variation of Hauteur Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	601	601	601
Average	44.9068	45.6532	**0.7464**
SD	4.3104	3.9735	1.7524
SE	0.1758	0.1621	0.0715
t value	255.4084	281.6648	10.4419
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	601
DF	599
R	0.9137
t-value	55.0118
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

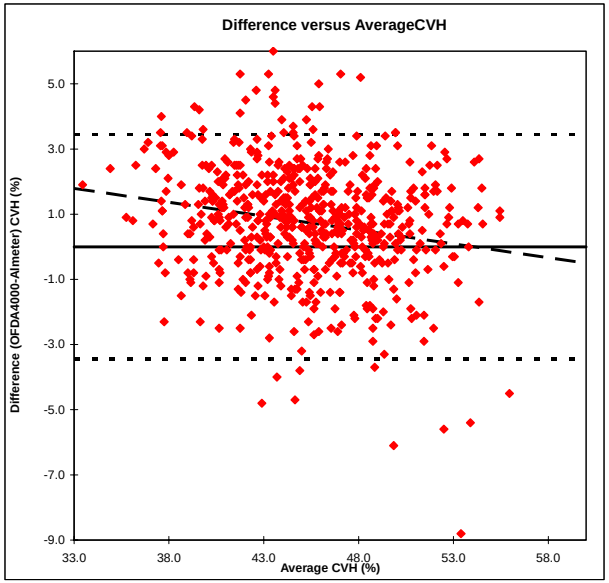
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9219	***	0.0153	5.1041	0.0000	0.8348
DVA	-0.0850	***	0.0173	4.9047	0.0000	
Intercept(GM)	4.2557					STEYX
Intercept(DVA)	4.5946					1.7535

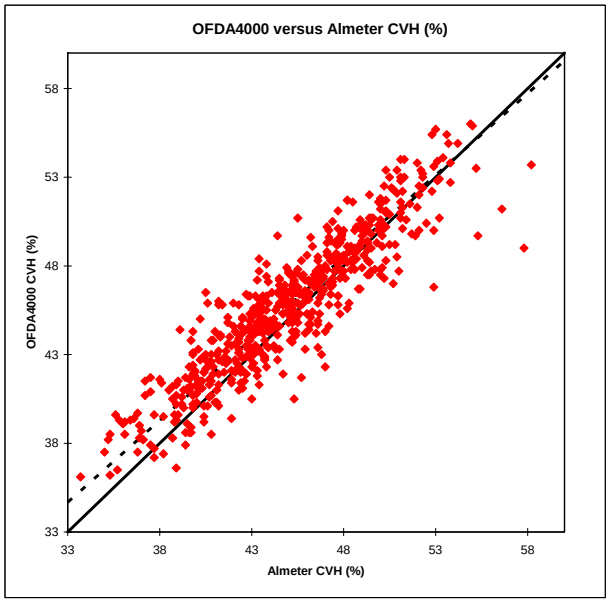
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
30	31.91	1.91
40	41.13	1.13
50	50.35	0.35
60	59.57	-0.43
70	68.79	-1.21
80	78.00	-2.00

Max/Mins.

Control	max	58.20
	min	32.50
Treatment	max	56.00
	min	33.20
average	max	55.95
	min	32.90
difference	max	6.00
	min	-8.80





Coefficient of Variation of Hauteur Comparison - Sale lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	304	304	304
Average	44.9514	45.2783	**0.3269**
SD	7.3980	6.8326	1.7925
SE	0.4243	0.3919	0.1028
t value	105.9407	115.5428	3.1799
p value	0.0000	0.0000	0.0016
Significance			**

(B) Test for Correlation.

Number	304
DF	302
R	0.9714
t-value	71.0689
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

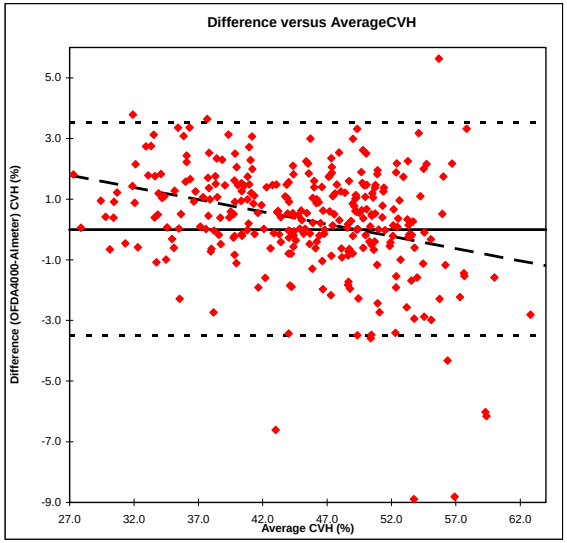
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9236	***	0.0126	6.0551	0.0000	0.9436
DVA	-0.0806	***	0.0138	5.8237	0.0000	
Intercept(GM)	3.7628					STEYX
Intercept(DVA)	3.9643					1.7601

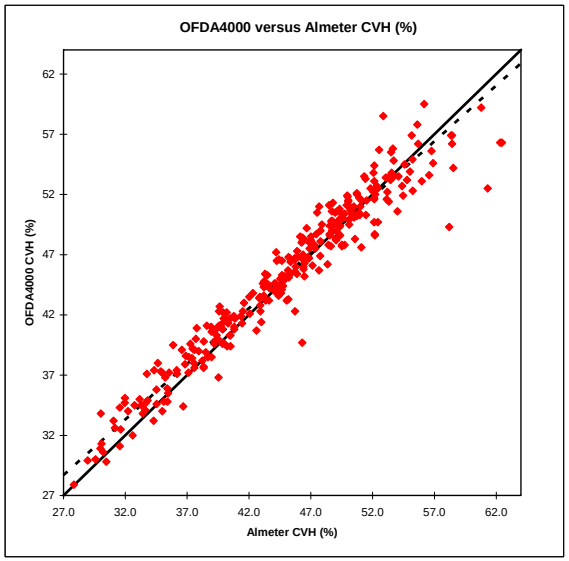
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
30	31.47	1.47
40	40.71	0.71
50	49.94	-0.06
60	59.18	-0.82
70	68.41	-1.59
80	77.65	-2.35

Max/Mins.

Control	max	64.21
	min	25.61
Treatment	max	61.40
	min	27.90
average	max	62.81
	min	26.81
difference	max	5.63
	min	-8.89





Barbe Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	553	553	553
Average	86.4510	86.0134	**-0.4376**
SD	6.2109	6.5280	1.5055
SE	0.2641	0.2776	0.0640
t value	327.3262	309.8482	-6.8357
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	553
DF	551
R	0.9733
t-value	99.5155
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

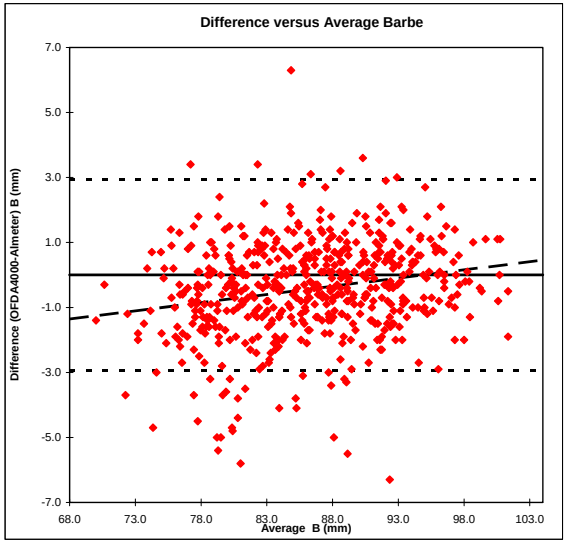
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0511	***	0.0103	4.9672	0.0000	0.9473
DVA	0.0505	***	0.0099	5.0940	0.0000	
Intercept(GM)	-4.8519					STEYX
Intercept(DVA)	-4.7892					1.4272

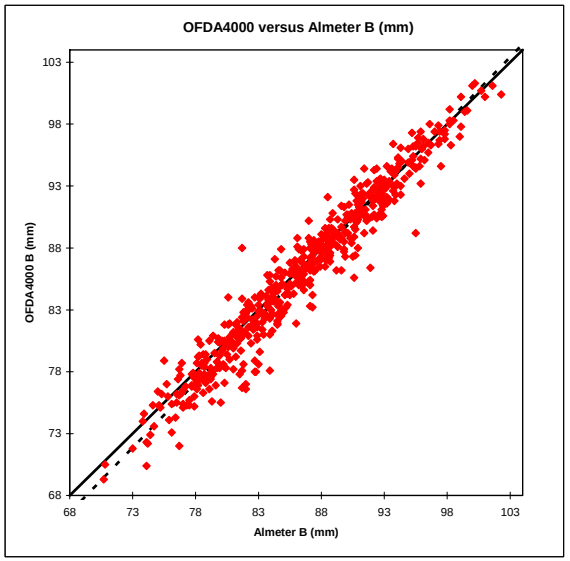
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
65	63.47	-1.53
75	73.98	-1.02
85	84.49	-0.51
95	95.00	0.00
105	105.51	0.51
115	116.02	1.02

Max/Mins.

Control	max	102.30
	min	68.90
Treatment	max	101.30
	min	66.40
average	max	101.35
	min	67.65
difference	max	6.30
	min	-6.30





Barbe Comparison - Sale lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	304	304	304
Average	79.6597	80.3359	**0.6761**
SD	12.3355	12.5821	1.3257
SE	0.7075	0.7216	0.0760
t value	112.5946	111.3247	8.8924
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	304
DF	302
R	0.9945
t-value	165.5302
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

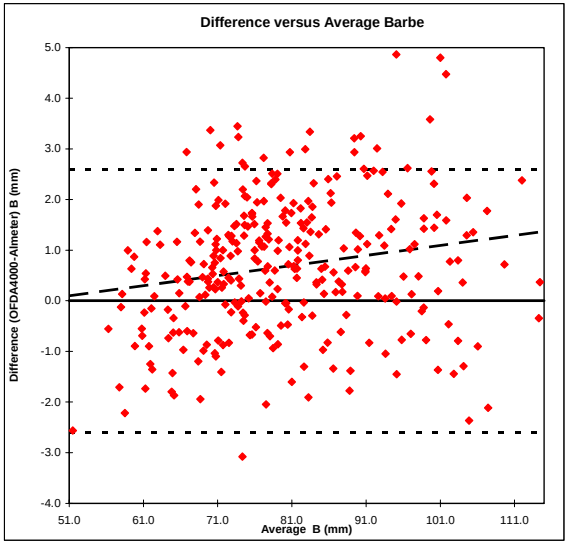
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0200	**	0.0061	3.2622	0.0012	0.9891
DVA	0.0198	**	0.0060	3.2948	0.0011	
Intercept(GM)	-0.9164					STEYX
Intercept(DVA)	-0.9117					1.2901

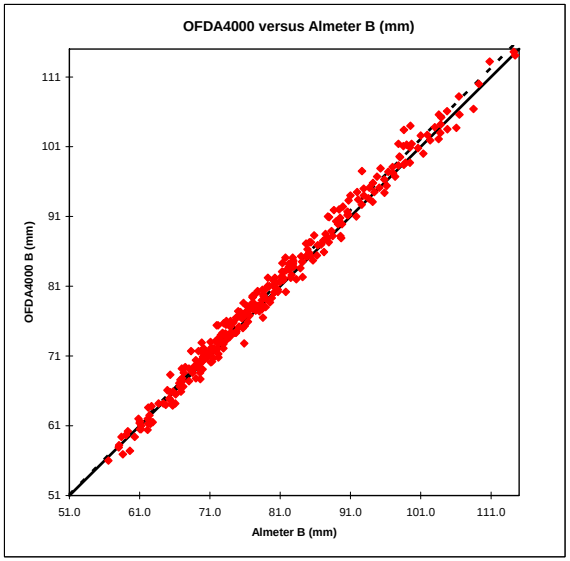
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
50	50.08	0.08
65	65.38	0.38
80	80.68	0.68
95	95.98	0.98
110	111.28	1.28
125	126.58	1.58

Max/Mins.

Control	max	114.44
	min	52.76
Treatment	max	114.60
	min	50.20
average	max	114.42
	min	51.48
difference	max	4.86
	min	-3.08





Coefficient of Variation of Barbe Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	553	553	553
Average	35.3483	35.7461	**0.3978**
SD	2.9067	2.8938	0.8513
SE	0.1236	0.1231	0.0362
t value	285.9802	290.4837	10.9895
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	553
DF	551
R	0.9569
t-value	77.3721
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

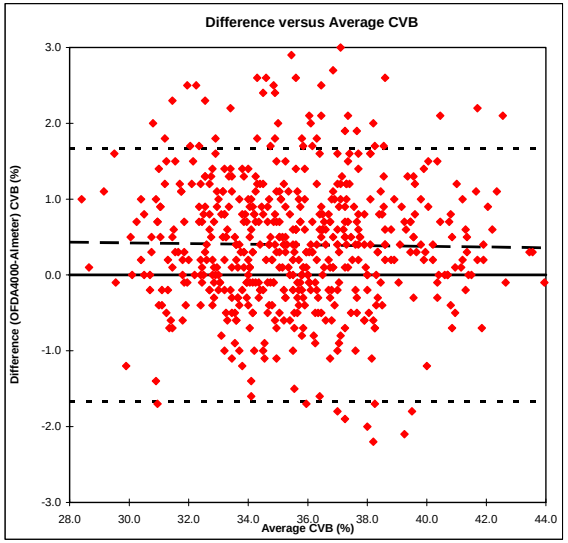
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9956	**NS**	0.0123	0.3592	0.7196	0.9157
DVA	-0.0045	**NS**	0.0126	0.3584	0.7202	
Intercept(GM)	0.5542					STEYX
Intercept(DVA)	0.5589					0.8446

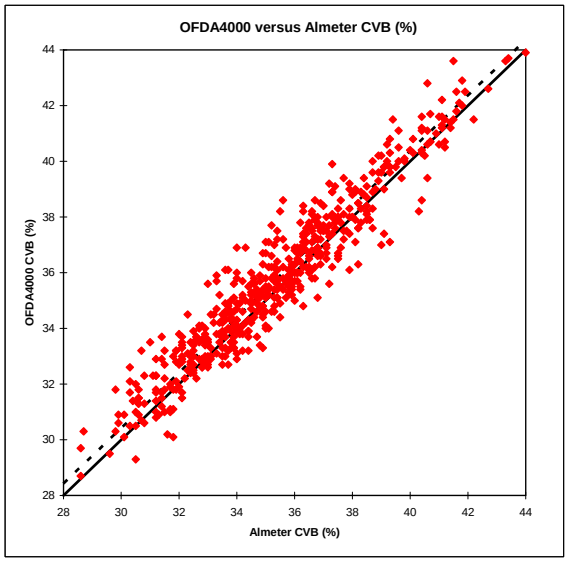
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
25	25.44	0.44
30	30.42	0.42
35	35.40	0.40
40	40.38	0.38
45	45.36	0.36
50	50.33	0.33

Max/Mins.

Control	max	44.00
	min	27.30
Treatment	max	43.90
	min	27.80
average	max	43.95
	min	27.55
difference	max	3.00
	min	-2.20





Coefficient of Variation of Barbe Comparison - Sale lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	304	304	304
Average	35.4774	35.6164	**0.1391**
SD	5.0014	4.8481	1.0028
SE	0.2868	0.2781	0.0575
t value	123.6803	128.0894	2.4182
p value	0.0000	0.0000	0.0162
Significance			*

(B) Test for Correlation.

Number	304
DF	302
R	0.9797
t-value	85.0329
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

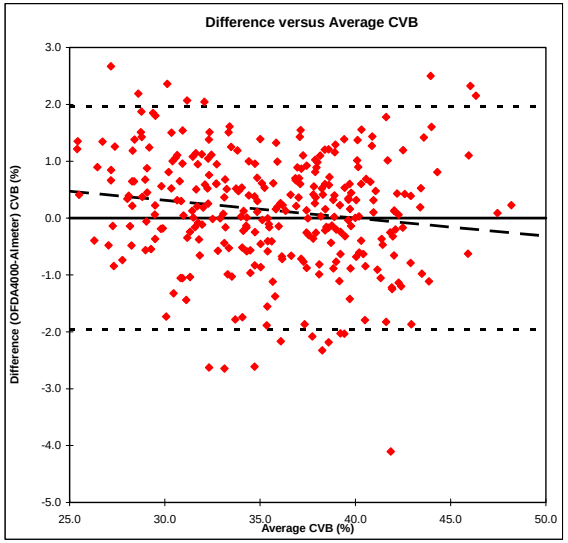
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.9694	**	0.0112	2.7430	0.0064	0.9599
DVA	-0.0314	**	0.0116	2.7010	0.0073	
Intercept(GM)	1.2260					STEYX
Intercept(DVA)	1.2564					1.0031

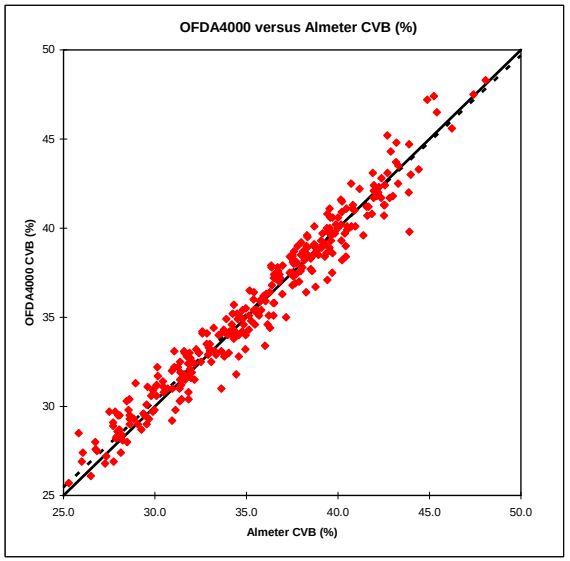
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
25	25.46	0.46
30	30.31	0.31
35	35.15	0.15
40	40.00	0.00
45	44.85	-0.15
50	49.69	-0.31

Max/Mins.

Control	max	48.07
	min	23.38
Treatment	max	48.30
	min	24.60
average	max	48.19
	min	24.14
difference	max	2.67
	min	-4.10





K15H Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	553	553	553
Average	0.9980	1.6213	**0.6233**
SD	1.0405	0.7365	0.8690
SE	0.0442	0.0313	0.0370
t value	22.5562	51.7678	16.8670
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	553
DF	551
R	0.5675
t-value	16.1795
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

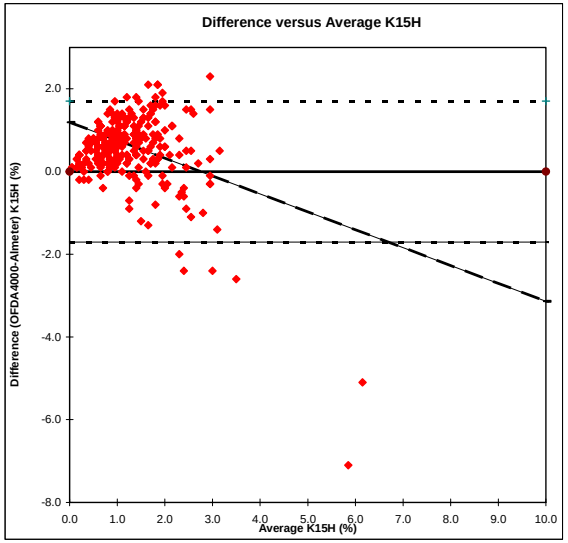
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.7079	***	0.0248	11.7662	0.0000	0.3221
DVA	-0.4330	***	0.0431	10.0475	0.0000	
Intercept(GM)	0.9149					STEYX
Intercept(DVA)	1.1904					0.8575

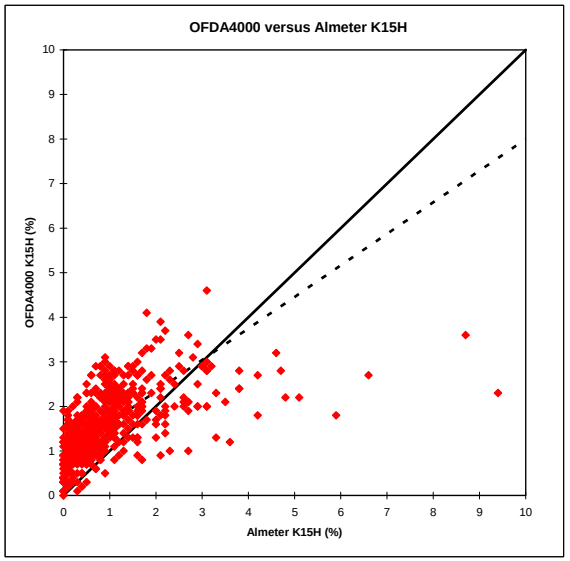
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
0	0.91	0.91
2	2.33	0.33
4	3.75	-0.25
6	5.16	-0.84
8	6.58	-1.42
10	7.99	-2.01

Max/Mins.

Control	max	9.40
	min	0.00
Treatment	max	4.60
	min	0.00
average	max	6.15
	min	0.00
difference	max	2.30
	min	-7.10





K15H Comparison - Sale Lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	287	287	287
Average	1.3835	1.8286	**0.4451**
SD	1.7567	1.2403	1.1427
SE	0.1037	0.0732	0.0675
t value	13.3422	24.9762	6.5983
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	287
DF	285
R	0.7615
t-value	19.8366
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

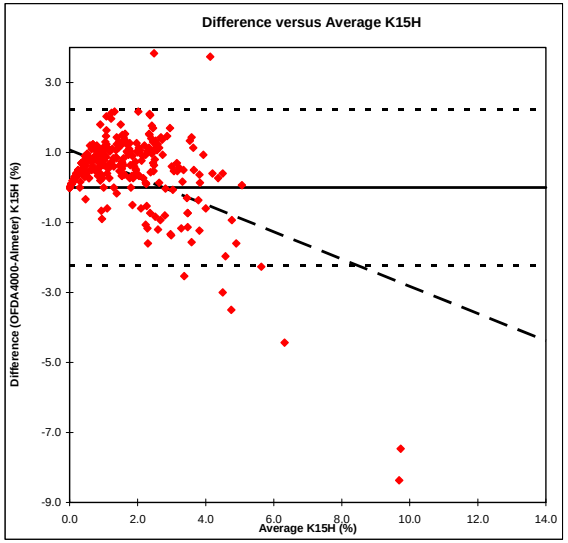
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.7060	***	0.0271	10.8449	0.0000	0.5800
DVA	-0.3897	***	0.0421	9.2509	0.0000	
Intercept(GM)	0.8518					STEYX
Intercept(DVA)	1.0709					1.1405

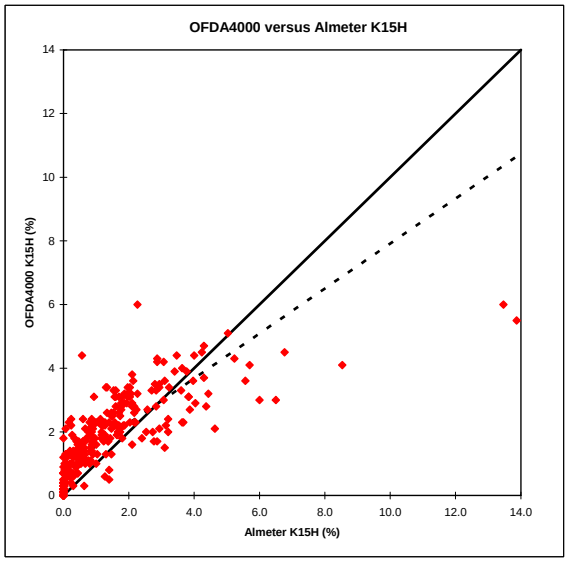
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
0	0.85	0.85
5	4.38	-0.62
4	3.68	-0.32
6	5.09	-0.91
8	6.50	-1.50
10	7.91	-2.09

Max/Mins.

Control	max	13.87
	min	0.00
Treatment	max	6.00
	min	0.00
average	max	9.73
	min	0.00
difference	max	3.83
	min	-8.37





K25H Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	553	553	553
Average	6.3588	7.6307	**1.2720**
SD	2.7177	2.3140	1.5750
SE	0.1156	0.0984	0.0670
t value	55.0218	77.5466	18.9913
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	553
DF	551
R	0.8157
t-value	33.1026
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

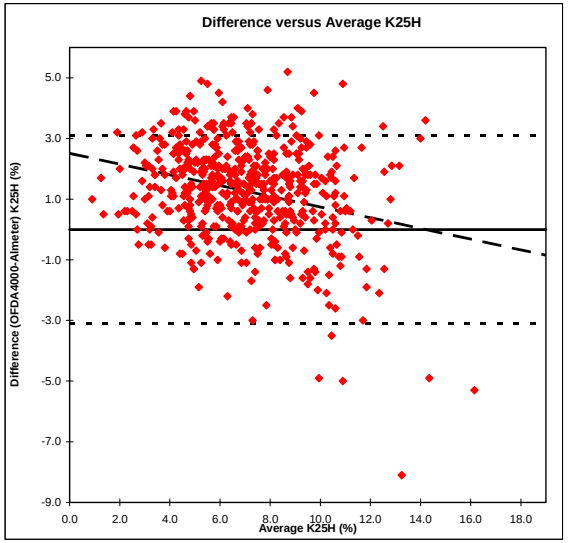
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.8515	***	0.0210	7.0793	0.0000	0.6654
DVA	-0.1766	***	0.0270	6.5535	0.0000	
Intercept(GM)	2.2165					STEYX
Intercept(DVA)	2.5074					1.5734

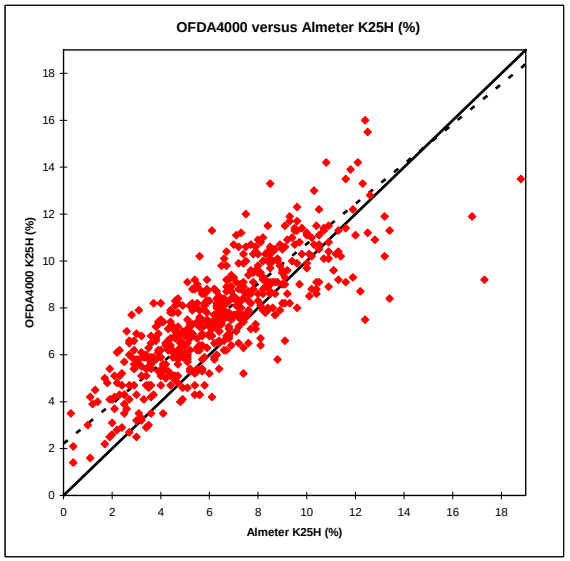
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
0	2.22	2.22
5	6.47	1.47
10	10.73	0.73
15	14.99	-0.01
20	19.25	-0.75
25	23.50	-1.50

Max/Mins.

Control	max	18.80
	min	0.30
Treatment	max	16.00
	min	1.40
average	max	16.15
	min	0.90
difference	max	5.20
	min	-8.10





K25H Comparison - Sale lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	287	287	287
Average	1.3835	1.8286	**0.4451**
SD	1.7567	1.2403	1.1427
SE	0.1037	0.0732	0.0675
t value	13.3422	24.9762	6.5983
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	287
DF	285
R	0.7615
t-value	19.8366
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

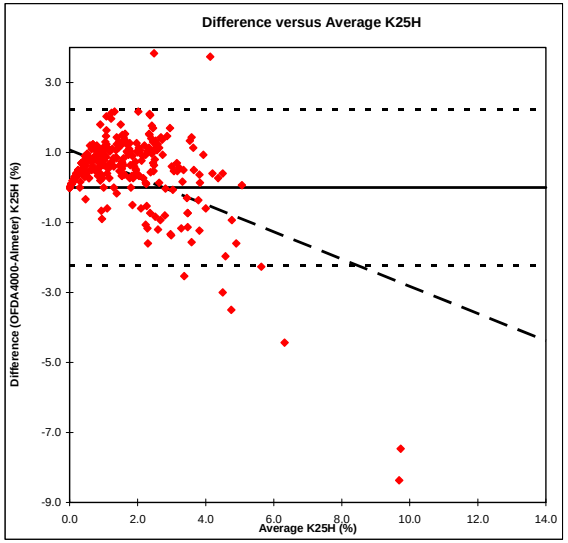
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	0.7060	***	0.0271	10.8449	0.0000	0.5800
DVA	-0.3897	***	0.0421	9.2509	0.0000	
Intercept(GM)	0.8518					STEYX
Intercept(DVA)	1.0709					1.1405

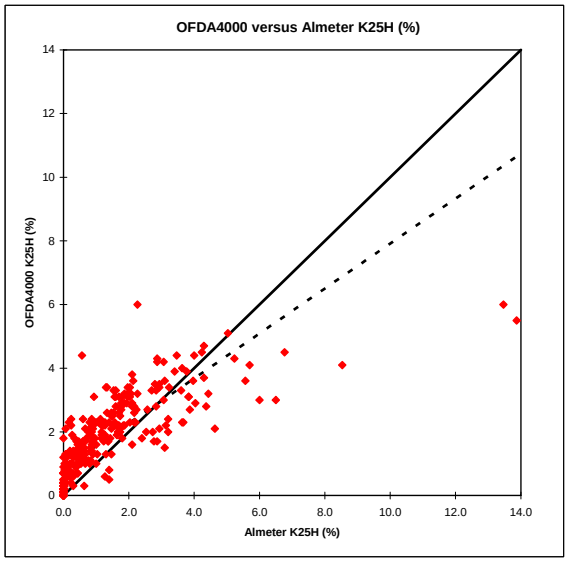
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
0	0.85	0.85
4	3.68	-0.32
6	5.09	-0.91
8	6.50	-1.50
10	7.91	-2.09
12	9.32	-2.68

Max/Mins.

Control	max	13.87
	min	0.00
Treatment	max	6.00
	min	0.00
average	max	9.73
	min	0.00
difference	max	3.83
	min	-8.37





L5H Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	553	553	553
Average	125.5396	125.6241	**0.0844**
SD	7.8148	8.3668	1.8863
SE	0.3323	0.3558	0.0802
t value	377.7702	353.0832	1.0528
p value	0.0000	0.0000	0.2929
Significance			**NS**

(B) Test for Correlation.

Number	553
DF	551
R	0.9751
t-value	103.2572
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

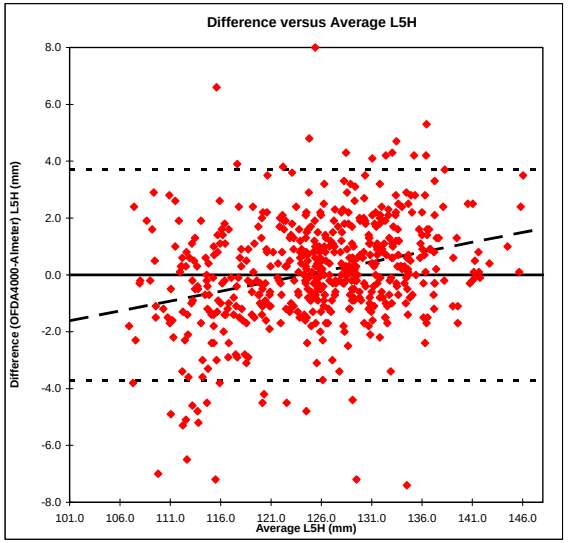
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0706	***	0.0101	6.9865	0.0000	0.9509
DVA	0.0691	***	0.0096	7.2332	0.0000	
Intercept(GM)	-8.7834					STEYX
Intercept(DVA)	-8.5916					1.7339

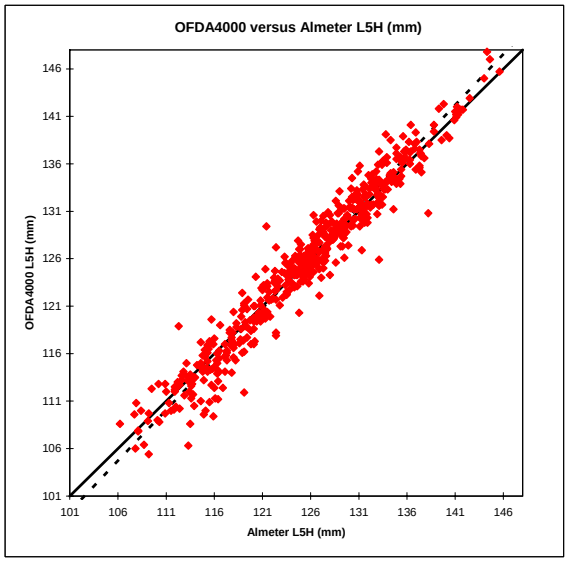
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
0	-8.78	-8.78
2	-6.64	-8.64
4	-4.50	-8.50
6	-2.36	-8.36
8	-0.22	-8.22
10	1.92	-8.08

Max/Mins.

Control	max	145.60
	min	102.40
Treatment	max	147.80
	min	99.50
average	max	146.05
	min	100.95
difference	max	8.00
	min	-7.40





L5H Comparison - Sale Lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	287	287	287
Average	115.5043	117.0753	**1.5710**
SD	17.2725	17.7293	1.6073
SE	1.0196	1.0465	0.0949
t value	113.2877	111.8704	16.5581
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	287
DF	285
R	0.9961
t-value	191.1469
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

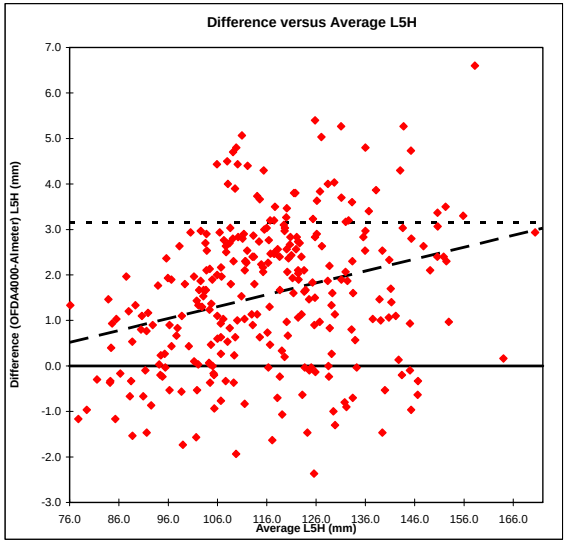
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0264	***	0.0053	4.9434	0.0000	0.9923
DVA	0.0261	***	0.0052	5.0087	0.0000	
Intercept(GM)	-1.4833					STEYX
Intercept(DVA)	-1.4698					1.5222

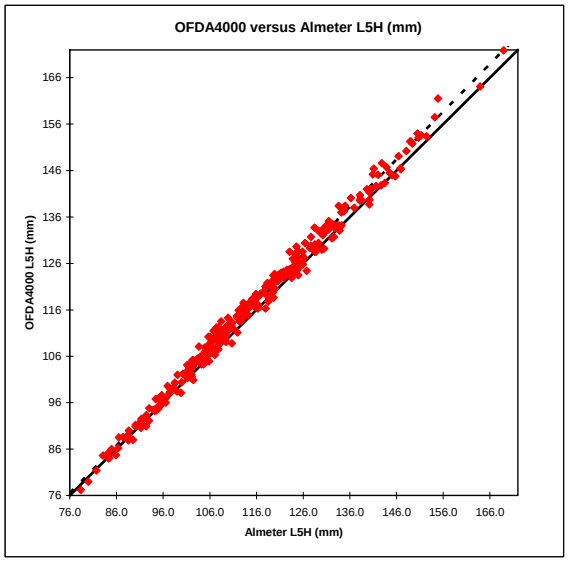
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
76	76.53	0.53
96	97.06	1.06
116	117.58	1.58
136	138.11	2.11
156	158.64	2.64
176	179.17	3.17

Max/Mins.

Control	max	168.97
	min	75.47
Treatment	max	171.90
	min	76.80
average	max	170.43
	min	76.13
difference	max	6.60
	min	-2.37





L1H Comparison - TEAM

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	553	553	553
Average	144.1609	144.2450	**0.0841**
SD	8.3688	9.0287	2.5661
SE	0.3559	0.3839	0.1091
t value	405.0851	375.6973	0.7706
p value	0.0000	0.0000	0.4413
Significance			**NS**

(B) Test for Correlation.

Number	553
DF	551
R	0.9593
t-value	79.7493
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

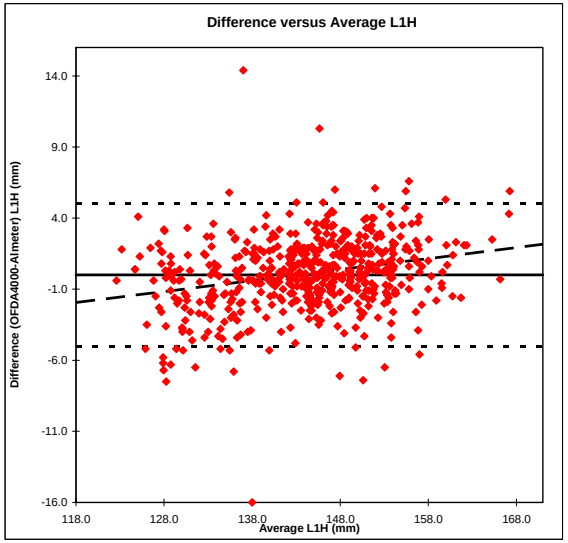
Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0789	***	0.0130	6.0759	0.0000	0.9203
DVA	0.0774	***	0.0123	6.3155	0.0000	
Intercept(GM)	-11.2831					STEYX
Intercept(DVA)	-11.0820					2.3652

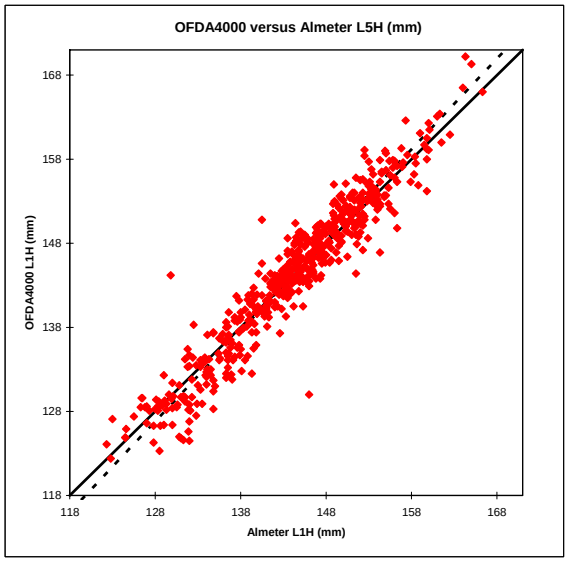
Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
118	116.02	-1.98
128	126.81	-1.19
138	137.60	-0.40
148	148.39	0.39
158	159.18	1.18
168	169.96	1.96

Max/Mins.

Control	max	166.30
	min	119.00
Treatment	max	170.20
	min	116.40
average	max	167.25
	min	117.70
difference	max	14.40
	min	-16.00





L1H Comparison - Sale Lots

(A) Test for Overall Relative Bias & Paired t-test.

	Overall Bias		Paired
	Almeter	OFDA4000	t-test
Number	287	287	287
Average	131.9623	133.8380	**1.8757**
SD	18.7298	19.4173	2.5824
SE	1.1056	1.1462	0.1524
t value	119.3598	116.7698	12.3053
p value	0.0000	0.0000	0.0000
Significance			***

(B) Test for Correlation.

Number	287
DF	285
R	0.9915
t-value	128.5118
p-value	0.0000
Significance	***

(C) Test for Level Dependent "Bias".

Statistical Significance

Regression	Slope	Significance	SE of Slope	t-Value	p-value	Rsq
GM	1.0367	***	0.0080	4.5896	0.0000	0.9830
DVA	0.0362	***	0.0077	4.6739	0.0000	
Intercept(GM)	-2.9685					STEYX
Intercept(DVA)	-2.9355					2.4438

Magnitude of the Level Dependent "Bias".

Nominal	Calculated	Avg. "Bias"
88	88.26	0.26
108	109.00	1.00
138	140.10	2.10
148	150.46	2.46
158	160.83	2.83
168	171.20	3.20

Max/Mins.

Control	max	196.03
	min	87.80
Treatment	max	201.60
	min	88.30
average	max	198.82
	min	88.05
difference	max	8.10
	min	-10.40