INTERNATIONAL WOOL TEXTILE ORGANISATION

TECHNOLOGY & STANDARDS COMMITTEE **HOBART MEETING**

Sliver Group **April 2005**

Chairman: G.S. SINGH (India) **Report No: SG 02**

Report on the 2004/05 OFDA4000 and Almeter/OFDA100/Laserscan round trial

By

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BRIEFING PAPER

SUMMARY OF FINDINGS

This paper summarises the analyses of round trial performance, in 3 non-IWTO-licensed laboratories, of OFDA4000 instruments compared with reference measurements undertaken on OFDA100, Laserscan and Almeter instruments. A wide range of wools were used in the trials from 4 countries of origin, covering mean fibre diameters from 16 to 36 micron and Hauteur values from 47 to 104 mm.

The analyses were undertaken on 49 parameters, not all of which would be considered commercially important. They indicate that in this trial the OFDA4000's can be considered technically equivalent to the reference instruments in some parameters but, unsurprisingly, not all 49. In terms of the main measurements intended to be used for certification (MFD, SD, H and B), it is the author's opinion that the instrument provides sufficient levels of performance to be considered commercially equivalent.

With respect to the detailed length distribution data, some statistically significant biases were detected, but on the whole these were relatively small when compared with the precision of these measurements by either instrument. The OFDA4000s demonstrated similar precision to the Almeters on H distribution parameters, but their performance on B distributions was slightly poorer than the Almeters – however a similar situation has been previously seen in the AL2000 – AL100 comparisons.

COMMERCIAL IMPLICATIONS – CURRENT AND FUTURE

This project has demonstrated that the OFDA4000 measuring sliver (native mode), or emulating an OFDA100 (in 70mm mode) is capable of providing results that are very similar to those provided by the reference instruments. In some cases the performance was better than the reference instruments, and in some cases it was slightly worse. In the author's view, the data is adequate to allow the finalisation of a draft test method for the instrument, so that more commercial experience can be obtained. The overall average results on the primary parameters were as follows:

Parameter	OFDA4000 native	OFDA4000 70mm mode	Reference method	Difference native	Difference 70mm mode
MFD m	23.55	23.69	23.64	-0.09	+0.05
SD m	5.28	5.43	5.36	-0.08	+0.07
H mm	74.72		74.85	-0.13	
CvH %	45.25		45.09	+0.16	
B mm	90.26		90.36	-0.10	
CvB %	36.26		36.16	+0.10	

NOTE

This report will be initially discussed in the Fibre Length working group, at 08:00 on Monday 18 April.

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INTRODUCTION

This report summarises the results of the 2004/05 round trial carried out to assess the equivalence of the OFDA4000 instrument with the Almeter (for fibre length and distribution) and the OFDA100 and Laserscan (for fibre diameter and distribution).

The development of the OFDA4000 has been described in papers previously submitted to this group (Brims 2002, 2003, 2004 and Brims & Baxter 2004). The instrument is designed to measure both length and diameter distributions, as well as the length-diameter profile, on wool sliver samples. The instrument can operate in 'native' mode, where it measures sliver for both length and diameter distribution, and in '70 mm mode', where it emulates an OFDA100 and measures 2 mm snippets spread on 70 mm glass slides, for diameter distribution only. Both modes are covered in this trial.

The Almeter is described in IWTO-17. Additional data on its performance in measuring certain length distribution parameters was reported by Couchman & Holmes (2003). For the purposes of this round trial, the Almeter is regarded as the reference instrument for the measurement of length distribution.

The OFDA100 and Laserscan are described in IWTO-47 and IWTO-12 respectively. For the purposes of this round trial, these instruments are regarded as reference instruments for the measurement of diameter distribution.

Fibre ends fineness index (FEFI) was measured in accordance with IWTO DTM-60.

The protocol for this round trial evolved over 2004 with the involvement of several participants, including representatives of the Federation of Australian Wool Organisations, and the IWTO length working group. The final version of the protocol was agreed in Shanghai and is reproduced as Appendix 1.

The measurements were undertaken in three laboratories:

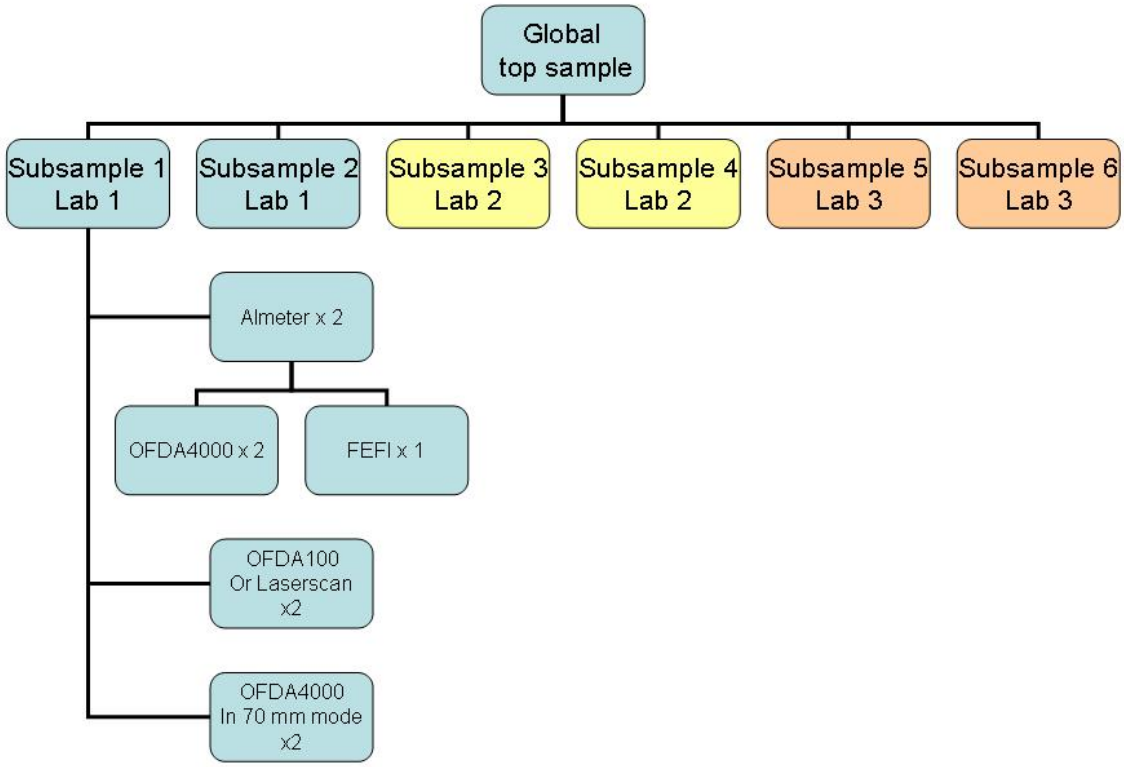
- BSC Electronics Pty Ltd, Perth, WA
- CSIRO Textile Laboratory, Geelong, VIC
- Pettinatura di Verrone, Biella, Italy

None of these laboratories were IWTO-licensed and therefore the round trial can be considered a reasonable representation of normal commercial usage of the instruments.

ROUND TRIAL METHOD

Appendix 1 describes the agreed protocol. This is summarised in figure 1.

Figure 1: Trial schema



The trial included 40 top samples. Each top sample was split into 10 sub-samples, which were twisted into hanks. Each of the 3 laboratories received 2 hanks from each top, selected at random and each identified with a coded number (i.e. blind pairs). The remaining hanks were kept as spares. Each hank was measured twice, firstly in the Almeter, and then in the OFDA4000. The Almeter beards were combined and measured for the fibre fineness index (FEFI). Slices taken from each hank were also

measured for fibre diameter distribution using either an OFDA100 (2 labs) or a Laserscan (1 lab), and also on the OFDA4000 operating in 70 mm mode (using a standard OFDA100 glass slide). Each laboratory therefore reported length and diameter distributions on 160 separate specimens, and FEFI on 80 specimens.

Exceptions

One laboratory did not measure all the specimens for FEFI. In the time available, the Laserscan comfort factor measurements could not be included in the analyses. In view of the fact that OFDA and Laserscan curvature measurements are biased with respect to each other and by preparation routes, the Laserscan curvature results were not included in the analyses. If possible, the curvature measurements will be 'calibrated' from the instruments' calibration data and re-analysed for the meeting.

Sample statistics

The range of samples included tops from New Zealand, Australia, Germany and Italy. The range of properties are summarised in Table 1.

Table 1: Range of samples used in the trial

Property	Minimum	Maximum	Average
Mean fibre diameter µm	16.4	36.3	23.6
Standard deviation µm	3.3	9.5	5.3
Hauteur mm	47.3	103.5	74.7
Coefficient of variation CvH %	32.7	54.6	45.3
Barbe mm	59.5	129.6	90.2
FEFI	-0.8	+0.5	-0.3

ROUND TRIAL ANALYSES

The round trial was analysed in general accordance with IWTO-0. Because of the very large number of parameters involved and the time restraints to meet the reporting deadline, the analyses were limited to a selection of the more important parameters, not all of which are necessarily of commercial consequence:

Diameter-related: Mean fibre diameter (MFD), Standard deviation (SD), Comfort Factor (CF), Mean curvature (curve), and Fibre Ends Fineness Index (FEFI)

Length-related: Hauteur (H), Coefficient of variation of hauteur (CvH), Barbe (B), Coefficient of variation of barbe (CvB), Percentage of fibres from hauteur distribution less than 10, 15, 20, 25, 30, 35, 40, 45 and 50 mm (K10H, K15H, etc), Length of fibres from the hauteur distribution in the upper 95, 90, 75, 50, 25, 10, 5, 2.5 and 1% (L95H, L90H, etc), Percentage of fibres from barbe distribution less than 10, 15, 20, 25, 30, 35, 40, 45 and 50 mm (K10B, K15B, etc), Length of fibres from the barbe distribution in the upper 95, 90, 75, 50, 25, 10, 5, 2.5 and 1% (L95B, L90B, etc).

The grand means across all sub-samples and laboratories were used to examine equivalence in terms of accuracy.

To compare precision, one-way analyses of variance were carried out for each parameter and each sample, with the general form as follows:

Source of variation	Sum of squares	Degrees of freedom	Mean square	Expected mean square
Amongst laboratories	A	2	A/2	$\sigma^2_\omega + 4\,\sigma^2_L$
Within laboratories	B	9	B/9	σ^2_ω
Total	C	11	-	-

Where: σ^2_ω is the within-laboratory component of variance

And σ^2_L is the between-laboratory component of variance

As with convention, calculated negative values of between-laboratory components of variance are set to zero. With the exception of FEFI, the general case ANOVA was applied to all samples and all parameters. The degrees of freedom were modified for the CF analyses. Since there were a number of missing values for FEFI, individual analyses were carried out for each sample using Unistat (2002)

95% confidence limits were calculated for two cases: a single measurement in a single laboratory, and for 5 measurements in a single laboratory as required by the *IWTO Regulations for the Testing of Wool Slivers for Mean Fibre Diameter and Mean Fibre Length*:

Case 1: $95\%CL(1) = 1.96 * \sqrt{(\sigma^2_\omega + \sigma^2_L)}$

Case 2: $95\%CL(5) = 1.96 * \sqrt{(0.2 * \sigma^2_\omega + \sigma^2_L)}$

In comparing the instruments, both confidence limits were evaluated.

No data were judged sufficiently outlying to be omitted from the analyses.

RESULTS - ACCURACY

Purely for reasons of practicality, only a limited set of analyses can be fully reported here. The tables show results for <u>all</u> parameters that have been analysed. The plots shown are limited to a representative selection of parameters, to include those that might be considered more commercially important. As will be shown, the small biases between the instruments in length measurement tended to be relatively systematic and therefore the shape of plots for intermediate distribution parameters can be estimated by interpolation. A file containing all the raw data and plots for all parameters has, however, been deposited with Australian Wool Innovation Ltd.

Appendix 2 shows the statistics for mean paired differences, difference versus average and geometric mean regressions in tabular form, following the general requirements of IWTO-0.

Appendix 3 shows the geometric mean and difference versus average plots for a selected range of parameters. Standard requirements in IWTO-0 have been followed: in the GM plots, the solid line is the 1:1 line, the dotted line is the GM regression line, and the equation is the GM regression equation; in the DVA plots, dashed lines are the 95%CL lines about zero, based on the SD of differences, the dotted line is the least squares regression, and the regression equation is for the least squares regression.

RESULTS – PRECISION

As indicated above, precision has been compared for two scenarios: single measurements, which are generally only used for QC, and for 5 measurements, this being the minimum required for IWTO certification of length. Of course, the more sub-samples that are measured for any consignment, the better the precision, and this is specifically enumerated in the precision table in IWTO-17.

Appendix 4 tabulates, for single measurements, the statistics for mean paired 95%CL differences, difference versus average and geometric mean regressions in tabular form, following the general requirements of IWTO-0.

Appendix 5 tabulates, for 5 measurements (the minimum for length certification), the statistics for mean paired 95%CL differences, difference versus average and geometric mean regressions in tabular form, also following the general requirements of IWTO-0.

Appendix 6 shows plots for a selected range of parameters where the 95%CL values for single measurements have been plotted for the OFDA4000 and the appropriate reference method. In this case, IWTO-0 has not been strictly followed, since in the majority of cases there were obvious differences in the precision relationships which did not warrant showing the GM regression line or the DVA plot. The dashed line in all these plots is the least squares regression line, and the equation shown is also the least squares regression equation. Alongside the comparison plots are the level-dependency plots, where the 95%CL values for single measurements have been plotted against the primary parameter of interest.

Appendix 7 shows plots for some parameters where the 95%CL values for the average of 5 measurements have been plotted for the OFDA4000 and the appropriate reference method. Only a limited number of plots are shown for those parameters where the significance of the differences against the reference method has obviously changed.

DISCUSSION

Accuracy

Figures 2 and 3 summarise the overall length distribution biases.

Figure 2: OFDA4000 minus Almeter grand means for Hauteur

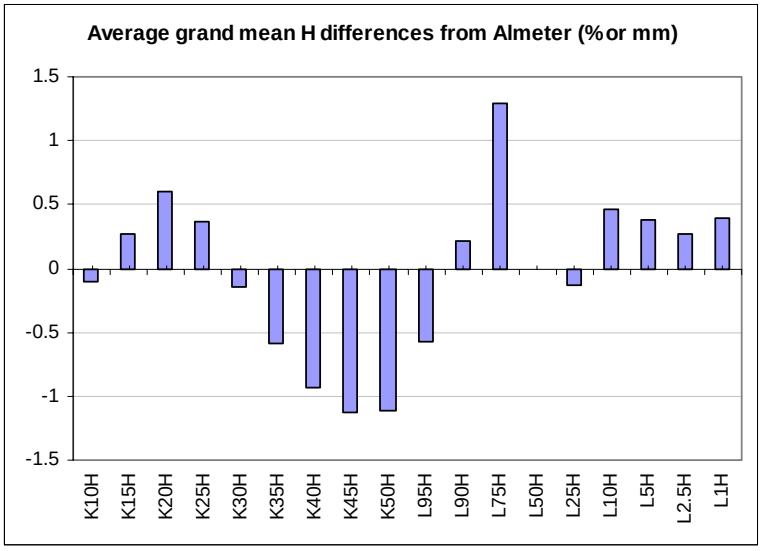
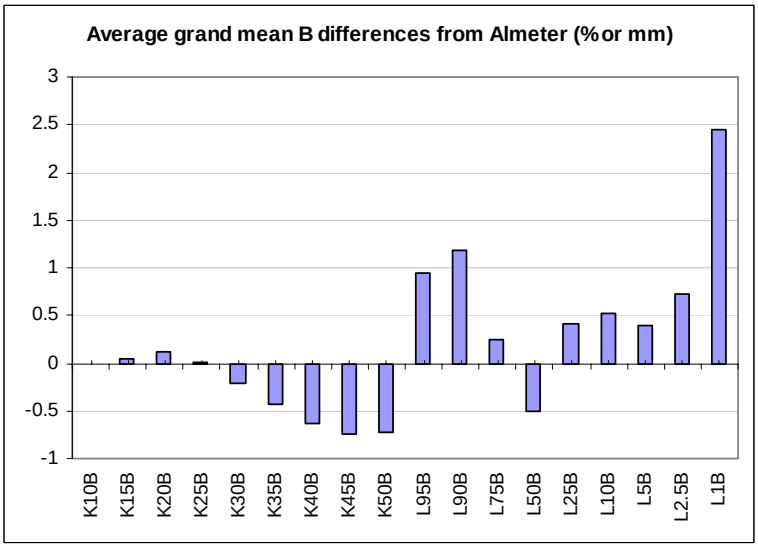
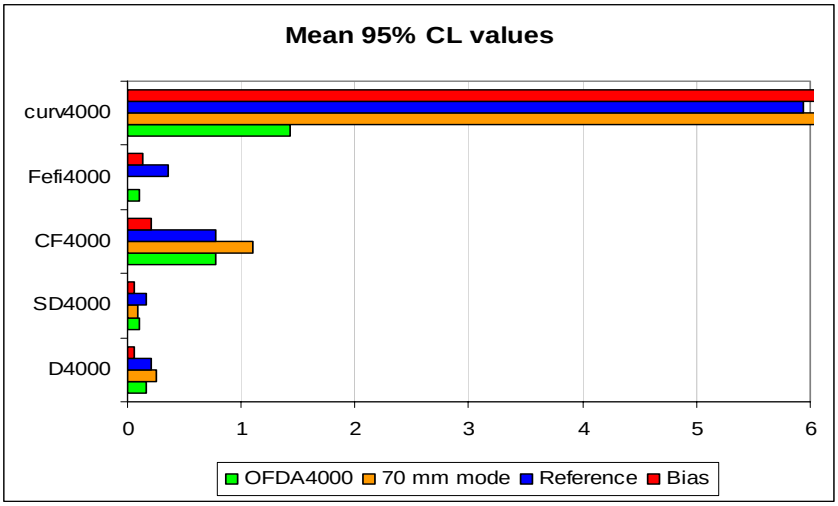


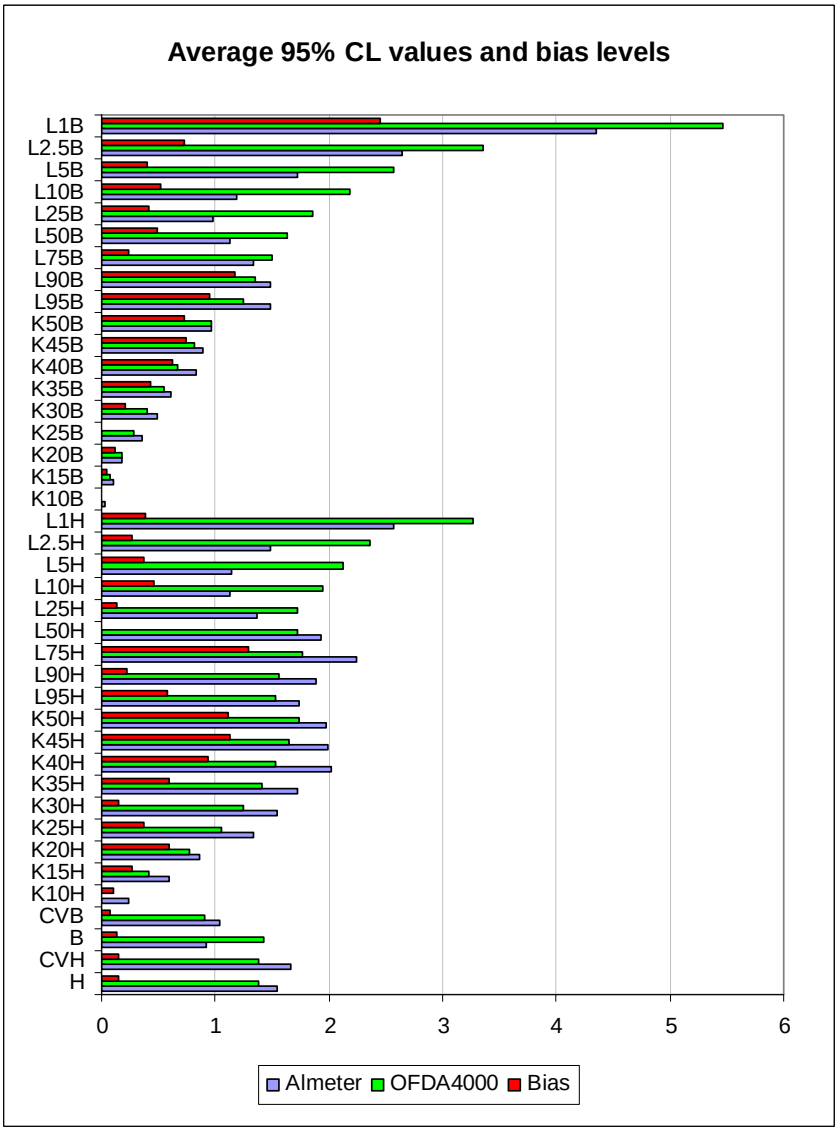
Figure 3: OFDA4000 minus Almeter grand means for Barbe



The biases noted above can be put into perspective by comparing them against the precision for each parameter. Figure 4 shows the absolute magnitude of each bias plotted against the 95%CL values estimated for the average of 5 measurements (i.e. for certification).

Figure 4: Comparison of bias magnitude with precision estimates for certification





Further comparison can be made with the data published for differences between Almeter models (Couchman & Holmes, 2003). Table 2 compares published mean differences between AL2000 and AL100, against mean differences between OFDA4000 and AL100 found in this trial, for those parameters examined in detail by Couchman & Holmes. It should be noted that whilst in this current trial the instrument means are based on measurements of blind replicate sub-samples (and therefore include a component of variance due to 'along-sliver'), the AL2000 – AL100 trial was specifically designed to minimise the effects of along-sliver variation by using, in each laboratory, one Fibroliner to draw specimens for each of the two measurement instruments.

Table 2: Average difference statistics between Almeter models and between OFDA4000 and AL100

Parameter	AL2000 - AL100			OFDA4000 - AL100		
	Mean Diff	SD diffs	no. tops	Mean Diff	SD diffs	no. tops
H	-0.26	0.95	5	0.15	0.95	40
CvH	0.16	0.78	5	-0.16	1.00	40
K15H	1.22	0.80	5	0.27	0.47	40
K25H	0.52	0.89	5	0.37	0.94	40
L5H	-0.98	1.24	5	0.38	1.35	40
L1H	-0.94	2.86	5	0.39	2.97	40
B	0.04	2.15	5	0.14	0.89	40
CvB	-0.54	0.59	5	-0.07	0.56	40

Whilst these were two quite different trial designs, it can nevertheless be observed that the levels of average differences between instrument types were similar for the two sets of comparisons, and that the SDs of differences are generally similar or smaller for the OFDA4000-AL100 comparisons (In the case of K15H and B, the SDs of differences were statistically significantly lower for this trial).

Examination of Appendix 2 shows that there are statistically significant average differences in approximately two thirds of the 49 parameters examined. Approximately half of the parameters showed detectable slope-dependent biases. However, most of the biases are relatively small and have been detected because of the statistical power of the trial.

Moving from the overview to the specific:

- The MFD, SD and CF values produced by the OFDA4000 in native and 70 mm mode were biased, but by amounts that in the past have been considered commercially insignificant. They are well within the bounds to be expected simply from calibration uncertainties. In the case of the CF values, the biases in the normal range of commercial interest (90 to 100%) were also relatively small.

- The FEFI values produced by the OFDA4000 were biased by slope and average to an extent that may have relevance if this parameter were to be used commercially. However, compared with the imprecision of the 'reference' DTM-60 measurements, the bias may still be regarded as small (see table 3).

- The mean curvature results indicated that the whilst the 70mm mode was biased by an amount that would be probably be considered insignificant, the native mode results will require calibration to bring them in line with whatever is to be regarded as the reference – this matter was alluded to earlier.

- The four primary length characteristics – H, CvH, B and CvB were unbiased on average, but with the exception of CvH, showed slight level-dependent biases. In the author's view, these small differences should probably be regarded as commercially acceptable.

- Most of the KxxH parameters were biased by small amounts but showed no level-dependent effects. The statistically-significant biases were of the order of 1% or less, and are all less than the precision of these parameters. For context, it should be recalled that in the IWTO-0 analyses

of the AL2000 – AL100 trial, the authors noted, with, for example, specific reference to K15H differences that "*a difference of 1.2% is considered very low in comparison with what is observed in commercial topmaking and recombing …. The differences shown in these trials are considered to be low and of no commercial significance.*"

- Most of the LyyH parameters, particularly in the range L50H to L1H were unbiased on average, but showed level-dependent biases which tended to become more pronounced in the L10H to L1H range.

- Whilst the KxxB values were generally biased on average, the biases were relatively small and in all cases less than 1%. Some of these parameters showed statistically-significant level-dependent effects, but these seemed to have been generated by the leverage effect of one extreme top.

- In the normal range of interest the LyyB values were marginally biased on average (less than 1mm) with the exception of L1B, where the bias reached 2.5mm. In the range L25B to L1B, there were level-dependent biases of increasing statistical significance.

It is the author's view that on the major parameters that are used for IWTO certification, the performance of the OFDA4000 instrument, whilst statistically not perfectly equivalent to the reference methods in all cases (partly because of the sensitivity of the trial), is, nevertheless, recommended for acceptance. With respect to the performance on individual length distribution parameters, which are not certifiable but are used commercially for guidance and QC, the results are less clear-cut. Nevertheless, the observed biases are relatively small by comparison with the apparent precision of these parameters, and appear to be similar to those previously accepted for equivalence of the AL2000 with the AL100.

Precision

For convenience of comparison, table 3 shows the 95% confidence limits calculated from this trial compared against those shown in the appropriate reference test methods. It should be noted that in IWTO-17, table 2 only shows the precision for within-laboratory measurements. In table 3 below, the 95% confidence limits for the Almeter have been recalculated on a basis consistent with current practice.

It should be noted that the values taken from the test methods may be for slightly different numbers of test specimens, since some of these methods do not give sufficient detail on the components of variance to allow recalculation. The mean values of 95%CL quoted are based on the formulae given in the test methods, applied to each of the individual sample mean values, and then averaged across the 40 samples. The values shown are nevertheless considered of adequate validity to indicate that the performance of all instruments in this trial were generally better than the precision expectations of current test methods. It should, however, be noted that with the exception of the AL2000 – AL100 trial, the precision values quoted in the test methods have generally been obtained in trials involving more than 3 laboratories (although sometimes much less than 40 samples).

Table 3: Comparisons of estimated mean 95%CL values with quoted values in test methods

	MFD	**SD**	**FEFI**	**Hauteur (as CV)**		**Barbe (as CV)**	
	4-5 measurements			1 meas	5 meas	1 meas	5 meas
OFDA4000	0.17	0.10	0.10	2.91	2.20	2.30	1.84
O4_70	0.26	0.14					
Ref MFD	0.21	0.16	0.36				
Almeter				2.72	2.28	1.92	1.50
IWTO-12	**0.35**	**0.26**					
IWTO-47	**0.39**	**0.32**					
DTM-60			**0.62**				
IWTO-17				**4.35**	**3.00**	**3.31**	**2.43**

Examining the data in Appendix 4, it becomes clear that on a single measurement basis, the OFDA4000 is at least equivalent in precision to the reference methods for approximately half the parameters. The results in Appendix 5 indicate that if used to certify consignments, with the average of at least 5 individual measurements, the instrument would be deemed equivalent or better in precision for approximately 75%

of the parameters examined. (It should be clear from this that the between-laboratory components of variance for the OFDA4000 were generally less than for the other instruments in this trial, but of course it may also be noted that OFDA4000 instruments were all virtually ex-factory.)

More specifically:

- For the diameter-related measurements, the OFDA4000 was as precise, or more precise, than the reference instruments in this trial. The exceptions were small statistically-detectable differences in the 70mm mode, when used in "certification" mode for mean fibre diameter and comfort factor, but the magnitude of the differences could be described as relatively trivial if the plots in Appendix 6 are examined.

- The precision of the OFDA4000 in measuring H, CvH and CvB was equivalent to the Almeter, but in measuring B, the performance was somewhat less precise (however, there also appeared to be been significant differences in precision of B between instrument types in the AL2000 – AL100 trial, suggesting that B is perhaps harder to measure than H).

- For the KxxH distribution parameters, the OFDA4000 had similar precision to the Almeter.

- For the LyyH parameters, the OFDA4000 had generally poorer precision, although when the averages of 5 measurements were used, the situation improved. Nevertheless, the precision remained poorer than the Almeter in the L10H to L1H range.

- For the KxxB measurements, the OFDA4000 had similar or poorer precision than the Almeter on single specimens, but when used in "certification" mode, the precisions were equivalent.

- For the LyyB measurements the OFDA4000 had poorer precision than the Almeter across the range for single measurements. Whilst the situation improved slightly in "certification" mode, the precision remained poorer than the Almeter for most of these parameters.

It is the author's view that on the major parameters that are used for IWTO certification, the precision of the OFDA4000 instrument was shown in this trial to be technically equivalent to the reference methods in all cases except for barbe. With respect to the performance on individual length distribution parameters, which are not certifiable but are used commercially for guidance, the results are less clear-cut, but nevertheless, the observed differences in precision are relatively small by comparison with the overall precision of these parameters. Performance on H distribution parameters was significantly better than on B distribution parameters, although a similar comment might also be applied to the prior comparison between the AL2000 and AL100.

REFERENCES

Brims, M.A. (2002) *Introducing OFDA4000: A new instrument for simultaneous measurement of fibre length and diameter in tops*, Barcelona, Report SG 02

Brims, M.A. (2003) *Progress of the OFDA4000 and comparison with Almeter*, Buenos Aires, Report SG 02.

Brims, M.A. (2004) *Improving Agreement on Hauteur Measurement between OFDA4000 and Almeter*, Shanghai, Report SG 01

Brims, M.A. and Baxter, B.P. (2004) *Experience with the OFDA4000 in two mills - comparisons with other instrument*s, Evian, Report SG 01

Couchman, R.C. and Holmes, P.J. (2003) *Report on equivalence round trials for the AL2000*, Dubrovnic, report SG 03 and supplements.

IWTO-0-01: *Procedures for the development, review, progression or relegation of IWTO test methods and draft test methods.*

IWTO-12-03: *Measurement of the Mean & Distribution of Fibre Diameter Using the Sirolan-Laserscan Fibre Diameter Analyser.*

IWTO-17-04: *Determination of fibre length and distribution parameters*.

IWTO-47-00: *Measurement of the mean and distribution of fibre diameter of wool using an Optical fibre Diameter Analyser (OFDA)*

IWTO DTM-60-01: *Method for the measurement of fibre end characteristics in wool slivers as a guide to fabric skin comfort.*

Unistat© (2002) Unistat Statistical Package, version 5, Unistat Ltd, London

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APPENDIX 1

ROUND TRIAL PROTOCOL

OFDA4000 round trial 1, rev C - trial protocol (29 Nov 04)

Objectives

The main requirement is to examine the equivalence of the OFDA4000 measurements with AL100 or AL2000 and OFDA or Laserscan. This requires examination of both accuracy and precision on the full range of parameters, whilst minimising the amount of work involved for each individual laboratory.

This revision incorporates suggestions put forward by FAWO and the IWTO working group in its meeting held in Shanghai in Nov 04. The revised (B) protocol included more samples tested in common, and the original requirement for participants to include their own samples has been removed. Whilst the original intent was to include the instrument within IWTO-17, the working group agreed that a new test method would be drafted.

Principles

- 3 instruments in total, although each one may cover more than one laboratory
- In each laboratory, measure 2 blind replicates of a supplied set of 40 tops on OFDA4000, Almeter and OFDA and/or Laserscan
- The same hanks are to be used for both OFDA4000 and Almeter measurements in order to minimize the effects of between-hank variability.
- BSC to keep adequate spare sample sets to allow additional or repeated participation
- Parameters to be examined include all OFDA4000 hauteur and barbe distribution data (means, coefficients of variation, L1 and K and L values at 5 %/mm intervals), MFD, SD, CF and mean curvature, FEFI; and from OFDA4000 in 100 mode: MFD, SD, CF and mean curvature.
- If feasible, the curvature results from the instruments will be "calibrated" in accordance with the principles outlined in RWG05, Istanbul/Dubrovnik conference, using the validation data from the instruments.
- A supplementary trial is to be carried out in one laboratory with at least two OFDA4000 instruments to examine the between-instrument component of variance. This is not required in IWTO-0 but will be carried out for information only.

In this manner we will be able to examine:

1. between-laboratory precision on a standard set of tops for OFDA4000
2. bias and precision comparison between the two instrument types (OFDA and Almeter) on all parameters over a wide range of commercial tops.
3. an estimate of the between-instrument components of variance for OFDA4000

Method

Sample preparation

1. 40 commercial tops to be selected from Australia, New Zealand and Europe. Tops are to cover as wide a range as feasible of both diameter and length. If necessary some IH tops may be included in order to expand the diameter range. Each top should be in the weight range 20 to 30 g/m.
2. Each lab is to receive blind duplicate samples of each top
3. Each top to be initially at least 20 m in length
4. Each top to be cut into 10 by 1.8m lengths

5. Each 1.8m length to be twisted under slight tension by 54 turns (ie. 30 turns/m), doubled and the ends secured by a rubber band (in general accordance with Appendix 5 of IWTO-17)
6. Each twisty to be placed in a re-sealable polythene bag
7. Each set of 10 twisties to be randomly divided into 2 sets of 5
8. Each subset of 5 twisted to be labelled with a random number selected from the range 1 to 80. A record must be kept of the sample number pairing.
9. From each subset of 5, select 3 for the trial to be allocated at random to the 3 laboratories.. Remainder to be stored in case the trial needs to be repeated in either 1 or all laboratories (in which case the sample numbers will be changed).
10. Once all tops have been sampled, the twisties for each laboratory (80 in total) will be boxed up and couriered to the laboratories, together with instructions.

Preparatory in each laboratory:

1. All measurements and sample preparation to be carried out in an atmosphere complying with IWTO-52.
2. Upon receipt of OFDA4000, check that:
   - The needle bed is clean and contains no bent needles
   - The beard guide is clean and free of any neps
   - The optical path is clear of dust and fibres
   - The gripper jaws are clean and in good condition.
3. At the start of each measurement session, ensure that the instrument is set up according to the operating manual. At least one sample of known characteristics shall be measured. If the mean fibre diameter or mean fibre length varies from the known values by more than the tolerances shown in the table below, (or from the mean values determined by at least 10 measurements carried out immediately after the instrument has been calibrated), the instrument shall be checked, adjusted, or re-calibrated until satisfactory performance is obtained.

Top MFD or MFL	Tolerance (µm or mm)
Up to 15.0 µm	0.3
15.1 to 20.0 µm	0.6
20.1 to 25.0 µm	0.8
25.1 to 30.0 µm	1.0
30.1 to 35.0 µm	1.2
35.1 µm or greater	1.4
Less than 60 mm	1.5 mm
60.1 mm or greater	2.0 mm

4. Calibrate the OFDA4000 in 100 mode for diameter using series 15 IH tops and the procedure in IWTO-47 Appendix B. Follow the same procedure for the instrument in length mode, with the exception that the top samples are prepared as follows:
   - Approximately 1 metre is broken off and offered to the instrument.
   - The pre-draw length is set to 130 mm for calibration, and 20 mm for validation (assuming that the same specimens as were used for calibration are to be used)
   - The tops are inserted in order from finest to broadest
   - At the end of each top measurement, the remaining combed portion of the top shall be automatically extracted and kept for later validation
   - The instrument is set to measure a minimum of 10,000 fibres. In most cases this will entail the measurement of approximately 100,000 individual diameter measurements.
   - After all 8 IH tops have been measured, the procedures in IWTO-47, Appendix B, clause B4 are to be followed

5. Validate the OFDA4000 diameter calibrations using series 15 IH tops and the procedure in IWTO-47 Appendix C as modified by 4 above. Validate the length measurement using a calibrated steel rule.
6. On the Fibroliner and Almeter, prior to each measurement session, check that:
   - The mylar transport sheets are clear of fibres and dust
   - The needle beds are clean and contain, at worst, a few damaged needles
   - The gripper jaws are clean and in good condition.
7. Validate the Almeter with trapeziums and at least one series of Interwoollabs length trial samples for which the trial grand mean values are available. Use the appropriate Interwoollabs original trial limits for assessment. They must have been stored in the twisted state and in an atmosphere complying with IWTO-52.
8. Validate OFDA100 and/or Laserscan with series 15 IH tops using 'tops' calibration and guillotined snippets. Curvature measurement to be enabled for all measurements. Where available, medullation and along-fibre measurements are to be enabled on the OFDA100 (for diagnostic purposes).
9. If any OFDA4000 or OFDA100 validation does not comply with IWTO-47, contact BSC Electronics and do not continue with the trial until issues are resolved and validation does comply. If Almeter validation does not comply with manufacturers specification, and Interwoollabs criteria, do not continue until instrument has been serviced and does comply. If Laserscan validation does not comply with IWTO-12, trial must not proceed until the instrument has been recalibrated and/or serviced and validation can be shown to comply.
10. All validation records (ie. raw data files) to be supplied to trial analyst.

Sample measurements

1. Each participant will receive 80 standard twisted hanks for OFDA4000 and Almeter measurement. Each hank is slightly longer than normal (twisted length approx 0.8m rather than 0.6m)
2. All hanks must be exposed in an atmosphere complying with IWTO-52 for at least 24 hours prior to testing.
3. To avoid any transcription errors, data will be stored in MES files, standard Laserscan and Almeter files, copies of which are to be sent to the analyst by email at the end of the measurement work. However, printers should be enabled on all instruments as backup.
4. Specimens for OFDA100 and/or Laserscan diameter and curvature measurement are to be prepared from 15cm lengths of sliver cut (cut not pulled since this may bias the diameter) from the broken ends of every doubled hank. In practice, remove the rubber band from the end of the doubled hank. If the length measurements are to be carried out immediately, it is not necessary to replace the band. However, if the hanks will not be immediately measured for length, replace the rubber band 150mm further along the doubled hank - do not untwist the hank. Cut off 150 mm from both of the released lengths and label with the sample number.
5. Do not cut snippets from predrawn end of top since this will bias the diameter.
6. Prior to diameter measurement, the 150 mm section is to be placed in an aluminium tray or similar receptacle together with a sample label, and then placed in an oven at 70 ºC for a period of 30 minutes. These pre-dried samples are then to be immediately transferred to the standard atmosphere, and remain exposed to the conditioned atmosphere for a period of at least 24 hours. Two guillotine cuts are then to be taken from this specimen for OFDA100 and/or Laserscan, and two further cuts for OFDA4000 in 100 mode measurements. Each of the 4 individual snippet specimens is to be measured once in accordance with IWTO-47 and/or IWTO-12, as appropriate. Label and keep the remaining sliver specimen.
7. Length measurement - hanks are first to be measured by Almeter. The sample is to be untwisted immediately before the start of testing. The sliver, held with one end in each hand, is then straightened by putting it under slight tension and subjecting it to gentle shaking. With the automatic motorised grip (Fibroliner) the sliver is introduced in a doubled condition and the draws are therefore taken simultaneously from both ends of the sliver. It is necessary to hand square the sample before the preparer begins its action. It must first be hand broken (pulled) before embedding, at a distance from the cut end equivalent to the length of the longest fibres to ensure no cut fibres are present to bias the sample. Then embed the sliver/roving in the preparer pins with 20 - 30 mm overhanging the

front. Carefully, taking small amounts of fibres, hand square the sample back to 10 mm. Make sure this leading edge is as square as possible. Start the preparer and take about 20 draws, these draws are then discarded, subsequent draws are used for the test. Prepare and measure 2 specimens. Measure each specimen twice. The 2 measurements are averaged to provide a single test result on each of the 2 specimens.

8. The two prepared beards are to be removed carefully from the Almeter and preserved on a piece of card. 2mm snippets are to be cut from the aligned ends of the beard in accordance with IWTO-DTM-60 and measured for mean fibre diameter of the fibre ends in accordance with that standard.
9. Carefully remove the folded sliver from the Fibroliner, and introduce the drawn end to the OFDA4000. Since the sliver has already been pre-drawn, it is not necessary to take a complete pre-draw in this instrument. Once the sliver has been fed through the needle bed, draw off 20mm of fibre to clean up the end. Carry out sufficient draws (usually 6 to 7) to allow the preset limit of 4000 counts to be achieved. Repeat this measurement. Each measurement comprises a single test result for the purposes of this trial.
10. Once the measurement is completed, instruct the instrument to clear the needle bed, remove any remaining sample, and then ensure that the conditions in 'preparatory' clause 4 are satisfied before commencing a new sample

Analyses

1. Receive from each laboratory all instrument validation data, all MES files from OFDA4000, all MES or Lsn files for fibre ends and MFD determinations, and all Almeter files.
2. Confirm satisfactory instrument validations. Set aside curvature measurements for 'calibration' of trial curvature results.
3. Confirm all necessary data files
4. Extract all primary parameters on a single measurement basis
5. Check all datasets for individual outliers
6. FEFI to be calculated for each sub-sample in each laboratory, using the mean of fibre ends fineness determined in 7 above and the mean fibre diameter from 5 above.
7. Combine/average all specimen and subsample data for each sample in each laboratory for parameter means (H, B, CvH, CvB, L1, and K & L values at 5 %/mm intervals, MFD, SD, CF, mean curvature, FEFI; and from OFDA4000 in 100 mode: MFD, SD, CF and mean curvature)
8. Compare parameter means from each instrument pair in each laboratory in accordance with IWTO-0. Examine for outliers amongst laboratories.
9. Calculate grand means across all laboratories for supplied samples and compare parameter grand means for instrument pairs as per IWTO-0
10. Carry out analyses of variance for each sample and each instrument type, with the effects being: instruments or laboratories (as appropriate), and residual for each parameter and each instrument/laboratory. Calculate precision values as 95% confidence limits for all parameters and all instruments and compare instrument type pairs using IWTO-0.
11. If possible, examine effects of curvature calibration on standardizing curvature measurements.

APPENDIX 2

TABULATED STATISTICS FOR AVERAGE DIFFERENCES AND REGRESSION MODELS

	Paired Differences						
	Min	Max	Avg	SD	t val	p val	signif
MFD4000	-0.27	0.19	-0.10	0.08	-7.319	0.000	***
SD4000	-0.26	0.07	-0.08	0.09	-5.828	0.000	***
CF4000	-0.98	1.74	0.21	0.50	2.597	0.013	*
FEFI4000	-0.46	0.19	-0.13	0.16	-5.119	0.000	***
curv4000	-18.37	-6.29	-11.15	3.32	-21.270	0.000	***
D4_70	-0.09	0.25	0.05	0.07	4.842	0.000	***
SD4_70	-0.04	0.50	0.07	0.10	4.616	0.000	***
CF4_70	-1.37	0.03	-0.34	0.36	-6.029	0.000	***
curv 70	-3.56	3.27	0.46	1.19	2.441	0.019	*
H	-1.47	2.21	0.15	0.95	0.994	0.326	NS
CVH	-2.25	1.67	-0.16	1.00	-0.981	0.332	NS
B	-1.65	1.93	0.14	0.89	0.962	0.342	NS
CVB	-1.09	1.11	-0.07	0.56	-0.824	0.415	NS
K10H	-1.75	0.04	-0.11	0.28	-2.424	0.020	*
K15H	-1.76	1.26	0.27	0.47	3.607	0.001	***
K20H	-1.96	2.65	0.59	0.83	4.569	0.000	***
K25H	-2.31	2.73	0.37	0.94	2.527	0.016	*
K30H	-2.69	1.89	-0.14	0.95	-0.964	0.341	NS
K35H	-2.98	1.30	-0.59	0.98	-3.827	0.000	***
K40H	-2.93	0.95	-0.93	1.00	-6.010	0.000	***
K45H	-3.06	0.71	-1.12	1.01	-7.102	0.000	***
K50H	-2.99	0.90	-1.11	1.07	-6.640	0.000	***
L95H	-3.41	3.22	-0.57	1.28	-2.870	0.007	**
L90H	-2.03	3.13	0.22	1.18	1.192	0.240	NS
L75H	-0.91	5.18	1.29	1.33	6.216	0.000	***
L50H	-1.88	3.10	-0.01	1.05	-0.067	0.947	NS
L25H	-2.09	2.00	-0.13	1.03	-0.834	0.409	NS
L10H	-2.13	3.23	0.46	1.18	2.494	0.017	*
L5H	-2.81	3.60	0.38	1.35	1.795	0.080	NS
L2.5H	-3.55	4.56	0.26	1.79	0.948	0.349	NS
L1H	-5.53	9.23	0.39	2.97	0.849	0.401	NS
K10B	-0.16	0.00	-0.01	0.03	-2.646	0.012	*
K15B	-0.18	0.25	0.05	0.08	3.785	0.001	***
K20B	-0.24	0.70	0.12	0.20	3.750	0.001	***
K25B	-0.63	0.72	0.02	0.26	0.429	0.670	NS
K30B	-1.32	0.34	-0.21	0.31	-4.301	0.000	***
K35B	-1.78	0.19	-0.44	0.39	-7.269	0.000	***
K40B	-1.83	0.07	-0.63	0.43	-9.364	0.000	***
K45B	-1.71	0.10	-0.75	0.47	-10.147	0.000	***
K50B	-1.67	0.33	-0.73	0.52	-9.051	0.000	***
L95B	-0.86	2.84	0.94	0.92	6.551	0.000	***
L90B	-0.47	2.92	1.18	0.87	8.657	0.000	***
L75B	-1.39	2.13	0.24	0.81	1.898	0.065	NS
L50B	-2.46	1.57	-0.50	1.00	-3.169	0.003	**
L25B	-2.20	3.37	0.42	1.23	2.174	0.036	*
L10B	-2.78	3.83	0.52	1.38	2.420	0.020	*
L5B	-3.69	5.71	0.40	1.96	1.306	0.199	NS
L2.5B	-5.05	9.78	0.72	3.00	1.544	0.131	NS
L1B	-5.97	10.21	2.45	4.58	3.428	0.001	**

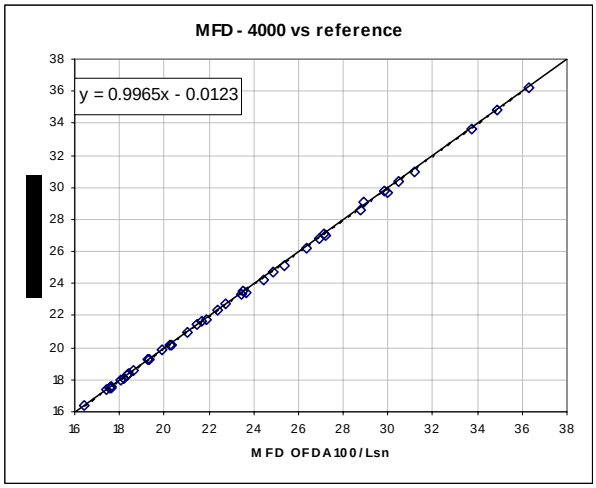
	Reference		OFDA4000		GM stats						
	Mean	SD	Mean	SD	b	a	Ryx	SE b	t val	p val	signif
MFD4000	23.64	5.33	23.55	5.31	0.9965	-0.01	0.9999	0.0024	1.442	0.158	NS
SD4000	5.36	1.73	5.28	1.65	0.9548	0.16	0.9996	0.0042	10.833	0.000	***
CF4000	83.25	20.92	83.45	20.89	0.9985	0.33	0.9997	0.0039	0.382	0.705	NS
FEFI4000	-0.17	0.36	-0.29	0.30	0.8190	-0.16	0.9034	0.0570	3.178	0.003	**
curv4000	60.09	14.20	48.93	11.21	0.7893	1.51	0.9936	0.0145	14.572	0.000	***
D4_70	23.64	5.33	23.69	5.36	1.0053	-0.08	0.9999	0.0018	-2.920	0.006	**
SD4_70	5.36	1.73	5.43	1.78	1.0343	-0.11	0.9990	0.0073	-4.670	0.000	***
CF4_70	83.25	20.92	82.91	21.14	1.0106	-1.22	0.9999	0.0022	-4.871	0.000	***
curv 70	60.09	14.20	60.54	14.69	1.0344	-1.61	0.9972	0.0126	-2.730	0.010	**
H	74.85	12.38	74.70	12.05	1.0278	-1.93	0.9973	0.0122	-2.285	0.028	*
CVH	45.09	5.48	45.25	5.45	1.0065	-0.45	0.9832	0.0298	-0.218	0.828	NS
B	90.36	16.07	90.23	15.75	1.0202	-1.69	0.9986	0.0087	-2.335	0.025	*
CVB	36.16	3.94	36.23	3.69	1.0672	-2.51	0.9912	0.0230	-2.925	0.006	**
K10H	0.02	0.05	0.12	0.30	0.1624	0.00	0.3517	0.0247	33.973	0.000	***
K15H	1.13	0.84	0.86	0.90	0.9390	0.32	0.8494	0.0804	0.758	0.453	NS
K20H	3.32	1.95	2.73	2.02	0.9631	0.70	0.9104	0.0646	0.571	0.571	NS
K25H	6.45	3.23	6.08	3.36	0.9607	0.61	0.9587	0.0444	0.885	0.382	NS
K30H	10.33	4.65	10.47	4.83	0.9620	0.25	0.9800	0.0311	1.224	0.228	NS
K35H	14.65	6.16	15.24	6.30	0.9779	-0.25	0.9874	0.0251	0.882	0.383	NS
K40H	19.23	7.64	20.16	7.68	0.9942	-0.82	0.9914	0.0212	0.274	0.786	NS
K45H	23.91	9.03	25.04	8.95	1.0094	-1.36	0.9935	0.0186	-0.507	0.615	NS
K50H	28.66	10.31	29.77	10.03	1.0275	-1.93	0.9946	0.0172	-1.598	0.118	NS
L95H	23.86	4.22	24.44	4.12	1.0223	-1.12	0.9519	0.0508	-0.439	0.663	NS
L90H	30.90	5.34	30.68	4.91	1.0867	-2.44	0.9762	0.0382	-2.269	0.029	*
L75H	48.24	8.31	46.95	8.05	1.0312	-0.17	0.9870	0.0269	-1.157	0.255	NS
L50H	72.95	12.95	72.96	12.97	0.9990	0.06	0.9966	0.0133	0.074	0.942	NS
L25H	99.05	17.96	99.18	17.73	1.0129	-1.42	0.9984	0.0094	-1.382	0.175	NS
L10H	120.91	21.52	120.45	21.06	1.0220	-2.19	0.9987	0.0085	-2.576	0.014	*
L5H	132.87	23.51	132.49	22.91	1.0262	-3.10	0.9986	0.0088	-2.978	0.005	**
L2.5H	142.89	25.69	142.63	24.55	1.0465	-6.36	0.9984	0.0095	-4.896	0.000	***
L1H	155.00	29.18	154.60	26.75	1.0908	-13.64	0.9980	0.0112	-8.116	0.000	***
K10B	0.00	0.01	0.01	0.03	0.1657	0.00	0.5726	0.0220	37.851	0.000	***
K15B	0.21	0.20	0.16	0.19	1.0625	0.04	0.9144	0.0698	-0.896	0.376	NS
K20B	0.77	0.60	0.65	0.58	1.0383	0.09	0.9421	0.0565	-0.678	0.502	NS
K25B	1.79	1.24	1.78	1.28	0.9664	0.08	0.9785	0.0324	1.038	0.306	NS
K30B	3.34	2.15	3.56	2.29	0.9427	-0.01	0.9915	0.0199	2.881	0.006	**
K35B	5.39	3.33	5.83	3.52	0.9462	-0.12	0.9950	0.0153	3.518	0.001	**
K40B	7.89	4.71	8.52	4.89	0.9624	-0.31	0.9966	0.0128	2.935	0.006	**
K45B	10.78	6.22	11.53	6.36	0.9778	-0.49	0.9974	0.0115	1.934	0.061	NS
K50B	14.04	7.80	14.77	7.81	0.9987	-0.71	0.9977	0.0109	0.116	0.908	NS
L95B	36.25	5.88	35.30	5.37	1.0951	-2.41	0.9903	0.0247	-3.845	0.000	***
L90B	46.67	8.03	45.49	7.82	1.0263	-0.02	0.9942	0.0180	-1.462	0.152	NS
L75B	66.84	12.24	66.60	12.42	0.9851	1.23	0.9979	0.0104	1.438	0.159	NS
L50B	90.35	16.96	90.85	16.88	1.0049	-0.94	0.9982	0.0097	-0.503	0.618	NS
L25B	113.64	20.81	113.23	20.32	1.0243	-2.34	0.9985	0.0092	-2.645	0.012	*
L10B	132.70	23.86	132.18	23.17	1.0297	-3.40	0.9987	0.0086	-3.439	0.001	**
L5B	143.68	26.34	143.28	24.96	1.0552	-7.51	0.9984	0.0096	-5.776	0.000	***
L2.5B	153.60	29.29	152.88	26.82	1.0920	-13.35	0.9980	0.0112	-8.185	0.000	***
L1B	166.47	32.62	164.02	28.84	1.1312	-19.07	0.9962	0.0160	-8.197	0.000	***

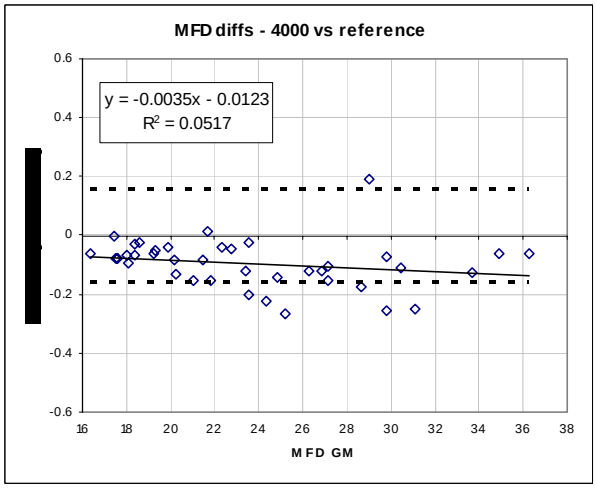
	DVA slope	Ryx	SE b	t val	p val	signif
MFD4000	-0.0035	-0.2274	0.0024	-1.439	0.158	NS
SD4000	-0.0463	-0.8642	0.0044	-10.588	0.000	***
CF4000	-0.0015	-0.0618	0.0039	-0.382	0.705	NS
FEFI4000	-0.2090	-0.4245	0.0723	-2.890	0.006	**
curv4000	-0.2363	-0.9040	0.0181	-13.037	0.000	***
D4_70	0.0053	0.4290	0.0018	2.928	0.006	**
SD4_70	0.0337	0.6104	0.0071	4.750	0.000	***
CF4_70	0.0105	0.6220	0.0021	4.897	0.000	***
curv 70	0.0339	0.4108	0.0122	2.777	0.008	**
H	0.0274	0.3518	0.0118	2.317	0.026	*
CVH	0.0065	0.0355	0.0299	0.219	0.828	NS
B	0.0200	0.3574	0.0085	2.359	0.023	*
CVB	0.0653	0.4404	0.0216	3.024	0.004	**
K10H	-1.7073	-0.9546	0.0865	-19.744	0.000	***
K15H	-0.0680	-0.1184	0.0925	-0.735	0.466	NS
K20H	-0.0394	-0.0906	0.0702	-0.561	0.578	NS
K25H	-0.0409	-0.1394	0.0471	-0.868	0.391	NS
K30H	-0.0392	-0.1912	0.0326	-1.201	0.237	NS
K35H	-0.0225	-0.1401	0.0258	-0.872	0.388	NS
K40H	-0.0058	-0.0442	0.0214	-0.273	0.786	NS
K45H	0.0094	0.0824	0.0185	0.510	0.613	NS
K50H	0.0272	0.2541	0.0168	1.620	0.113	NS
L95H	0.0226	0.0718	0.0509	0.444	0.659	NS
L90H	0.0841	0.3585	0.0355	2.367	0.023	*
L75H	0.0309	0.1872	0.0263	1.175	0.247	NS
L50H	-0.0010	-0.0119	0.0133	-0.073	0.942	NS
L25H	0.0129	0.2201	0.0092	1.391	0.172	NS
L10H	0.0218	0.3892	0.0084	2.605	0.013	*
L5H	0.0259	0.4396	0.0086	3.017	0.004	**
L2.5H	0.0454	0.6307	0.0091	5.010	0.000	***
L1H	0.0869	0.8090	0.0102	8.484	0.000	***
K10B	-1.5979	-0.9631	0.0724	-22.062	0.000	***
K15B	0.0634	0.1483	0.0686	0.924	0.361	NS
K20B	0.0387	0.1114	0.0560	0.691	0.493	NS
K25B	-0.0345	-0.1633	0.0338	-1.020	0.313	NS
K30B	-0.0592	-0.4133	0.0212	-2.798	0.008	**
K35B	-0.0554	-0.4855	0.0162	-3.424	0.001	**
K40B	-0.0384	-0.4233	0.0133	-2.880	0.006	**
K45B	-0.0225	-0.2963	0.0118	-1.913	0.063	NS
K50B	-0.0013	-0.0188	0.0109	-0.116	0.908	NS
L95B	0.0912	0.5470	0.0227	4.028	0.000	***
L90B	0.0260	0.2337	0.0176	1.482	0.146	NS
L75B	-0.0150	-0.2256	0.0105	-1.428	0.161	NS
L50B	0.0049	0.0815	0.0097	0.504	0.617	NS
L25B	0.0241	0.3983	0.0090	2.677	0.011	*
L10B	0.0293	0.4927	0.0084	3.490	0.001	**
L5B	0.0537	0.6936	0.0091	5.935	0.000	***
L2.5B	0.0881	0.8115	0.0103	8.561	0.000	***
L1B	0.1233	0.8170	0.0141	8.734	0.000	***

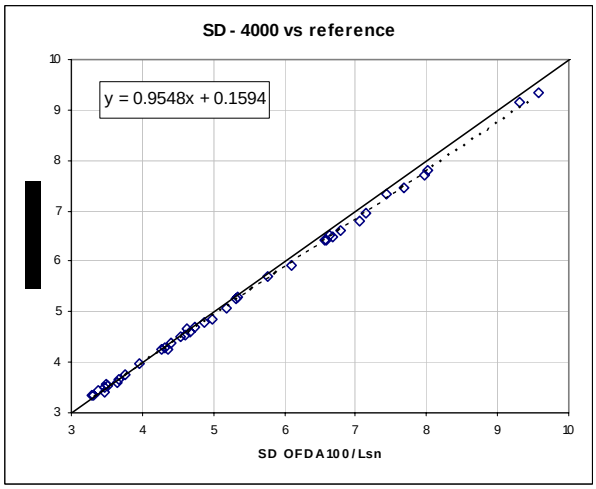
APPENDIX 3

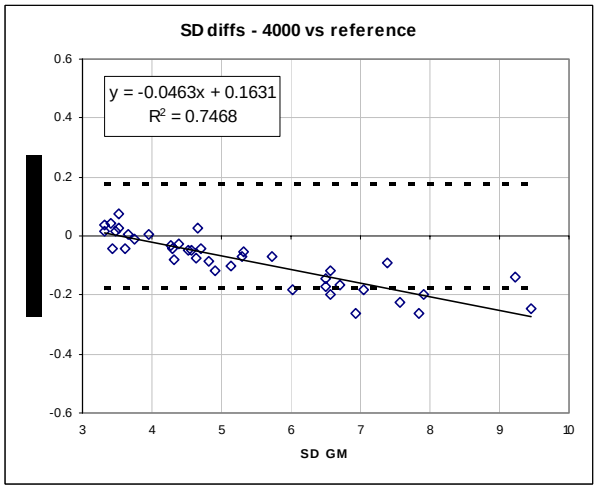
GM & DVA PLOTS FOR SELECTED RANGE OF PARAMETERS

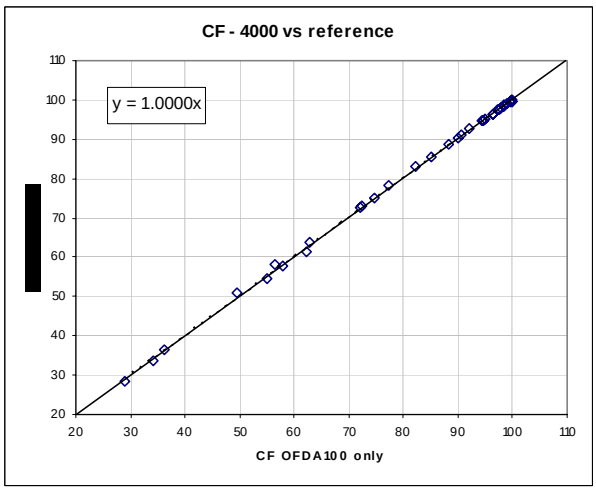
3.1 OFDA4000 DIAMETER-RELATED MEASUREMENTS

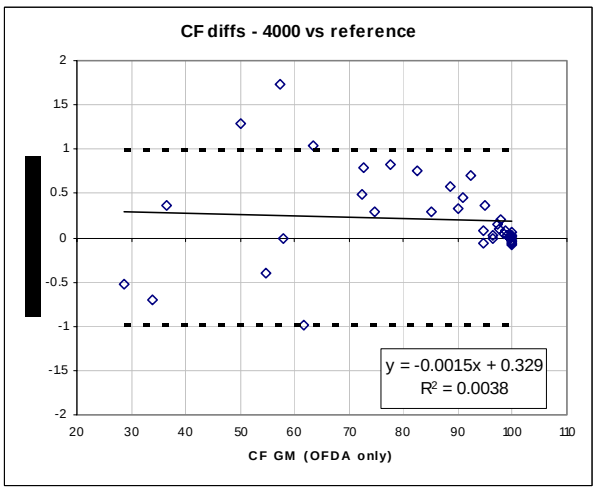


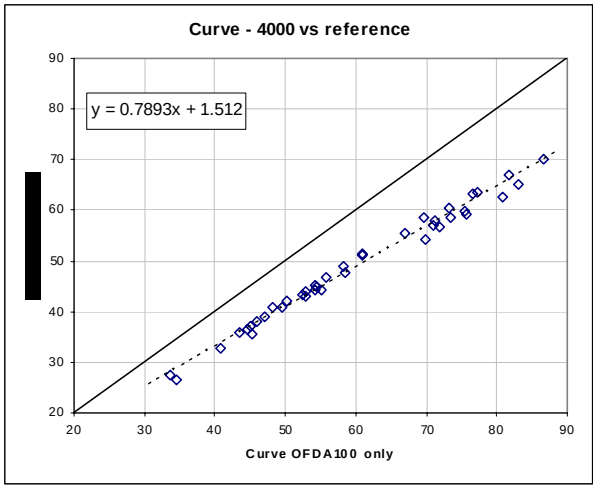


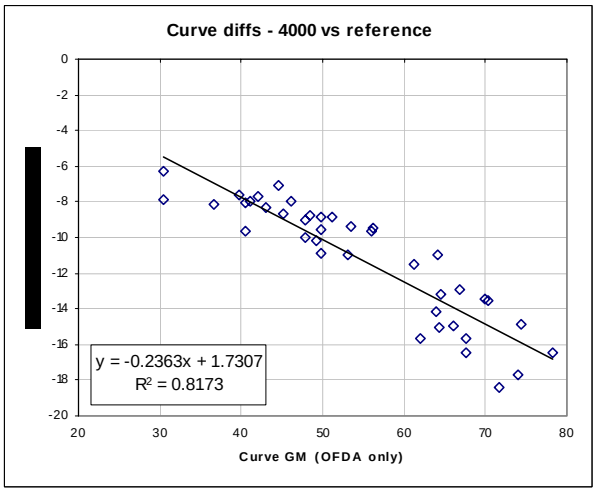


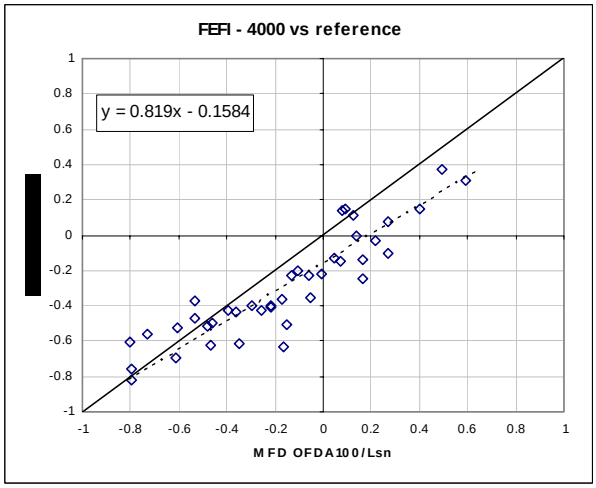


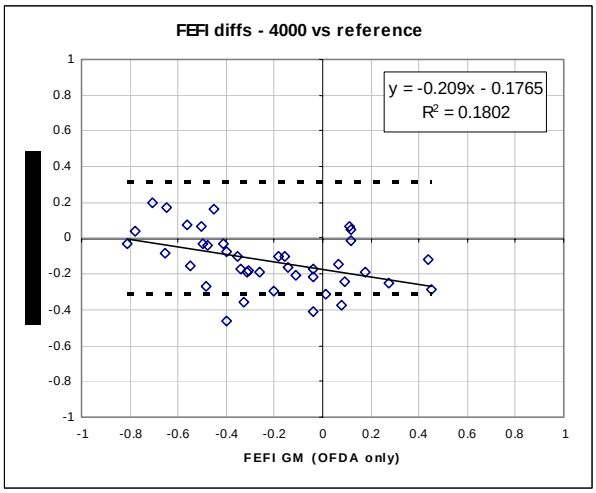




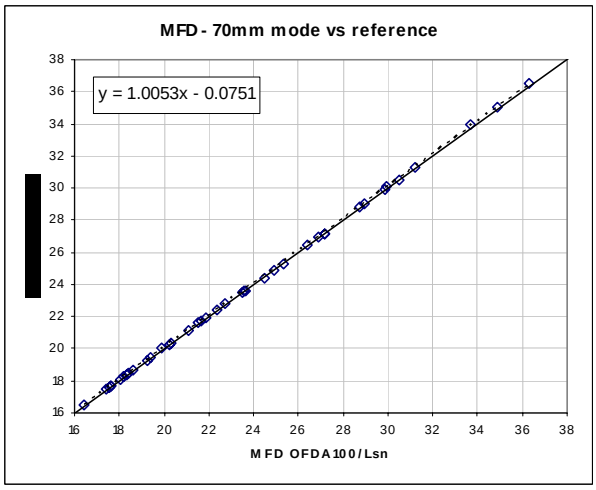


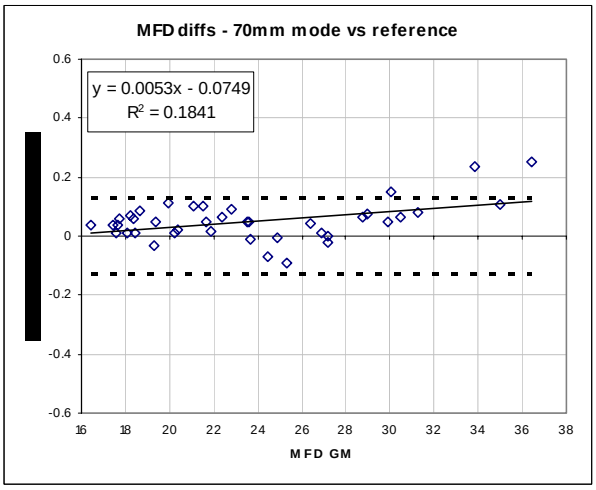


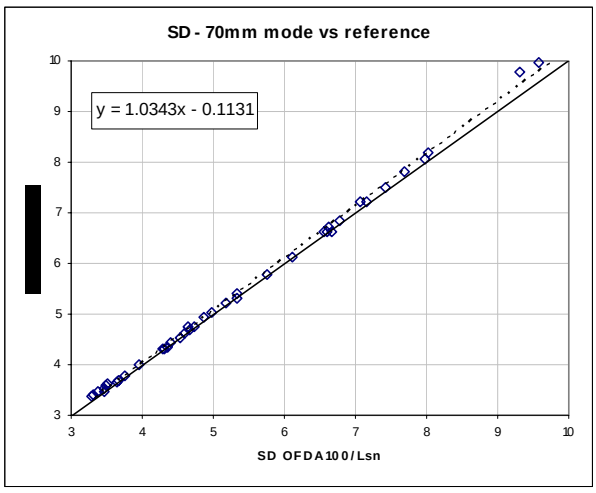


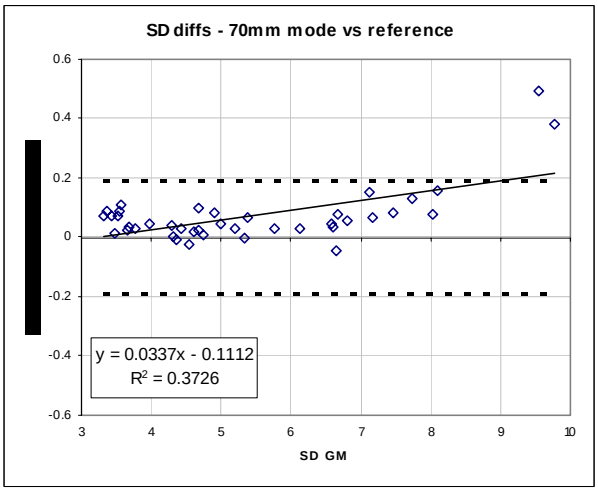


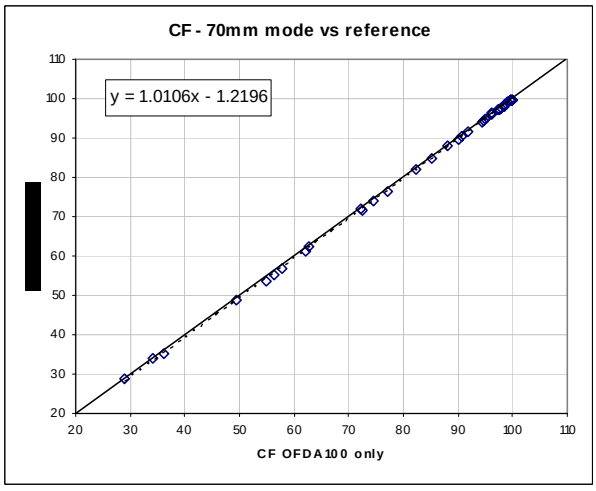
3.2 OFDA4000 IN 70mm MODE DIAMETER-RELATED MEASUREMENTS

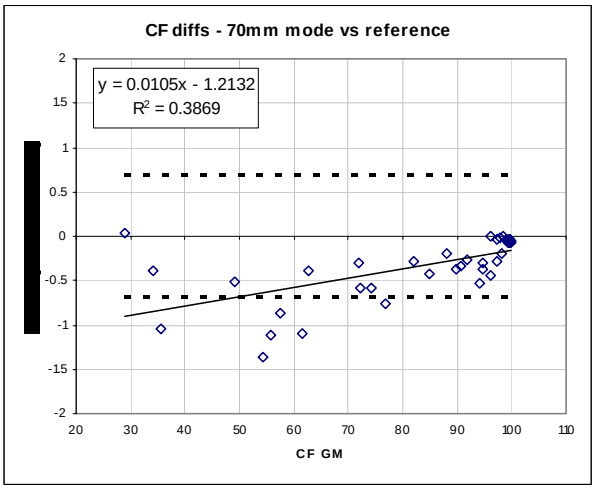


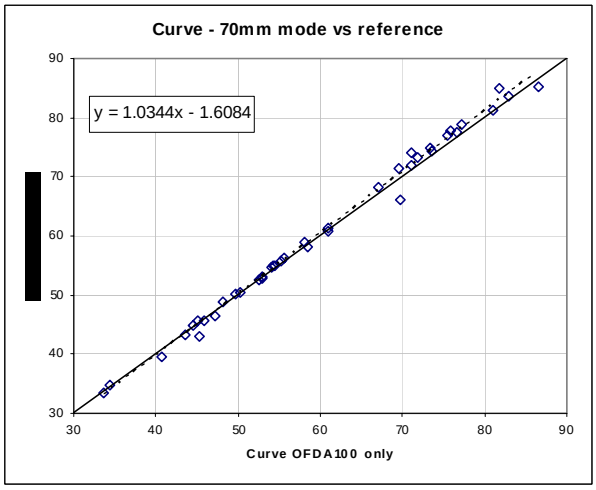


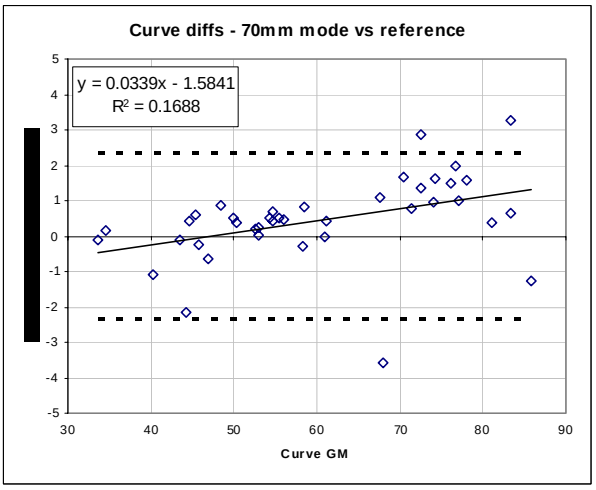

SD - 70mm mode vs reference
y = 1.0343x - 0.1131
SD OFDA100/Lsn


SD diffs - 70mm mode vs reference
y = 0.0337x - 0.1112
R2 = 0.3726
SD GM

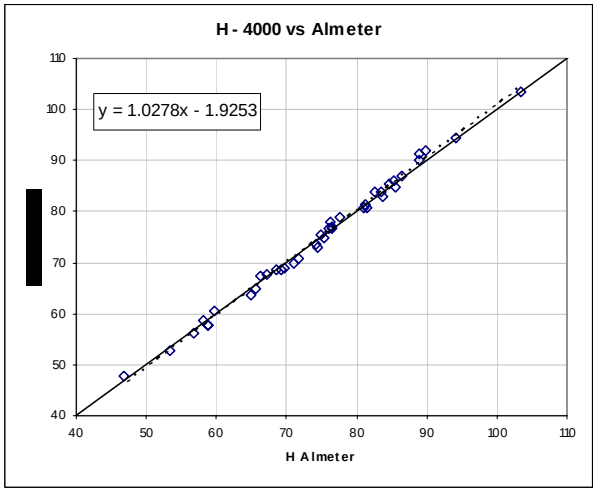

CF - 70mm mode vs reference
y = 1.0106x - 1.2196
CF OFDA100 only

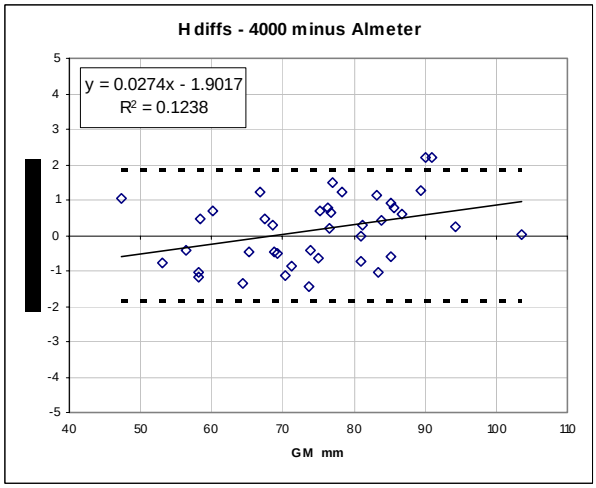

CF diffs - 70mm mode vs reference
y = 0.0105x - 1.2132
R2 = 0.3869
CF GM

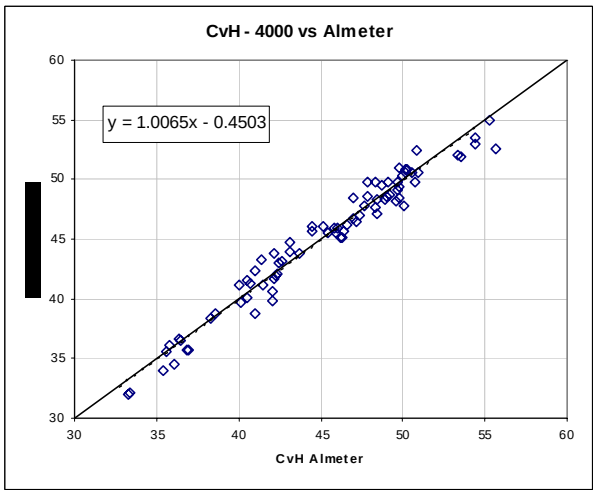

Curve - 70mm mode vs reference
y = 1.0344x - 1.6084
Curve OFDA100 only

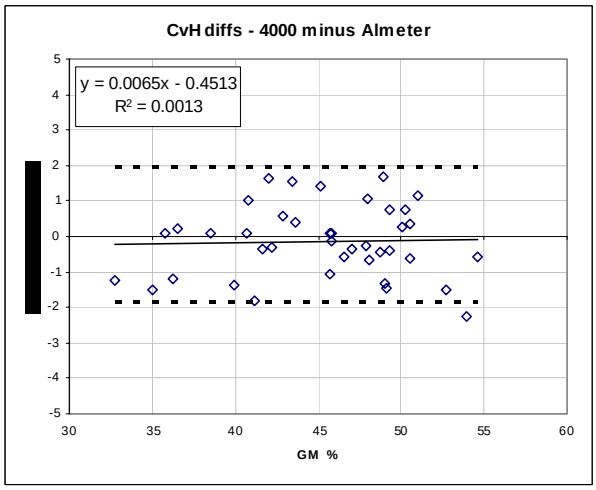

Curve diffs - 70mm mode vs reference
y = 0.0339x - 1.5841
R2 = 0.1688
Curve GM

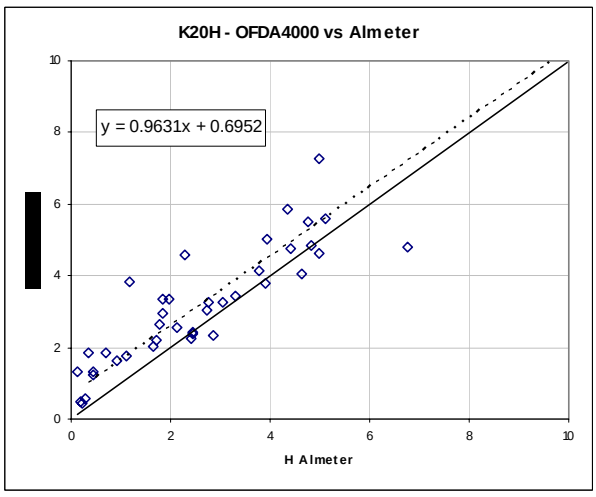
3.3 OFDA4000 HAUTEUR MEASUREMENTS

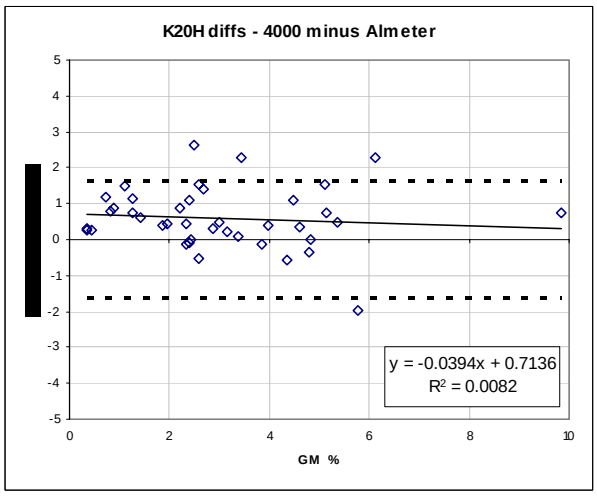


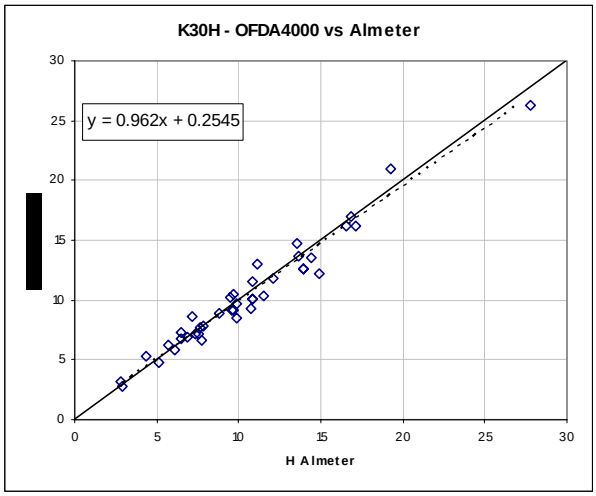


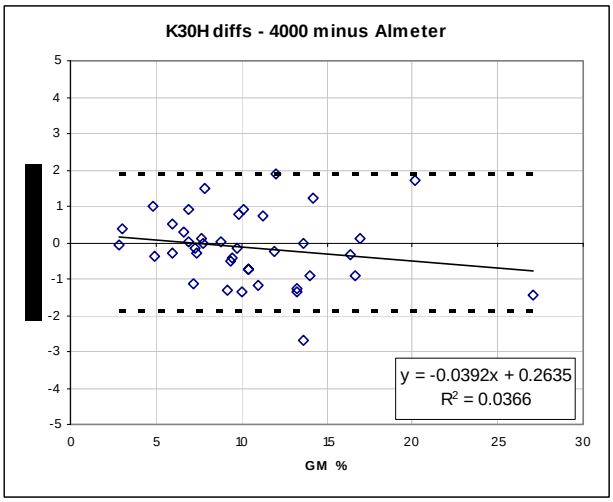


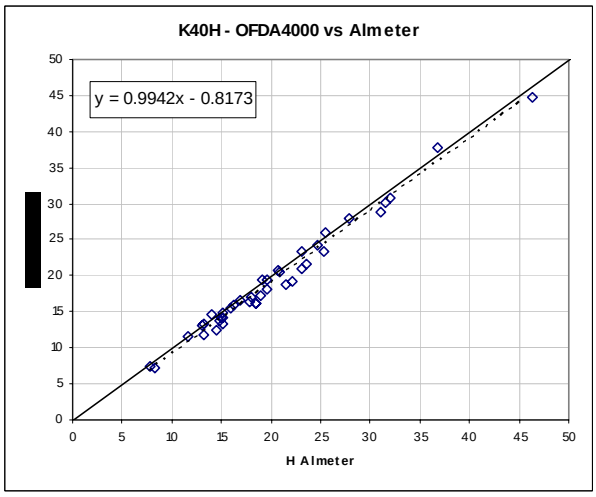


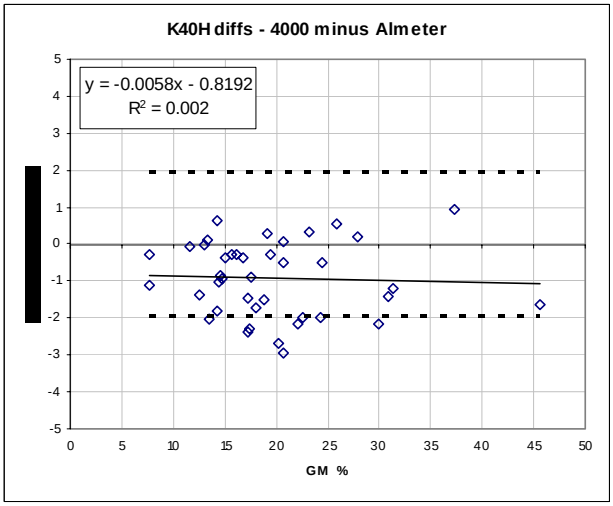


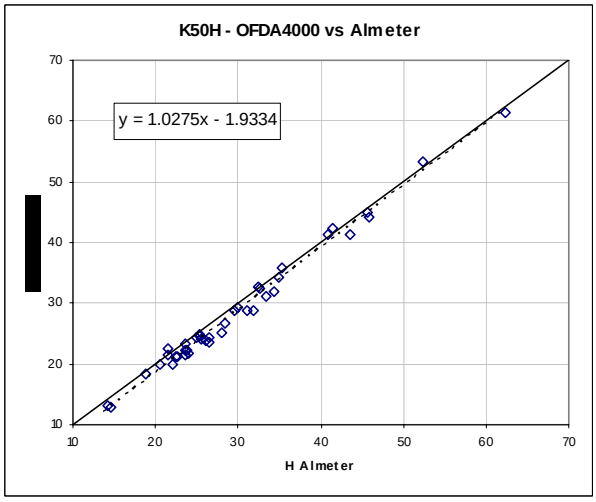


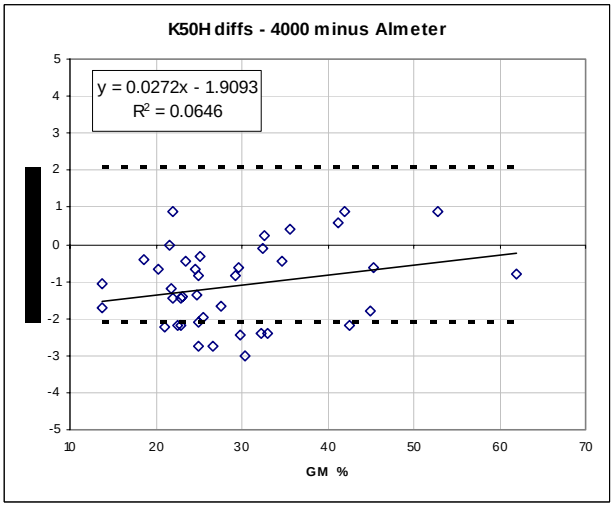

K30H - OFDA4000 vs Almeter
y = 0.962x + 0.2545
H Almeter

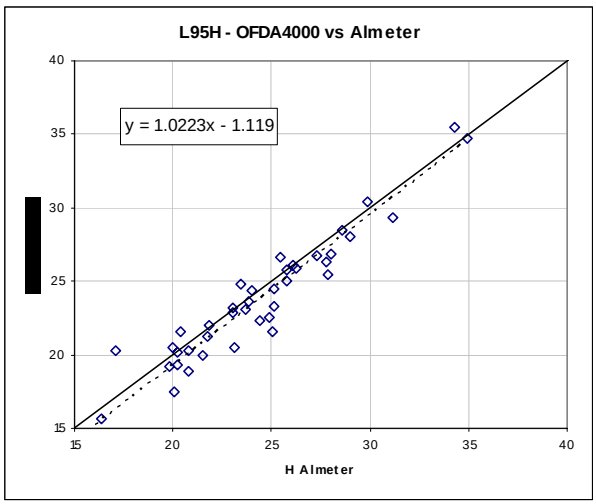

K30H diffs - 4000 minus Almeter
y = -0.0392x + 0.2635
R2 = 0.0366
GM %

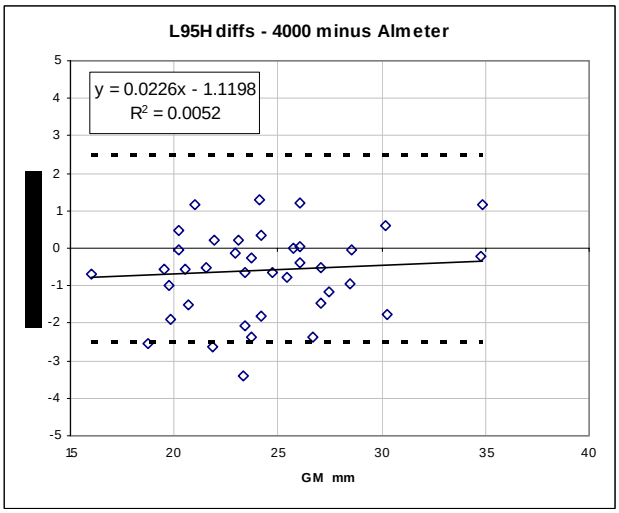

K40H - OFDA4000 vs Almeter
y = 0.9942x - 0.8173
H Almeter

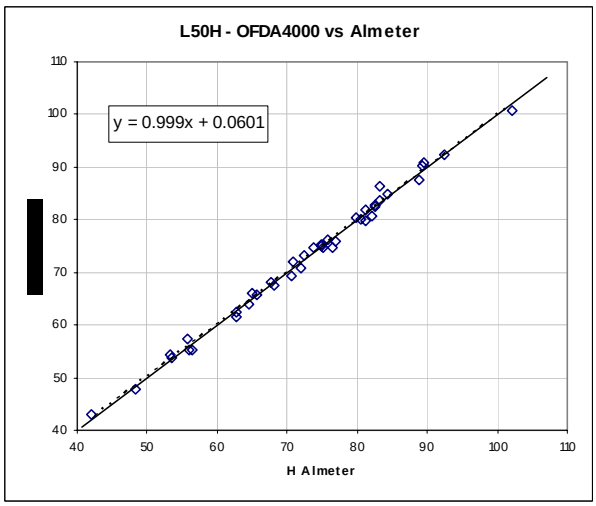

K40H diffs - 4000 minus Almeter
y = -0.0058x - 0.8192
R2 = 0.002
GM %

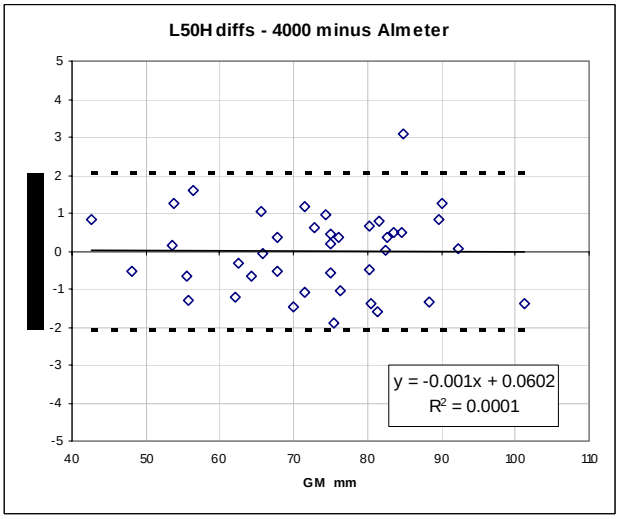

K50H - OFDA4000 vs Almeter
y = 1.0275x - 1.9334
H Almeter

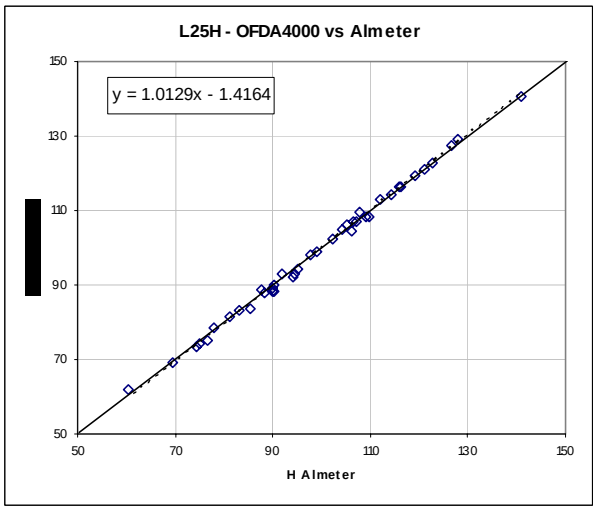

K50H diffs - 4000 minus Almeter
y = 0.0272x - 1.9093
R2 = 0.0646
GM %

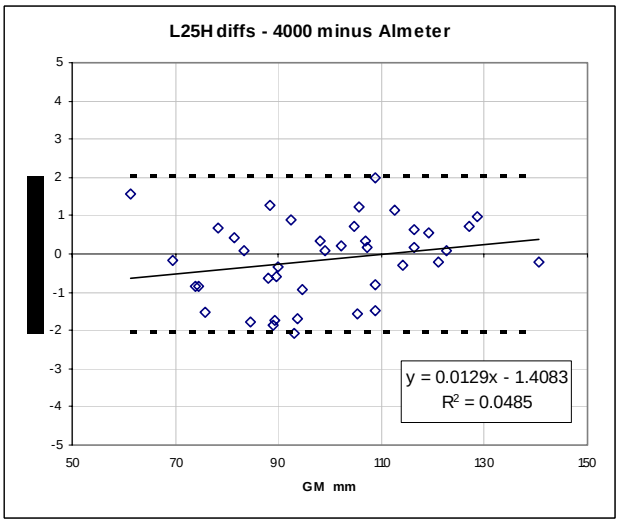

L95H - OFDA4000 vs Almeter
y = 1.0223x - 1.119
H Almeter

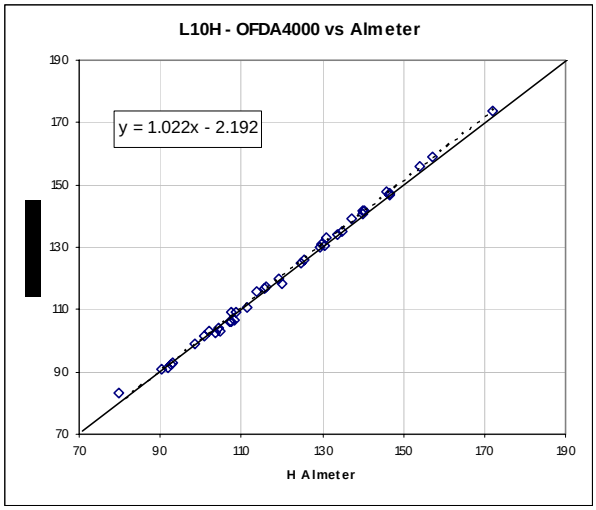

L95H diffs - 4000 minus Almeter
y = 0.0226x - 1.1198
R² = 0.0052
GM mm

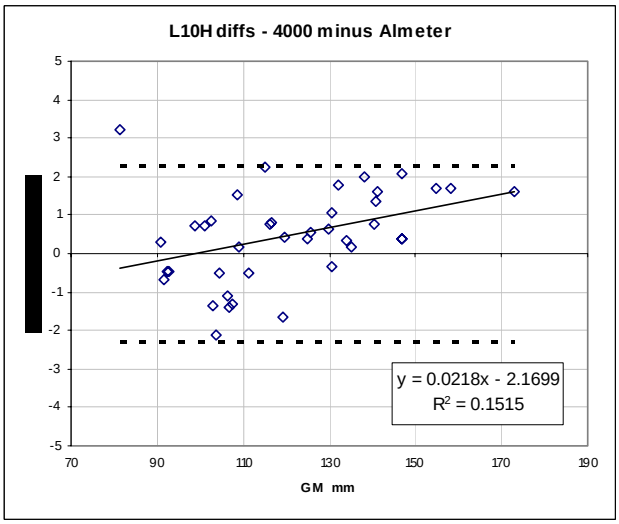

L50H - OFDA4000 vs Almeter
y = 0.999x + 0.0601
H Almeter

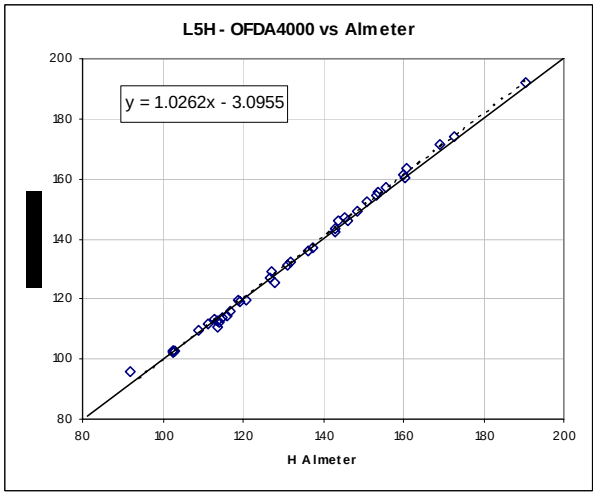

L50H diffs - 4000 minus Almeter
y = -0.001x + 0.0602
R² = 0.0001
GM mm

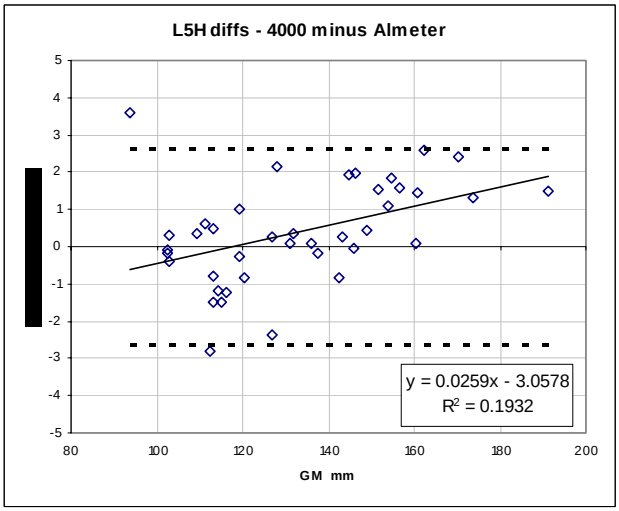

L25H - OFDA4000 vs Almeter
y = 1.0129x - 1.4164
H Almeter

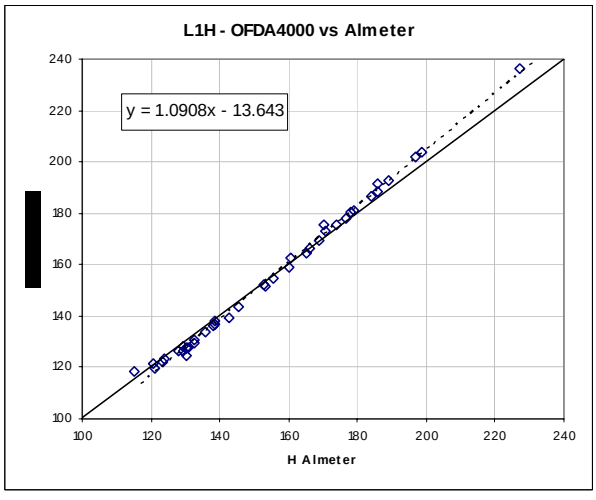

L25H diffs - 4000 minus Almeter
y = 0.0129x - 1.4083
R² = 0.0485
GM mm

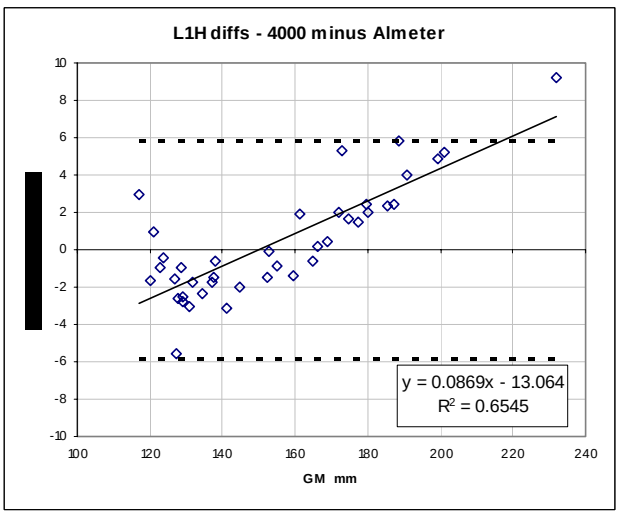

L10H - OFDA4000 vs Almeter
y = 1.022x - 2.192
H Almeter


L10H diffs - 4000 minus Almeter
y = 0.0218x - 2.1699
R² = 0.1515
GM mm

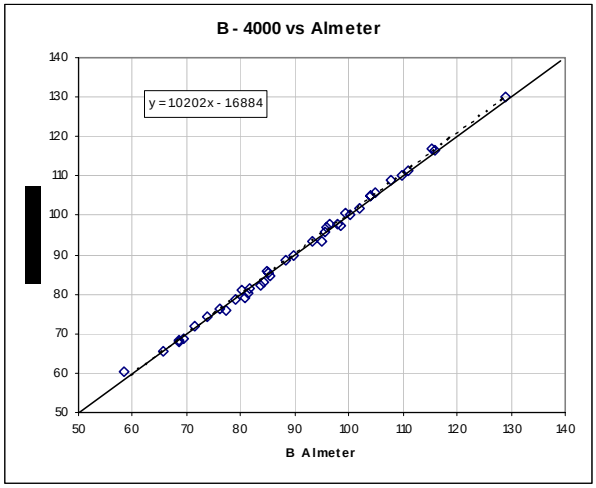

L5H - OFDA4000 vs Almeter
y = 1.0262x - 3.0955
H Almeter

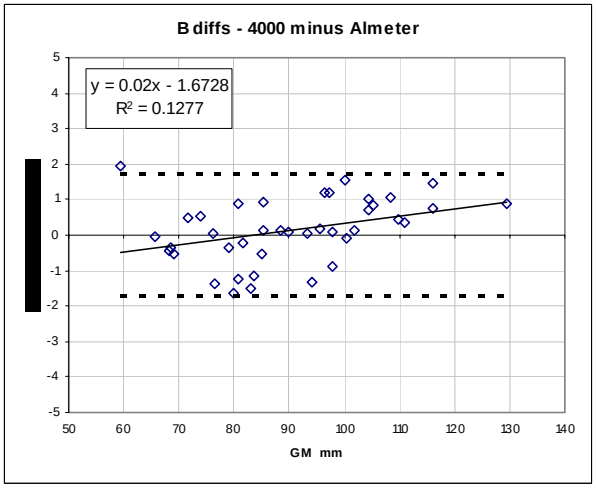

L5H diffs - 4000 minus Almeter
y = 0.0259x - 3.0578
R² = 0.1932
GM mm

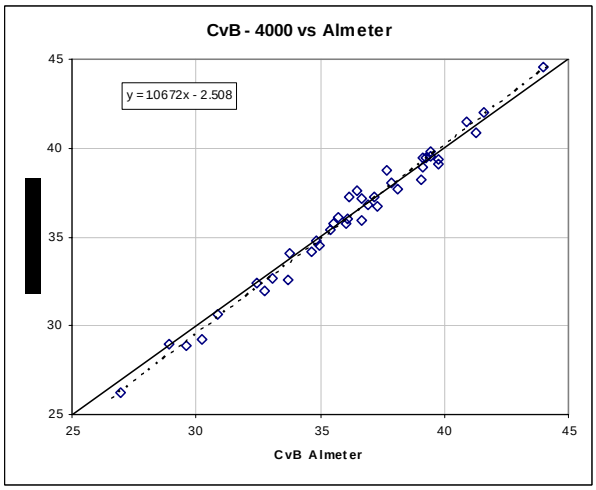

L1H - OFDA4000 vs Almeter
y = 1.0908x - 13.643
H Almeter

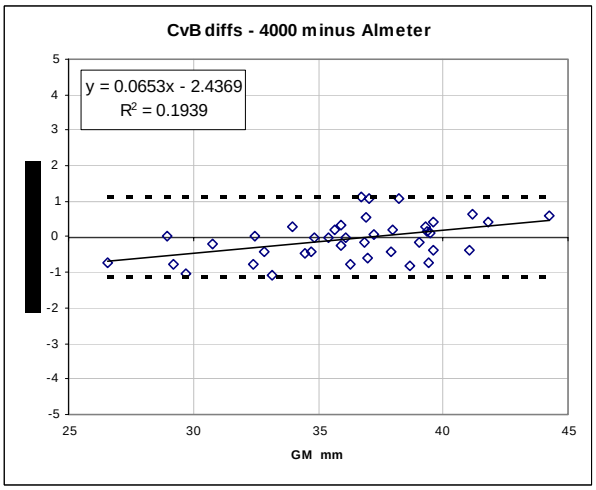

L1H diffs - 4000 minus Almeter
y = 0.0869x - 13.064
R² = 0.6545
GM mm

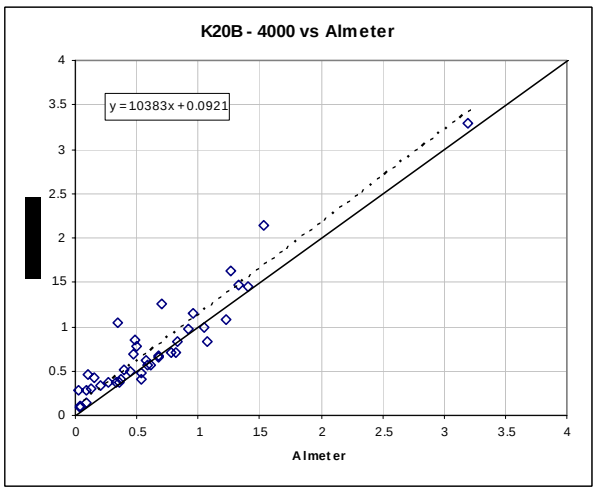
3.4 OFDA4000 BARBE MEASUREMENTS

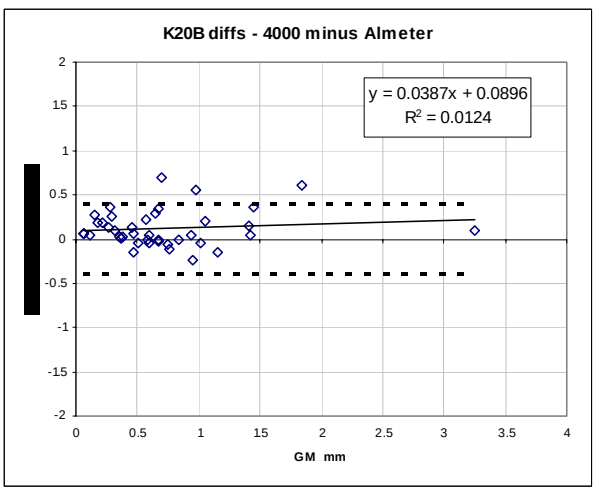


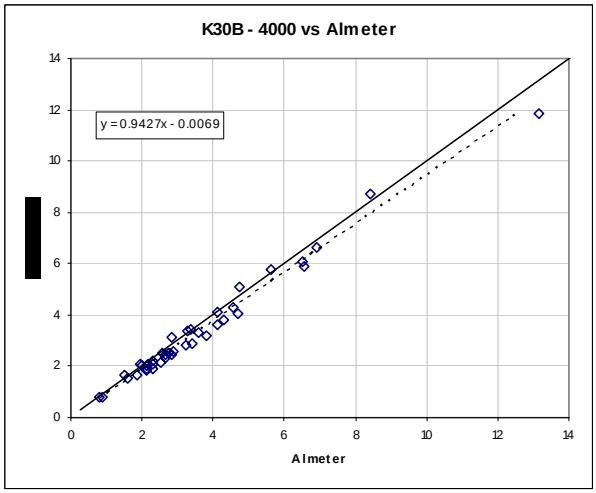


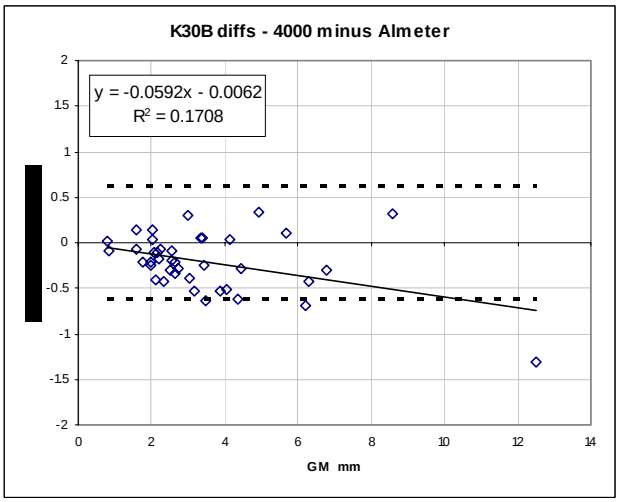


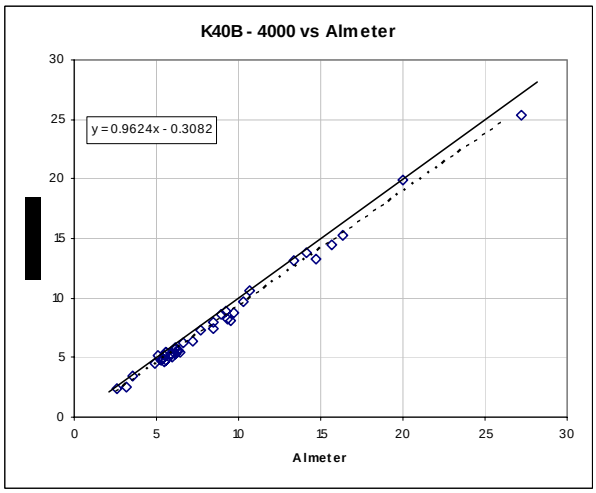


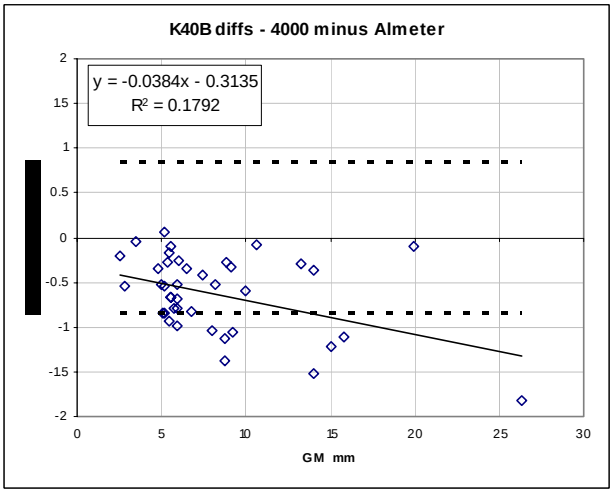


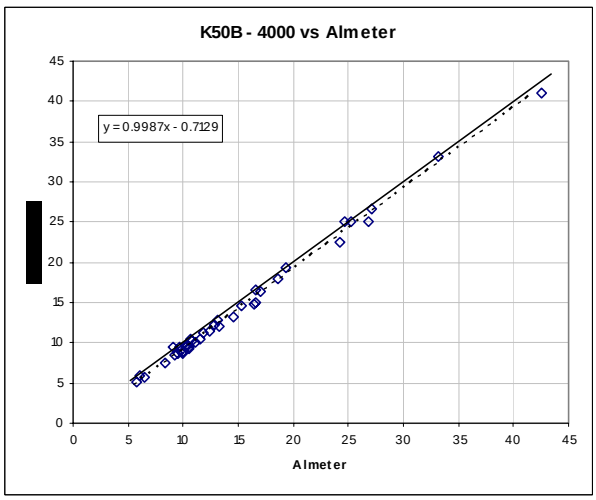


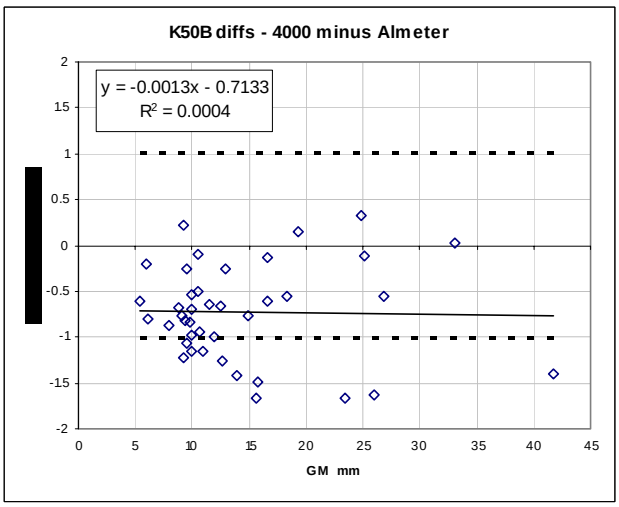

K30B - 4000 vs Almeter
y = 0.9427x - 0.0069
Almeter

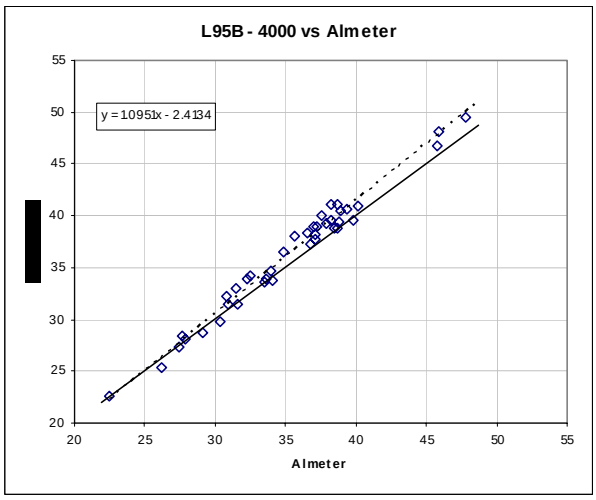

K30B diffs - 4000 minus Almeter
y = -0.0592x - 0.0062
R² = 0.1708
GM mm

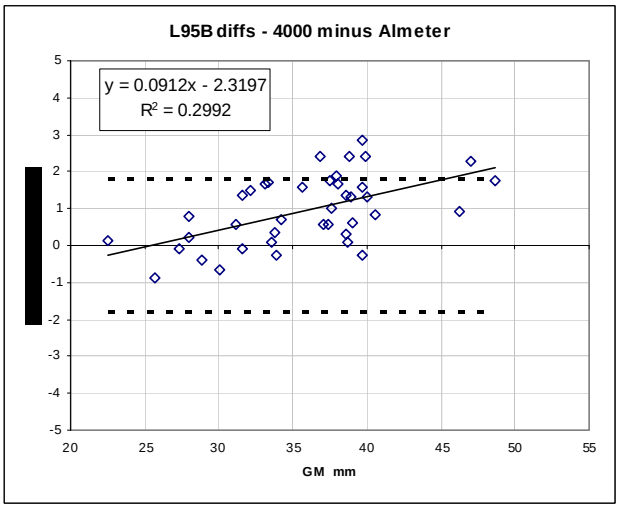

K40B - 4000 vs Almeter
y = 0.9624x - 0.3082
Almeter

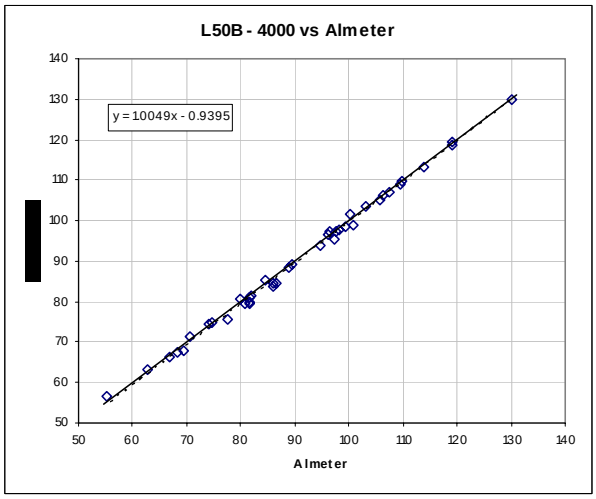

K40B diffs - 4000 minus Almeter
y = -0.0384x - 0.3135
R² = 0.1792
GM mm

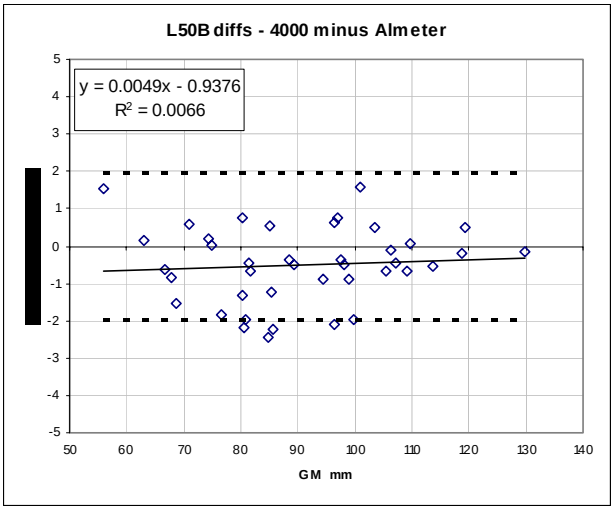

K50B - 4000 vs Almeter
y = 0.9987x - 0.7129
Almeter

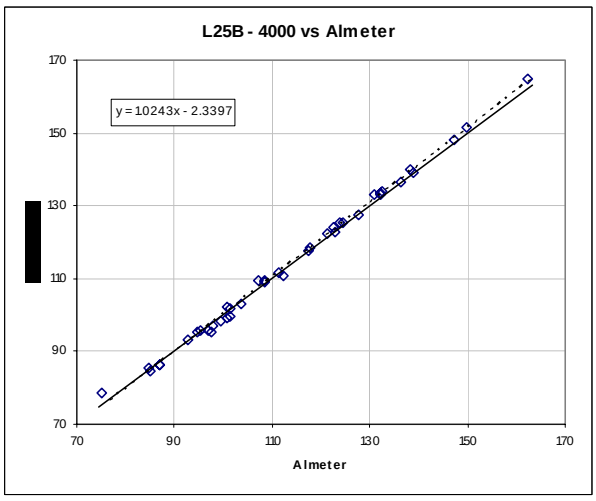

K50B diffs - 4000 minus Almeter
y = -0.0013x - 0.7133
R² = 0.0004
GM mm

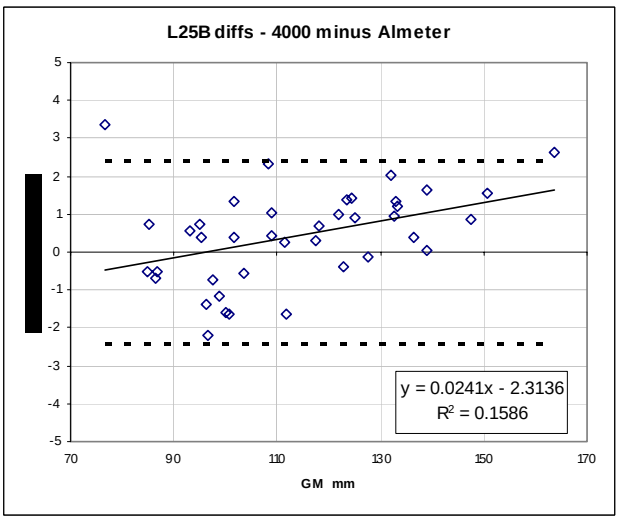

L95B - 4000 vs Almeter
y = 1.0951x - 2.4134
Almeter

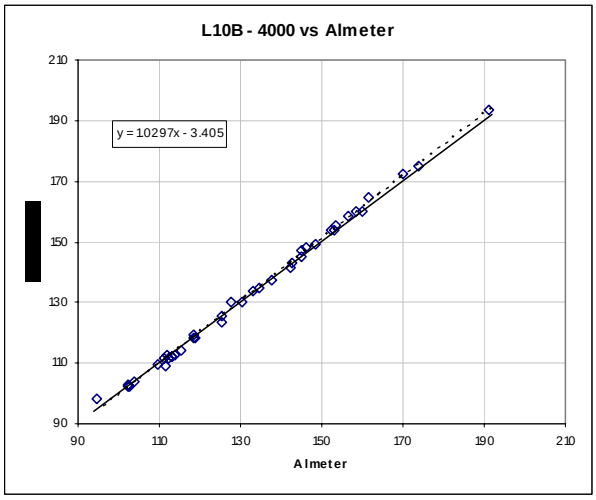

L95B diffs - 4000 minus Almeter
y = 0.0912x - 2.3197
R² = 0.2992
GM mm

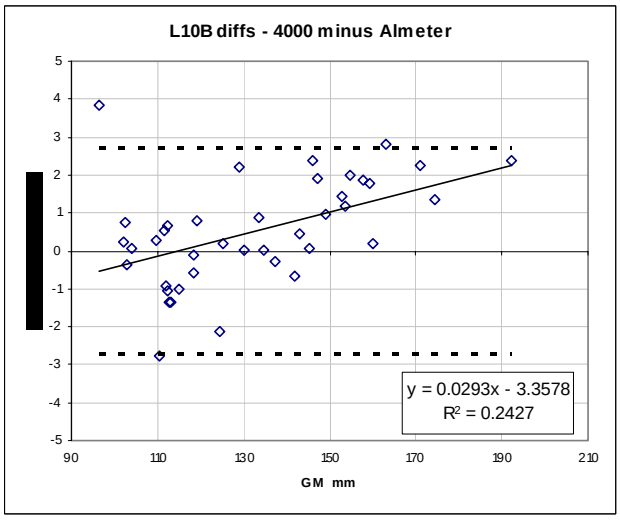

L50B - 4000 vs Almeter
y = 1.0049x - 0.9395
Almeter

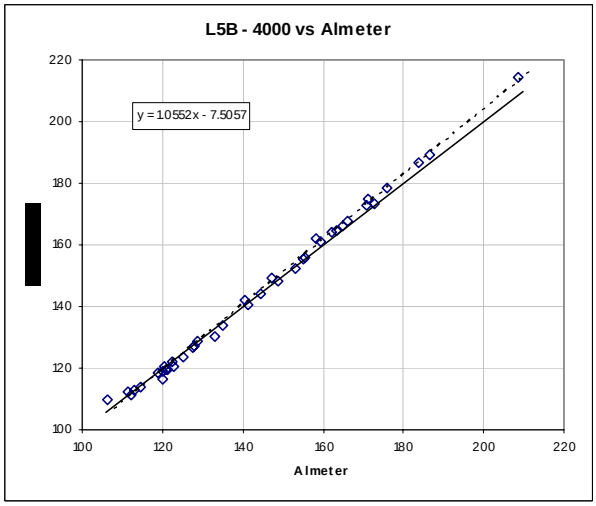

L50B diffs - 4000 minus Almeter
y = 0.0049x - 0.9376
R² = 0.0066
GM mm

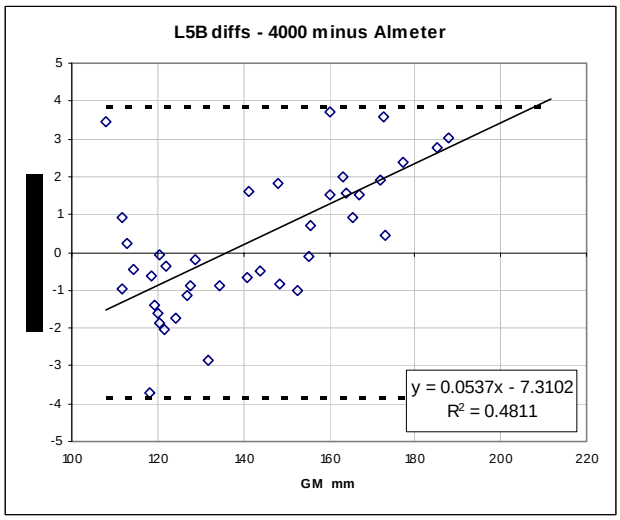

L25B - 4000 vs Almeter
y = 1.0243x - 2.3397
Almeter

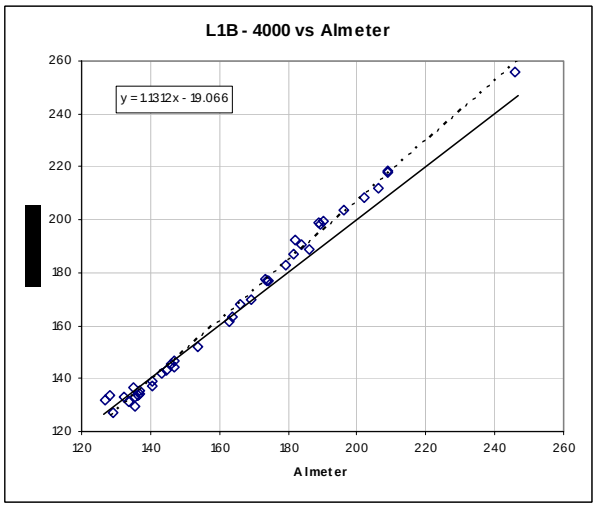

L25B diffs - 4000 minus Almeter
y = 0.0241x - 2.3136
R² = 0.1586
GM mm

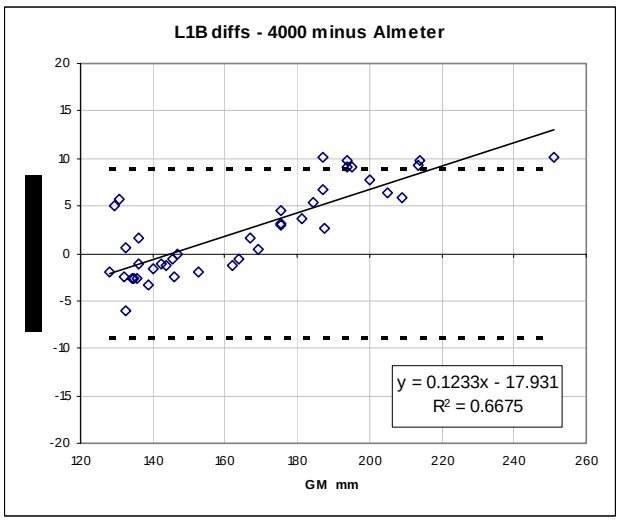

L10B - 4000 vs Almeter
y = 1.0297x - 3.405
Almeter


L10B diffs - 4000 minus Almeter
y = 0.0293x - 3.3578
R² = 0.2427
GM mm


L5B - 4000 vs Almeter
y = 1.0552x - 7.5057
Almeter


L5B diffs - 4000 minus Almeter
y = 0.0537x - 7.3102
R² = 0.4811
GM mm


L1B - 4000 vs Almeter
y = 1.1312x - 19.066
Almeter


L1B diffs - 4000 minus Almeter
y = 0.1233x - 17.931
R² = 0.6675
GM mm

APPENDIX 4

STATS FOR AVG 95%CL DIFFS ON SINGLE MEASUREMENTS, AND REGRESSION MODELS

	Average differences							
	Min	Max	Avg	SD	T val	p val	signif	OFDA4000
D4000	-0.55	0.17	-0.13	0.13	-6.182	0.000	***	Lower
SD4000	-0.49	0.03	-0.11	0.11	-6.082	0.000	***	Lower
CF4000	-2.76	1.60	-0.28	0.70	-2.516	0.016	*	Lower
Fefi4000	-1.57	0.28	-0.33	0.31	-6.889	0.000	***	Lower
curv4000	-56.84	0.09	-8.42	14.26	-3.736	0.001	***	Lower
D4_70	-0.14	0.50	0.02	0.11	1.358	0.182	NS	Same
SD4_70	-0.25	0.21	-0.04	0.10	-2.285	0.028	*	Lower
CF4_70	-1.30	1.74	0.17	0.61	1.818	0.077	NS	Same
curv70	-47.70	10.85	-2.02	12.77	-1.000	0.323	NS	Same
H	-2.46	1.91	0.24	0.89	1.718	0.094	NS	Same
CVH	-1.78	2.41	0.13	0.90	0.896	0.376	NS	Same
B	-0.88	2.22	0.68	0.78	5.485	0.000	***	Higher
CVB	-1.14	1.56	0.16	0.56	1.793	0.081	NS	Same
K10H	-2.77	0.11	-0.31	0.55	-3.573	0.001	***	Lower
K15H	-3.20	1.27	-0.09	0.70	-0.810	0.423	NS	Same
K20H	-2.04	1.38	0.19	0.65	1.836	0.074	NS	Same
K25H	-1.54	1.45	0.13	0.72	1.112	0.273	NS	Same
K30H	-1.29	1.73	0.18	0.74	1.511	0.139	NS	Same
K35H	-1.60	2.14	0.18	0.82	1.384	0.174	NS	Same
K40H	-2.18	2.74	0.06	0.98	0.403	0.689	NS	Same
K45H	-2.08	3.54	0.24	1.00	1.506	0.140	NS	Same
K50H	-2.22	4.25	0.36	1.14	1.988	0.054	NS	Same
L95H	-3.48	3.05	0.37	1.33	1.773	0.084	NS	Same
L90H	-1.99	2.72	0.34	1.03	2.068	0.045	*	Higher
L75H	-3.06	1.93	0.15	1.12	0.862	0.394	NS	Same
L50H	-3.47	2.42	0.26	1.05	1.545	0.131	NS	Same
L25H	-2.15	4.19	0.74	1.16	3.998	0.000	***	Higher
L10H	-0.76	3.27	1.09	1.11	6.231	0.000	***	Higher
L5H	-0.52	3.74	1.29	1.08	7.518	0.000	***	Higher
L2.5H	-1.34	4.16	1.34	1.25	6.738	0.000	***	Higher
L1H	-2.72	5.52	1.43	1.94	4.641	0.000	***	Higher
K10B	-0.29	0.00	-0.04	0.07	-3.742	0.001	***	Lower
K15B	-0.33	0.23	0.00	0.09	0.032	0.975	NS	Same
K20B	-0.15	0.29	0.06	0.09	3.976	0.000	***	Higher
K25B	-0.27	0.48	0.04	0.16	1.734	0.091	NS	Same
K30B	-0.32	0.71	0.07	0.22	2.055	0.047	*	Higher
K35B	-0.44	1.18	0.09	0.31	1.948	0.059	NS	Same
K40B	-0.74	1.71	0.07	0.43	1.096	0.280	NS	Same
K45B	-0.93	2.52	0.19	0.52	2.364	0.023	*	Higher
K50B	-1.09	3.17	0.32	0.66	2.999	0.005	**	Higher
L95B	-1.50	2.26	0.31	0.76	2.554	0.015	*	Higher
L90B	-2.27	1.71	0.30	0.79	2.430	0.020	*	Higher
L75B	-1.45	2.21	0.49	0.84	3.648	0.001	***	Higher
L50B	-0.76	3.66	0.72	0.96	4.756	0.000	***	Higher
L25B	-1.18	3.64	1.05	0.99	6.727	0.000	***	Higher
L10B	-0.33	3.90	1.32	1.11	7.516	0.000	***	Higher
L5B	-0.99	4.10	1.38	1.37	6.389	0.000	***	Higher
L2.5B	-2.90	6.12	1.44	1.98	4.586	0.000	***	Higher
L1B	-3.92	12.29	2.72	3.58	4.802	0.000	***	Higher

	Reference		OFDA4000		GM stats						
	Mean	SD	Mean	SD	b	a	Ryx	SE b	t val	p val	signif
D4000	0.35	0.19	0.23	0.12	0.6185	0.01	0.7419	0.0673	5.671	0.000	***
SD4000	0.25	0.12	0.14	0.05	0.4386	0.03	0.2950	0.0680	8.257	0.000	***
CF4000	1.27	1.19	0.99	0.89	0.7471	0.04	0.8098	0.0711	3.556	0.001	**
Fefi4000	0.53	0.31	0.20	0.07	0.2351	0.07	0.2008	0.0374	20.473	0.000	***
curv4000	10.34	14.59	1.91	1.10	0.0755	1.13	0.3338	0.0115	80.124	0.000	***
D4_70	0.35	0.19	0.38	0.23	1.1936	-0.04	0.8764	0.0933	-2.076	0.045	*
SD4_70	0.25	0.12	0.21	0.14	1.1840	-0.08	0.7075	0.1357	-1.356	0.183	NS
CF4_70	1.27	1.19	1.44	1.28	1.0759	0.08	0.8818	0.0823	-0.922	0.362	NS
curv70	10.34	14.59	8.32	4.06	0.2783	5.44	0.5595	0.0374	19.290	0.000	***
H	2.12	0.93	2.36	0.76	0.8188	0.63	0.4556	0.1182	1.532	0.134	NS
CVH	2.20	0.92	2.33	0.71	0.7672	0.64	0.4131	0.1133	2.054	0.047	*
B	1.48	0.47	2.16	0.74	1.5798	-0.18	0.2207	0.2500	-2.320	0.026	*
CVB	1.39	0.55	1.54	0.55	0.9956	0.16	0.4912	0.1407	0.031	0.975	NS
K10H	0.35	0.58	0.04	0.06	0.1075	0.00	0.4631	0.0155	57.758	0.000	***
K15H	0.87	0.84	0.78	0.33	0.3982	0.44	0.5672	0.0532	11.313	0.000	***
K20H	1.26	0.85	1.44	0.51	0.6014	0.69	0.6423	0.0748	5.332	0.000	***
K25H	1.79	0.91	1.92	0.72	0.7880	0.51	0.6283	0.0994	2.132	0.040	*
K30H	2.08	1.01	2.26	0.85	0.8427	0.50	0.6968	0.0981	1.604	0.117	NS
K35H	2.35	1.03	2.53	0.96	0.9334	0.33	0.6650	0.1131	0.589	0.559	NS
K40H	2.68	1.11	2.74	1.07	0.9602	0.17	0.5990	0.1247	0.319	0.751	NS
K45H	2.73	1.08	2.97	1.08	0.9993	0.24	0.5765	0.1325	0.005	0.996	NS
K50H	2.76	1.07	3.12	0.98	0.9116	0.60	0.3844	0.1365	0.647	0.521	NS
L95H	2.39	1.11	2.77	0.95	0.8575	0.71	0.1661	0.1372	1.039	0.305	NS
L90H	2.51	1.11	2.85	0.97	0.8697	0.67	0.5112	0.1213	1.075	0.289	NS
L75H	3.04	1.57	3.19	1.17	0.7468	0.92	0.6997	0.0865	2.926	0.006	**
L50H	2.76	1.25	3.02	1.14	0.9115	0.50	0.6144	0.1167	0.759	0.453	NS
L25H	2.10	0.90	2.84	1.17	1.3070	0.09	0.3899	0.1952	-1.573	0.124	NS
L10H	1.86	0.68	2.95	1.15	1.6827	-0.18	0.3532	0.2554	-2.673	0.011	*
L5H	1.99	0.65	3.27	1.09	1.6659	-0.03	0.3087	0.2570	-2.591	0.014	*
L2.5H	2.50	1.13	3.84	1.31	1.1573	0.94	0.4777	0.1649	-0.954	0.346	NS
L1H	4.08	2.26	5.51	2.55	1.1258	0.91	0.6793	0.1340	-0.939	0.354	NS
K10B	0.04	0.07	0.00	0.02	0.2245	-0.01	0.5322	0.0308	25.146	0.000	***
K15B	0.15	0.13	0.15	0.08	0.6270	0.06	0.6937	0.0733	5.092	0.000	***
K20B	0.27	0.19	0.33	0.19	0.9824	0.06	0.8862	0.0738	0.239	0.813	NS
K25B	0.49	0.32	0.53	0.35	1.0966	0.00	0.8890	0.0815	-1.186	0.243	NS
K30B	0.67	0.48	0.74	0.50	1.0543	0.03	0.9032	0.0734	-0.740	0.464	NS
K35B	0.88	0.61	0.97	0.67	1.1139	-0.01	0.8895	0.0826	-1.380	0.176	NS
K40B	1.15	0.74	1.22	0.84	1.1434	-0.09	0.8586	0.0951	-1.508	0.140	NS
K45B	1.30	0.81	1.49	0.94	1.1614	-0.02	0.8361	0.1034	-1.561	0.127	NS
K50B	1.44	0.83	1.75	0.92	1.1112	0.16	0.7148	0.1261	-0.882	0.383	NS
L95B	1.95	0.76	2.26	0.81	1.0632	0.18	0.5378	0.1454	-0.435	0.666	NS
L90B	2.15	0.94	2.45	0.83	0.8796	0.56	0.6061	0.1135	1.061	0.295	NS
L75B	2.08	0.76	2.57	0.93	1.2177	0.03	0.5196	0.1688	-1.290	0.205	NS
L50B	1.84	0.63	2.56	1.06	1.6908	-0.55	0.4476	0.2453	-2.816	0.008	**
L25B	1.75	0.54	2.81	1.10	2.0500	-0.78	0.4401	0.2986	-3.516	0.001	**
L10B	2.09	0.70	3.41	1.22	1.7361	-0.22	0.4333	0.2538	-2.900	0.006	**
L5B	2.82	1.48	4.20	1.59	1.0765	1.17	0.6064	0.1389	-0.551	0.585	NS
L2.5B	4.24	2.45	5.68	2.83	1.1531	0.79	0.7267	0.1285	-1.191	0.241	NS
L1B	6.96	4.12	9.68	3.91	0.9471	3.09	0.6029	0.1226	0.432	0.668	NS

	DVA slope	Ryx	SE b	t val	p val	signif
D4000	-0.5369	-0.5972	0.1170	-4.589	0.000	***
SD4000	-1.1130	-0.6938	0.1874	-5.939	0.000	***
CF4000	-0.3192	-0.4500	0.1027	-3.107	0.004	**
Fefi4000	-1.6434	-0.8989	0.1300	-12.643	0.000	***
curv4000	-1.8830	-0.9899	0.0437	-43.085	0.000	***
D4_70	0.1880	0.3465	0.0826	2.277	0.029	*
SD4_70	0.1971	0.2335	0.1332	1.480	0.147	NS
CF4_70	0.0777	0.1534	0.0812	0.957	0.345	NS
curv70	-1.3285	-0.8944	0.1078	-12.329	0.000	***
H	-0.2727	-0.2205	0.1957	-1.393	0.172	NS
CVH	-0.3702	-0.2824	0.2040	-1.815	0.077	NS
B	0.7135	0.4367	0.2384	2.992	0.005	**
CVB	-0.0059	-0.0051	0.1895	-0.031	0.975	NS
K10H	-1.7792	-0.9819	0.0556	-31.983	0.000	***
K15H	-1.0451	-0.7887	0.1321	-7.909	0.000	***
K20H	-0.5983	-0.5693	0.1401	-4.269	0.000	***
K25H	-0.2904	-0.2954	0.1523	-1.906	0.064	NS
K30H	-0.2010	-0.2332	0.1360	-1.478	0.148	NS
K35H	-0.0828	-0.0920	0.1453	-0.570	0.572	NS
K40H	-0.0508	-0.0507	0.1624	-0.313	0.756	NS
K45H	-0.0008	-0.0008	0.1682	-0.005	0.996	NS
K50H	-0.1334	-0.0999	0.2157	-0.619	0.540	NS
L95H	-0.2621	-0.1546	0.2716	-0.965	0.341	NS
L90H	-0.1842	-0.1609	0.1833	-1.005	0.321	NS
L75H	-0.3399	-0.3829	0.1330	-2.555	0.015	*
L50H	-0.1147	-0.1168	0.1581	-0.725	0.473	NS
L25H	0.3800	0.2823	0.2095	1.814	0.078	NS
L10H	0.7296	0.5028	0.2035	3.586	0.001	***
L5H	0.7391	0.4887	0.2140	3.453	0.001	**
L2.5H	0.1971	0.1646	0.1915	1.029	0.310	NS
L1H	0.1409	0.1598	0.1412	0.998	0.325	NS
K10B	-1.4729	-0.9283	0.0957	-15.396	0.000	***
K15B	-0.5364	-0.5578	0.1295	-4.143	0.000	***
K20B	-0.0188	-0.0383	0.0797	-0.236	0.814	NS
K25B	0.0976	0.1977	0.0785	1.243	0.221	NS
K30B	0.0555	0.1223	0.0731	0.760	0.452	NS
K35B	0.1141	0.2302	0.0782	1.458	0.153	NS
K40B	0.1439	0.2536	0.0891	1.616	0.114	NS
K45B	0.1626	0.2640	0.0964	1.687	0.100	NS
K50B	0.1228	0.1493	0.1319	0.931	0.358	NS
L95B	0.0796	0.0725	0.1777	0.448	0.656	NS
L90B	-0.1594	-0.1597	0.1599	-0.997	0.325	NS
L75B	0.2576	0.2260	0.1801	1.430	0.161	NS
L50B	0.6920	0.5237	0.1826	3.789	0.001	***
L25B	0.9141	0.6563	0.1705	5.362	0.000	***
L10B	0.7299	0.5412	0.1840	3.968	0.000	***
L5B	0.0917	0.0924	0.1603	0.572	0.571	NS
L2.5B	0.1646	0.2037	0.1283	1.283	0.207	NS
L1B	-0.0678	-0.0680	0.1613	-0.420	0.677	NS

APPENDIX 5

STATS FOR AVG 95%CL DIFFS ON AVG OF 5 MEASUREMENTS, AND REGRESSION MODELS

	Average differences							
	Min	Max	Avg	SD	T val	p val	signif	OFDA4000
D4000	-0.23	0.24	-0.04	0.11	-2.426	0.020	*	Lower
SD4000	-0.35	0.08	-0.06	0.11	-3.683	0.001	***	Lower
CF4000	-2.55	1.74	0.00	0.71	-0.008	0.993	NS	Same
Fefi4000	-0.86	0.10	-0.26	0.22	-7.488	0.000	***	Lower
curv4000	-24.20	1.32	-4.54	6.21	-4.621	0.000	***	Lower
D4_70	-0.17	0.32	0.05	0.10	3.118	0.003	**	Higher
SD4_70	-0.30	0.17	-0.02	0.10	-1.029	0.310	NS	Same
CF4_70	-1.29	2.67	0.33	0.75	2.769	0.009	**	Higher
curv70	-16.61	13.50	1.28	5.13	1.581	0.122	NS	Same
H	-3.35	2.30	-0.17	1.12	-0.960	0.343	NS	Same
CVH	-2.51	1.66	-0.29	0.95	-1.911	0.063	NS	Same
B	-1.25	2.46	0.50	0.73	4.374	0.000	***	Higher
CVB	-1.30	1.16	-0.13	0.59	-1.439	0.158	NS	Same
K10H	-1.36	0.05	-0.21	0.36	-3.746	0.001	***	Lower
K15H	-1.73	0.63	-0.17	0.51	-2.119	0.041	*	Lower
K20H	-1.77	0.87	-0.08	0.60	-0.863	0.394	NS	Same
K25H	-2.10	1.17	-0.28	0.79	-2.272	0.029	*	Lower
K30H	-2.20	1.56	-0.30	0.86	-2.218	0.032	*	Lower
K35H	-2.27	2.36	-0.30	0.96	-1.995	0.053	NS	Same
K40H	-2.87	3.22	-0.50	1.08	-2.910	0.006	**	Lower
K45H	-2.94	4.06	-0.35	1.11	-1.979	0.055	NS	Same
K50H	-3.17	4.56	-0.24	1.23	-1.238	0.223	NS	Same
L95H	-2.90	1.56	-0.20	1.12	-1.153	0.256	NS	Same
L90H	-3.21	1.12	-0.32	0.97	-2.090	0.043	*	Lower
L75H	-4.27	2.21	-0.49	1.20	-2.572	0.014	*	Lower
L50H	-4.35	2.75	-0.21	1.27	-1.054	0.298	NS	Same
L25H	-2.90	3.84	0.36	1.26	1.818	0.077	NS	Same
L10H	-1.28	3.92	0.82	1.12	4.642	0.000	***	Higher
L5H	-1.36	4.14	0.98	1.14	5.413	0.000	***	Higher
L2.5H	-1.77	4.13	0.88	1.26	4.412	0.000	***	Higher
L1H	-4.30	6.72	0.70	2.09	2.107	0.042	*	Higher
K10B	-0.20	0.00	-0.03	0.05	-3.563	0.001	***	Lower
K15B	-0.29	0.12	-0.02	0.08	-1.731	0.091	NS	Same
K20B	-0.38	0.20	0.00	0.12	-0.091	0.928	NS	Same
K25B	-0.63	0.35	-0.07	0.20	-2.198	0.034	*	Lower
K30B	-1.02	0.76	-0.08	0.28	-1.800	0.080	NS	Same
K35B	-1.23	1.32	-0.07	0.39	-1.073	0.290	NS	Same
K40B	-1.37	2.01	-0.16	0.50	-2.035	0.049	*	Lower
K45B	-1.34	2.81	-0.08	0.62	-0.809	0.423	NS	Same
K50B	-1.98	3.18	0.00	0.76	0.024	0.981	NS	Same
L95B	-2.12	1.47	-0.24	0.75	-2.014	0.051	NS	Same
L90B	-2.95	1.85	-0.14	0.88	-0.983	0.332	NS	Same
L75B	-2.05	2.24	0.17	0.93	1.132	0.265	NS	Same
L50B	-1.68	3.43	0.51	0.96	3.323	0.002	**	Higher
L25B	-0.53	4.60	0.87	1.00	5.462	0.000	***	Higher
L10B	-0.68	4.39	1.01	1.18	5.411	0.000	***	Higher
L5B	-1.44	3.76	0.84	1.42	3.774	0.001	***	Higher
L2.5B	-5.44	7.67	0.72	2.19	2.076	0.045	*	Higher
L1B	-6.03	8.44	1.11	3.00	2.351	0.024	*	Higher

	Reference		OFDA4000		GM stats						
	Mean	SD	Mean	SD	b	a	Ryx	SE b	t val	p val	signif
D4000	0.21	0.14	0.17	0.12	0.8249	0.00	0.6982	0.0958	1.82727	0.076	NS
SD4000	0.16	0.10	0.10	0.05	0.4703	0.02	0.1912	0.0749	2.77007	0.009	**
CF4000	0.78	0.86	0.78	0.80	0.9279	0.06	0.6402	0.1156	0.11264	0.911	NS
Fefi4000	0.36	0.22	0.10	0.04	0.1663	0.04	0.1584	0.0266	5.26298	0.000	***
curv4000	5.97	6.51	1.44	1.03	0.1589	0.49	0.3599	0.0240	2.33672	0.025	*
D4_70	0.21	0.14	0.26	0.16	1.1358	0.02	0.8055	0.1092	-0.1685	0.867	NS
SD4_70	0.16	0.10	0.14	0.09	0.8635	0.01	0.4740	0.1233	0.28804	0.775	NS
CF4_70	0.78	0.86	1.11	1.05	1.2220	0.15	0.7097	0.1397	-0.3128	0.756	NS
curv70	5.97	6.51	7.25	4.01	0.6159	3.57	0.6154	0.0787	0.62417	0.536	NS
H	1.55	0.89	1.38	0.61	0.6825	0.32	-0.0786	0.1104	-4.0412	0.000	***
CVH	1.68	0.86	1.39	0.61	0.7068	0.21	0.1984	0.1124	1.47784	0.148	NS
B	0.92	0.43	1.43	0.69	1.6172	-0.07	0.2142	0.2563	-2.8822	0.006	**
CVB	1.05	0.49	0.91	0.49	0.9913	-0.12	0.2851	0.1541	0.03068	0.976	NS
K10H	0.23	0.37	0.02	0.03	0.0820	0.00	0.4545	0.0119	2.0195	0.051	NS
K15H	0.60	0.59	0.42	0.20	0.3357	0.22	0.5411	0.0458	1.22758	0.227	NS
K20H	0.87	0.68	0.78	0.31	0.4659	0.38	0.4563	0.0673	1.17039	0.249	NS
K25H	1.34	0.80	1.05	0.45	0.5620	0.30	0.3090	0.0867	1.41739	0.165	NS
K30H	1.56	0.91	1.26	0.54	0.5936	0.33	0.3846	0.0889	1.0567	0.297	NS
K35H	1.73	0.93	1.42	0.63	0.6772	0.26	0.2900	0.1051	1.113	0.273	NS
K40H	2.03	1.01	1.54	0.75	0.7376	0.04	0.2808	0.1148	0.93466	0.356	NS
K45H	2.00	0.96	1.66	0.83	0.8648	-0.08	0.2449	0.1360	0.55219	0.584	NS
K50H	1.98	1.00	1.74	0.79	0.7870	0.18	0.0672	0.1274	3.16917	0.003	**
L95H	1.74	0.91	1.54	0.63	0.6920	0.33	-0.0357	0.1122	-8.6288	0.000	***
L90H	1.89	0.98	1.57	0.61	0.6213	0.40	0.3267	0.0953	1.15914	0.254	NS
L75H	2.26	1.34	1.77	0.73	0.5434	0.54	0.4541	0.0785	1.00559	0.321	NS
L50H	1.94	1.11	1.73	0.81	0.7315	0.31	0.1576	0.1172	1.7037	0.097	NS
L25H	1.37	0.82	1.74	1.07	1.2953	-0.04	0.1241	0.2085	-2.3797	0.022	*
L10H	1.14	0.62	1.96	1.08	1.7434	-0.03	0.2178	0.2760	-3.414	0.002	**
L5H	1.15	0.55	2.13	1.05	1.9257	-0.08	0.0827	0.3113	-11.188	0.000	***
L2.5H	1.49	0.75	2.37	1.06	1.4032	0.28	0.0572	0.2273	-7.0463	0.000	***
L1H	2.58	1.58	3.28	1.87	1.1793	0.23	0.2740	0.1840	-0.6541	0.517	NS
K10B	0.03	0.05	0.00	0.01	0.1436	0.00	0.6862	0.0169	1.2481	0.220	NS
K15B	0.10	0.10	0.08	0.04	0.4442	0.03	0.6454	0.0550	0.86122	0.395	NS
K20B	0.18	0.16	0.18	0.10	0.6402	0.06	0.7060	0.0736	0.50954	0.613	NS
K25B	0.36	0.27	0.29	0.18	0.6791	0.04	0.6558	0.0832	0.48937	0.627	NS
K30B	0.49	0.40	0.41	0.27	0.6719	0.08	0.7184	0.0758	0.45675	0.650	NS
K35B	0.62	0.49	0.55	0.37	0.7597	0.08	0.6222	0.0965	0.38615	0.702	NS
K40B	0.84	0.60	0.68	0.51	0.8603	-0.04	0.5993	0.1117	0.23315	0.817	NS
K45B	0.90	0.65	0.82	0.62	0.9663	-0.05	0.5314	0.1328	0.06336	0.950	NS
K50B	0.97	0.68	0.97	0.63	0.9303	0.07	0.3301	0.1425	0.21109	0.834	NS
L95B	1.49	0.73	1.25	0.49	0.6629	0.26	0.3072	0.1023	1.09732	0.279	NS
L90B	1.49	0.82	1.36	0.58	0.7084	0.30	0.2480	0.1113	1.17546	0.247	NS
L75B	1.34	0.67	1.50	0.77	1.1485	-0.03	0.1639	0.1838	-0.9058	0.371	NS
L50B	1.13	0.55	1.64	0.96	1.7651	-0.36	0.2819	0.2747	-2.714	0.010	**
L25B	0.99	0.40	1.86	1.05	2.6667	-0.78	0.3077	0.4116	-5.4165	0.000	***
L10B	1.19	0.50	2.20	1.14	2.2642	-0.49	0.1230	0.3645	-10.274	0.000	***
L5B	1.73	0.94	2.58	1.18	1.2513	0.41	0.1256	0.2014	-2.0006	0.053	NS
L2.5B	2.66	1.59	3.38	2.06	1.2941	-0.07	0.3064	0.1998	-0.9598	0.343	NS
L1B	4.38	2.70	5.49	2.90	1.0745	0.79	0.4274	0.1576	-0.1743	0.863	NS

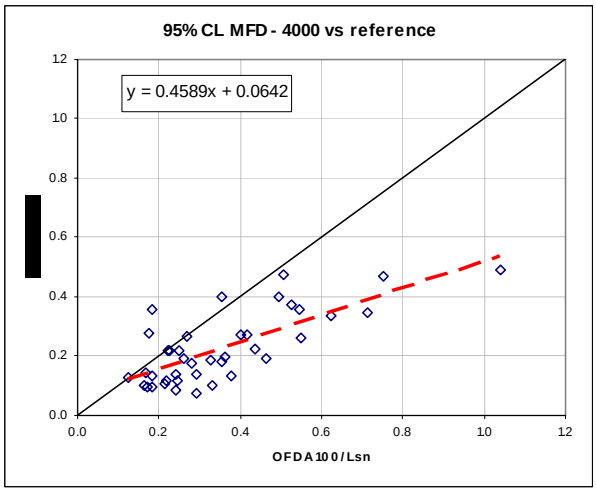
	DVA					
	slope	Ryx	SE b	t val	p val	signif
D4000	-0.2256	-0.2611	0.1353	-1.667	0.104	NS
SD4000	-1.1117	-0.6447	0.2138	-5.199	0.000	***
CF4000	-0.0912	-0.0971	0.1517	-0.601	0.551	NS
Fefi4000	-1.8001	-0.9474	0.0986	-18.255	0.000	***
curv4000	-1.7106	-0.9567	0.0844	-20.266	0.000	***
D4_70	0.1408	0.2106	0.1060	1.3279	0.192	NS
SD4_70	-0.1985	-0.1650	0.1924	-1.0315	0.309	*
CF4_70	0.2333	0.2754	0.1321	1.766	0.085	NS
curv70	-0.5808	-0.5386	0.1474	-3.941	0.000	***
H	-0.7863	-0.3654	0.3250	-2.420	0.020	*
CVH	-0.5623	-0.3397	0.2525	-2.227	0.032	*
B	0.7500	0.4553	0.2379	3.152	0.003	**
CVB	-0.0137	-0.0092	0.2420	-0.057	0.955	NS
K10H	-1.8372	-0.9893	0.0438	-41.897	0.000	***
K15H	-1.2023	-0.8437	0.1241	-9.688	0.000	***
K20H	-0.9534	-0.6865	0.1638	-5.820	0.000	***
K25H	-0.8227	-0.5391	0.2085	-3.945	0.000	***
K30H	-0.7160	-0.5088	0.1966	-3.643	0.001	***
K35H	-0.5848	-0.3854	0.2271	-2.575	0.014	*
K40H	-0.4657	-0.3066	0.2346	-1.985	0.054	NS
K45H	-0.2323	-0.1487	0.2505	-0.927	0.360	NS
K50H	-0.4412	-0.2355	0.2954	-1.494	0.143	NS
L95H	-0.7291	-0.3526	0.3139	-2.323	0.026	*
L90H	-0.6852	-0.4633	0.2126	-3.222	0.003	**
L75H	-0.7880	-0.5885	0.1756	-4.487	0.000	***
L50H	-0.5266	-0.3063	0.2655	-1.984	0.055	NS
L25H	0.4520	0.2550	0.2781	1.625	0.112	NS
L10H	0.8500	0.5141	0.2301	3.694	0.001	***
L5H	1.0775	0.5766	0.2477	4.350	0.000	***
L2.5H	0.6193	0.3269	0.2905	2.132	0.040	*
L1H	0.2573	0.1697	0.2423	1.062	0.295	NS
K10B	-1.6087	-0.9780	0.0556	-28.909	0.000	***
K15B	-0.9067	-0.7637	0.1243	-7.292	0.000	***
K20B	-0.5100	-0.5454	0.1271	-4.011	0.000	***
K25B	-0.4582	-0.4652	0.1415	-3.240	0.002	**
K30B	-0.4540	-0.5061	0.1255	-3.618	0.001	***
K35B	-0.3352	-0.3349	0.1530	-2.191	0.035	*
K40B	-0.1876	-0.1855	0.1612	-1.163	0.252	NS
K45B	-0.0447	-0.0404	0.1794	-0.249	0.804	NS
K50B	-0.1085	-0.0764	0.2298	-0.472	0.640	NS
L95B	-0.6070	-0.4060	0.2217	-2.738	0.009	**
L90B	-0.5375	-0.3411	0.2403	-2.237	0.031	*
L75B	0.2367	0.1394	0.2727	0.868	0.391	NS
L50B	0.8279	0.5298	0.2150	3.850	0.000	***
L25B	1.2533	0.7693	0.1688	7.424	0.000	***
L10B	1.2348	0.6764	0.2181	5.661	0.000	***
L5B	0.3929	0.2222	0.2797	1.405	0.168	NS
L2.5B	0.3891	0.2641	0.2305	1.688	0.100	NS
L1B	0.1006	0.0793	0.2051	0.490	0.627	NS

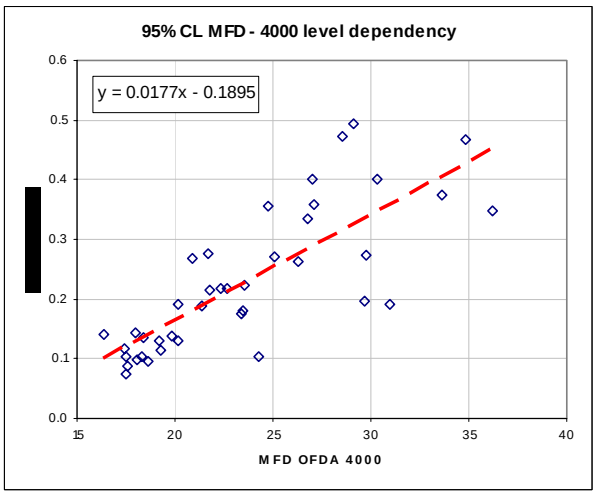
APPENDIX 6

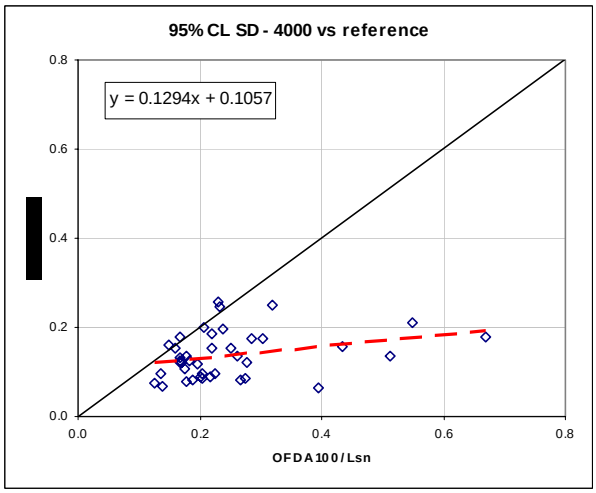
PRECISION COMPARISON PLOTS FOR SELECTED RANGE OF PARAMETERS

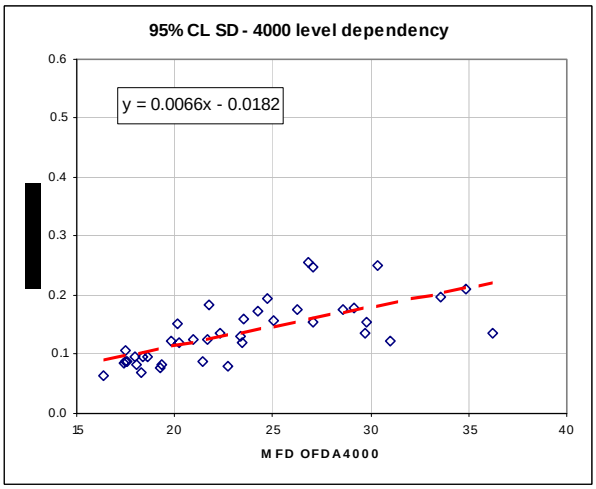
95%CL BASED ON SINGLE MEASUREMENTS

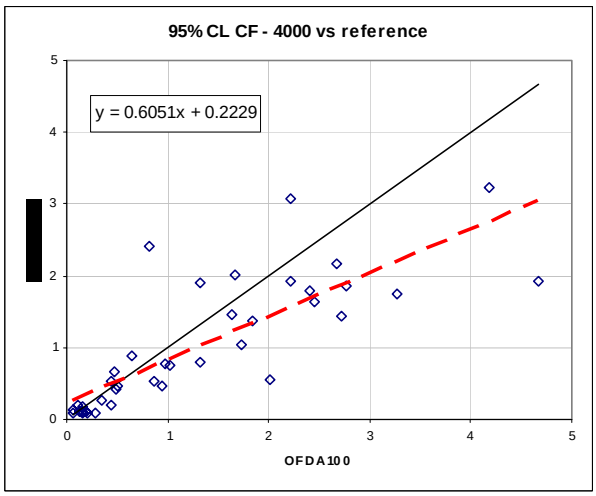
6.1 OFDA4000 DIAMETER-RELATED MEASUREMENTS

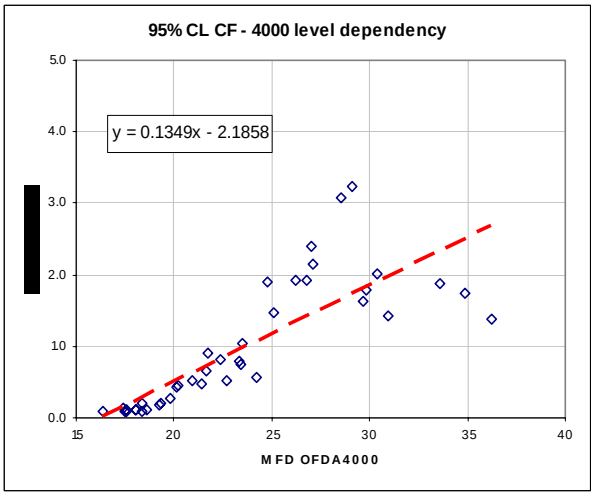


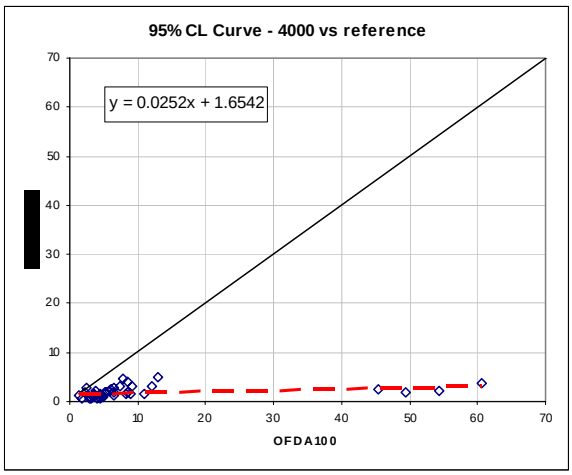


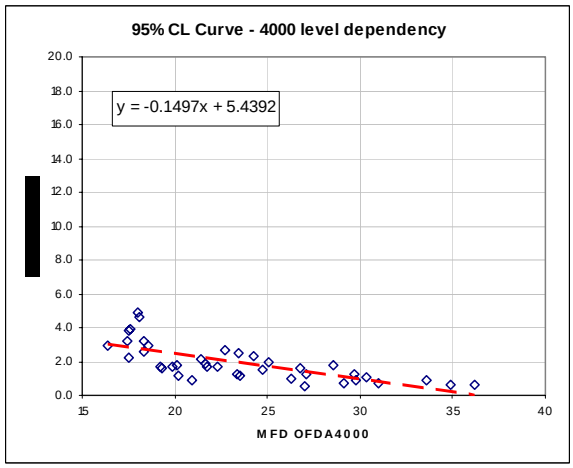


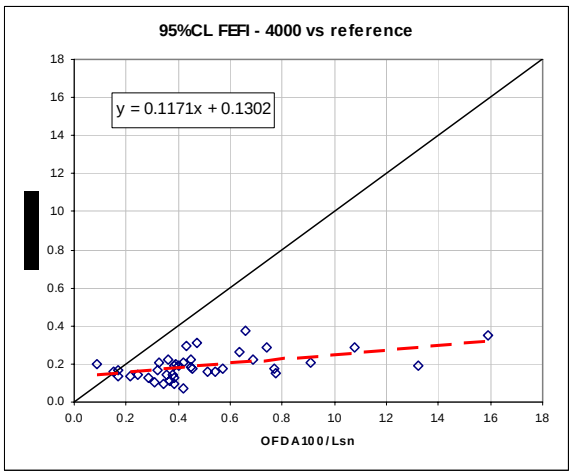


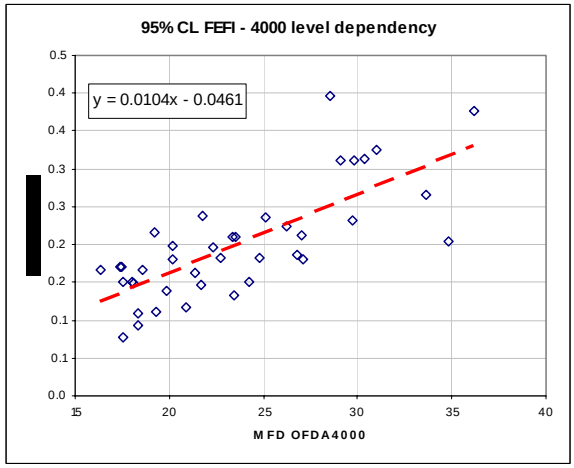




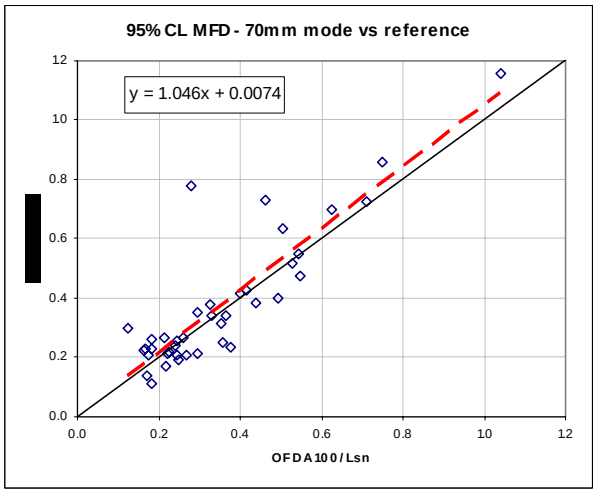


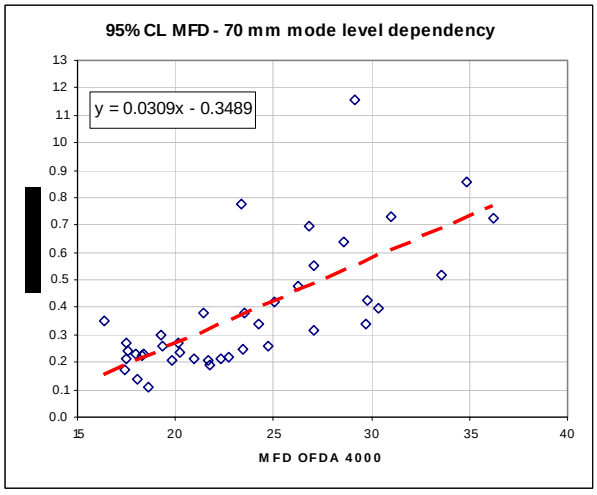


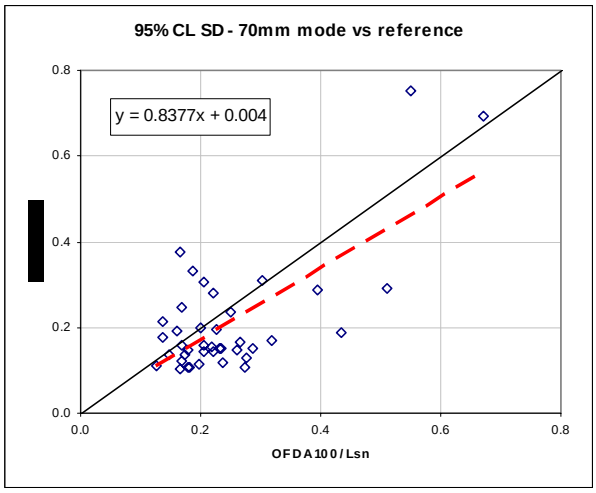


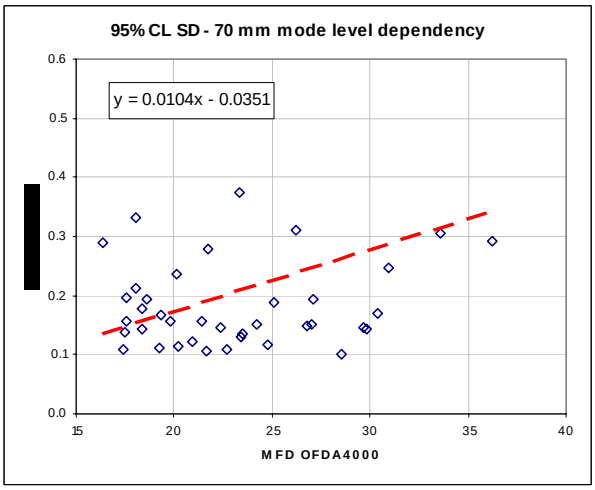


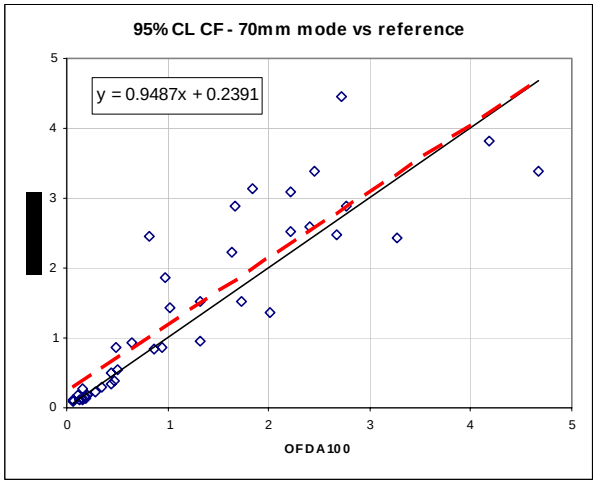
6.2 OFDA4000 IN 70MM MODE DIAMETER-RELATED MEASUREMENTS

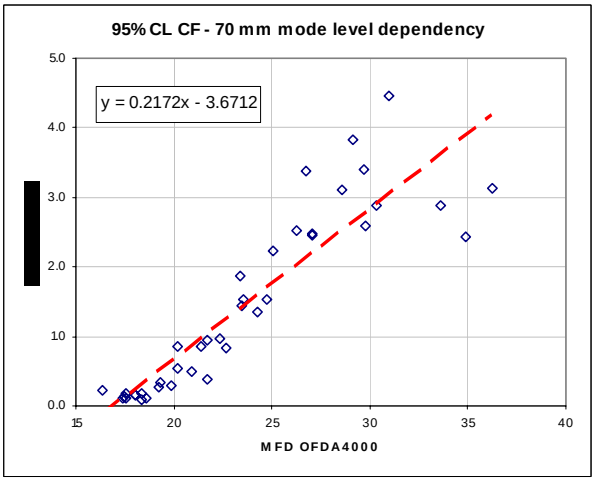


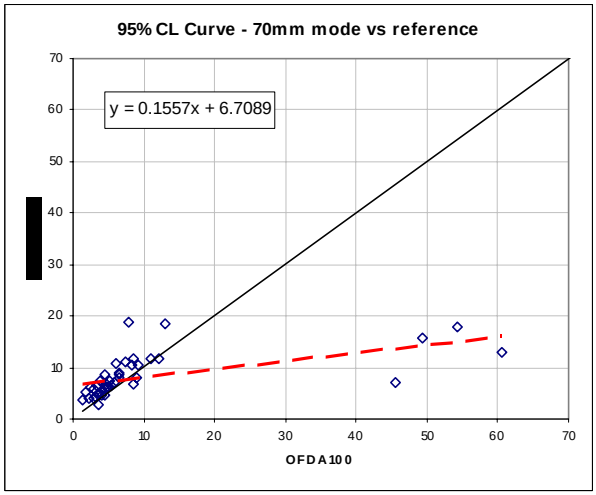


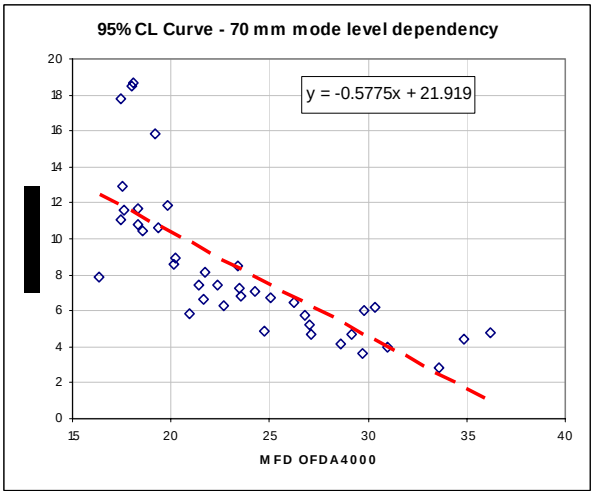

95% CL SD - 70mm mode vs reference
y = 0.8377x + 0.004
OFDA100/Lsn


95% CL SD - 70 mm mode level dependency
y = 0.0104x - 0.0351
MFD OFDA4000

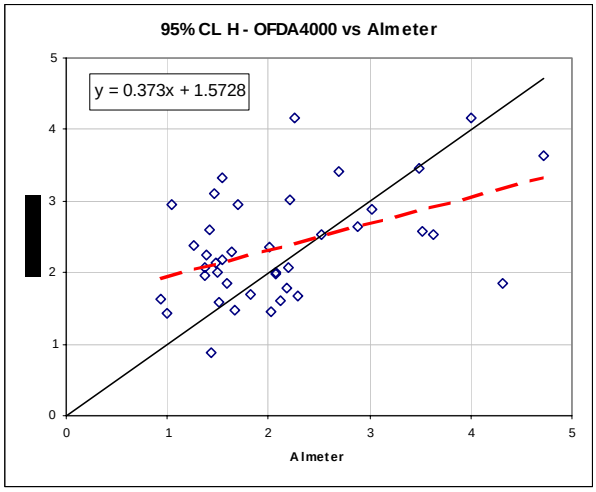

95% CL CF - 70mm mode vs reference
y = 0.9487x + 0.2391
OFDA100

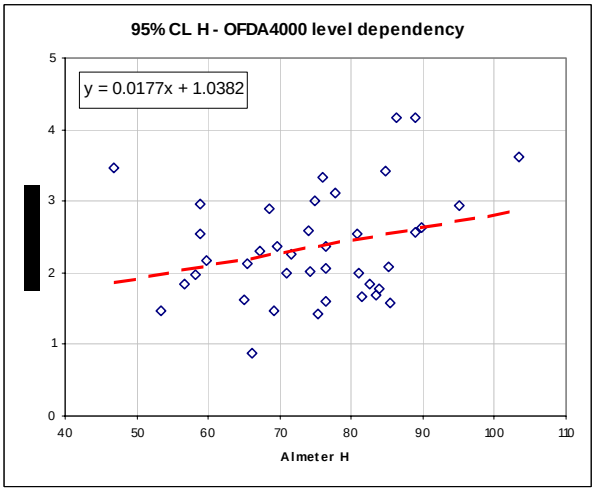

95% CL CF - 70 mm mode level dependency
y = 0.2172x - 3.6712
MFD OFDA4000

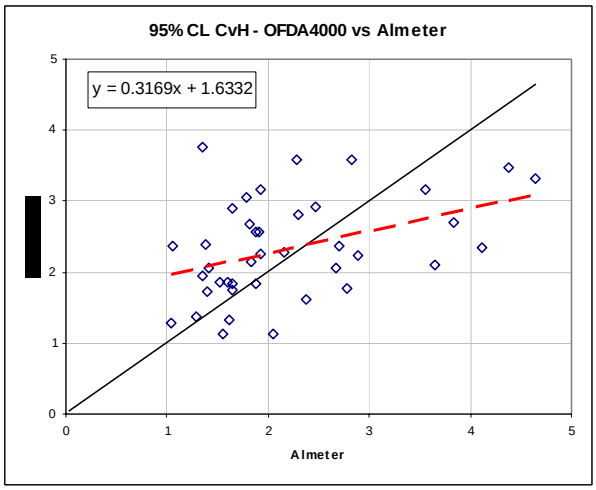

95% CL Curve - 70mm mode vs reference
y = 0.1557x + 6.7089
OFDA100

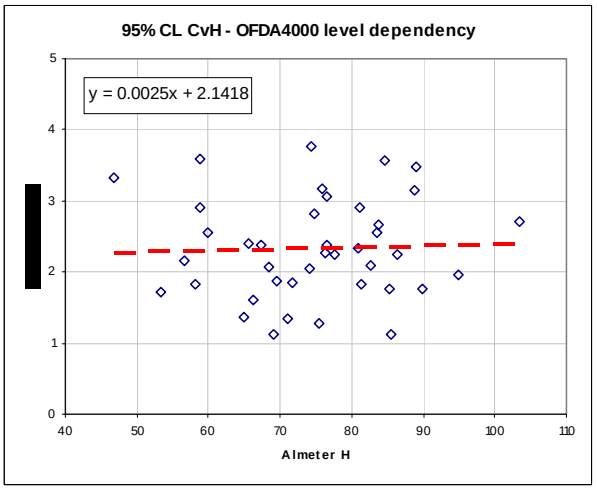

95% CL Curve - 70 mm mode level dependency
y = -0.5775x + 21.919
MFD OFDA4000

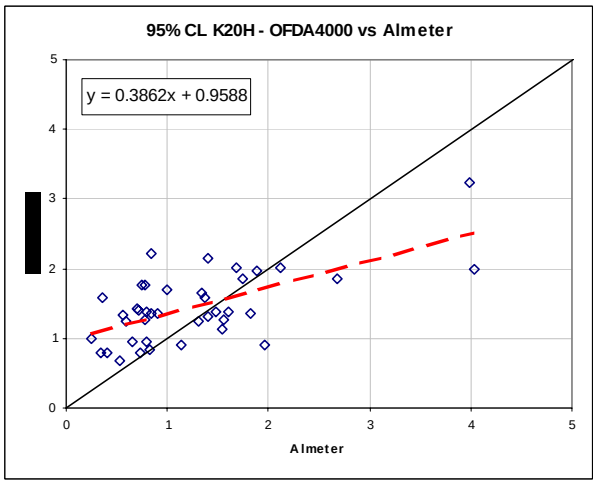
6.3 OFDA4000 HAUTEUR MEASUREMENTS

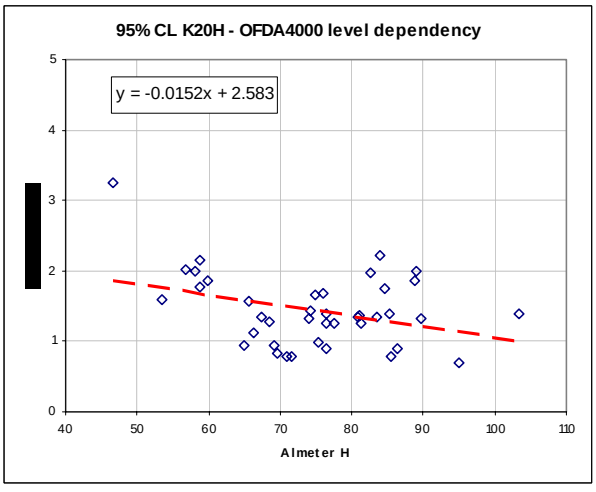


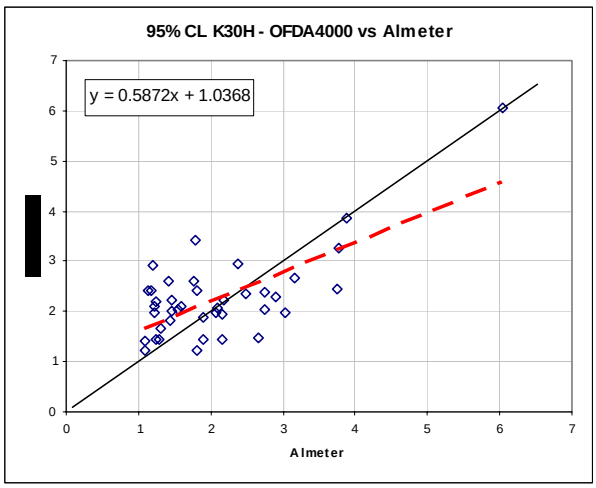


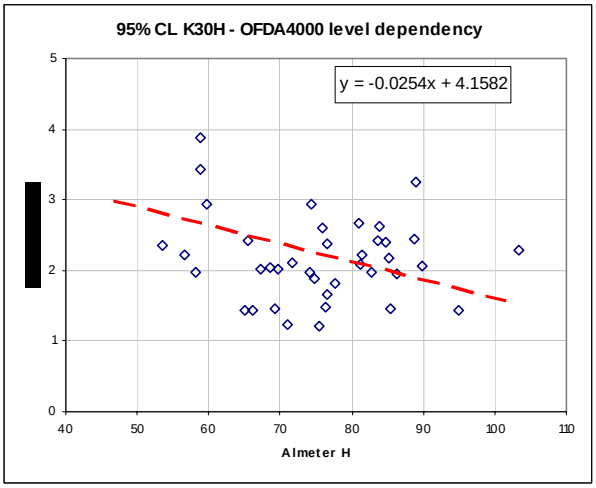


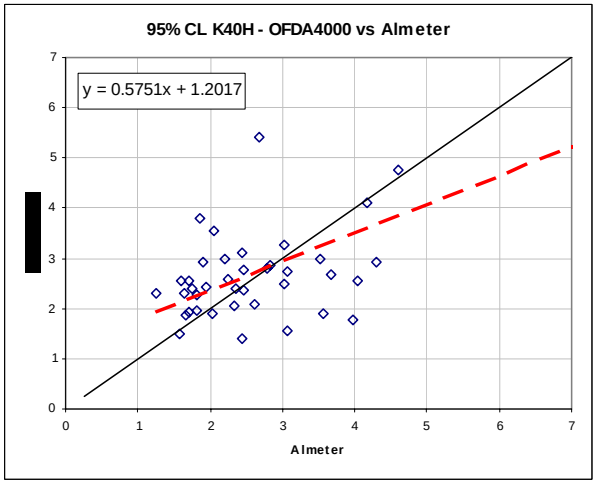


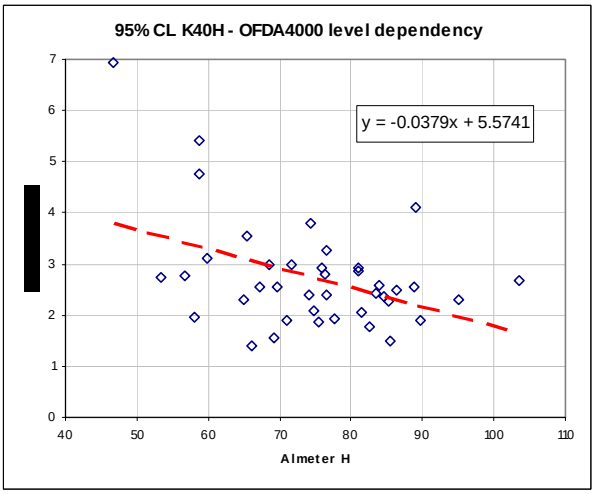


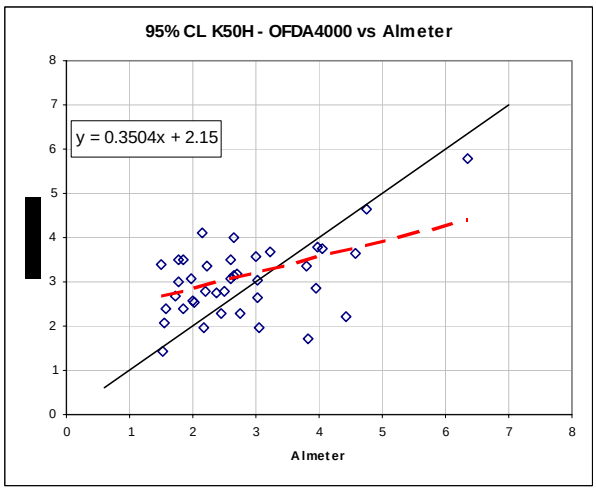


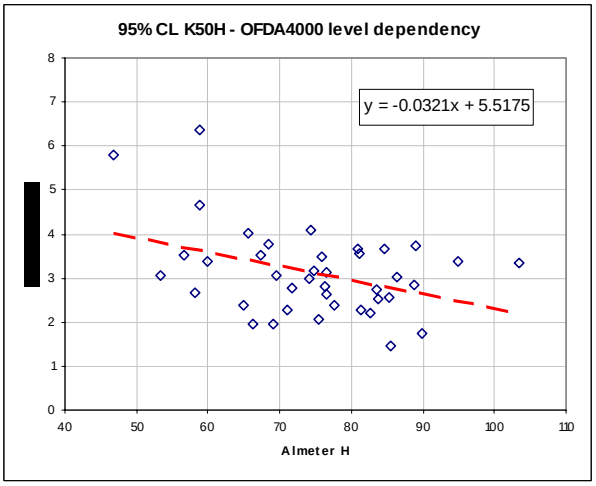

95% CL K30H - OFDA4000 vs Almeter
y = 0.5872x + 1.0368
Almeter

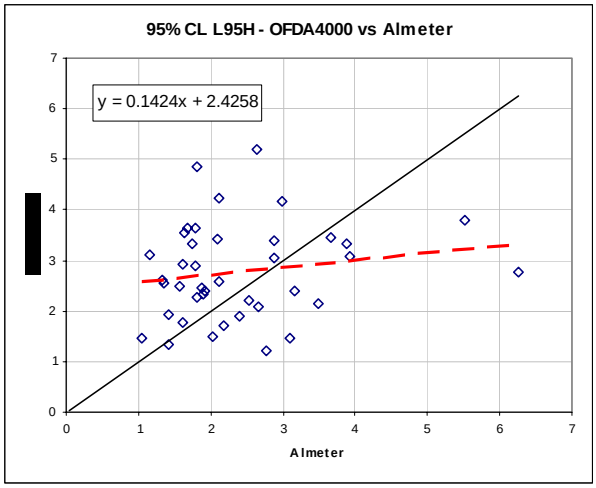

95% CL K30H - OFDA4000 level dependency
y = -0.0254x + 4.1582
Almeter H

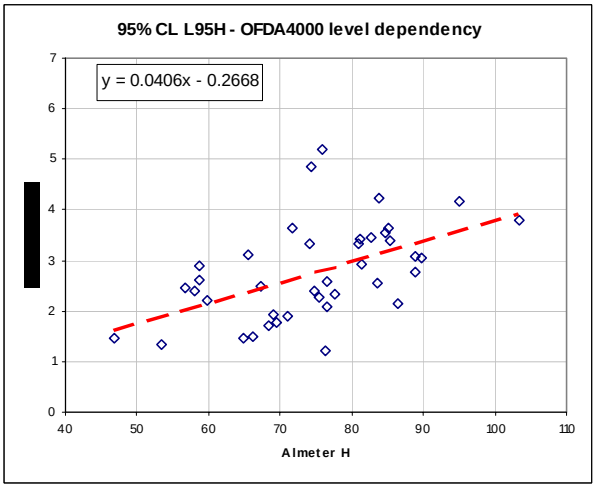

95% CL K40H - OFDA4000 vs Almeter
y = 0.5751x + 1.2017
Almeter

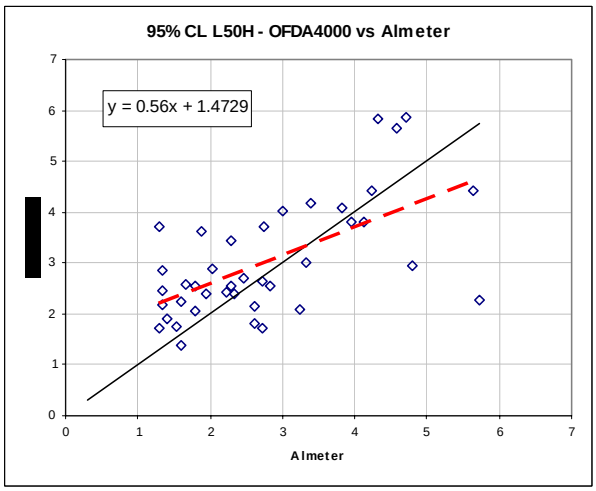

95% CL K40H - OFDA4000 level dependency
y = -0.0379x + 5.5741
Almeter H

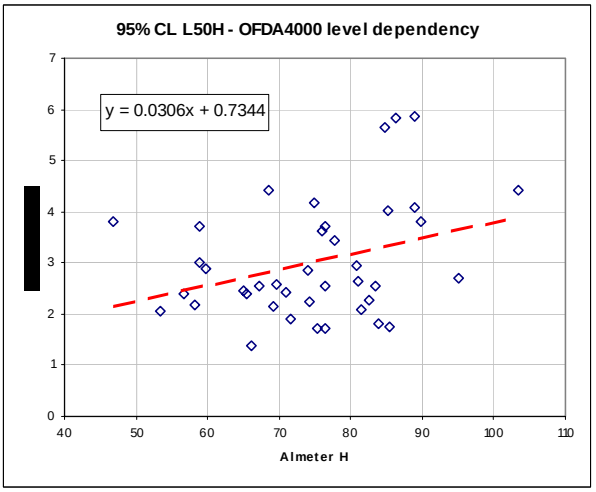

95% CL K50H - OFDA4000 vs Almeter
y = 0.3504x + 2.15
Almeter

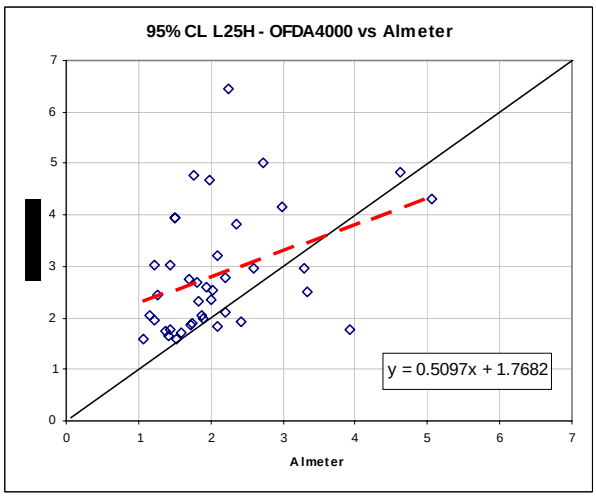

95% CL K50H - OFDA4000 level dependency
y = -0.0321x + 5.5175
Almeter H

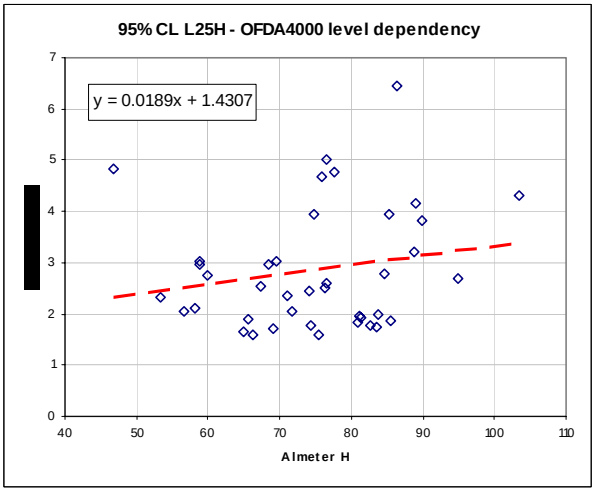

95% CL L95H - OFDA4000 vs Almeter
y = 0.1424x + 2.4258
Almeter

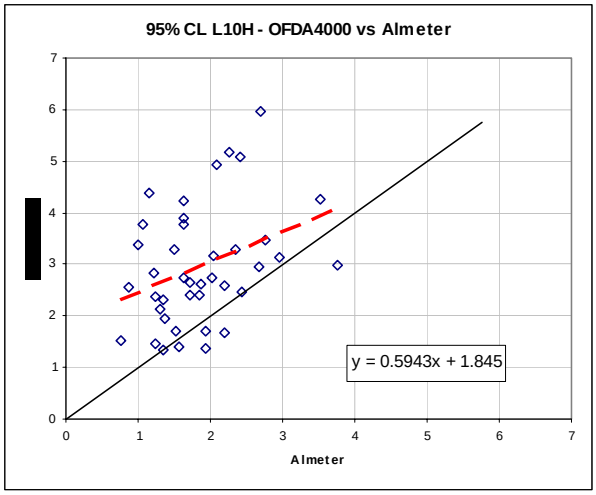

95% CL L95H - OFDA4000 level dependency
y = 0.0406x - 0.2668
Almeter H

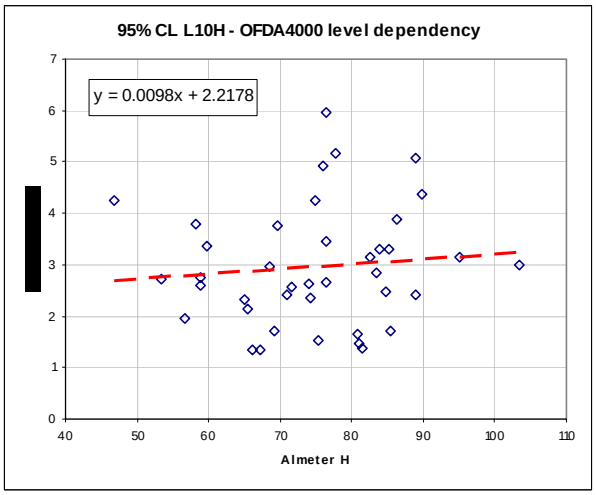

95% CL L50H - OFDA4000 vs Almeter
y = 0.56x + 1.4729
Almeter

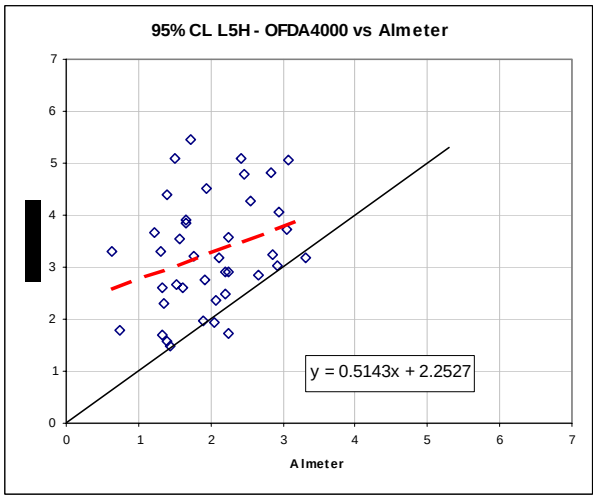

95% CL L50H - OFDA4000 level dependency
y = 0.0306x + 0.7344
Almeter H

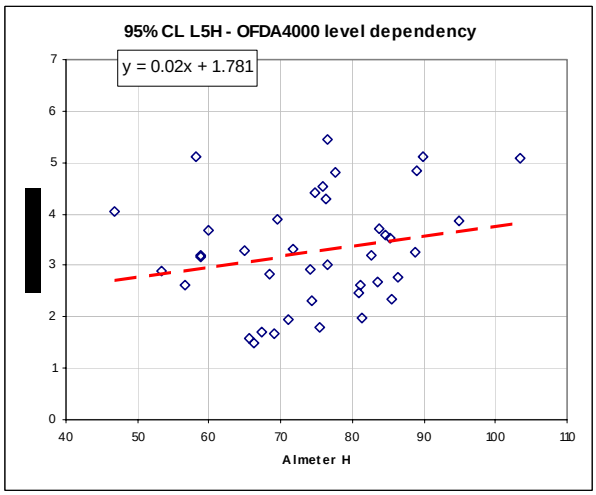

95% CL L25H - OFDA4000 vs Almeter
y = 0.5097x + 1.7682
Almeter

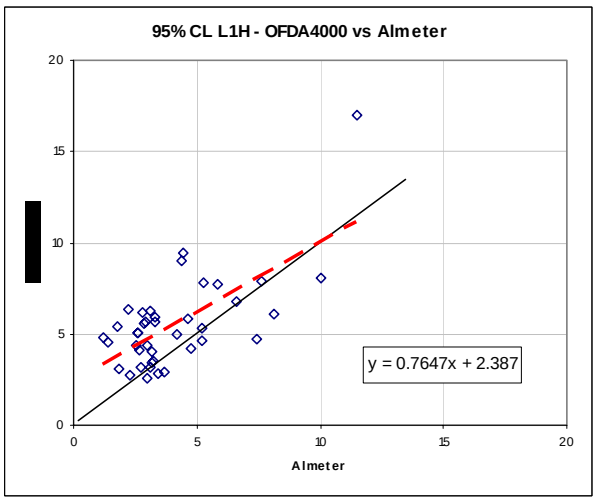

95% CL L25H - OFDA4000 level dependency
y = 0.0189x + 1.4307
Almeter H

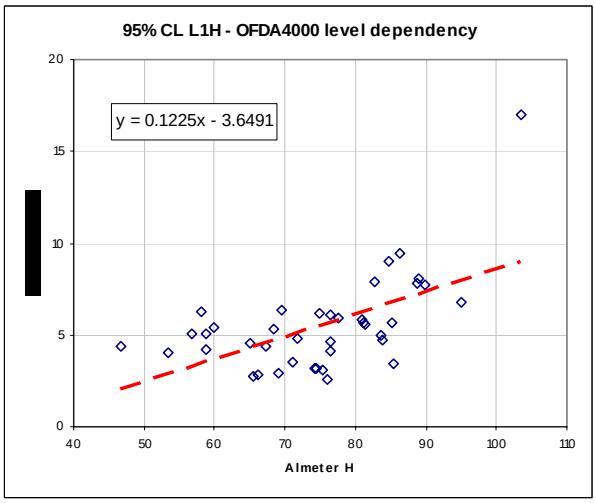

95% CL L10H - OFDA4000 vs Almeter
y = 0.5943x + 1.845
Almeter


95% CL L10H - OFDA4000 level dependency
y = 0.0098x + 2.2178
Almeter H

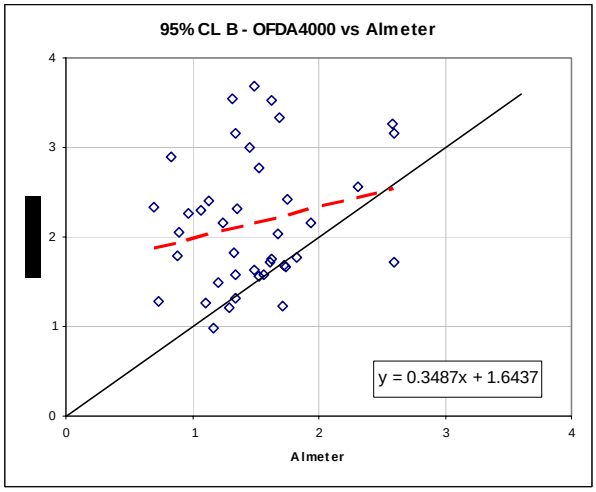

95% CL L5H - OFDA4000 vs Almeter
y = 0.5143x + 2.2527
Almeter

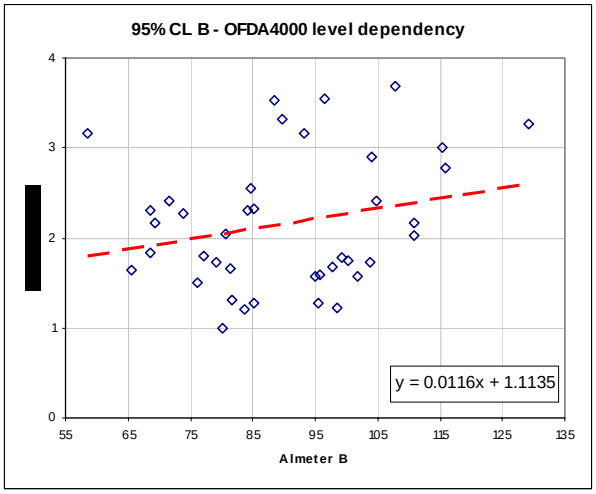

95% CL L5H - OFDA4000 level dependency
y = 0.02x + 1.781
Almeter H

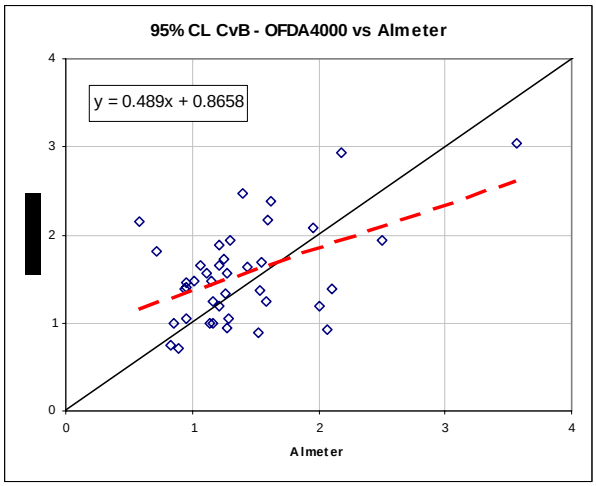

95% CL L1H - OFDA4000 vs Almeter
y = 0.7647x + 2.387
Almeter

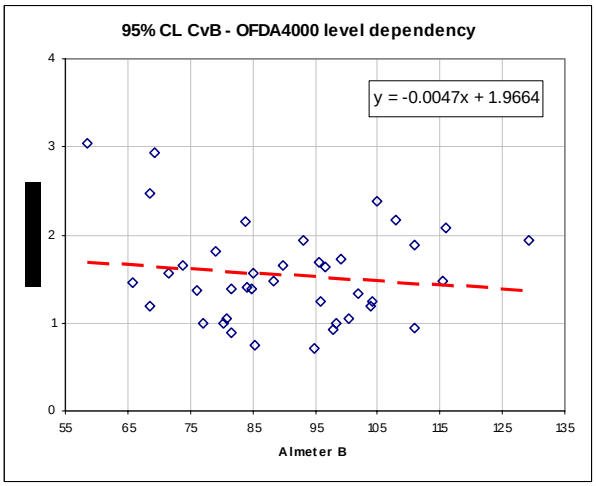

95% CL L1H - OFDA4000 level dependency
y = 0.1225x - 3.6491
Almeter H

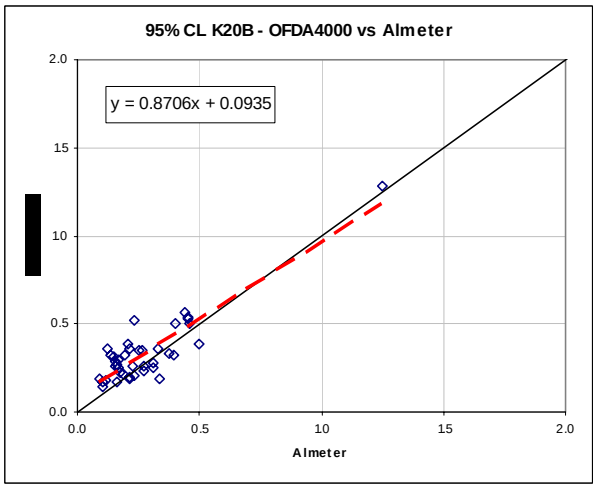
6.4 OFDA4000 BARBE MEASUREMENTS

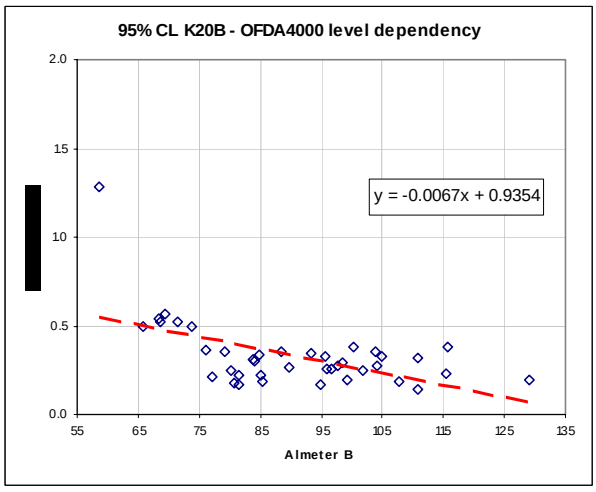


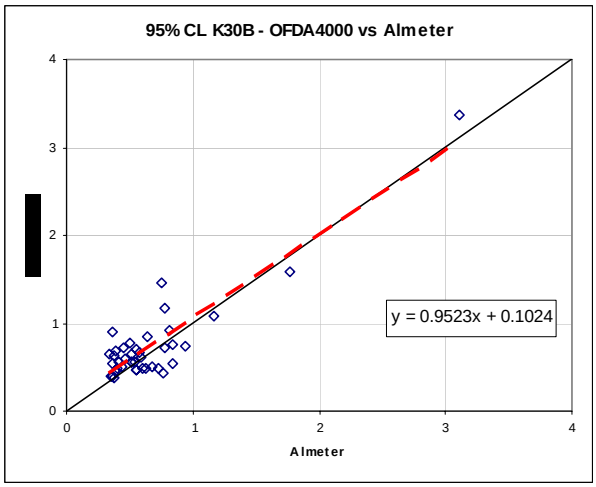


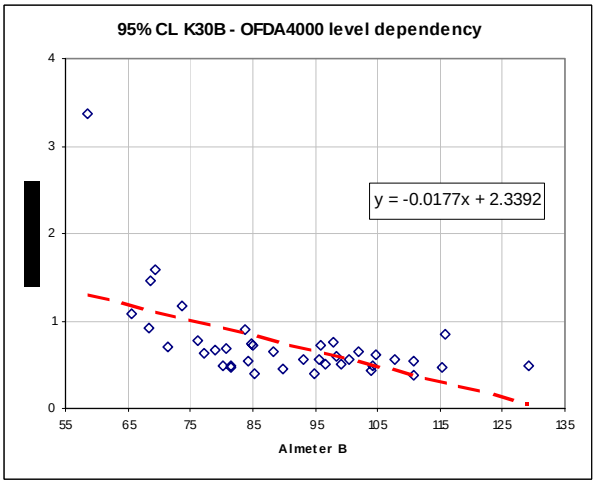


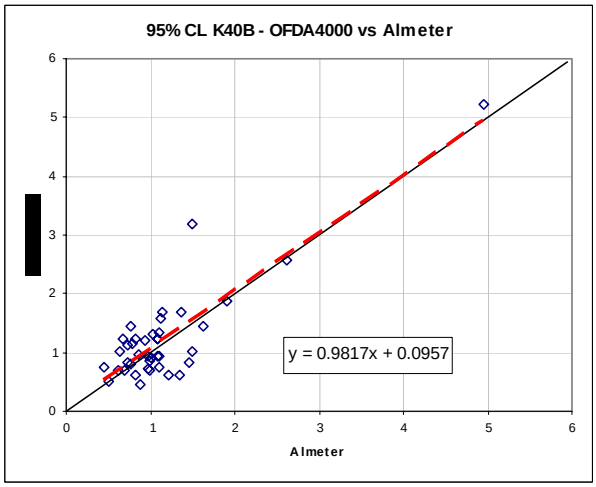


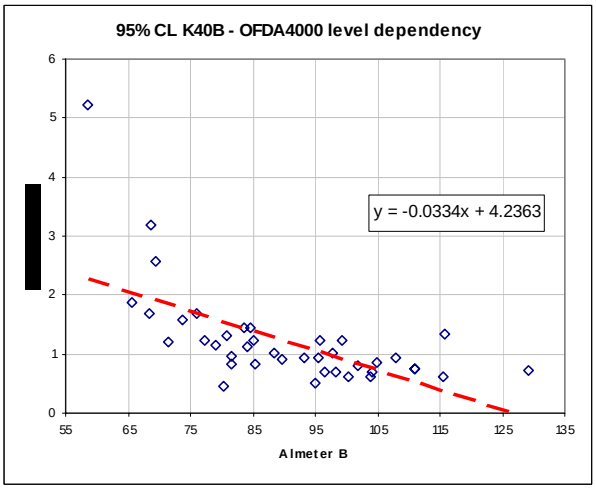


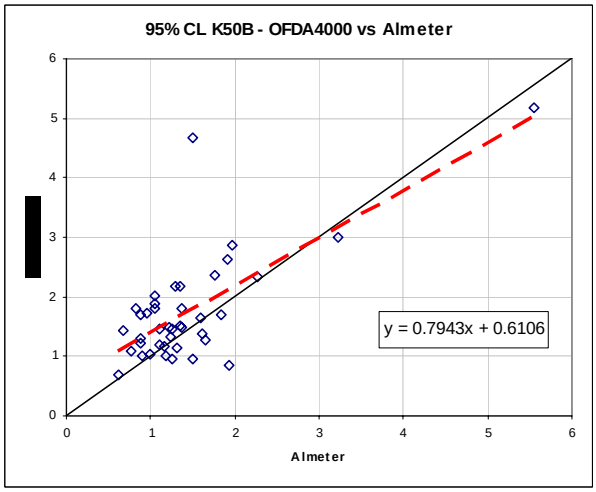


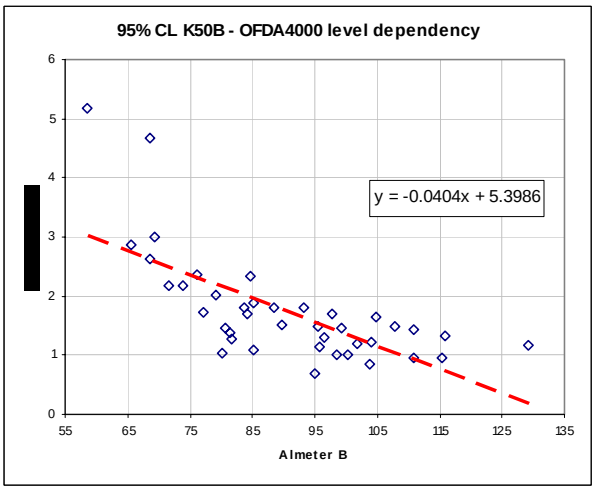

95% CL K30B - OFDA4000 vs Almeter
y = 0.9523x + 0.1024
Almeter

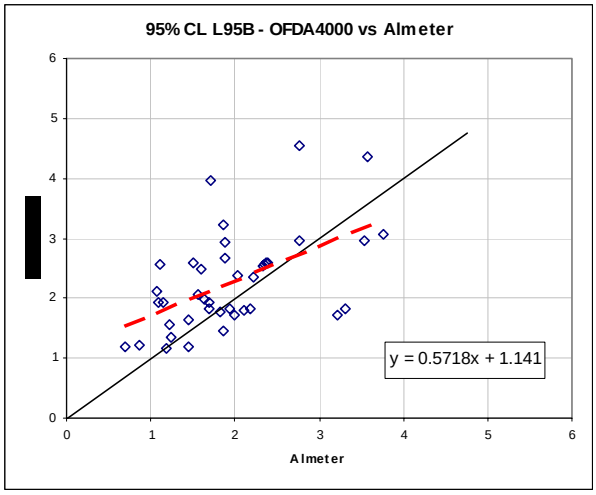

95% CL K30B - OFDA4000 level dependency
y = -0.0177x + 2.3392
Almeter B

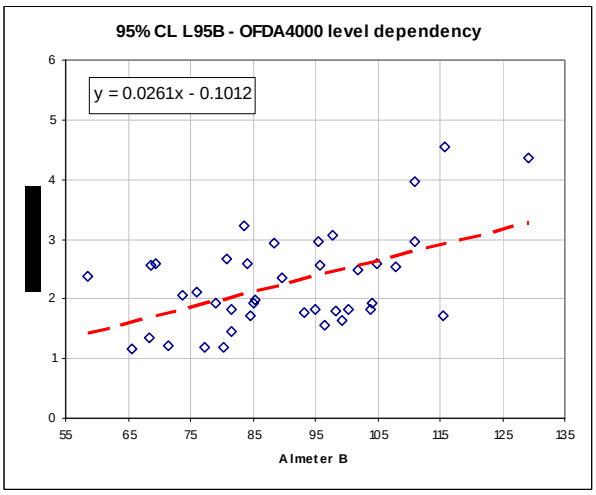

95% CL K40B - OFDA4000 vs Almeter
y = 0.9817x + 0.0957
Almeter

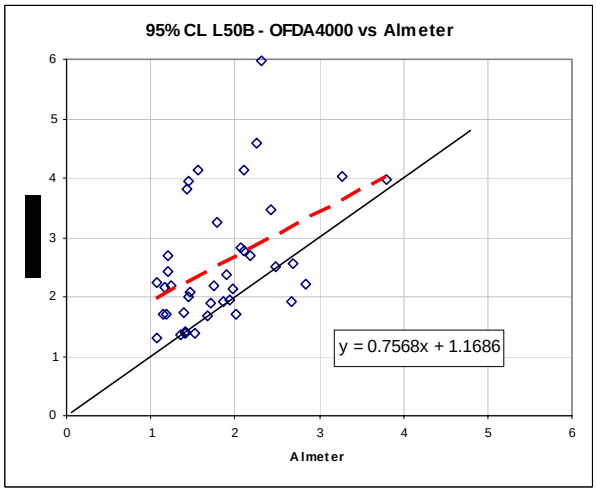

95% CL K40B - OFDA4000 level dependency
y = -0.0334x + 4.2363
Almeter B

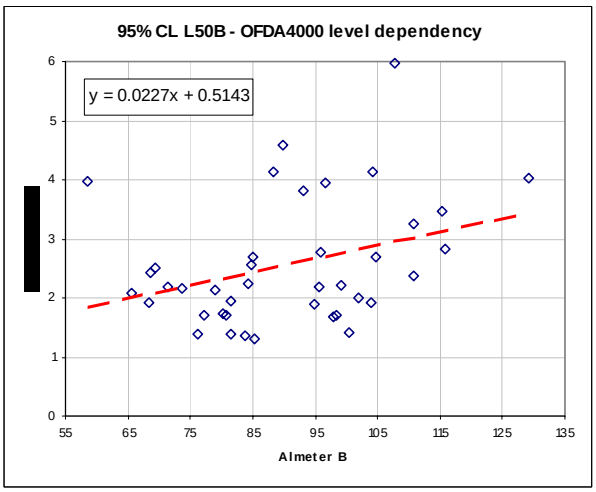

95% CL K50B - OFDA4000 vs Almeter
y = 0.7943x + 0.6106
Almeter

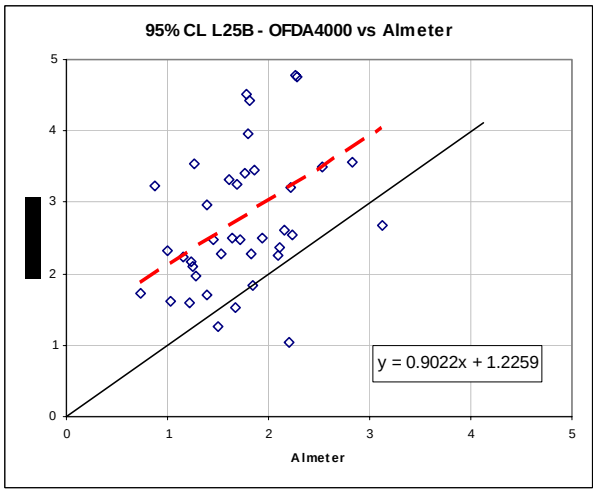

95% CL K50B - OFDA4000 level dependency
y = -0.0404x + 5.3986
Almeter B

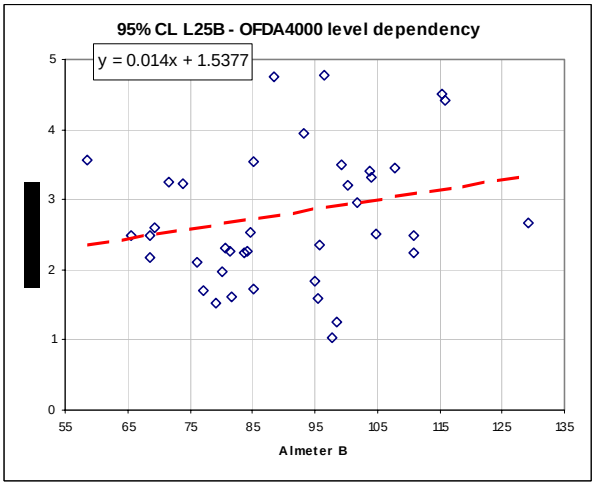

95% CL L95B - OFDA4000 vs Almeter
y = 0.5718x + 1.141
Almeter

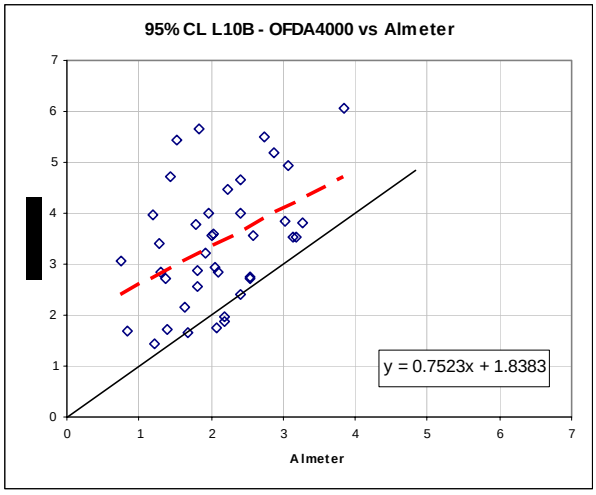

95% CL L95B - OFDA4000 level dependency
y = 0.0261x - 0.1012
Almeter B

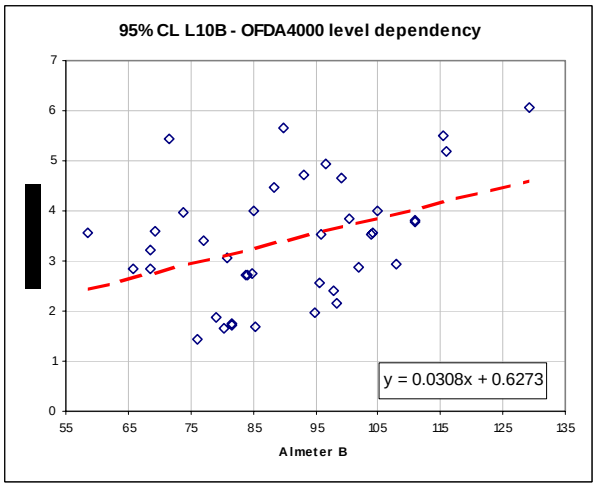

95% CL L50B - OFDA4000 vs Almeter
y = 0.7568x + 1.1686
Almeter

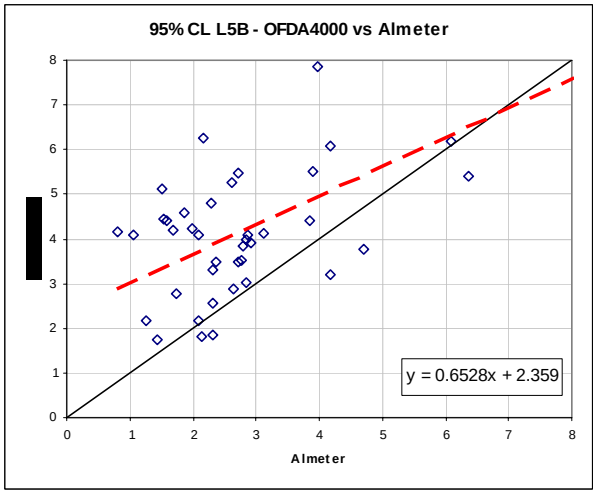

95% CL L50B - OFDA4000 level dependency
y = 0.0227x + 0.5143
Almeter B

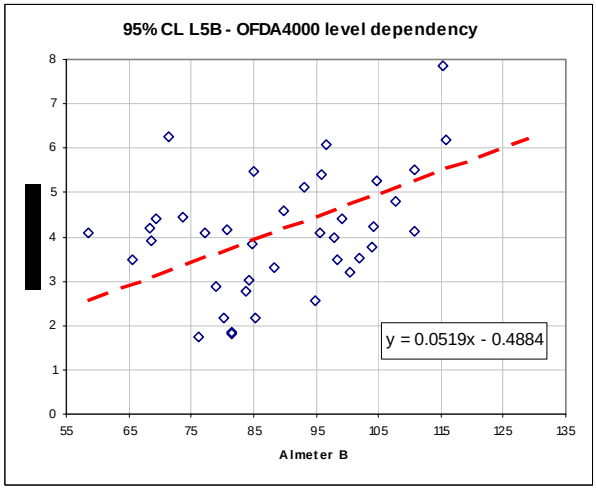

95% CL L25B - OFDA4000 vs Almeter
y = 0.9022x + 1.2259
Almeter

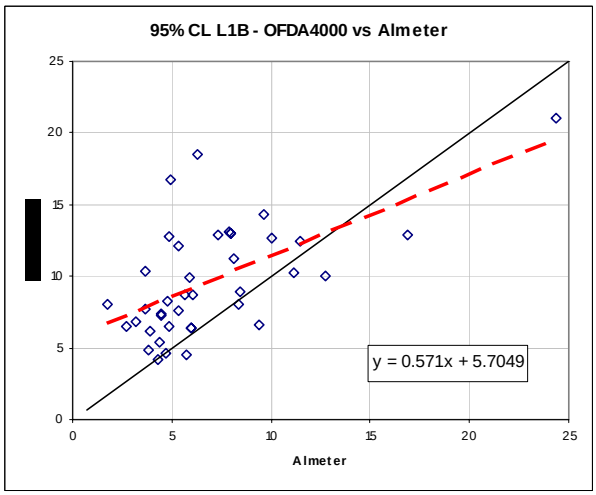

95% CL L25B - OFDA4000 level dependency
y = 0.014x + 1.5377
Almeter B

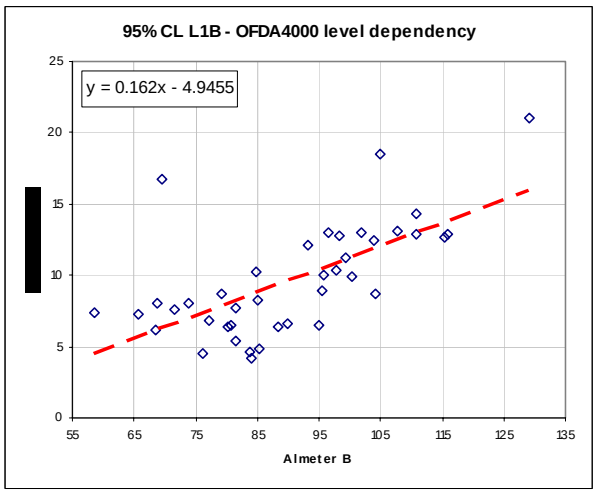

95% CL L10B - OFDA4000 vs Almeter
y = 0.7523x + 1.8383
Almeter


95% CL L10B - OFDA4000 level dependency
y = 0.0308x + 0.6273
Almeter B


95% CL L5B - OFDA4000 vs Almeter
y = 0.6528x + 2.359
Almeter


95% CL L5B - OFDA4000 level dependency
y = 0.0519x - 0.4884
Almeter B


95% CL L1B - OFDA4000 vs Almeter
y = 0.571x + 5.7049
Almeter


95% CL L1B - OFDA4000 level dependency
y = 0.162x - 4.9455
Almeter B

APPENDIX 7

PRECISION COMPARISON PLOTS FOR SELECTED RANGE OF PARAMETERS

95%CL VALUES BASED ON AVG OF 5 MEASUREMENTS (CERTIFICATION)