final report

Report on Ultrasound Proficiency Test on Beef Cattle

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Armidale, 25th and 26th May 2008
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A proficiency test for ultrasound scanners of beef cattle was organised by ABRI and AGBU. The proficiency test was conducted on the 25th and 26th May 2008 at the Armidale Saleyards. This report outlines the procedure and results of this ultrasound scanning proficiency test on beef cattle.

1. Outline of Proficiency Course

1.1 Scanning

Thirty two steers of mixed breed were accumulated for the test. These animals were purchased 10 weeks prior to the proficiency test and sixteen were grain fed with extra high protein and energy pelleted ration while 14 were mainly grass fed with some protein supplementation in the last few weeks. The animals remained on the property of origin at Inverell, NSW until being transported direct to the proficiency accreditation course.

Fourteen candidate scanners, thirteen using Pie equipment and one using an Aloka, attempted accreditation for ultrasound recording of rump and rib fat depth, eye muscle area (EMA) and intra-muscular fat percentage (IMF%). Three of the 14 candidates had not previously attempted a full proficiency test.

Two animals were excluded from the course based on temperament. The remaining 30 animals were scanned twice, with technicians scanning at the same anatomical locations and using the same animal handling equipment (crush) for both runs. The cattle were then slaughtered on Tuesday 27th May 2008 at Cargills abattoir, Tamworth and carcase measurements taken on the following day (Wednesday).

All technicians were able to scan all 30 animals twice. A time limit of six minutes per animal was enforced. The venue used for the test ensured that all elements of the accreditation exercise were carried out under cover. Animals had ad lib access to the ration to which they were adapted and water for the duration of the test, with the exception noted below, and then trucked to Tamworth on the Monday evening prior to slaughter. The pen of 16 animals that had been on extra feed prior to the course were incorrectly trucked from the Armidale Saleyards to Grafton late on the Sunday evening and returned from Grafton by mid-day Monday.

The 16 errant animals were obviously fatigued on their return to Armidale on Monday. They accepted water on offer, but lay down in the holding pen between accreditation runs and therefore did not consume much of the feed that was on offer. This behavior was not observed in the non-travellers.

All technicians had a scanning station to themselves, in sequentially aligned crushes. Official sheets were provided to record measurements. Sheets were collected at the end of each run with all measurements recorded. These were then photocopied and returned to participants for checking against the data entered into the computer. All PIE operators submitted all readings on the spot, ie all measurements were done crush-side. The candidate using the Aloka equipment submitted fat depth and EMA results crush side, but sent IMF results back after analyzing the images.

There were no delays during the scanning on the first day (Sunday) but a change to the program was necessary on Monday to accommodate the errant trucking event. While the animals were being trucked back to Armidale on Monday morning, the remaining 14 animals were scanned twice in two separate runs. The 16 errant animals were then scanned twice in two separate runs once they arrived back at the Armidale Saleyards. The road trip for these animals would take approximately 3 hours each way by truck.

1.2 Carcase

After all the animals were scanned by all technicians, cattle were trucked to Tamworth on Monday evening for slaughter on Tuesday 27th May 2008. Hence there was no delay between scanning and slaughter.

Carcase data was recorded on Wednesday 28th May by the first author, an AGBU staff member and two ABRI staff in the chiller at Cargill abattoir. The left sides of the carcases were quartered at the 12th/13th rib where rib fat and EMA measures were taken. Fat measurements were taken and eye muscles traced on the left side of each carcase by two measurers. The two measurers recorded fat depth and EMA independently of each other. EMA was assessed by tracing the outline of the *Longissimus dorsi* (LD) muscle onto transparent sheets. These traces were later digitised to provide an accurate assessment of EMA. P8 fat depths were measured on the carcasees using a cut and measure technique. Meat samples were collected from the LD muscle between the 12th and 13th ribs of the left side of each carcase. These samples were analysed at the UNE Meat Science laboratories to provide accurate measurements of IMF% (using the soxhlet technique). All fat and EMA carcase data were averaged over the two records for comparison with scanner data. No MSA grading results for EMA or fat were available, although P8 fat depth was recorded as part of the standard abattoir carcase specification.

2. Carcase Results

As a check of measurement techniques, correlations were calculated between measurers for EMA and fat. The correlation between carcase EMA measured by different operators on the same side was 0.95; 0.83 for rib fat and 0.91 for P8 fat. However, the correlation between the abattoir measures and the two operators for P8 fat was 0.55 and 0.51. The abattoir P8 fat was therefore not used in the subsequent analyses.

Damage to the carcase fat layers from the hide removal process was evident on at least 13 carcases. Some fat measures were difficult due to fat damage but a measure was taken for all carcases. Even so, scorers had 0.91 correlations for P8 fat measures and 0.83 for rib fat.

Table 1a presents descriptive statistics relating to the group of animals used for the 2008 proficiency clinic. Tables from previous years' proficiency clinics are included in Appendix I.

Table 1a: Carcase results for 30 animals measured in the 2008 proficiency clinic

	Range	Mean	Standard Deviation
P8 FD (mm)	2.0 – 11.5	7.23	2.4
Rib FD (mm)	1.5 – 8.0	4.45	1.7
EMA (cm^2)	57.8 – 87.9	76.65	7.7
IMF%	2.1 – 6.2	3.49	1.0

Based on the carcase results, it was felt that the animals presented for accreditation were reasonable for EMA and IMF. While the animals did not show as much variation in fat depth as anticipated, they were still suitable for accreditation.

There was some concern that the animals that traveled may have been adversely affected in their carcase traits. Descriptive statistics of the carcase data for Grass (non-travelers) and Fed (travelers) animals are given in Table 1b.

Table 1b: Carcase results for 30 animals measured in the 2008 proficiency clinic by feed/travel

Trait	Grass Animals (1-14) – non-Travel			Fed / Travel Animals (15-30)		
	Range	Mean	Std Dev	Range	Mean	Std Dev
P8 FD (mm)	2.0 – 10.5	7.11	2.6	4.0 – 11.5	7.34	2.2
Rib FD (mm)	1.5 – 8.0	4.29	1.8	1.5 – 8.0	4.59	1.7
EMA (cm^2)	57.8 – 87.2	75.8	8.6	64.4 – 87.9	77.4	7.0
IMF%	2.3 – 5.5	3.57	1.0	2.1 – 6.2	3.42	1.0

Note that the traveler animals were also the animals that were being fed a higher protein and energy pelleted ration. Hence, had the animals not traveled, there was an expectation that these animals might reflect the higher feeding regime in their carcase results and we may therefore expect differences in the means of the two groups of animals on this basis. However, this expected difference due to feeding was not evident in the carcase results. As further support for a discrepancy, the scanners on day 1 recorded an average IMF for the grain fed animals that was higher than the grass fed while the soxhlet results are ranked the opposite way. As a result of these concerns the carcase results for the animals that traveled to Grafton by mistake were removed from the scan vs carcase comparison.

3. Scanner Results

Results for scanners 1 – 14 are tabulated in the following tables. The criteria used for accreditation are:
1. Correlation of Repeatability (ie comparison of first scan results with their second scan)
2. Standard Error (SE) of Repeat Measures,
3. SE of Accuracy (scan compared with carcase)
4. Correlation of Accuracy.
5. SE of Accuracy to Selected Scanners (scanner compared to average of selected scanners)
6. Correlation of Accuracy to Selected Scanners

Adjustments are made to pass criteria according to the range of cattle provided for each test and the observed difficulty in scanning the animals. Based on the results and prior experience, two levels of accreditation are listed in the following Tables. The "Accreditation Criteria" is the standard full accreditation criteria and is used to award "Accredited" status. The "Provisional criteria" is the modified criteria which is used to give "Provisional accreditation". Provisional accreditation indicates that the scanner is below full accreditation level but shows some competency in scanning and should improve with practice. Fail status is given where the scanner does not meet the "Provisional" criteria.

In recent years, a further guide to proficiency using SE of accuracy against selected scanners and correlation to the selected scanners is also included. Scanners are selected based on their ability to attain a minimum standard for repeat measures based on proficiency criteria 1 and 2 above. Novice (first time at accreditation) scanners were not included. Seven scanners were used in the "selected scanners" average data for Fat, EMA and IMF. The 7 scanners were used because they had attained at least a "Provisional" status for Fat, EMA and IMF based on the scanner's repeatability proficiency levels (SE and correlation). The results of the 7 selected scanners were combined so that each animal was given the average of these seven scanners' results. The selected scanners comprised 3 scanners from Day 1 and 4 from Day 2.

3.1 Repeatability for Scanners

Repeatabilities are calculated by comparison of the first and second scans given by the scanner on each animal. Standard errors for repeatability (Table 2) of fat measurements was not a problem for any scanner. Most results are reasonable. However, scanner 3 failed to achieve required criteria for EMA and IMF.

Table 2: Standard Error for repeated measures

Scanner No.	P8	Rib	EMA	IMF
	SE of repeat Measures			
Accreditation Criteria	$\leq$**1.5**	$\leq$**1.5**	$\leq$**5.5**	$\leq$**1.0**
Provisional Criteria	$\leq$*2.0*	$\leq$*1.7*	$\leq$*8.0*	$\leq$*1.3*
1	0.93	0.79	4.73	0.53
2	0.83	0.93	3.76	0.49
3	1.48	1.25	8.88	1.44
4	1.11	0.76	4.16	0.80
5	0.76	0.86	3.65	0.81
6	1.30	1.20	4.50	0.57
7	0.50	0.61	2.76	0.65
8	0.81	0.88	6.05	0.95
9	1.05	0.69	2.24	0.54
10	0.18	0.25	0.67	0.10
11	0.79	0.57	2.49	0.89
12	0.83	0.52	2.69	0.54
13	0.61	0.64	3.27	0.57
14	0.79	0.69	4.05	0.58
Average	**0.86**	**0.76**	**3.85**	**0.68**
SD	**0.32**	**0.26**	**1.94**	**0.30**

Table 3: Correlations for repeated measures

Scanner No.	P8	Rib	EMA	IMF
	Correlations of Repeat Measures			
Accreditation Criteria	$\geq$**0.90**	$\geq$**0.85**	$\geq$**0.80**	$\geq$**0.70**
Provisional Criteria	$\geq$*0.75*	$\geq$*0.75*	$\geq$*0.70*	$\geq$*0.55*
1	0.89	0.81	0.72	0.71
2	0.89	0.76	0.53	0.48
3	0.79	0.75	0.33	0.57
4	0.83	0.81	0.82	0.57
5	0.92	0.76	0.74	0.60
6	0.83	0.76	0.76	0.89
7	0.97	0.91	0.89	0.77
8	0.90	0.78	0.41	0.72
9	0.84	0.76	0.85	0.85
10	0.99	0.97	0.99	1.00
11	0.93	0.86	0.87	0.70
12	0.91	0.94	0.84	0.80
13	0.96	0.92	0.86	0.74
14	0.92	0.86	0.69	0.67
Average	**0.90**	**0.83**	**0.74**	**0.72**
SD	**0.06**	**0.08**	**0.19**	**0.14**

Correlations for repeatability (Table 3) on fat and IMF are generally reasonable. However, four scanners did not meet provisional criteria for EMA. The accreditation criteria for rib fat is slightly lower than rump fat due to the lower standard deviation for rib fat.

3.2 Accuracy with Carcase

Scan EMA results again showed the tendency to under estimate the carcase measure for the larger EMAs (Figure 1) and the trend was similar to previous years (Figure 2).

Figure 1: Comparison of Difference (scan – carcase) for EMA – 2008 proficiency test (R^2=0.76).

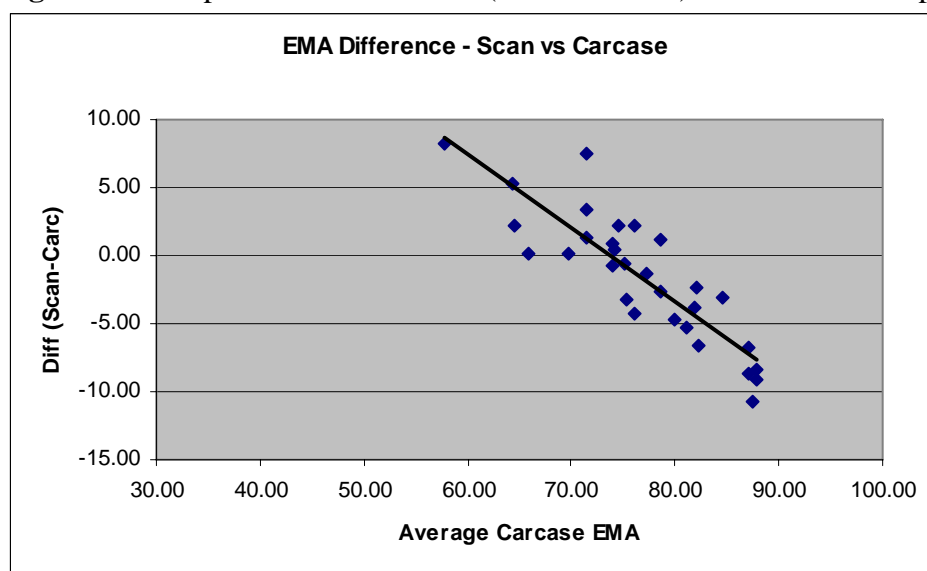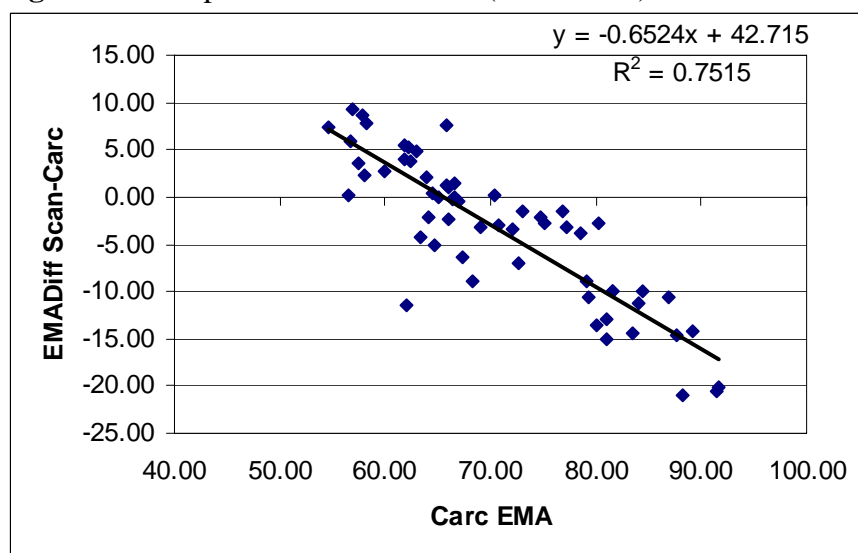**Figure 2:** Comparison of Difference (scan – carc) for EMA – 2004 & 2005 accreditation tests (R^2=0.75).

Abattoir accuracies are calculated by comparing the scan results for each scanner against the abattoir carcase measures for each trait.

Standard errors for accuracy with carcase measures (Table 4) for fat and EMA were generally reasonable with only scanner 3 having problems with EMA and IMF.

Table 4: Standard Error for accuracy with all carcase measures (n=30)

Scanner No.	SE with Carcase Measures			
	P8	Rib	EMA	IMF
Accreditation Criteria	≤1.5	≤1.5	≤5.5	≤1.0
Provisional Criteria	*≤2.0*	*≤1.7*	*≤8.0*	*≤1.3*
1	1.58	1.05	5.53	0.79
2	1.58	1.30	6.19	0.99
3	1.85	1.17	8.65	1.39
4	1.80	1.24	6.20	1.06
5	1.64	1.07	5.24	0.91
6	1.51	1.18	6.08	0.95
7	1.49	1.23	4.65	1.01
8	1.55	1.16	6.81	1.28
9	1.70	1.21	5.78	1.02
10	1.78	1.44	5.58	1.02
11	1.65	1.17	5.89	1.10
12	1.61	1.05	5.39	0.87
13	1.62	0.96	4.75	0.97
14	1.56	1.21	6.03	0.92
Average	**1.64**	**1.17**	**5.91**	**1.02**
SD	**0.11**	**0.12**	**0.98**	**0.16**

Correlations of scan results with carcase results (Table 5) for all traits is a concern. Given that some animals traveled between scanning days, further investigation of the scan and carcase relationships was warranted.

Table 5: Correlations for accuracy with all carcase measures (n=30)

Scanner No.	Correlations with Carcase Measures (n=30)			
	P8	Rib	EMA	IMF
Accreditation Criteria	≥0.90	≥0.85	≥0.80	≥0.60
Provisional Criteria	*≥0.75*	*≥0.75*	*≥0.70*	*≥0.50*
1	0.75	0.79	0.69	0.60
2	0.74	0.65	0.58	0.21
3	0.68	0.77	0.37	0.47
4	0.66	0.69	0.64	0.32
5	0.73	0.78	0.73	0.53
6	0.78	0.76	0.64	0.63
7	0.78	0.70	0.79	0.44
8	0.75	0.73	0.50	0.36
9	0.70	0.72	0.66	0.46
10	0.66	0.54	0.70	0.46
11	0.74	0.73	0.63	0.48
12	0.74	0.79	0.71	0.54
13	0.76	0.83	0.78	0.41
14	0.75	0.71	0.61	0.44
Average	**0.73**	**0.73**	**0.65**	**0.45**
SD	**0.04**	**0.07**	**0.11**	**0.11**

A basic review of potential changes in the animals is to compare the measures taken on Day 1 (Scanners 1-7) compared to those taken on Day 2 (scanners 8-14) for the traits of interest.

The first section of Table 6 (Scanners – Day 1 vs Day 2) compares the average results for each animal taken by scanners on the first day compared to different scanners scanning the same animals on the second day. The second section of Table 6 (Scanners Day 1 – Run 1 vs Run 2) compares the average results for each animal taken by scanners on the first day in their first run compared to the same scanners scanning the same animals on the second run on the same day.

Table 6. Comparison of averaged scan data - Day 1 versus Day 2; Day 1 Run 1 versus Run 2

| | Scanners – Day 1 vs Day 2 | | | | | Scanners Day 1 – Run 1 vs Run 2 | | | | |
| | Average (SD) | | Corr | Regrsn (ax+b) | | Average (SD) | | Corr | Regrsn (ax+b) | |
Trait	Day 1	Day 2	R	a	b	Run1	Run2	R	a	b
P8	7.2 (2.1)	7.0 (1.9)	0.976	0.96	0.09	7.1 (2.1)	7.3 (2.1)	0.973	0.95	0.48
Rib	5.3 (1.6)	5.0 (1.3)	0.969	0.87	0.37	5.4 (1.5)	5.3 (1.6)	0.947	0.96	0.15
EMA	77.4 (10.3)	72.7 (6.4)	0.926	0.80	10.61	77.6 (9.8)	77.3 (10.8)	0.939	0.89	8.12
IMF	5.2 (1.2)	4.7 (1.2)	0.876	0.94	0.08	5.1 (1.2)	5.2 (1.1)	0.869	0.81	1.07

The correlation between scanners on day 1 versus different scanners on day 2 is very similar to the correlations achieved by scanners on day 1 between runs 1 and 2 (ie their repeatability of scans). This would indicate that it is reasonable to compare the scan results from day 1 and day 2, and to compare all scan results to the carcase measures.

However, the raw phenotypic averages for the carcase traits from Day 2 are consistently less than for Day 1. This difference is not reflected between Runs 1 and 2 on Day 1. The percentage difference in the averages between Day 1 and Day 2 are 3% for P8 fat, 6% for rib fat, 6% for EMA and 10% for IMF.

Table 7. Average values for Abattoir and Scans by day of scan and feeding/traveling regimes

| | | Carcase | | Day 1 (scanners 1-7) | | | | Day 2 (scanners 8-14) | | | |
Trait	Grass / Fed (travel)	Avg	SD	Avg	SD	Diff	Cor	Avg	SD	Diff	Cor
P8	Non-Travel (n=14)	7.11	2.6	6.84	2.3	-0.27	0.82	6.79	2.3	-0.32	0.81
	Travel (n=16)	7.34	2.3	7.50	1.8	0.16	0.75	7.19	1.6	-0.15	0.77
	Avg Diff (trvl-non)	*0.23*	*-0.3*	*0.66*	*-0.5*			*0.40*	*-0.5*		
Rib	Non-Travel	4.29	1.9	5.04	1.7	0.76	0.96	4.82	1.5	0.54	0.94
	Travel	4.59	1.7	5.56	1.4	0.97	0.72	5.15	1.0	0.56	0.70
	Avg Diff (trvl-non)	*0.30*	*-0.2*	*0.52*	*-0.3*			*0.33*	*-0.5*		
EMA	Non-Travel	75.83	8.5	75.82	10.2	0.01	0.91	71.98	6.7	-3.85	0.91
	Travel	77.38	6.9	78.83	10.3	1.46	0.74	73.41	6.0	-3.97	0.66
	Avg Diff (trvl-non)	*1.55*	*-1.6*	*3.01*	*0.1*			*1.43*	*-0.7*		
IMF	Non-Travel	3.57	1.0	5.16	1.2	1.59	0.75	4.67	1.2	1.10	0.69
	Travel	3.42	1.0	5.17	1.1	1.75	0.58	4.82	1.1	1.40	0.51
	Avg Diff (trvl-non)	*-0.15*	*0.0*	*0.01*	*-0.1*			*0.15*	*-0.1*		

The "Travel" animals were the ones that traveled between scanning on Day 1 and Day 2.
"Cor" is correlation of Carcase to Average-Scans
"Diff" column is (Average-Scans – Carcase)

Note that the comparison between average scans between Day 1 and Day 2 is confounded by having different scanners on each day. That is, scanners 1-7 scanned on Day 1 and scanners 8-14 scanned on Day 2 - and no scanner scanned on both days. Table 7 compares the average data from the non-Travel animals (animals 1-14) and the Traveler animals (15-30) for the carcase results and the two scan Days. Note that the Travel animals were also the group that had been fed extra rations, whereas the non-Travel animals were mainly grass fed.

There are differences in the average values and standard deviations (Table 7) obtained by the two groups of scanners irrespective of whether the scanned animals traveled or not. The correlation between carcase and the average of the scanners was higher for the non-Travel animals than the Traveled animals in all cases – irrespective of scan day. This suggests that the Travel animals may have been more affected by their road trip than the average carcase data statistics would suggest.

Given the potential differences in Travel versus non-Travel animals, the SE of abattoir accuracy and correlation with abattoir carcases was calculated on just the non-travel animals (animals 1-14). These results are presented in Tables 8 and 9 respectively.

Table 8: Standard Error for accuracy with carcase measures for non-Travel animals (n=14)

	SE with non-Travel Carcase Measures (n=14)			
Scanner No.	**P8**	**Rib**	**EMA**	**IMF**
Accreditation Criteria	**≤1.5**	**≤1.5**	**≤5.5**	**≤1.0**
Provisional Criteria	*≤2.0*	*≤1.7*	*≤8.0*	*≤1.3*
1	1.63	0.82	5.74	0.81
2	1.58	0.89	6.06	0.97
3	1.67	0.92	8.89	1.49
4	1.80	0.90	5.19	1.05
5	1.66	0.88	4.93	0.84
6	1.58	1.15	6.09	0.79
7	1.48	0.92	4.22	0.93
8	1.49	0.81	7.03	1.23
9	1.97	1.15	5.36	1.02
10	2.07	1.23	4.94	1.09
11	1.65	1.07	5.11	1.01
12	1.53	0.66	5.36	0.91
13	1.75	0.83	4.45	0.78
14	1.52	0.96	6.14	0.76
Average	**1.67**	**0.94**	**5.68**	**0.98**
SD	**0.18**	**0.16**	**1.18**	**0.20**

Standard errors for accuracy with non-Travel carcase measures (Table 8) for all traits were generally reasonable with only scanner 3 having problems with EMA and IMF which is consistent with Table 4 where all carcase measures were considered. Scanners 9 and 10 are now showing as marginal for P8 fat whereas they were within the provisional limits in Table 4.

Table 9: Correlations for accuracy with carcase measures for non-Travel animals (n=14)

Scanner No.	P8	Rib	EMA	IMF
		Correlations with non-Travel Carcase Measures		
Accreditation Criteria	≥0.90	≥0.85	≥0.80	≥0.60
Provisional Criteria	*≥0.75*	*≥0.75*	*≥0.70*	*≥0.50*
1	0.78	0.89	0.73	0.56
2	0.79	0.87	0.73	0.31
3	0.79	0.87	0.47	0.65
4	0.73	0.86	0.79	0.38
5	0.77	0.87	0.84	0.66
6	0.80	0.82	0.69	0.75
7	0.82	0.85	0.87	0.59
8	0.82	0.89	0.57	0.48
9	0.66	0.78	0.82	0.49
10	0.61	0.74	0.87	0.49
11	0.79	0.81	0.80	0.52
12	0.81	0.94	0.78	0.54
13	0.78	0.89	0.85	0.61
14	0.82	0.84	0.71	0.65
Average	**0.77**	**0.85**	**0.75**	**0.55**
SD	**0.06**	**0.05**	**0.11**	**0.12**

There are many changes in the correlation of accuracy with non-Travel carcase measures (Table 9) compared to all measures (Table 5). There are fewer scanners failing to meet at least Provisional status in Table 9 compared to Table 4 for all traits. It was decided that Tables 8 and 9 were a better reflection of accuracy with carcase measures and these results have been used for accreditation purposes.

3.3 Accuracy with Selected Scanners

As a further test of accuracy, the average of selected scanners was used as a benchmark against which individual scanners were compared. While this statistic is a part-whole relationship, if one scanner is still divergent from the group then it indicates that he/she is getting a different result. The questions about accuracy of the carcase are removed. These results need to be considered in conjunction with the other results.

All scanners meet at least the provisional criteria for SE against the Selected scanners average (Table 10). The correlation to selected scanners (Table 11) indicates that scanners 2, 6 and 8 are marginal for EMA; scanner 3 is having problems for EMA and scanner 2 is having difficulty for IMF.

As with previous years proficiency test results, scanners have large positive biases (Table 12) compared to carcase measures for IMF (ie. they over-estimated the carcase IMF value). This is different to earlier research experiences where biases tended to be small and in the negative range. While carcase bias values are not used as accreditation criteria for BREEDPLAN, scanners should be aware of the biases compared to carcase values when conveying raw data. Table 13 looks at the biases of individual scanners against the Selected scanners. Scanner 3 appears to be an outlier for EMA bias in both Table 12 and 13.

Table 10: SE for accuracy with average of selected scanners

Scanner No.	P8	Rib	EMA	IMF
	SE with average of selected scanners			
Accreditation Criteria	≤1.5	≤1.5	≤5.5	≤1.0
Provisional Criteria	*≤2.0*	*≤1.7*	*≤8.0*	*≤1.3*
1	0.66	0.55	3.42	0.50
2	0.74	0.74	3.30	0.70
3	1.15	0.99	7.01	1.18
4	0.91	0.71	4.08	0.68
5	0.67	0.57	2.96	0.70
6	0.95	0.96	4.94	0.94
7	0.54	0.69	2.56	0.52
8	0.80	0.68	4.47	0.95
9	0.85	0.53	2.32	0.52
10	0.87	0.63	2.16	0.49
11	0.74	0.55	2.74	0.80
12	0.72	0.64	2.70	0.59
13	0.73	0.67	3.34	0.50
14	0.71	0.64	3.68	0.64
Average	**0.79**	**0.68**	**3.55**	**0.69**
SD	**0.15**	**0.14**	**1.28**	**0.21**

Table 11: Correlations for accuracy with average of selected scanners

Scanner No.	P8	Rib	EMA	IMF
	Correlations with average of selected scanners			
Accreditation Criteria	≥0.90	≥0.85	≥0.80	≥0.70
Provisional Criteria	*≥0.75*	*≥0.75*	*≥0.70*	*≥0.55*
1	0.94	0.90	0.84	0.75
2	0.92	0.83	0.69	0.38
3	0.87	0.86	0.46	0.68
4	0.88	0.81	0.83	0.62
5	0.94	0.88	0.81	0.64
6	0.90	0.87	0.65	0.62
7	0.96	0.87	0.91	0.83
8	0.90	0.84	0.61	0.66
9	0.89	0.87	0.85	0.86
10	0.88	0.82	0.87	0.89
11	0.94	0.87	0.83	0.73
12	0.93	0.93	0.83	0.73
13	0.96	0.93	0.86	0.78
14	0.93	0.87	0.71	0.60
Average	**0.92**	**0.87**	**0.77**	**0.70**
SD	**0.03**	**0.04**	**0.13**	**0.13**

Table 12: Biases for each trait against all carcase measures

Scanner No.	P8	Rib	EMA	IMF
			Trait Bias	
1	0.9	0.9	-2.7	2.2
2	0.9	2.0	2.9	2.3
3	-0.7	0.0	20.2	1.8
4	-1.1	0.1	-5.7	2.2
5	-0.1	0.7	-4.3	1.1
6	-0.1	1.7	-3.5	0.6
7	0.0	0.8	-1.5	1.5
8	-0.7	0.6	-11.0	-0.1
9	-0.2	0.6	-0.6	1.9
10	-0.2	0.6	-0.8	1.7
11	0.0	0.1	-2.4	1.5
12	-0.3	0.7	-1.7	1.7
13	-0.2	0.6	-9.4	1.1
14	0.0	0.6	-1.4	1.0
Average	**-0.1**	**0.7**	**-1.6**	**1.5**
SD	**0.5**	**0.5**	**7.2**	**0.7**

Table 13: Biases for each trait against Selected scanners

Scanner No.	P8	Rib	EMA	IMF
			Trait Bias	
1	0.9	0.3	0.4	0.6
2	0.8	1.4	6.0	0.7
3	-0.7	-0.6	23.4	0.3
4	-1.2	-0.5	-2.6	0.6
5	-0.1	0.1	-1.2	-0.5
6	-0.1	1.1	-0.4	-1.0
7	-0.1	0.2	1.6	-0.1
8	-0.7	0.0	-7.9	-1.7
9	-0.3	0.0	2.5	0.3
10	-0.2	0.0	2.3	0.2
11	0.0	-0.5	0.7	-0.1
12	-0.4	0.1	1.4	0.1
13	-0.2	0.0	-6.3	-0.5
14	-0.1	0.0	1.7	-0.6
Average	**-0.2**	**0.1**	**1.5**	**-0.1**
SD	**0.5**	**0.5**	**7.2**	**0.7**

3.4 Summary of Proficiency Results

Tables 14a and 14b present results for repeatabilities, accuracy with carcase and comparison to the average of selected scanners, rating the scanner results for fat, EMA and IMF as meeting Accredited (A), Provisional (P) or Fail (F) proficiency levels.

Each of the six accreditation criteria is given an "A", "P" or "F" rating for each trait. The symbol "^" is used to indicate that the scanner's result is very close to achieving the higher level (viz "P^" indicates just missed the "A" rating, "F^" has just missed the "P" rating).

These ratings are amalgamated across all six accreditation criteria for each trait to give each scanner a "Result" for the trait based on the following logic:

    A - all/most ratings are "A" with maximum of one "P" rating, no "F" rating allowed

    P^ - all/most ratings are "A" with maximum of one "P" and one "P^" rating, no "F" rating allowed

    P - all/most ratings are "A", "P^" or "P" with maximum of one "F" rating

    F^ - all/most ratings are "A", "P^" or "P" with maximum of one "F" and one "F^" rating

    F - two or more "F" ratings

A PBBA committee has allocated overall Proficiency Status for Fat/EMA combined and IMF and this is recorded in the "PBBA Status" column. Some leniency was given to the "P^" and "F^" Results. Note that if either Fat or EMA is a Fail, then the whole accreditation is a Fail as Fat and EMA are considered fundamental scanning traits. However, a Fail for IMF only will be a Fail for that trait only.

Table 14a: Report Card for Scanners 1 to 7

Scanner Number	PBBA STATUS	Trait	Result	Repeatability		Carcase (14) Accuracy		Accuracy Sel Scanners	
				SE	Corr.	SE	Corr.	SE	Corr.
1	PROV	P8 Fat	**P**	A	P^	P	P	A	A
		Rib Fat	**A**	A	P	A	A	A	A
		EMA	**P**	A	P	P	P	A	A
	ACCRED	IMF	**A**	A	A	A	P	A	A
2	PROV	P8 Fat	**P**	A	P^	P	P	A	A
		Rib Fat	**P**	A	P	A	A	A	P
		EMA	**F^**	A	F	P	P	A	F^
	FAIL	IMF	**F**	A	F	A	F	A	F
3	FAIL	P8 Fat	**P**	A	P	P	P	A	P
		Rib Fat	**A**	A	P	A	A	A	A
		EMA	**F**	F	F	F	F	P	F
	FAIL	IMF	**F**	F	P	F	A	P	P
4	PROV	P8 Fat	**P**	A	P	P	F	A	P
		Rib Fat	**P**	A	P	A	A	A	P
		EMA	**A**	A	A	A	P^	A	A
	PROV	IMF	**P**	A	P	P^	F	A	P
5	ACCRED	P8 Fat	**P**	A	A	P	P	A	A
		Rib Fat	**A**	A	P	A	A	A	A
		EMA	**A**	A	P	A	A	A	A
	PROV	IMF	**P**	A	P	A	A	A	P
6	PROV	P8 Fat	**P**	A	P	P	P	A	A
		Rib Fat	**P**	A	P	A	P	A	A
		EMA	**F^**	A	P	P	F^	A	F
	ACCRED	IMF	**A**	A	A	A	A	A	P
7	ACCRED	P8 Fat	**A**	A	A	A	P	A	A
		Rib Fat	**A**	A	A	A	A	A	A
		EMA	**A**	A	A	A	A	A	A
	ACCRED	IMF	**A**	A	A	A	P^	A	A

    * Note that if either fat or EMA is a Fail, then the whole accreditation is a Fail as Fat and EMA are considered fundamental scanning traits. However, a Fail for IMF only will be a Fail for that trait only.

    ^ result is only marginally outside the criteria for the higher category (-0.01 for Cor; +0.05 for SE)

Table 14b: Report Card for Scanners 8 to 14

Scanner Number	PBBA STATUS	Trait	Result	Repeatability		Carcase (14) Accuracy		Accuracy Sel Scanners	
				SE	Corr.	SE	Corr.	SE	Corr.
8	**FAIL**	P8 Fat	**A**	A	A	A	P	A	A
		Rib Fat	**P^**	A	P	A	A	A	P^
		EMA	**F**	P	F	P	F	A	F
	FAIL*	IMF	**P**	A	A	P	F	A	P
9	**PROV**	P8 Fat	**P**	A	P	P	F	A	P^
		Rib Fat	**P**	A	P	A	P	A	A
		EMA	**A**	A	A	A	A	A	A
	PROV	IMF	**P**	A	A	P^	F^	A	A
10	**PROV**	P8 Fat	**P**	A	A	F†	F	A	P
		Rib Fat	**P**	A	A	A	F^	A	P
		EMA	**A**	A	A	A	A	A	A
	PROV	IMF	**P**	A	A	P	F^	A	A
11	**ACCRED**	P8 Fat	**P**	A	A	P	P	A	A
		Rib Fat	**A**	A	A	A	P	A	A
		EMA	**A**	A	A	A	A	A	A
	ACCRED	IMF	**P^**	A	A	P^	P	A	A
12	**ACCRED**	P8 Fat	**P^**	A	A	P^	P	A	A
		Rib Fat	**A**	A	A	A	A	A	A
		EMA	**A**	A	A	A	P	A	A
	ACCRED	IMF	**A**	A	A	A	P	A	A
13	**ACCRED**	P8 Fat	**P**	A	A	P	P	A	A
		Rib Fat	**A**	A	A	A	A	A	A
		EMA	**A**	A	A	A	A	A	A
	ACCRED	IMF	**A**	A	A	A	A	A	A
14	**PROV**	P8 Fat	**P^**	A	A	P^	P	A	A
		Rib Fat	**A**	A	A	A	P^	A	A
		EMA	**P**	A	F^	P	P	A	P
	PROV	IMF	**P**	A	P	A	A	A	P

*   *Note that if either fat or EMA is a Fail, then the whole accreditation is a Fail as Fat and EMA are considered fundamental scanning traits. However, a Fail for IMF only will be a Fail for that trait only.*
^   *result is only marginally outside the criteria for the higher category (-0.01 for Cor; +0.05 for SE)*
†   *indicates trait was Provisional when all carcase data considered.*

Two scanners failed proficiency accreditation – both on the basis of their EMA results. Another scanner failed IMF accreditation but gained Provisional status for Fat and EMA. Another 7 scanners achieved Provisional status in either Fat /EMA or IMF and four scanners achieved Accredited status for both Fat/EMA and IMF.

The summary of Scanners by Result category (Table 15) indicates that scanners need to be vigilant in taking repeatable measures as nearly half the candidates had difficulty with the correlation of repeat measures. This suggests technique problems that these Scanners need to address. In general, Scanners had less trouble with achieving standard error guidelines than the correlations.

Table 15. Percentage of scanners by Result category

Trait	Repeatability						Abattoir Acc (14)						Sel Scanners Acc						All Comparisons					
	Std Error			Correl.			Std Error			Correl			Std Error			Correl.			Std Error			Correl.		
	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F	A	P	F
P8	100	0	0	57	43	0	14	79	7	0	79	21	100	0	0	71	29	0	71	26	2	43	50	7
Rib	100	0	0	43	57	0	100	0	0	64	29	7	100	0	0	71	29	0	100	0	0	60	38	2
EMA	86	7	7	50	21	29	57	36	7	43	36	21	93	7	0	64	7	29	79	17	5	52	21	26
IMF	93	0	7	64	29	7	57	36	7	36	29	29	93	7	0	50	43	7	81	14	5	50	33	14

Scanners obtaining **Accredited** Status are eligible to have their records submitted to BREEDPLAN for genetic evaluation purposes for the next 3 years. Accredited Status scanners will need to present themselves for re-accreditation within three years to re-evaluate their Scanning Status.

Scanners obtaining **Provisional** Status are eligible to have their records submitted to BREEDPLAN for genetic evaluation purposes for the next 12 months. Provisional Status scanners will need to present themselves for re-accreditation within 12 months to re-evaluate their Scanning Status.

Scanners who **Fail** this accreditation are **not** eligible to have their records submitted to BREEDPLAN for genetic evaluation purposes. These scanners may request a crush side test to gain Provisional Status. These crush side tests will be conducted in accordance with PBBA guidelines. It is the responsibility of the scanner to organize this crush side test and at his/her own expense. Scanners will need to meet Accreditation Criteria at the crush side test to gain the Provisional Status (as outlined above). If successful, the scanner will also need to attend the next available full accreditation test following their crush side assessment in order to be re-evaluated to determine their new Scanning Status.

Scanners who do not have either a current Accredited or Provisional Status will not have their scan data accepted by Breed Societies (and hence not be available to be analysed in BREEDPLAN).

4. Summary and Conclusion

A committee of the PBBA has met and considered the results of the 2008 scanning proficiency accreditation test. Aggregate results are shown in the "PBBA Status" column of Tables 14a and 14b. Scanners have been awarded a Scanning Status of either Accredited (ACCRED), Provisional (PROV) or Fail (FAIL) for P8 fat, Rib fat and EMA combined and IMF. These are based on the Results for each trait.

Four scanners gained full accreditation, 7 gained Provisional status, one failed IMF but was provisional for Fat/EMA and two failed to meet proficiency guidelines.

Scanners generally have less trouble meeting standard error guidelines than correlations. This indicates that some scanners need to review their technique in taking measurements.

Overall results from the proficiency accreditation course are reasonable and continue to indicate that scanners need to be retested on a regular basis and that ongoing scanning experience is a pre-requisite for meeting accreditation standards.

* * * *

APPENDIX I

Carcase Statistics from Previous Proficiency Clinics

The following tables are the summary statistics of the carcase measures obtained from previous proficieny clinics.

Table A1. Summary of carcase data from 30 animals used in 1998 accreditation test

	Range	Mean	Stand. Deviation	SED Left-Right
Left Side				
P8 FD (mm)	4.7 – 18.3	9.8	3.1	
Rib FD (mm)	1.7 – 12.3	5.7	3.0	
EMA (cm^2)	59.7 – 92.6	72.3	9.5	
Right Side				
P8 FD (mm)	4.7 – 17.7	9.8	2.9	
Rib FD (mm)	1.3 – 12.3	5.4	3.1	
EMA (cm^2)	57.1 – 86.4	69.7	8.8	
Average				
P8 FD (mm)	4.7 – 18.0	9.8	3.0	0.9
Rib FD (mm)	1.7 – 12.2	5.6	3.0	0.8
EMA (cm^2)	58.4 – 88.8	71.0	9.1	2.5
IMF%	2.00 – 7.75	3.95	1.31	

Table A2. Summary of carcase data from 24 animals used in 1999 accreditation test

	Range	Mean	Stand. Deviation	SED Left-Right
Left Side				
P8 FD (mm)	4.0 – 19.3	9.9	3.8	
Rib FD (mm)	4.3 – 14.7	8.0	2.9	
EMA (cm^2)	53.1 – 86.1	67.9	8.7	
Right Side				
P8 FD (mm)	3.7 – 20.5	9.9	3.9	
Rib FD (mm)	4.7 – 11.7	7.7	2.0	
EMA (cm^2)	51.7 – 83.4	66.6	8.7	
Average				
P8 FD (mm)	3.8 – 19.8	9.9	3.7	1.0
Rib FD (mm)	4.5 – 13.2	7.8	2.3	1.8
EMA (cm^2)	52.4 – 84.8	67.2	8.8	2.9
IMF%	2.28 – 7.08	3.94	1.19	

Table A3. Summary of carcase data from 30 animals used in 2000 accreditation test

	Range	Mean	Stand. Deviation	SED Left-Right
Left Side				
P8 FD (mm)	1.0 – 15.7	8.5	3.8	
Rib FD (mm)	0.7 – 13.7	5.6	3.1	
EMA (cm^2)	54.2 – 89.9	70.7	8.7	
Right Side				
P8 FD (mm)	2.0 – 15.0	9.0	3.8	
Rib FD (mm)	1.3 – 13.7	6.9	3.3	
EMA (cm^2)	53.7 – 93.2	71.2	9.3	
Average				
P8 FD (mm)	1.5 – 14.8	8.8	3.1	1.1
Rib FD (mm)	1.3 – 12.7	6.2	3.8	1.4
EMA (cm^2)	53.9 – 91.5	71.0	8.9	3.1
IMF%	1.7 – 6.0	3.30	1.00	

Table A4. Summary of carcase data from 29 HEIFERS used in 2002 accreditation test

	Range	Mean	Stand. Deviation	SED Left-Right
Left Side				
P8 FD (mm)	3.0 – 25.0	9.5	5.1	
Rib FD (mm)	1.7 – 11.3	6.6	2.6	
Right Side				
P8 FD (mm)	4.3 – 26.5	11.0	4.9	
Rib FD (mm)	2.0 – 12.0	6.5	3.0	
Average				
P8 FD (mm)	3.0 – 25.8	10.5	4.7	0.5
Rib FD (mm)	1.8 – 12.0	6.9	2.8	0.5
EMA (cm^2)	52.0 – 81.5	65.9	9.0	0
IMF%	2.2 – 7.1	4.2	1.2	

Table A5: Carcase results for 30 heifers scanned in the 2004 accreditation clinic

	Range	Mean	Stand. Deviation
P8 FD (mm)	4.8 – 18.0	10.9	3.1
Rib FD (mm)	3.0 – 14.8	8.7	2.9
EMA (cm^2)	56.5 – 91.6	76.4	9.6
IMF%	1.9 – 5.2	3.1	0.8

Table A6: Carcase results for 29 heifers scanned in the 2005 accreditation clinic

	Range	Mean	Stand. Deviation
P8 FD (mm)	5.3 – 19.4	10.69	3.5
Rib FD (mm)	3.3 – 9.7	7.14	1.5
EMA (cm^2)	53.5 – 76.7	63.8	6.2
IMF%	1.5 – 4.3	2.6	0.8

Table A7: Carcase results for 30 animals scanned in the 2007 accreditation clinic

	Range	Mean	Stand. Deviation
P8 FD (mm)	1.3 – 13.5	4.60	2.8
Rib FD (mm)	1.0 – 7.0	3.12	1.7
EMA (cm^2)	57.8 – 87.9	76.7	7.7
IMF%	0.4 – 2.8	1.3	0.6