Comparisons of moisture Content of wool in bulk by the Malcam Equipment and the Standard IWTO Procedures

By

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SUMMARY

At the sliver group meeting hold in Biella in November 2005, a report concerning the determination of the invoice mass of tops by microwave method was presented.

At the time of this meeting four combing mills had installed and tested this method using the MMA 2020. A mill located in Belgium has been trialling the machine this method since July 2006 for the measurement of moisture content of scoured and carbonised wool and a second located in England for the measurement of moisture of scoured wool. This present report summarizes the comparative results obtained over a period of three months. Lots of scoured, carbonised wool and cashmere were used for this purpose. The regain of each bale was measured by the conventional method (IWTO 33-98) for comparison

INTRODUCTION

The MMA 2020 is the equipment using microwave technology to determine the invoice weight of scoured or carbonized wool and tops. A paper was first presented at the Commercial Technology Forum in Barcelona. It was then published (Report CTF 04). A second one was presented at the Sliver Group in Biella. It was then published (SG Submission 03).One mill in Belgium currently using this method and their results were used to establish the comparison between these methods to the standard

This report has been prepared to provide information to Technical and Commercial delegates to IWTO relevant to the performance of the microwave method for the determination of moisture percentage of scoured and carbonised wools and the calculation of the precision.

METHODOLOGY

INSTRUCTIONS

The instructions given to each of the two participants are detailed below:

<table>
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Stage 1 - Calibration verification

1. Take at least 30 samples from different 30 bales that have been produced in the line (do it a part of your regular operation mode as was mentioned in the IWTO regulation) and attached the MMA result for each sample.
2. Measure the sample in the IWTO TM 33.
3. Calculate the New A and B parameters and insert the new parameters to the system.

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Stage 2 - Validation

1. Take at least 30 samples from different 30 bales FROM OTHER SIMILAR LOTS that have been produced in the line (do it as a part of your regular operation mode as was mentioned on the IWTO regulation) and attached the MMA result for each sample.
2. Measure the sample in the existing laboratory measuring method.
3. The statistical result of the grouping MALCAM Vs. grouping OV method should be as the following:

      a. 67% of bales within 0.5% of moisture difference
      b. 91% of bales within 1% of moisture difference
      c. 97% of the result within 1.5% of moisture difference

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The moisture content was determined by using the two methods:

- IWTO – 33-98; and

- The MALCAM Microwave Method.

CALIBRATION

At least 30 bales of each family were conditioned in accordance with the appropriate IWTO Condition Testing Regulations for wool tops.

The measured moisture of the samples from the QC laboratory, using the existing laboratory measuring method, was collected.

The results for Stage 1 were used to calibrate the MMA.

The calibration process is done by comparing the MMA results to the IWTO Lab standard method. The linear regression should be implemented on calibration data.

CALCULATION OF THE REGAIN

The following linear regression model explains relationship between MMA readings (X) and results of testing by IWTO-33 standard method (Y):

$Y = A*X + B + C*(T_c - t^o)$

Where:

A – Calibration constant (Slope)

B – Calibration constant (Regression intercept)

$$X = \sum_{i=1}^{n} x_i$$

n – Number of measurements in the bale

n ≤ 1,000

x_i – sample (slice)

T_c – Calibration temperature

t^o – Current temperature of material   C – Temperature dependence constant

The moisture of the bales of each presentation is measured using the MMA.

The samples from different bales (1 sample per bale) are taken from regular production in the line and then tested by the IWTO-33 standard method.

PARTICIPANT

TRAITEX VERVIERS (Belgium)°

Description of the lots

See table 1:description of the lots

Table 1:description of the lots:

lot	bales number	brut weight	type of wool	micron
10051	2	543	carbonised bleached	34
33645	20	5625	blended	-
33646	50	14540	scoured bleached	33
33647	2	590	scoured bleached	33
33652	24	6963	scoured bleached	30
33569	37	4217	scoured cashmere	-
33570	18	5105	scoured cashmere	-
33573	81	24138	scoured cashmere	-
33574	80	23588	scoured cashmere	-
33619	32	9658	scoured cashmere	-
33603	17	4849	scoured white	35
33625	34	10195	scoured white	31
33633	4	1117	scoured white	35
33651	10	2982	scoured white	30
33659	47	14030	scoured white	34
33665	67	20095	scoured white	36
33670	84	25051	scoured white	32
33671	33	9538	scoured white	35
33675	34	5305	scoured white	34
33681	21	6263	scoured white	34
33684	20	5585	scoured white	34
24 lots	717 bales	199977 kg		

RESULTS AND DISCUSSION

Example of the data examined

LOT	bale No	Weight	regain	Branca	Operator	C/M	Date	Time	SD	Type
10051	1	274	12,68	12,85	JMP	C5	19/09/2006	14:24	0,27	0

The collection sheet is print by the Malcam 2020 and competed by the operator who reports the regain determined by IWTO-33-98 (apparatus BRANCA) and the calibration used (type)

CALIBRATION

Pre - calibration

As the Malcam equipment was used for the same time a pre-calibration has to be done for each type of wool as basis of the calculation of the calibration factors. The pre-calibration factors are:

A = 1

B = 0

As the scale was not connected to the malcam 2020 at the beginning of the experimented, the first calibrations were calculated manually.

Examples of calibration

They are given for the types of wool, *scoured white wool, scoured cashmere and scoured coloured wool*

Table 2: results of calibrations:

Type	Pre-calibration				calibration			
	IWTO-33	Malcam 2020	Diff	factors	IWTO-33	Malcam 2020	diff	factors
White scoured	13.47	13.33	0.14	A = 1 B = 0	13.47	13.48	0.01	A = 1 B =0.15
Scoured cashmere	14.80	15.73	-0.93	A = 1 B = 0	14.80	14.73	0.07	A = 1 B = -1
Scoured coloured wool	8.99	10.83	-1.84	A = 1 B = 0	8.99	9.61	-0.62	A = 1 B -1.22

Table 2: legend of the calibration curves

Type	designation	Factor A	Factor B
White scoured	C 1	1	+0.5
Scoured coloured wool	C 2	1	-1.22
Scoured cashmere	C 3	1	-1

Comments from MALCAM on the calibration curves

There is no need to recalibrate the system at Traitex; as part of MALCAM on going support the fine calibration process will be implemented, based on new received data. (MALCAM expects no changes in the A factor but minor adjustments of B factor.)

Regarding automatic calibration, the situation at Traitex now (after scale connection) is that the regain calculations are performed automatically and there is no need for recalibration

COMPARATIVE RESULTS BETWEEN THE TWO METHODS

Procedure of the hand sampling

The operator takes a sample of about 300 from the bulk during the loading of the bale press bale, the samples of 8 consecutive bales are blended and about 500 grams of the mass are used for the determination of regain according the method IWTO-33-98. This procedure is the routine procedure in application in the mill.

Results presented by type of wool

Table 3 **:** carbonised bleached

lot	brut weight	micron	iwto-33	MMA 2020	diff iwto/MMA
10051	543	34	12,85	12,78	0,07

Table 4**:** carbonised bleached

lot	brut weight	micron	iwto-33	MMA 2020	diff iwto/MMA
33645	5625	-	10,83	11,40	-0,57

Table 4 : scoured bleached

lot	brut weight	micron	iwto-33	MMA 2020	diff iwto/MMA
33646	14540	33	12,60	12,29	0,31
33647	590	33	12,78	12,97	-0,19
33652	6963	30	12,31	11,98	0,33
		Average	**12,56**	**12,41**	**0,15**

Table 5 : scoured cashmere

lot	brut weight	micron	iwto-33	MMA 2020	diff iwto/MMA
33569	4217	-	15,46	15,52	-0,06
33570	5105	-	13,62	12,95	0,67
33573	24138	-	14,80	14,73	0,07
33574	23588	-	15,03	15,55	-0,52
33619	9658	-	15,65	16,37	-0,72
		average	**14,91**	**15,02**	**-0,11**

Table 6 : scoured white

lot	brut weight	micron	iwto-33	MMA 2020	diff iwto/MMA
33603	4849	35	15,07	14,33	0,74
33625	10195	31	12,10	13,02	-0,92
33633	1117	35	12,50	12,48	0,02
33651	2982	30	15,35	15,55	-0,20
33659	14030	34	12,95	13,41	-0,46
33665	20095	36	13,24	13,66	-0,42
33670	25051	32	13,52	13,40	0,12
33671	9538	35	12,50	12,27	0,23
33675	5305	34	13,74	14,06	-0,32
33681	6263	34	12,92	12,88	0,04
33684	5585	34	13,79	13,53	0,26
		average	**13,26**	**13,43**	**-0,17**

Statistical Analysis of the results of the type cashmere and the type soured wool.

 The data obtained are analyzed according the IWTO-0 procedure (appendix B). In order to analyze a significant number of results, the lots have been analyzed together. Certain lots have been sampled by batch of 8 bales according to the sampling procedure in use in the mill. In this case, the average of the results of the same 8 bales is calculated to obtain the pair
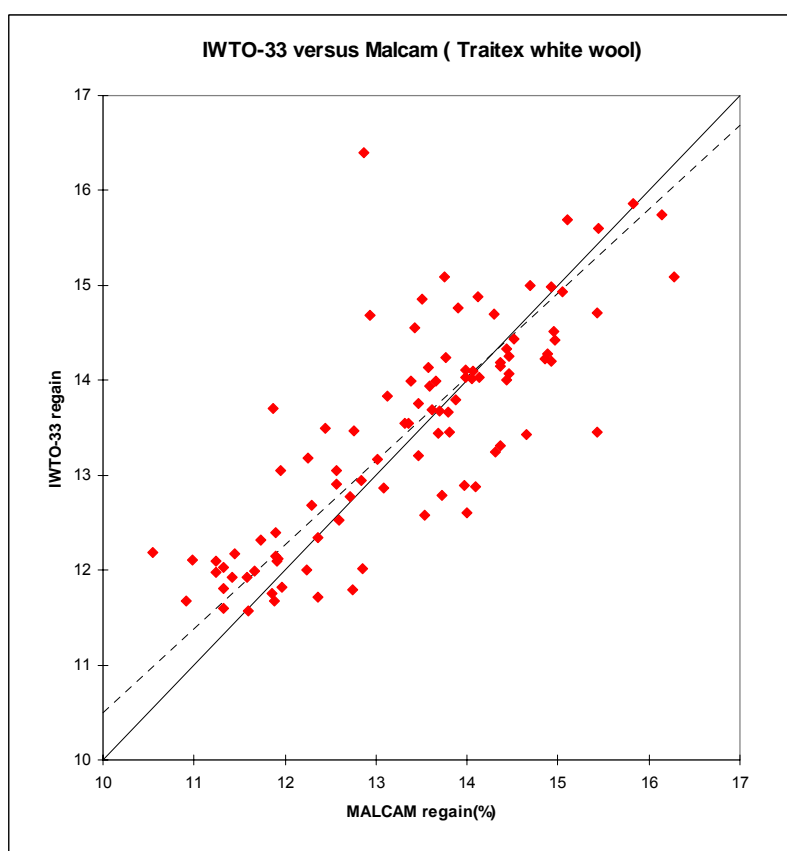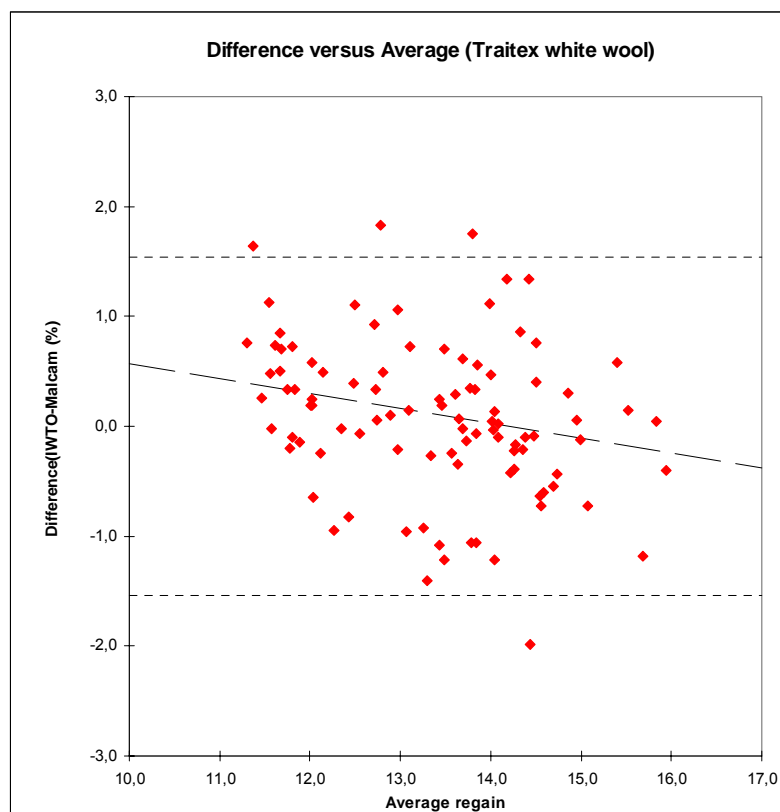
Type white scoured wool

Table 7: lots analysed

Lot	Number of bales	quality
33616	25	White medium 30 microns
33636	24	White medium 30 micron
33614	25	Bleached 25 microns
33588	23	White medium 35 micron

Table 8 : results of the statistical analyse

PAIRED TESTS			Correlation factor	signification
Average difference	**Standard deviation**	**signification**		
0.11	0.78	**N.S**	**0.80**	*******

<u>Graph 1 : scoured white wool</u>

Difference versus Average (Traitex white wool)

IWTO-33 versus Malcam (Traitex white wool)

Type scoured cashmere

Table 9: lots analysed (regain IWTO grouped)

Lot	Number of bales
33569	38
33670	18
33673	82
33574	21

Table 8 : results of the statistical analyse

PAIRED TESTS			Correlation factor	signification
Average difference	**Standard deviation**	**signification**		
0.23	0.71	**N.S**	**0.90**	*******

Graph 2 : scoured cashmere

Difference versus Average (Traitex cashmere)

IWTO-33 versus Malcam (Traitex cashmere)
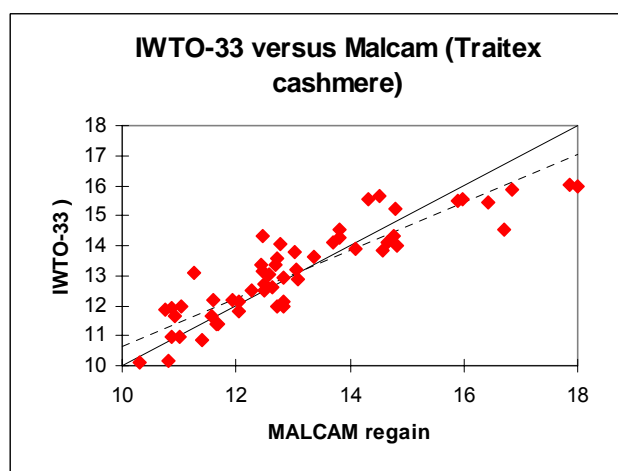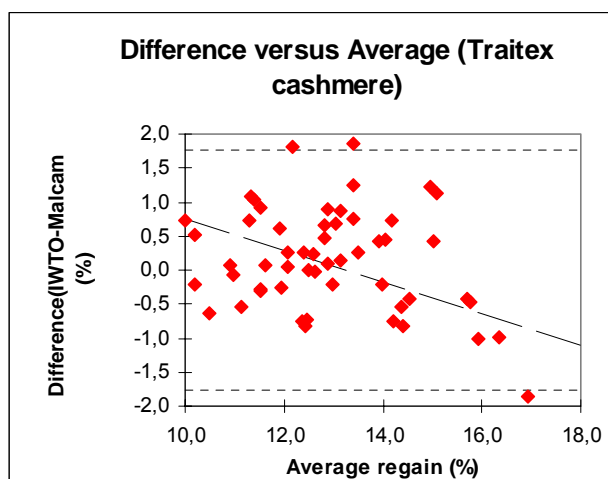
DISCUSSION

The tables 5, 6, 8 and 9 and the graphics 1 and 2 show a statistical analysis of the average results site and the types of wool. The Analysis shows high correlation and low standard deviation between the two methods. The results also show that the equipment meets the requirements we have set and it is an accurate and reliable method for determining moisture levels in wool

Comparison of the two methods

The measurement of regain by the oven method is a direct method, the measurement of regain by the Malcam method is an indirect method, It have to be compared to the oven method.

The variance of the IWTO 33-98 method is due to two factors

 ➢ The measurement
 ➢   The hand sampling (picking out of the sampling and unevenness of moisture of the wool intra the wool lot)

The variance of the MALCAM method is due to one factor
The measurement

Comparison of the sampling

<div align="center">Table 10: Comparison of the sampling</div>

method	IWTO 33-98	Malcam method
Size of the sample per bale	0.8 kg	All the bale(300 kg)
Weight used for the measurement	400 grams	80%(240 kgs)*
Frequency of the measurement	Each 8 bales	Each bale
Number of measurement per sample	1	800

Remark : 1000 measurements of the MALCAM 2020 are carried out per bale but due to the shape of the bale the 100 measures of the beginning and 100 measures of th end of the bales are discarded

<div align="center">Table 11: Comparative examples of the two samplings</div>

|			iwto method	malcam method
lot	bales number	weight of the bales	quantity measured	quantity measured
10051	2	543	0,8	434
33645	20	5625	8	4500
33646	50	14540	20	11632
33647	2	590	0,8	472
33652	24	6963	9,6	5570
total	98	28261	39	22609
	percentage of the weight measured		0,1%	80,0%

The high correlation and low standard deviation between the two methods proves also that the procedure of the hand sampling is well respected. This respect is important as the moisture of scoured lots may be sometimes uneven As the MMA 2020 calculates the standard deviation intra–bale it is possible to compare the evenness of moisture of tops and scoured wool

<u>Table 11: standard deviation of regain intra bale</u>

SD Average of the 45 first bales

BUMP 400 KG				SCOURED WOOL			
9344 P	9296 P	9307 P	9309 P	33573	33574	33622	33647
0,37	0,46	0,33	0,32	0,88	0,88	0,85	0,44

Graph 3: standard deviations of 45 bales
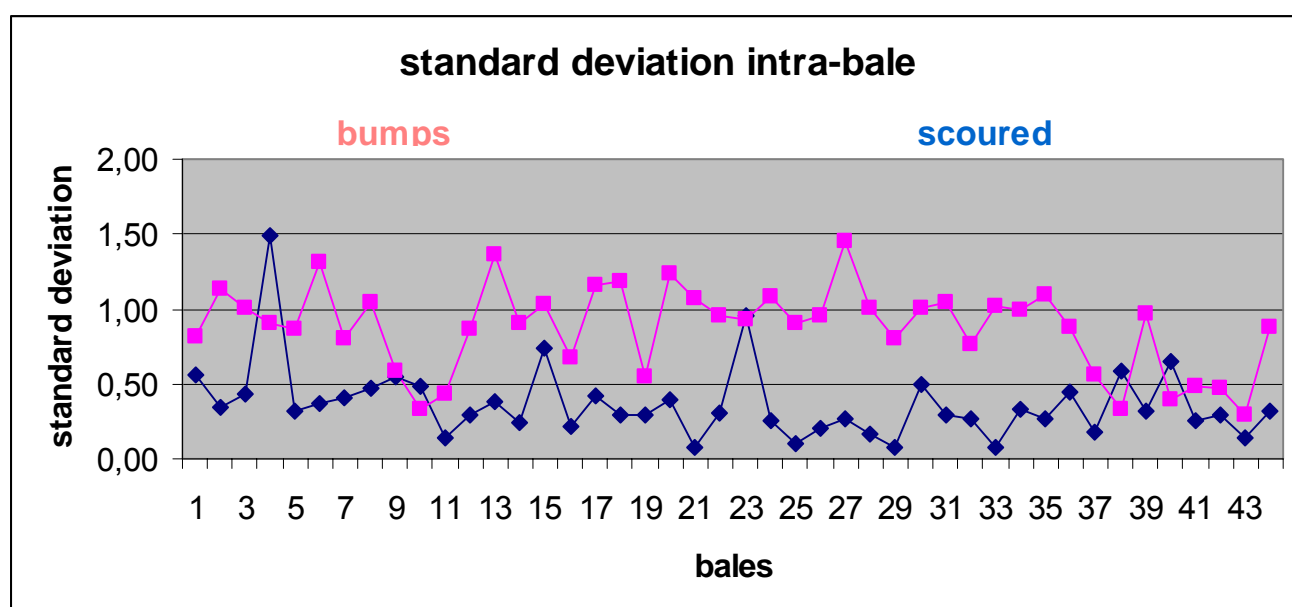
PRECISION

PRECISION

As never an average moisture content of a consignment measured by a Malcam equipment will be measured by a Malcam equipment in operation in an other mill, and only a measurement is carried out per bale, it is not possible to determine the variances required by IWTO- 0 (appendix B page 14).

> **The 95 %confidence limit of the average value within the consignment has to be used**

Table 12: Example of the 95 %confidence limits according to the size of the consignment

In comparison with the IWTO-33-98

	Scoured wool 10	
Weight	*MMA 2020*	**IWTO-33-98**
3000	*1.13*	**1.8**
6000	*0.97*	**1.9**
9000	*0.78*	**1.7**
12000	*0.78*	**1.6**

CONCLUSION

The accuracy of the Malcam measurement is better than the oven method measurement 'one.

The material of the bale cloth has any influence on the result.

The type of scoured wool influences the result. A calibration for each type has to be established

The Analysis presented in this Submission shows a high correlation and low standard deviation between the MALCAM microwave method and the Standard oven-drying method. The results also show that the equipment meets the requirements we have set and it is an accurate and reliable method for determining moisture levels in scoured wool and scoured wool. All the average of the   values difference between the two methods are below the value of retest (=/- 1%)

The results permit to amend the IWTO-TM 63-06 in order to be applicable to scoured wool and scoured cashmere

Graph 4:conclusion of the report
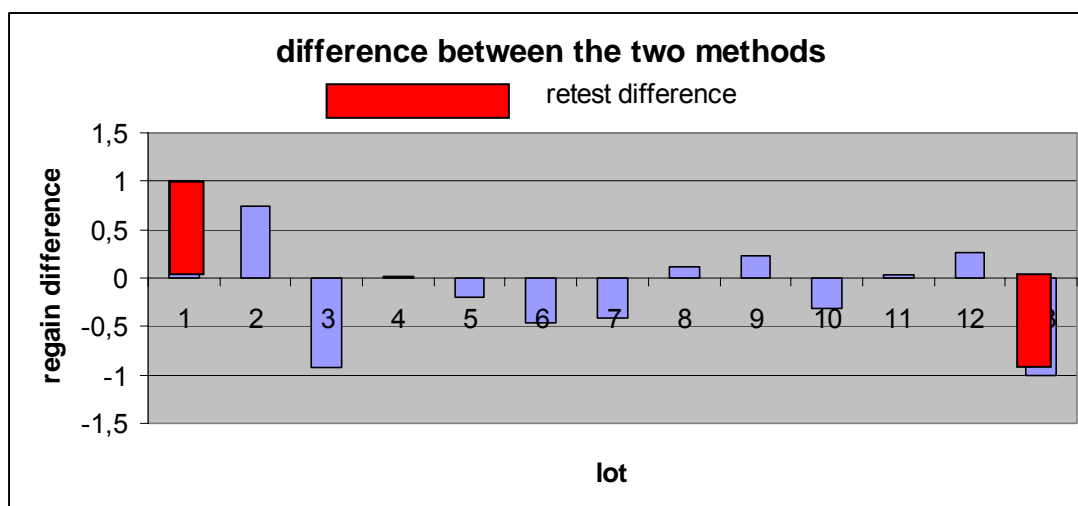
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Leman, B, De Pablos, A, and Matityaho, S, (2002) *Working Group Draft, Determination Of The Invoice Mass of tops, Noils, Scoured or Carbonized Wool By Microwave Method..* T & S Committee, Nice, Report SG03.

Dumetz, A, Lassman,I, Leman,B, De Pablos,A, and Shaham,D (2005). *Comparisons of Moisture Content Measurements by the MALCAM Equipment and the Standard IWTO Procedures.* T & S Committee, Biella, Submission SG03

IWTO-0--01: *Procedures For The Development, Review, Progression or Relegation of IWTO Test Methods and Draft Test Method*, Appendix B.

IWTO-33-98: *Determination of Oven-Dry Mass, Calculated Invoice Mass and Calculated Merchantable Mass of scoured and carbonised wool.*

Technical Manual Malcam MMA 2020 MALCAM LTD 27 Habarzel ST, 67910 Tel Aviv, Israel