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REPORTING OF HARVESTER MEASUREMENT ACCURACY CONTROL

Specification of the reporting application **Version 2009-10-19**

Document history and reasons for changes	Date	Changes of the specification
Version 1.0 of the specification	22.01.2009	
	13.03.2009	several
	19.10.2009	changes related to calibration values and calibration history (table 4) decided in StanForD Finland meeting 2009-10-06
English version of the specification	13.10.2010	

1 GENERAL

Finnish StanForD working group has discussed in its meetings needs and possibilities to specify and implement a common and uniform summary report for follow-up of harvester control measurements and for calibrations of the measuring system. It was set as a goal to specify a summary report which would be based on the use of StanForD ktr-files. The report should include main information about the control measurements carried out, statistical key figures of measuring accuracy calculated out of control measurement data as well as diameter and length calibrations carried out and the correction (adjustment) values of the calibrations.

Summary report is designed for verifying how the measuring accuracy of the harvester has been followed, how control measurements have been carried out for following purposes and how the changes to the calibration of the measuring system have made. It is expected that the new reporting tool will promote common and uniform practices for measuring accuracy follow-up. In the first place the report is supposed to serve logging contractors and timber sellers as well as their representatives. In the wood procurement organizations the follow-up of the measuring accuracy will probably be based also in the near future on ktr-files transferred automatically from the harvester as it is done today. However, a common summary report gives support also to the follow-up practices of the forest companies.

Starting point for the specification has been that not a new version of ktr-file is defined. Only a summary report will be specified in which the data contents and variables behind the data would be the same in all machine manufacturers' applications. Primarily the aim is to build up the report in pdf-format for sending it via e-mail or for printing out in the machine. It is possible also that the information of the report is gathered in a spreadsheet application (e.g. Excel) and changed into some more suitable format. The report information can be transferred for instance in xls- or text format to the user.

Languages to be used in printout of the report are Finnish and Swedish.

INFORMATION, CONSTRUCTION OF DATA AND STANFORD VARIABLES

In the layout of the report notice should be taken to good readability. There can be several printing options:

- all parts (tables) of the report at the same time
- each part (table) to be printed separately.

On every page of the report printout reporting time interval (see below) and printing time are shown in order to attach the page to other parts of the report and to other pages of the same part. Then it is not necessary to repeat machine identification information on each of the printouts pages.

The report is required to include the next information groups and data inside them. An example of the proposed report output is attached to this specification.

Identification information

- Identification information of logging contractor, machine, harvesting head, measuring system and its program version

Reporting time information

- Reporting time interval: time, which is used for selecting control measurement stem and log data and calibration data for the tables of the report

Time interval must be freely selectable (for example a day/week/month backwards from the reporting time point, previous calendar month etc.). The maximum time in the reporting is 6 months backwards and it is not required for the reporting application to support older data than that.

Control measurements -table

- Summary information of each control measurement event carried out during the reporting time interval: time, type of the measurement, tree species codes, number of individual diameter and length measurements and reason of the rejection of randomly selected control stem.

  All randomly selected sample stems (type 1, also the rejected) and sample stems selected by the harvester operator (type 2) are shown in the table. Type 2 category includes both single stems selected by the operator and also a larger item of measured stems selected for calibration control or calibration adjustment. When the operator saves control measuring data of the stems selected by himself he can decide if they are included in the list or not. All the stems accepted in this list are included also in Measuring accuracy –table (statistical key figures), if both diameters and lengths have been measured from them. Stems which are selected just for length control are listed in this table only.

  Measurement information is reported in time order, latest information as first.

Measuring accuracy –tables

- Basic information and statistical key figures describing the measuring accuracy by log strata (log grouping) within the selected report time interval:

- number of logs
  - harvester (pieces), control measurement (pieces)

- volume of logs
  - harvester (m^3), control measurement (m^3)
  - difference in volume (m^3 and %)
  - absolute difference in volume (m^3) is calculated by formula

    $$harvester\ (m3) - control\ measurement\ (m3)$$

    and relative difference in volume (%) by formula

    $$\frac{harvester\ (m3) - control\ measurement\ (m3)}{harvester\ (m3)} \times 100$$

- differences in diameter
  - average (mm), median (mm), standard deviation (mm), [−x .. +y] mm (%)
  - harvester operator can select parameters x and y
  - differences in diameter are calculated from single diameter measurement values by formula
    harvester (mm) – control measurement (mm)
  - a single diameter measurement value is the average of two cross-measured diameter values (rounding principle used??)

- differences in length
  - average (cm), median (cm), standard deviation (cm) , [−x .. +y] cm (%)
  - harvester operator can select parameters x and y
  - differences in length are calculated from single length measurement values (lengths of logs) by formula
    harvester (cm) – control measurement (cm)
  - if the accuracy of the length measurement device is better than 1 cm, length values are rounded into even classes of 1 cm before length differences are calculated

Statistical key figures are presented in two equal tables:

1) randomly selected control stems
   - key figures of randomly sampled stems only
2) control stems selected by harvester operator
   - key figures of all other control stems than those of randomly sampled

Proposed layout of the tables in printing:

- key figures of a single log strata (group) on a horizontal line (number of key figures does not change)

Log stratification (grouping) of the tables can be done by three different principles:

I Grouping based on log's stem type
II Grouping based on log's top diameter
III Grouping based on log's timber assortment (name, code)

Report printout based on alternative I should be possible to get from all of the new measuring system versions (priority 1). However, this alternative alone does not fulfill all the information needs of different measurement parties. Therefore it is recommended that machine manufacturers would implement also either alternative II or alternative III, or both.

Reporting alternatives:

I. Measurement accuracy by stem types

Statistical key figures are calculated and presented by log strata (group) that are based on the stem type into which timber assortment of measured log in ktr-file belongs to (log's stem type in ktr according to variables 123_t1 and 124_t1).

Stem type value of a log is specified by stem type code of apt-file (stem type codes of the forest company). It is recommended that commonly in Finland used PMP stem type codes (described in StanForD) would be applied:

- 11 Sawlogs of tree species 1 (in Finland usually pine, Mät)
- 12 Pulpwood logs of tree species 1 (in Finland usually pine, Mäk)
- 21 Sawlogs of tree species 2 (in Finland usually spruce, Kut)
- 22 Pulpwood logs of tree species 2 (in Finland usually spruce, Kuk)
- 31 Sawlogs of tree species 3 (in Finland usually birch, Kot)
- 32 Pulpwood logs of tree species 3 (in Finland usually birch, Kok)
- etc.

Statistical key figures are calculated and presented also by tree species.

Those stems and logs which do not have stem type information should not be included in this measurement accuracy table. Weakness of this type of calculation and reporting is that butt end reject pieces or other unclassified logs can not be recognized and kept separated.

II. Measurement accuracy by top diameter classes

Logs are stratified into sawlog sized (large) and pulpwood sized (small) groups by tree species according to the top diameter registered by the harvester. Diameter limit value between the groups is set as the same as the minimum diameter of sawlog is and it is presented as a parameter specified by tree species. The operator can change the diameter limit value freely. This enables a common and permanent way to follow measurement accuracy. It is not possible in this type of reporting either to keep butt end reject pieces or other unclassified logs separated, so they should be counted in the group in which they belong according to the top diameter.

Grouping that is based on top diameter does not separate sawlog and pulpwood log assortments as effectively as alternative I. This is problematic specifically with hardwood because its sawlog minimum diameter can vary several times during the reporting interval and variation of timber quality is big. However, this alternative makes it possible to prepare for those situations where stem type information lacks for some reason.

III. Measurement accuracy by timber assortments

Timber assortment stands here for log stratum (group) for which an unambiguous and usually company-specific timber assortment code has been specified.

Information of each timber assortment is presented separately. Number of rows in the table depends on the number of timber assortments. It can be considerably large particularly if the reporting period is long. When the report is interpreted, it must be noticed that one single timber assortment may contain a very little number of logs which makes also the result of that timber assortment unreliable.

Presenting order of the timber assortments can be selected openly, but from a point of readability it is recommended that the timber assortments are presented in alphabetical order or so that those timber assortments that have been used latest are presented first in the list.

This reporting alternative is needed particularly when information about one single and specific timber assortment (e.g. spruce veneer logs, small-sized logs) is needed.

Calibration adjustment values and adjustment history

Harvester measurement order of Ministry of Agriculture and Forestry provides that length and diameter calibration adjustment values and times must be possible to print out.

Calibration principles and presentation style of adjustment values varies from machine to machine. That is why it is not relevant to make a strict definition for the presentation form of the calibration history. Easyness of printing out and a definite and clear presentation layout are prerequisites for the requirement provided by Harvester measurement order.

There are several variables in ktr-file in which calibration adjustment values are saved. Using those variables it is possible to report at least next key figures that describe the calibration history:
- Calibration time stamps (date, time)
- Calibration adjustment values of length and butt end correction of length by tree species at different calibration times
- Calibration adjustment values of diameter by tree species at different calibration times

”Adjustment value” can be for example a diameter class specific adjustment value. Number of diameter classes can vary from machine to machine and by harvesting head models (by size of harvesting head). In the measuring systems which have a “one point” calibration principle the calibration value can be presented as combined regression factors for the whole diameter range instead of diameter classes.

As a minimum requirement it must be presented in the report the times (time stamps) of length and diameter calibrations by calibration events and by tree species (table 4). This data is normally saved also in ktr- and prd-files. Calibration adjustment values can be included in the table as optional. Calibration adjustment values of diameter can be

presented in millimeters or per mille according to the calibration method that is used by the machine manufacturer.

Data specifications

Priority of data 1 = mandatory
2 = recommended

Data group	Data	Definition and construction of data	StanForD variable	Presentation form	Data type	Example	Priority
Identification information	Contractor information	Identification and contact information of logging contractor	var34_t1-6 (all are not needed)	text in row or in table	string	Mittamoto Oy Yrittäjänpolku 13 00970 Metsälä puh. 040 5555159	var34_t3: 1 other types: 2
	Machine information	Identification information of harvester (make and model)	var3_t2 var3_t5-6	text in row or in table	string	1234 John Deere 1270E	1 1
	Harvesting head information	make and model information of harvesting head	var3_t7-8	text in row or in table	string	John Deere H270	1
	Measuring system information	Model and program version of measuring equipment	var5_t1	text in row	string	Timbermatic 300	2
Reporting time	Reporting time	Time interval of reporting: it is specified from which time period the control measurements and calibrations are reported	-	text in row	date dd.mm.yyyy	30.6.2008 - 30.8.2008	1
Control measurements	Control measurement time	Time of the caliper measurement of the control	var18_t5 or var18_t6	table	date dd.mm.yyyy time hh:mm	19.7.2008 6:20	1
	Type of control measurement	Type of control measurement: 1= randomly selected sample stems 2= sample stems selected by the harvester operator *Code 0 is not used.*	var38_t4	table	integer	2	1
	Tree species	Tree species codes of control measurement item in list. Names of tree species can be used as well.	var120_t1	code list in a cell of a table	string	1, 2, 3 or pine, spruce, birch	1

	Number of measured diameters	Total number of measured diameters of all the logs in the control item. Information is achieved from the machine's measuring system (database).		table	integer	126	1
	Number of measured lengths	Total number of logs in control item = total number of length values. Information is achieved from the machine's measuring system (database).		table	integer	28	1
	Rejection reason	Reason for the rejection of randomly selected control stems. Codes of StanForD are used. To be presented by stem and only when the operator has rejected the stem.	var38_t10	table	integer	-	2
Statistical key figures of measurement accuracy	Number of logs (harvester)	Number of logs in harvester measurement per group. Information is achieved from the machine's measuring system (database).	-	table	integer	25	1
	Number of logs (control)	Number of logs in control measurement per group. Information is achieved from the machine's measuring system (database).	-	table	integer	25	1
	Volume (harvester)	Total volume of logs in group according to harvester measurement.	to be summed (var299_t3)	table	float 3 desim.	4.017	1
	Volume (control)	Total volume of logs in group according to control (caliper) measurement.	to be summed (var299_t4)	table	float 3 desim.	3.941	1
	Difference in volume (m^3)	Volume difference, m^3 *calculation formula:* *volume diff.* = $vol_{harvester} - vol_{control}$		table	float 3 desim.	+0.076	1

	Difference in volume (%)	Volume difference, % *calculation formula:* *volume diff. = ($vol_{harvester}$ − $vol_{control}$) / $vol_{harvester}$ x 100*	-	table	float 1 desim.	+1.9	1
	Difference in diameter (average)	Average value of diameter differences, mm	(differences of var373_t3 and var373_t5)	table	float 1 desim.	+0.2	1
	Difference in diameter (median)	Median of diameter differences, mm		table	float 1 desim.	0	1
	Difference in diameter (standard deviation)	Standard deviation of of diameter differences, mm		table	float 1 desim.	2.6	1
	Difference in diameter [−x .. +y] mm, %	Percentage of diameter differences which are inside the variation range defined by the operator (set in application)		table	float 1 desim.	74.8	1
	Difference in length (average)	Average value of length differences, cm	(var293_t3 ja var293_t5 erot)	table	float 1 desim.	-1.3	1
	Difference in length (median)	Median of length differences, cm		table	float 1 desim.	0	1
	Difference in length (standard deviation)	Standard deviation of length differences, cm		table	float 1 desim.	1.8	1
	Difference in length	Percentage of length differences which are inside the variation range defined		table	float 1 desim.	92.0	1

	[−x .. +y] cm, %	by the operator (set in application)					
Calibration information	Calibration time	Times of length and diameter calibrations done during the reporting period presented by calibration events and by tree species. Date and time when the calibration has been registered in the measuring system. Date and time can be presented separated in their own columns.	var41_t4 / var44_t4	table	date dd.mm.yyyy time hh:mm	17.8.2008 14:40	1
Next information is optional and not required in the minimum version of the report.							

Calibration adjustment values	Adjustment values	Changes of adjustment values set in calibration:
		- Diameter correction done
		  - ”yes / no” is enough
		  - optionally it is possible to show the change that has been done either in millimeters or per mille according to the calibration method
		- Length correction (mm or %)
		  - base value on second title row
		- Butt end length correction (mm or %)
		  - base value on second title row
			var46_t1 (length and butt end length correction)
			var48_t1 (diameters)
				table	string / integer	*Diameter correction:*
						Lpm-korjaus
						kyllä
						
						Length correction:
						Pituus -1
						
						Butt end length correction:
						Tyvikorjaus 0
						…
							1

PRINTING LAYOUT MODELS **Appendix** 2

Note: In the implementation version titles and texts of tables must be either in Finnish or Swedish. Look at the original Finnish version of this specification.

Table 1

MACHINE IDENTIFICATION:
MEASURING SYSTEM IDENTIFICATION:
PROGRAM VERSION OF MEASURING SYSTEM:

REPORTING TIME INTERVAL: 1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

CONTROL MEASUREMENTS (1=randomly selected, 2=selected by operator):

Date	Time	Type	Tree species	Diam. 1)	Length 2)	Rej. reason
29.8.2008	4:27	1	1	9	2	-
29.8.2008	4:15	1	1	-	-	3
28.8.2008	14:01	1	1	17	4	-
28.8.2008	8:21	2	1	-	9	-
26.8.2008	14:50	2	2,3	70	15	-
26.8.2008	14:25	1	2	24	5	-
26.8.2008	14:00	1	3	-	-	2
26.8.2008	9:00	1	2	16	3	-
23.8.2008	16:00	1	1	20	4	-
22.8.2008	12:20	1	1	15	3	-
17.8.2008	14:28	2	1,2	56	12	-
17.8.2008	14:11	1	2	20	4	-
22.7.2008	11:20	1	3	9	2	-
21.7.2008	12:33	1	1	16	3	-
19.7.2008	6:20	2	1	126	28	-

1) Number of measured diameters

2) Number of measured lengths

There is a summary from July-August 2008 in this example of report output. The harvester has been working one week in the end of July and the two last weeks of August.
After both of the breaks (19.7. and 17.8.) operator has measured a larger amount of control stems (28 and 12 logs).
The first item was purely of tree species 1. The second item included tree species 1 and 2.
There has been a problem with measuring accuracy on 26.8., when the operator has measured 15 control logs of tree species 2 and 3.
On 28.8. at 8:21 the operator has taken one more separate item of length control (9 logs).
Rest of the stems from the reporting interval have been randomly selected and the operator has rejected two of them (on 26.8. at 14:00 and on 29.8. at 4:15).

PRINTING LAYOUT MODELS **Appendix** 2

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Table 2

ALTERNATIVE I (Grouping based on stem type of the log):

MEASURING ACCURACY (randomly selected control stems):

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

		NUMBER OF LOGS		VOLUME				DIFFERENCE IN DIAMETER				DIFFERENCE IN LENGTH			
		machine pieces	control pieces	machine m3	control m3	difference m3	%	average mm	median mm	std. dev. mm	[-3 .. +3] %	average cm	median cm	std. dev. cm	[-3 .. +3] %
TREE SPECIES 1	*11 (Sawlog)*														
	12 (Pulpwood)														
	Tree species 1 total														
TREE SPECIES 2	*21 (Sawlog)*														
	22 (Pulpwood)														
	Tree species 2 total														
TREE SPECIES 3	*31 (Sawlog)*														
	32 (Pulpwood)														
	Tree species 3 total														
ALL	*Sawlog*														
	Pulpwood														
	Tree species total														

PRINTING LAYOUT MODELS **Appendix** 2

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Table 2

ALTERNATIVE II (Grouping based on diameter limit values by tree species):

MEASURING ACCURACY (randomly selected control stems):

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

	DIAMETER CLASS	NUMBER OF LOGS		VOLUME				DIFFERENCE IN DIAMETER				DIFFERENCE IN LENGTH			
		machine pieces	control pieces	machine m3	control m3	difference m3	%	average mm	median mm	std. dev. mm	[-3 .. +3] %	average cm	median cm	std. dev. cm	[-3 .. +3] %
TREE SPECIES 1	? *15 cm*														
	< 15														
	Tree species 1 total														
TREE SPECIES 2	? *16 cm*														
	< 16														
	Tree species 2 total														
TREE SPECIES 3	? *18 cm*														
	< 18														
	Tree species 3 total														
ALL	? *15,16,18 cm*														
	< 15, 16, 18														
	Tree species total														

PRINTING LAYOUT MODELS **Appendix** 2

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Table 2

ALTERNATIVE III (Grouping based on timber assortment of the log):

MEASURING ACCURACY (randomly selected control stems):

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

TIMBER ASSORTMENT	NUMBER OF LOGS		VOLUME				DIFFERENCE IN DIAMETER				DIFFERENCE IN LENGTH			
	machine pieces	control pieces	machine m3	control m3	difference m3	%	average mm	median mm	std. dev. mm	[-3 .. +3] %	average cm	median cm	std. dev. cm	[-3 .. +3] %
Anjakuk4														
HAK_AANE														
JOENSUU														
KEITELE														
KUI32														
KUK_JAMS														
KUTKINN														
LAHOKUUS														
PIKKUTUK														
RAAKKI														
SELLUKUK														
SUOLAHTI														
UHARJ16														
UNCLASSIFIED														
Total														

PRINTING LAYOUT MODELS **Appendix** 2

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Table 3

ALTERNATIVE I (Grouping based on stem type of the log):

MEASURING ACCURACY (control stems selected by machine operator):

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

		NUMBER OF LOGS		VOLUME				DIFFERENCE IN DIAMETER				DIFFERENCE IN LENGTH			
		machine pieces	control pieces	machine m3	control m3	difference m3	%	average mm	median mm	std. dev. mm	[-3 .. +3] %	average cm	median cm	std. dev. cm	[-3 .. +3] %
TREE SPECIES 1	*11 (Sawlog)*														
	12 (Pulpwood)														
	Tree species 1 total														
TREE SPECIES 2	*21 (Sawlog)*														
	22 (Pulpwood)														
	Tree species 2 total														
TREE SPECIES 3	*31 (Sawlog)*														
	32 (Pulpwood)														
	Tree species 3 total														
ALL	*Sawlog*														
	Pulpwood														
	Tree species total														

PRINTING LAYOUT MODELS **Appendix** 2

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Table 3

ALTERNATIVE II (Grouping based on diameter limit values by tree species):

MEASURING ACCURACY (control stems selected by machine operator):

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

	DIAMETER CLASS	NUMBER OF LOGS		VOLUME				DIFFERENCE IN DIAMETER				DIFFERENCE IN LENGTH			
		machine pieces	control pieces	machine m3	control m3	difference m3	%	average mm	median mm	std. dev. mm	[-3 .. +3] %	average cm	median cm	std. dev. cm	[-3 .. +3] %
TREE SPECIES 1	*≥ 15 cm*														
	< 15														
	Tree species 1 total														
TREE SPECIES 2	*≥ 16 cm*														
	< 16														
	Tree species 2 total														
TREE SPECIES 3	*≥ 18 cm*														
	< 18														
	Tree species 3 total														
ALL	*≥ 15,16,18 cm*														
	< 15, 16, 18														
	Tree species total														

PRINTING LAYOUT MODELS **Appendix** 2

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Table 3

ALTERNATIVE III (Grouping based on timber assortment of the log):

MEASURING ACCURACY (control stems selected by machine operator):

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

TIMBER ASSORTMENT	NUMBER OF LOGS		VOLUME				DIFFERENCE IN DIAMETER				DIFFERENCE IN LENGTH			
	machine pieces	control pieces	machine m3	control m3	difference m3	%	average mm	median mm	std. dev. mm	[-3 .. +3] %	average cm	median cm	std. dev. cm	[-3 .. +3] %
Anjakuk4														
HAK_AANE														
JOENSUU														
KEITELE														
KUI32														
KUK_JAMS														
KUTKINN														
LAHOKUUS														
PIKKUTUK														
RAAKKI														
SELLUKUK														
SUOLAHTI														
UHARJ16														
UNCLASSIFIED														
Total														

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Table 4

CALIBRATIONS:

1.7.2008 - 31.8.2008 (Printed 4.9.2008 09:45)

Date	Time	Tree species	Diam. correction (yes/no, mm or ‰)	Length (mm or %)	Butt end correction (mm or %)
26.8.2008	15:05	1	+1 mm		
	15:05	2	yes	-1	
17.8.2008	14:41	2	-1 mm		
	14:40	1	-1 mm		
19.7.2008	14:24	3	yes		+1
	13:52	1	yes	+1	+1
	13:52	2	yes		

There is a summary from July-August 2008 in this example of report output.
The machine has been calibrated altogether three times during the time interval.
On 19.7. calibration has been corrected for all tree species, later only for species 1 and 2.
Shape of the diameter calibration curve has been changed with all of the tree species on 19.7. (=x) ja with species 2 once again on 26.8.
Rest of the calibrations have been equal in value on whole range of the diameter area.
Length measurement has been calibrated on 19.7. and 26.8., and the length correction has also been changed at the first calibration.
Calibration events are presented in time order, last calibrations are on top of the list.