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Laser Log Scanning Trial

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Introduction

- Forestry companies are investigating new scaling methods to reduce costs while maintaining scale accuracy.
- A potential new scaling method is using laser log scanning technology.
- Laser scanners are used in British Columbia sawmills to optimize cutting programs.

Study objectives

- Evaluate the log scanner's measuring precision on log top diameter, butt diameter and length
- Compare manual (stick) scaled log volume to scanner scaled volume
- Compare historical mill records of scanner scaled volume to stick scaled volume

Study site and methods

- The study took place in Sept. 2011 near Vancouver, British Columbia.
- The logs were first manually scaled at Pacific Custom sortyard.
- The logs were then bundled and towed to International Forest Product's (Interfor) Acorn sawmill.
- At Acorn the logs were debarked and then scanned by a laser log scanner.

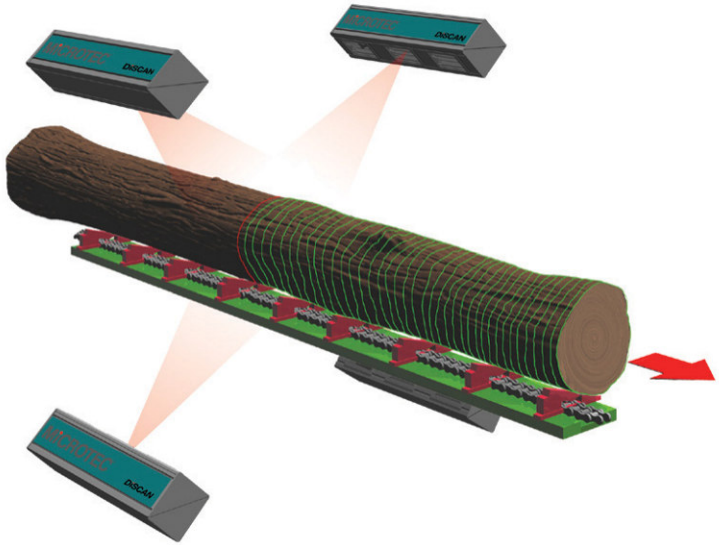
Scaling and scanning the logs

- 68 (130 m^3) (25.4 MFBM [1]) of second growth sorted Western Hemlock and balsam logs were used in the trial.
- Three scalers scaled each log log 3 times.
- Each log was scanned 3 times at the sawmill.

[1]Conversion =1MFBM=5.128 m^3

Microtec laser log scanner

DiScan scanning heads



Typical scanner installation

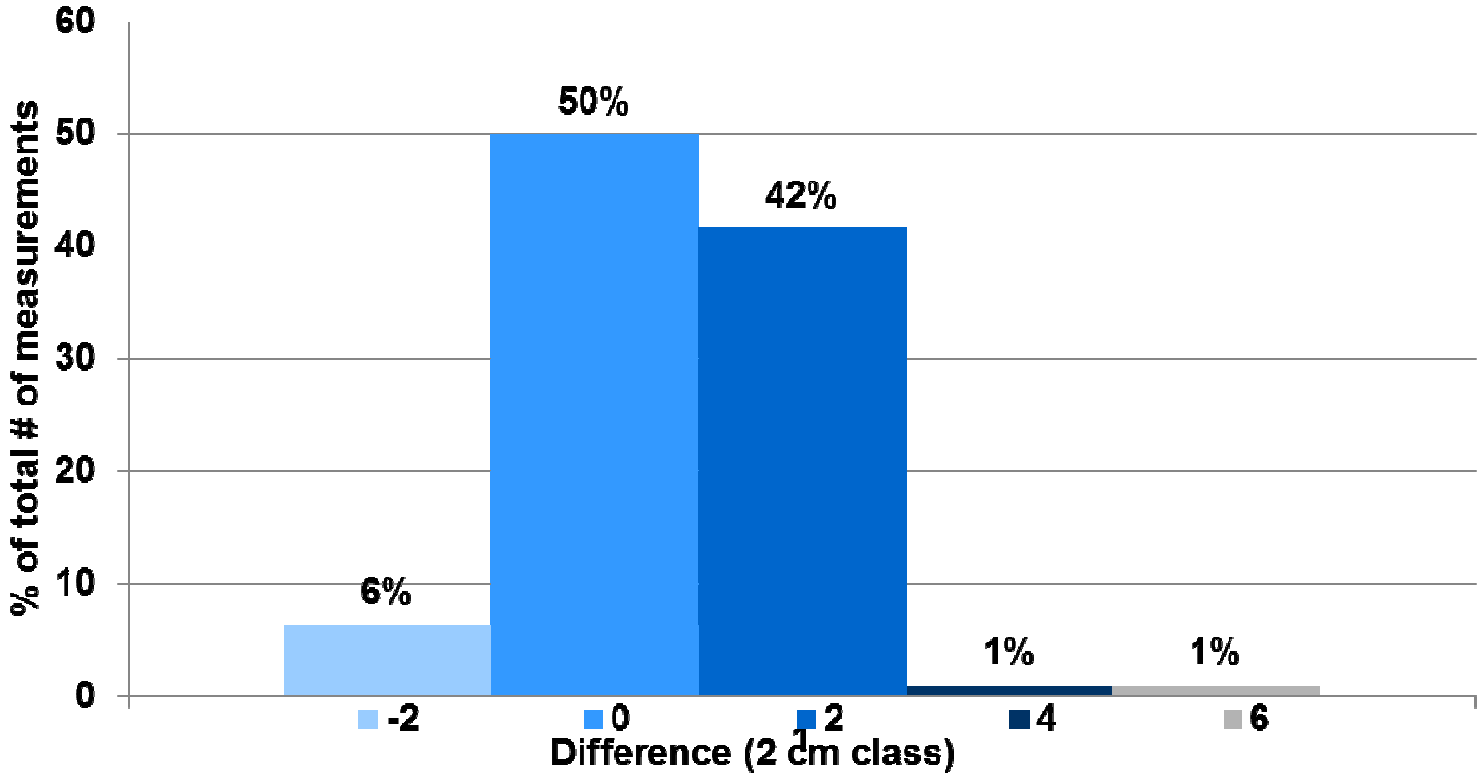
Images courtesy of
Microtec Industries

Scanner and scaler measurements

- The scanner measures diameter in millimetres (1mm = 0.04 inches) and length in cm (1 cm = 0.4 inches)
- The scalers measured diameters in 2 cm classes and length to the nearest 10 cm (4 inches).
- The scanner measurements were converted to the same units as the scalers in order to compare the two scaling methods.

Difference [1] between scaler and scanner measured top diameter.

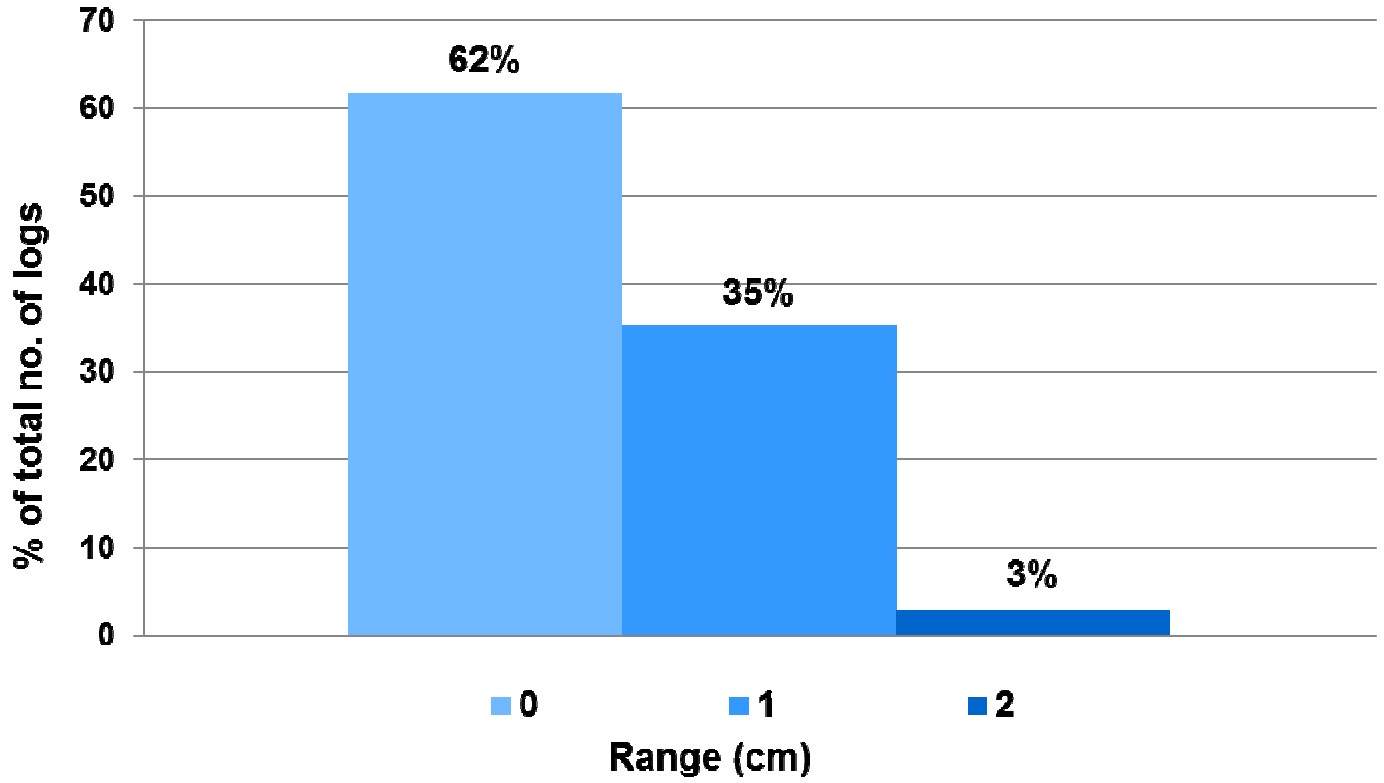
- The difference between scaler and scanner measured top diameter was 2.0 cm (0.8 inches) cm or less in 98% (200) of the measurements.



[1] Difference = scaler diameter – scanner diameter

Scanner top diameter precision [1]

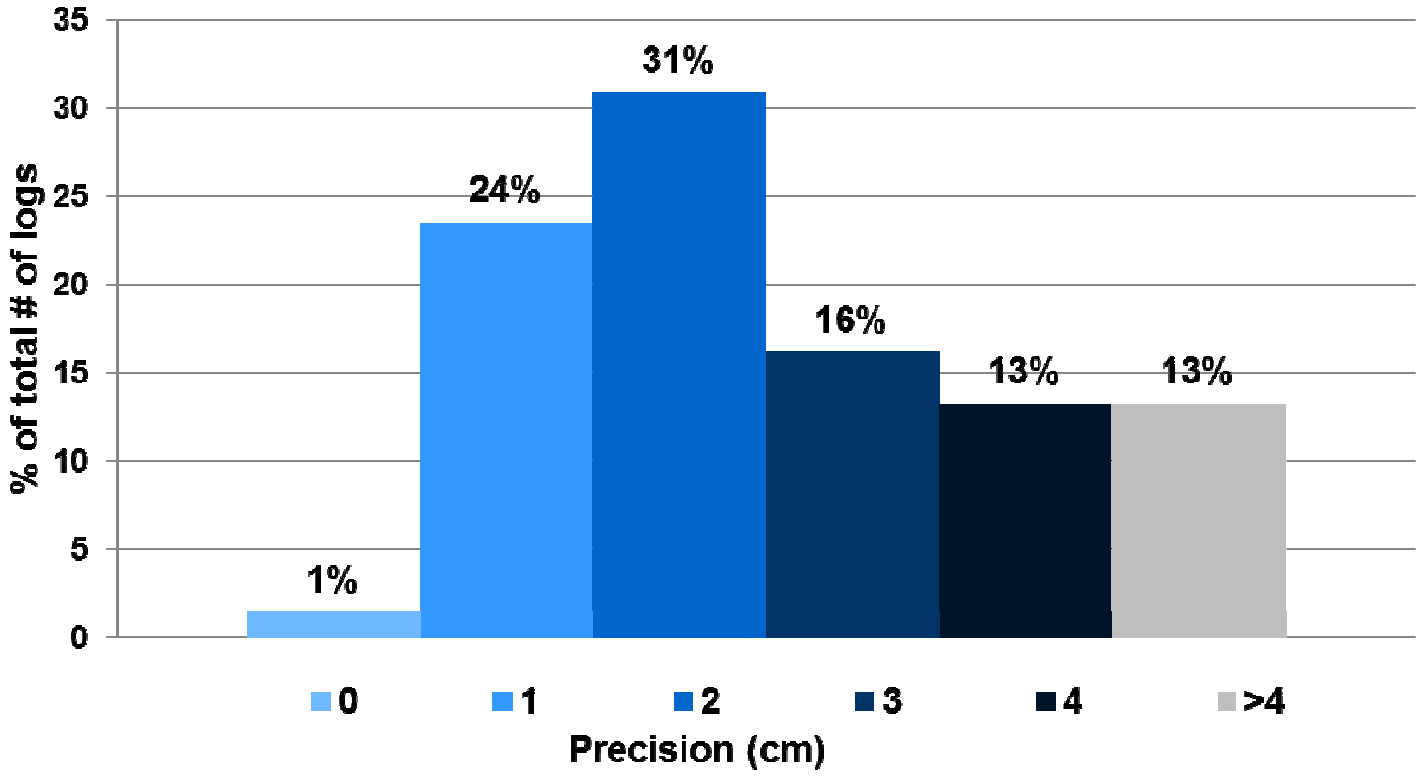
- In 97% of the logs the scanner measured the top diameter to a precision of 1 cm (0.4 inches).



[1] Maximum diameter – minimum diameter from 3 scans

Scanner butt diameter precision [1]

- In 25 % of the logs the scanner measured the butt diameter to a precision of 1 cm (0.4 inches).



- [1] Maximum diameter – minimum diameter from 3 scans

Why did the scanner measure the butt diameter less precisely than the top?

- The scanner measured top diameters are “filtered” by an algorithm that uses the average and a regression to calculate the most accurate measurement for the top diameter.
- This algorithm was not used when calculating the butt diameter and this caused more variation in the butt diameter measurement.
- Microtec said precision of butt diameter measurements will be similar to the top diameter precision when the algorithm is applied.

Length precision [1]

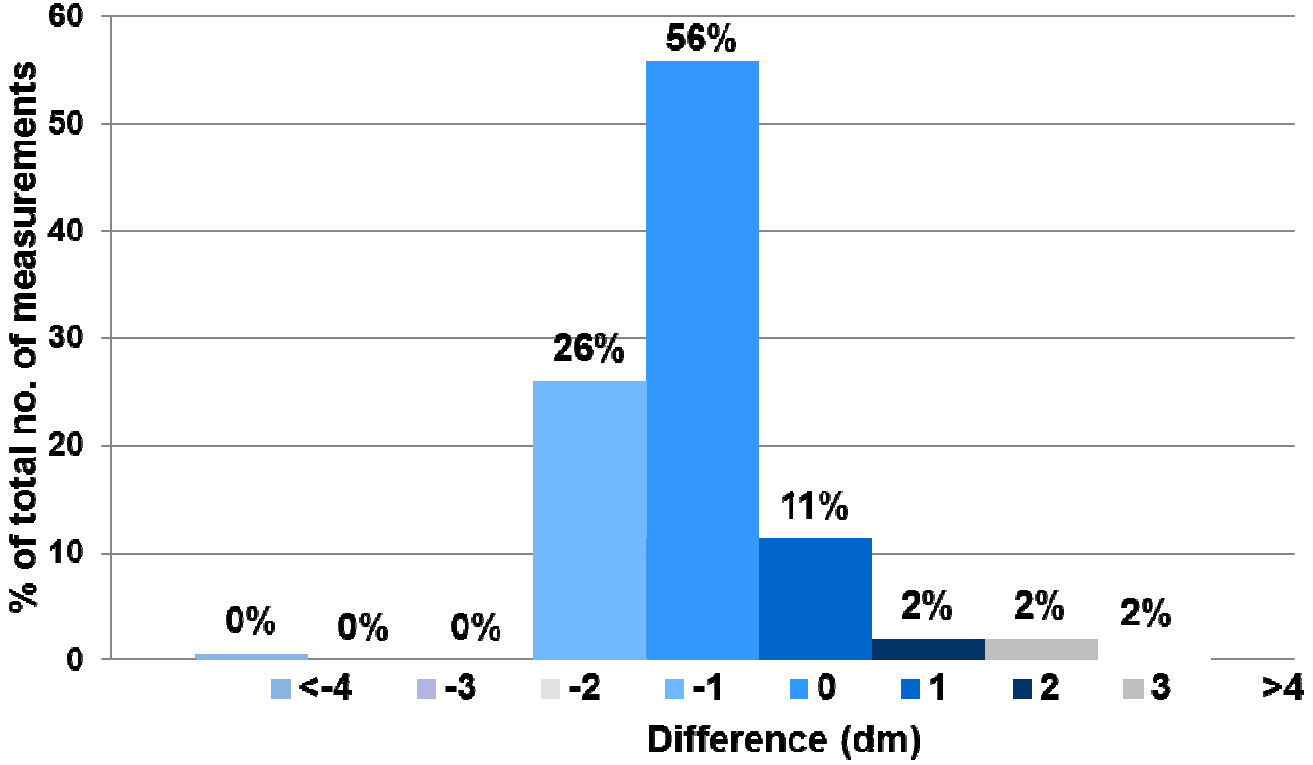
- In 59 % of the logs the difference between repeated scans was 5 cm (1 inch) or less

Precision category cm (inches)		No. of logs	% of total
0-2	(0 -0.8)	21	31
3-5	(1.2 - 2.0)	19	28
6-8	(2.4 -3.1)	8	12
9-11	(3.5 - 4.3)	8	12
12	(4.7)	12	17

- [1]Maximum length – minimum length from 3 scans of each log

Scanner lengths versus scaler's lengths

- There was no difference[1] between scaler and scanner lengths in 56 % (114) of the measurements.



- [1]Difference =Scaler length – scanner length

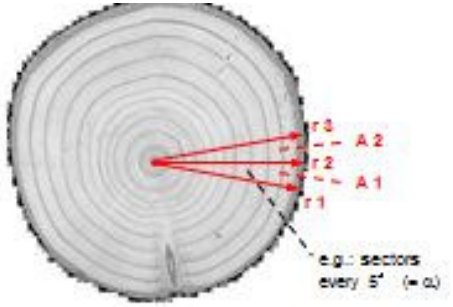
1dm =4 inches

The debarkers proximity to the scanner affected scanner length measuring

- Scanner measures length using a photocell and encoder mounted on a conveyor chain.
- The debarking arms held the log back while the chain conveyor was trying to move the log forward causing the log to “slip” on the conveyor.
- Log “slippage” on the conveyor caused the encoder to record an incorrect length.
- At other sawmills Microtec has found length is measured accurately to 2 cm.

Volume calculation formulas

Segment



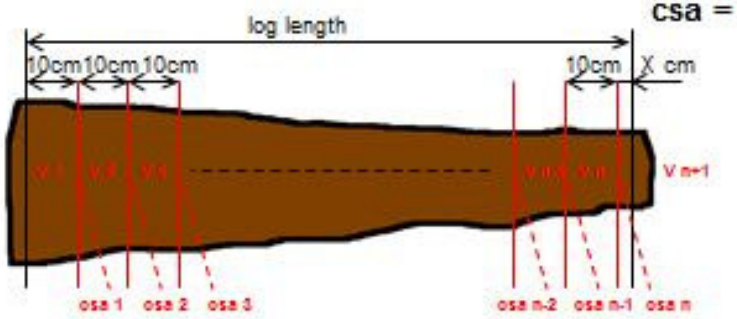
calculation of the single cross-sectional area:

radiuses r1, r 2, r 3, ..., r n
are calculated in 5° steps (for example)
A = area of each sector

$$A = \frac{r^2 \times \pi \times \alpha}{360°}$$

csa = total cross-sectional area

csa = A 1 + A 2 + ... + A n



calculation of the physical volume:

The total cross-sectional areas csa 1, csa 2, csa 3, ...csa n are calculated in 10cm (4 ") steps (for example)

V 1, V 2, V 3, ... V n, V n+1 are calculated for each section (frustum)

V = total volume of the log

V = V 1 + V 2 + V 3 + ... V n + V n+1

Smalian's

V=(A1+A2)/2 XL

V=volume

A1=area of small end the of log.

A2 =area of the large end of log.

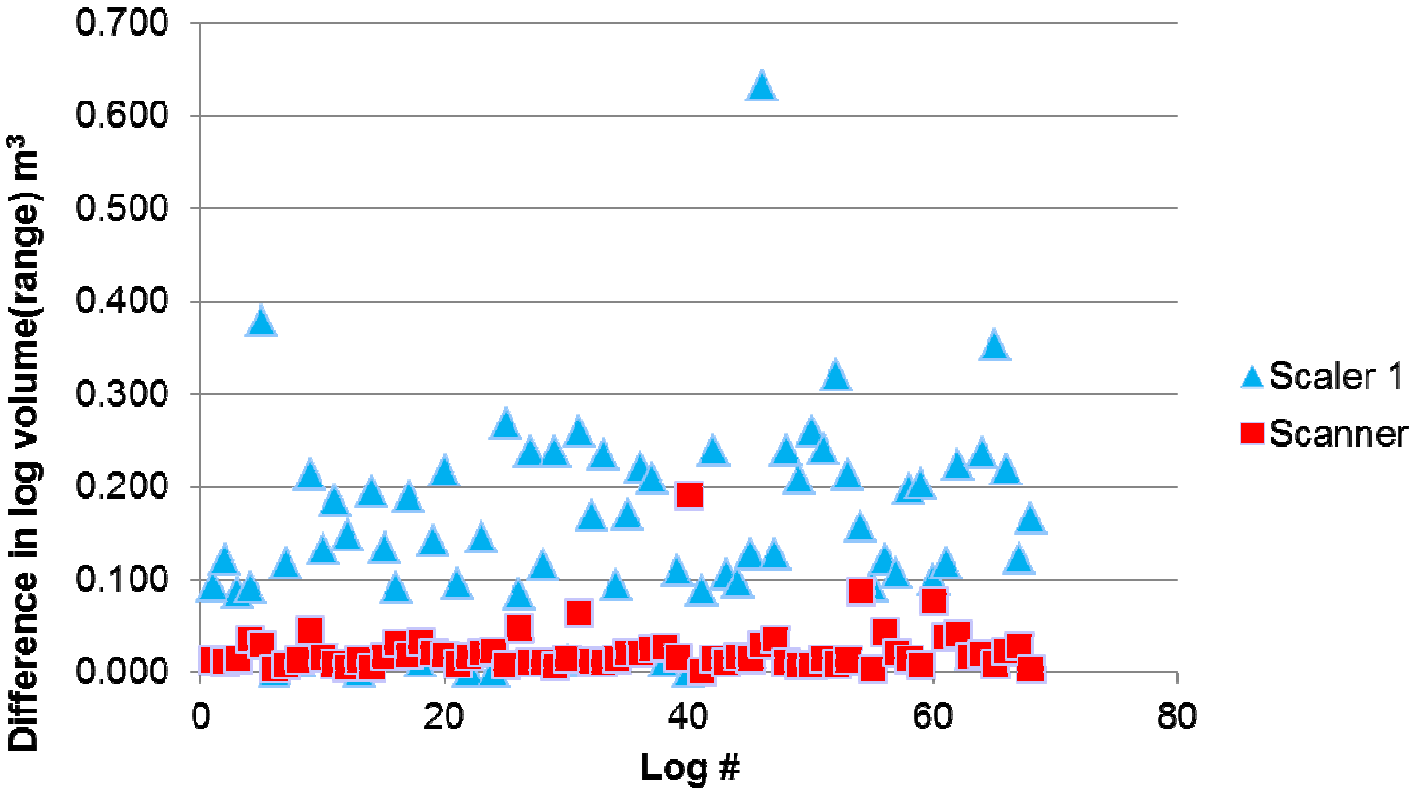
L= length

Average load volume

Load	Scaler 1 (m^3)	Scaler 2 (m^3)	Scaler 3 (m^3)	Scanner segment formula (m^3)	Scanner Smalian's formula (m^3)	**Maximum difference scanner (segment formula) compared to scalers (m^3)**	**Maximum difference scanner (Smalian) compared to scalers (m^3)**
1	44.50	44.14	44.11	44.77	41.14	**0.66**	**3.36**
2	46.82	47.01	46.86	47.33	44.05	**0.51**	**2.96**
3	47.2	48.48	48.1	49.92	45.74	**2.72**	**2.74**

Scale of individual logs

- There was less variation in scanner (segment formula) log volume than scaler (Smalian's formula) volume.



Difference between stick and scanner scaled boom volume

- On larger volumes there was only a small difference between stick and scanned volume.

Sort	Booms #	Logs #	Stick scaled volume (m^3)	Scanned volume (m^3) [1]	Difference (m^3) [2]	Difference (%) [3]
Thrifty	43	36 215	60 434	60 465	-31	**- 0.1**
Standard	29	10 781	22 488	22 669	-181	**- 0.8**
Mix	7	1 458	2 870	2 848	22	**0.8**
All Other	2	354	977	928	49	**5.0**
Utility	1	215	468	487	-19	**- 4.5**
Total	**82**	**49 023**	**87 237**	**87 396**	**-159**	**- 0.2**

[1] Volume calculated from segment formula.
[2] Stick scaled volume – scanner volume
[3] (Stick scaled volume-scanner volume)/stick scaled volume x100

Summary

- The scanner measured log top diameters precisely and as accurately as the scalers.
- The scanner measured individual log volume more consistently and with less variation than the scalers.
- The scanner scale of load volumes was similar to the scalers.
- The difference in scale volume between the scanner and stick scaling was of 0.2% on 87 237 m^3 (82 log booms).

Continuing work on scanner scaling

- The Canadian Standards Association Technical Committee on Scaling of Primary Forest Products is working to develop a national measurement standard for electronic/laser type scanners.

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- The standard will likely focus on the measuring accuracy of log top and butt diameter and length.
- Measurement Canada will test and certify scanners to ensure they meet this standard.

Thank you