Forintek Canada Corp.
Western Division
2665 East Mall
Vancouver, BC
V6T 1W5

Improving Processing Efficiency of Post-MPB Wood
Part 1A: Mill Survey

by

John White
Senior Technologist
Sawmilling Group

and

John Taylor
Group Leader
Sawmilling Group

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John White
Project Leader

John Taylor
Reviewed

Peter Lister
Department Manager

Confidential

Summary

In order to determine the best practices for machining post-Mountain Pine Beetle (MPB) attacked wood, a survey was sent to 32 BC interior sawmills processing a large volume of this resource. Information on bandsawing, circular sawing and chipping was received back from 11 mills and information from a further 8 mills was obtained through subsequent mill visits. Respondents provided information on the direct effects of processing post-MPB attacked wood, and the changes that they had implemented as a result. Machine specifications, blade specifications, operating conditions and cutting accuracies were documented.

The survey results are presented in this report. They indicate that there is opportunity to improve the sawing process through changes to saw design and operating conditions. Few mills have made any specific changes to their sawing or chipping processes. Additionally, band and circular saw machines are processing this material with a wide range of feed speeds indicating that, for many mills, there is an opportunity to increase production.

Acknowledgements

Funding for this work was provided by the Province of British Columbia through the Forestry Innovation Investment Mountain Pine Beetle Program.

Forintek Canada Corp. would like to thank its industry members, Natural Resources Canada (Canadian Forest Service), British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Nova Scotia, New Brunswick, Newfoundland and Labrador, and the Yukon Territory, for their guidance and financial support for this research.

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1 Objectives

The objective of this project was to survey BC interior sawmills that are processing large volumes of post-Mountain Pine Beetle (MPB) attacked wood to determine the best sawing practices for this material.

2 Introduction

The MPB epidemic currently occurring in BC has resulted in large volumes of post-MPB attacked wood being processed by the lumber industry. The point at which it becomes unprofitable to process will determine the shelf life of this deteriorating resource. Improving processing speeds and saw performance for this material represents an opportunity to prolong its shelf life.

The dead red and grey attack logs that are currently being processed by the sawmills are more difficult to process than the green logs historically processed by the mills. The wood has more pitch pockets, checks and cracks and is drier and therefore harder and more abrasive to cutting tools. Bluestain and sap-rot also affect this wood. Sawing practices that have been successfully used in the past may not be well suited to processing MPB attacked wood. Additionally, reduced value recovery often necessitates processing this material at a higher rate for sawmills to remain profitable.

We surveyed sawmills in the MPB affected region to determine the current best practices in use for sawing and chipping post-MPB attacked wood.

3 Staff

- John White, Senior Engineering Technologist, Sawmilling Group, Forintek Canada Corp.
- Dr. John Taylor, Group Leader, Sawmilling Group, Forintek Canada Corp.
- Dr. Bruce Lehmann, Industrial Advisor, Sawmilling Group, Forintek Canada Corp.
- Matthew Warkentin, Engineering Student, Sawmilling Group, Forintek Canada Corp.

4 Materials and Methods

In order to determine current best practices for machining post-MPB attacked wood, a survey was developed and sent to both mill managers and filing room supervisors at 32 BC interior sawmills that process large quantities of MPB wood. Visits to a number of sawmills were also conducted to interview mill staff and collect more detailed information. Originally, five mill visits were planned, but eight mills were visited for the project. Mill visits improved the quality of data collected compared to that in surveys received by mail.

The survey was divided into sections on bandsaws, circular saws, chipping heads and general processing questions. A copy of the survey is included in Appendix I. To encourage participation, the identities of the mills surveyed have been kept confidential.

5 Results and Discussion

5.1 Sawing Survey Participants

Response to the survey was very positive. Out of 32 surveys sent to sawmills, 11 mills returned completed surveys within three weeks of the mailing. An additional 8 surveys were obtained during subsequent mill visits. Although 12 surveys were not received back, only two mills directly declined to participate in the survey due to concerns about sharing proprietary information. The percentage of respondents by geographical location is shown in Figure 1.

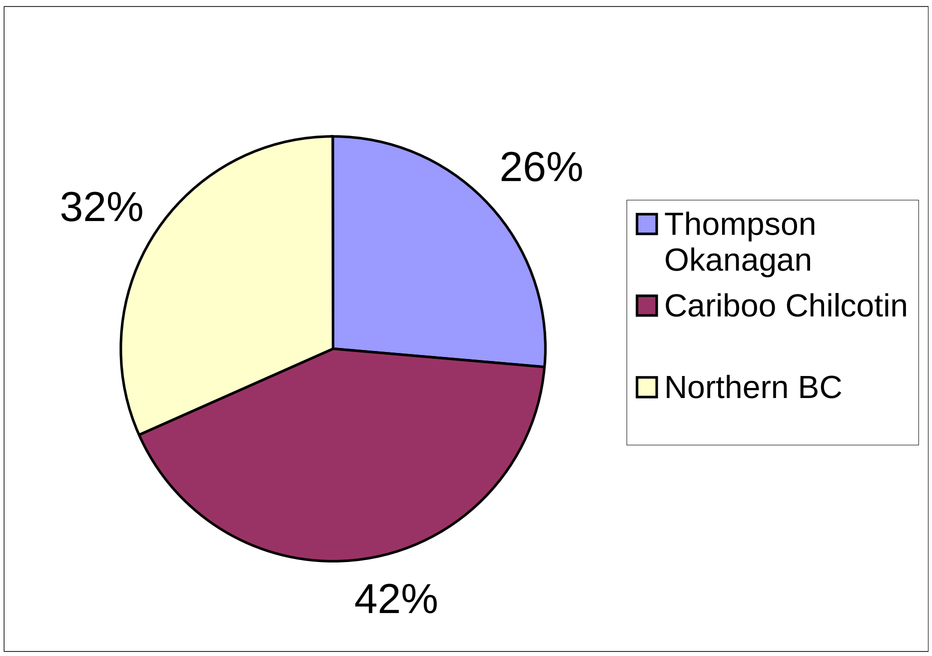

Figure 1: Survey Respondents by Geographic Location

5.2 General Information Questions

The first section of the survey asked general questions related to the specifics of processing post-MPB attacked wood at their plant (see Table 1). Of the 19 mills that responded, about 70% stated that their log supply had an 80% or higher percentage of beetle attacked wood. Many mills in the Quesnel and Prince

George region were processing logs from 100% MPB attacked areas. Figure 2 shows the percentage of MPB wood the mills are processing by geographic region. All of the mills in Northern BC surveyed are processing 75% or more MPB attacked wood.

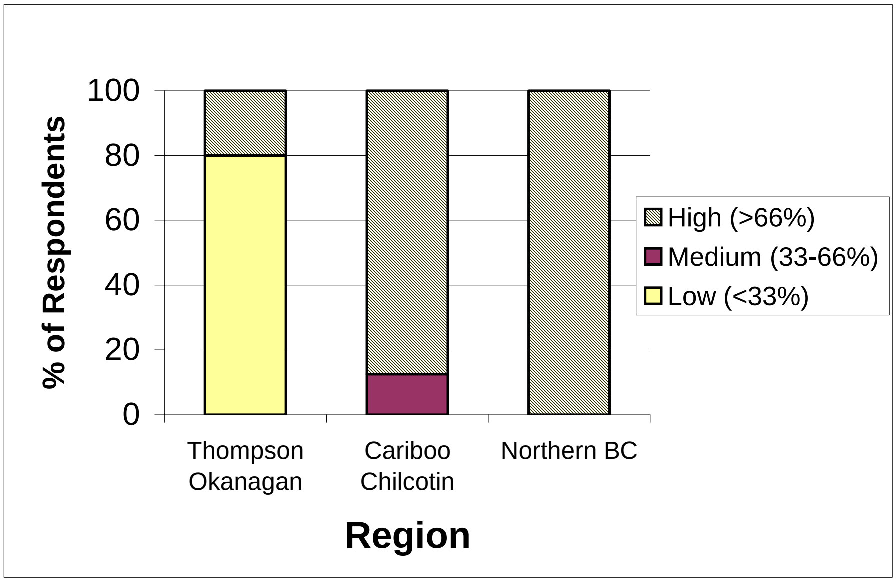

Figure 2: Percentage of MPB wood processed by geographic location.

From the responses, MPB attacked wood is impacting products and recovery primarily by reducing the recovery of visual grade products such as J-Grade. Additionally, sap-rot in wet-belt regions, pin-holes and reduced MSR out-turn are other common concerns. Most of the mills have reported a reduction in productivity due to mill flow issues related to breakage in un-scramblers and on transfer decks. For example, the side board shown on the right side of Figure 3 has a large check that will reduce recovery and will likely cause the piece to break during handling. The broken piece could easily disrupt production if it gets skewed on a deck or gets caught in equipment during subsequent processing operations.

The sawing process itself can also be negatively affected by MPB attacked wood. Most significantly, many mills report that the increased abrasiveness of the wood is decreasing saw and knife run time thereby increasing tooling costs. Additionally, breakage in machine centres is a common concern as are increased dust levels.

One benefit of cutting grey-attack wood, however is that winter processing speeds in many cases do not need to be reduced. Logs with heavy frost have, in the past, required mills to slow down in the winter but with the dry MPB logs some mills are finding that they can maintain summer speeds year round. One problem with this approach, however, is that when the occasional frozen green log with heavy frost is processed, the saws can deviate excessively.

More than half of the mills surveyed have not made any changes to the set-up of saws or machines for processing MPB attacked wood. Of the mills that have made some changes, these include increases or decreases in saw side-clearances or changes in tooth bite, changing the number of teeth in the saw and revised feed speeds and arbor speeds. Other changes implemented by some mills include variable pitch saws, chipping head speed changes and the addition of blue-stain and crack detection systems.

Mills reported that implementing changes in their saw or machine set-up improved saw performance. The two mills that installed blue-stain detection systems noted the systems were beneficial although no data was provided with respect to grade out-turn or recovery.

Figure 3: Sideboard with large spiral grain check.

Table 1: Responses to general survey questions.

Mill Number	1: Approximately what percentage of your log supply is MPB attacked?	2: How do the effects of post-MPB wood impact on your products or recovery?	3: How does post-MPB wood affect your sawing process?	4: Any changes to your saw/machine set-up to minimize the impact?	5: Did changes you implemented improve the sawing process?	Additional Notes
1	Low	Grade loss due to blue stain, pin holes, and checking	Some burn marks from the saw on the lumber which occurs on dry logs only, some additional tearing on canter heads	No.	n/a	
2	60 to 70%	Very little so far. Some upper appearance grades are limited. Breakage has been the most noticeable recovery effect.	Has not changed our process. Dry wood is more abrasive resulting in more frequent saw changes	No.	n/a	
3	20%	Producing less premium products i.e. J-grade etc. Producing more #3 due to shake.	n/a	n/a	n/a	
4	High, in excess of 75%	The stain affects products for the Japanese market. The wood is hard to bark which affects our chips. The dryer wood tends to break and affects our lumber drying [processes	The MPB wood tends to be a lot harder on our saws. More breakage in edgers.			
5	90% + of the pine is attacked	Potential to extract export grades is near zero. Wet belt attack has an increasing frequency of ambrosia beetle attack and sap rot.	It hasn't had much impact.	Kerf has been reduced, and canter line speeds have been increased. Added variable gullets.	Variable gullet sizes have improved saw performance.	
6	About 30% has blue stain. D-fir is 20% of our production which is not susceptible to MPB	Excludes our lumber from J-Grade.	Dry timber with checking: C-frame operator tries to align the cant's main defect parallel to the saws.	No.	No.	
7	High - almost 100%	Split and breakage	Change more saws.	No.	No.	
8	High	Causes high checking, blue stain and some twisting when drying. Recovery is down.	Harvested wood is dryer and harder on the teeth of saws.	We change saws and knives a little more frequently.	Yes.	
9	High - 100%	Increased shake and more breakage at the mill and in the planer.	No changes but crack detection at the canters and edger would be beneficial.	No changes. Finding in winter that bug kill is easier on our saws due to low moisture content of frozen wood.	Didn't make any changes.	
11	Low currently	Lower grades due to blue stain.	No effect as most logs are lake sorted and stay fresh	No change to machine or saws. Same speeds as spruce.	No.	

Mill Number	1: Approximately what percentage of your log supply is MPB attacked?	2: How do the effects of post-MPB wood impact on your products or recovery?	3: How does post-MPB wood affect your sawing process?	4: Any changes to your saw/machine set-up to minimize the impact?	5: Did changes you implemented improve the sawing process?	Additional Notes
12	100% MPB attacked. High % of red top, with times of grey trees	Impact on grade out-turn, more breakage, heavy checking and 5-10% recovery loss.	Winter sawing - less heavy frost conditions, Summer sawing - dulls canter knives faster, Dust is an issue	No.	n/a	
13	80% +	J-Grade reduced due to stain and lumber recovery down due to checking.	No major changes. More dust from saw boxes and bandmills	None.	n/a	
14	High - Some grey but mostly trees w/ dropped needles		More breakage in saw boxes causing jambs, some knife changes doubled, carbide usage doubles (dirt gets in surface checks)	Increased side clearance on CNS VDA by 0.005"/side for drier wood	Extra side clearance improved sawing performance and reduced saw heating	Cut-to-length also impacts tool life, as there are more dirty ends from hauling over dirt roads.
15	80%	MSR Grades effected.	Saws dull quicker but winter cutting better (keeps frost notches year round)	Increased number of teeth.	More teeth improves surface finish and saw better is supported	
16	80% MPB, 100% from effected stands		Some breakage in machines that operator cannot respond to due to attention and feed speeds	Changed knife speeds for drier wood, added lubrication.		
17	80%	Sideboard breakage due to checking, minimal sap rot. Recovery dropping and mill productivity dropping.	Cutting ok - breakage in machines result in saw damage	No.	No.	Graders have difficulty differentiating between Sap rot and brown stain.
18	High	Lowers J-grade due to blue-stain. Reduces LFR due to cracks. Lowers grade due to knot tear-out and pinholes.	Lost of dust & lumber breakage. Broken pieces stop lumber flow on decks. Dry logs don't move same as green. More breakage in yard and bush. [De]Barking is harder and chips have more bark residue as does lumber	Replaced debarkers. Rebuilt mill. [Installed] crack detection and blue-stain equipment. Better optimization; ways to remove waste (broken chunks of logs and boards). More dust removal systems.	Yes - Optimization, automatic log rotation, crack and blue-stain detection.	
19	80% (100% stand attacked)	Reduced J-grade.	[Increased] breakage, particularly with full-length stems (cut-to-length is better).	Add variable pitch to bands ~50% increase in feed speed. Tried less teeth and slower arbor speed for heavier bites on circulars.	Yes - Increased feed speeds with less sawing deviation.	Knives dull quickly. Added chipper line for broken stems.

Note: See Appendix I for the full text of the survey general questions.

5.3 Bandmills: Machine, Blade and Operating Parameters.

Section B of the survey covered machine specifications, saw blade specifications and operating conditions for bandsaws used to process MPB attacked logs. Data was obtained for 24 bandmills including headrigs, twin and quad machines as well as resaws. Basic information such as machine type and size is included in the machine specifications. The blade specifications section contains most of the important saw and tooth specifications. Additionally, a tooth rubbing was requested, which provides important information on tooth angles and the gullet shape and area, all of which will effect saw performance in different wood species and operating conditions. The operating conditions portion of Section B lists important parameters for determining feed speeds and cutting accuracy. Detailed survey bandmill information is given in Appendix II.

For the mills surveyed, twin bandmills were the most common bandmill type followed by quad bandmills and 6ft machines are more common than 5ft machines. Not surprisingly, headrigs are not common in the BC interior because of the relatively small log diameters. For both the 5ft and 6ft bandmills, 16 gauge sawblades were most commonly used followed by 15 gauge blades. All of the machines surveyed used blades with swaged tooth tips and only one mill was side-grinding the teeth after swaging.

Average, maximum and minimum kerf widths for the different machine types are shown in Figure 4. The horizontal marker represents the average kerf, while the vertical bars show the maximum and minimum values, and the numbers beside the bars represent the number of machines sampled. With the use of both 15 and 16 gauge saws on the 6ft primary breakdown machines, the average kerf of 0.147” is only 0.005” heavier than that of the 5ft machines.

Feed speeds for the primary breakdown twin and quad bandmills at maximum depth of cut can been seen in Figure 5. The saw tooth pitch used on these machines varied from 1.75” to 2.25”. Generally speaking, saws with greater pitch are better for large depths of cut and high feed speeds but cause increased roughness on the surface of smaller cants due to the larger bite. Tooth bite should typically stay below half the saw’s kerf width to maintain an acceptable surface finish. With the exception of one machine, the survey results showed that machines with smaller pitch saws were cutting at higher speeds for large depths of cut than machines with larger pitch saws. This may indicate that for the log diameters currently being processed by these machines, the smaller pitch is a better choice because it reduces the bite. This will reduce the surface roughness and should allow smaller target sizes provided the same sawing accuracy is maintained.

Figure 6 shows the maximum feed speeds for each machine type for the shallowest depths of cut. The range of speeds shown indicates that there is an opportunity for some mills to increase feed speeds at the smaller depths of cut, provided that the tooth bite (feed per tooth) remains less than approximately half the saw plate thickness. Reducing the tooth pitch is one way to keep tooth bite within reasonable limits at high feed speeds but the reduced gullet capacity associated with the smaller teeth can limit feed speeds at larger depths of cut.

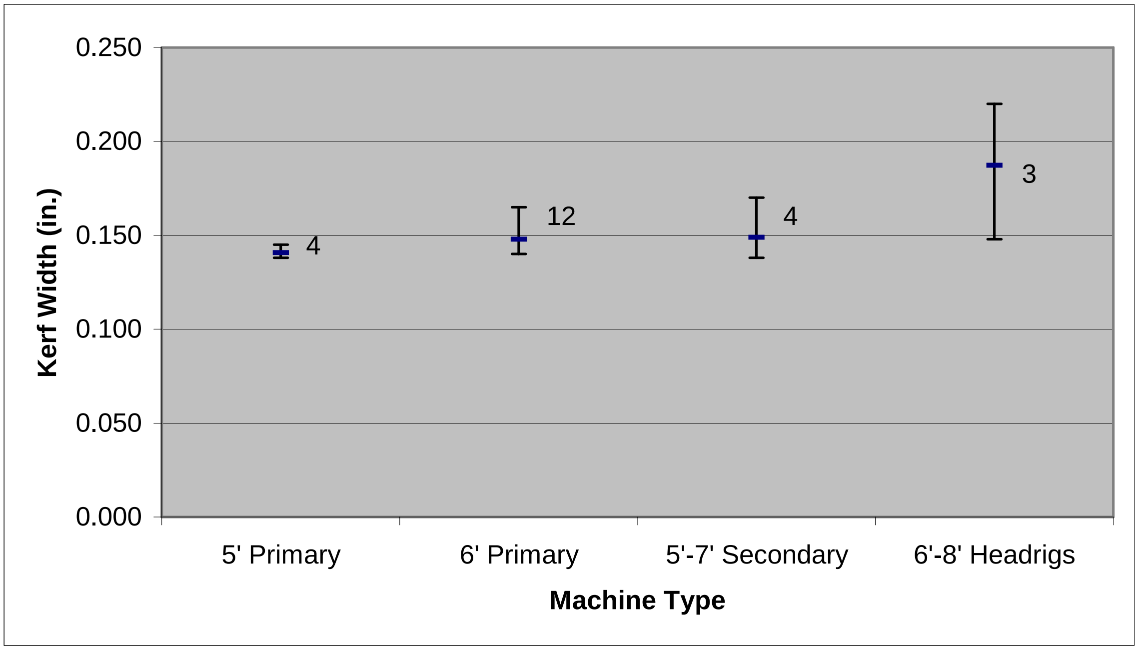

Figure 4: ***Kerf width (average, minimum and maximum) by bandmill type.***

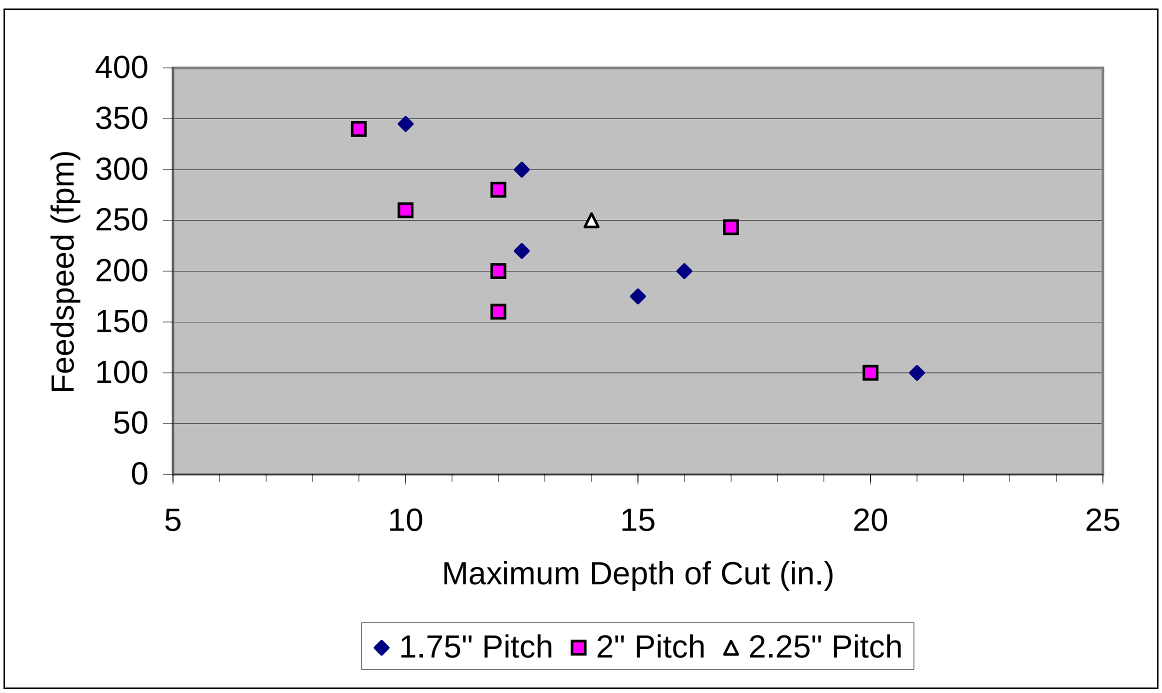

Figure 5: ***Feed speeds by tooth pitch for primary breakdown twin and quad bandmills at maximum cutting depth.***

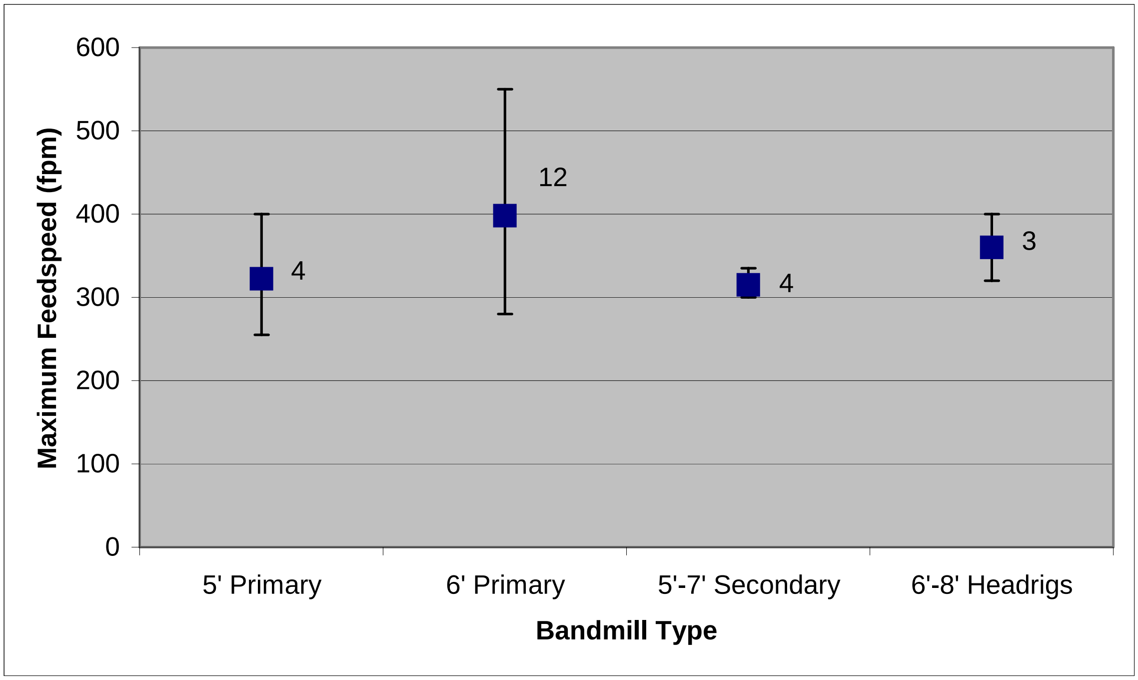

Figure 6: Maximum feed speed by bandmill type.

None of the mills participating in the survey reported making any significant changes to the bandsaw blades they are using when cutting MPB wood. Of the mills that provided us with tooth rubbings (21 of 24 machines), every one was using a frost notch in their blade, which is common practice during winter months. In addition, two mills were also punching the notch to increase the width of the gullet to reduce sawdust spillage. A typical tooth rubbing is shown in Figure 7. Data was not collected on how many mills run the frost notch year round. More work needs to be done to determine the effect of frost notches on bandsaw performance for dry MPB attacked wood.

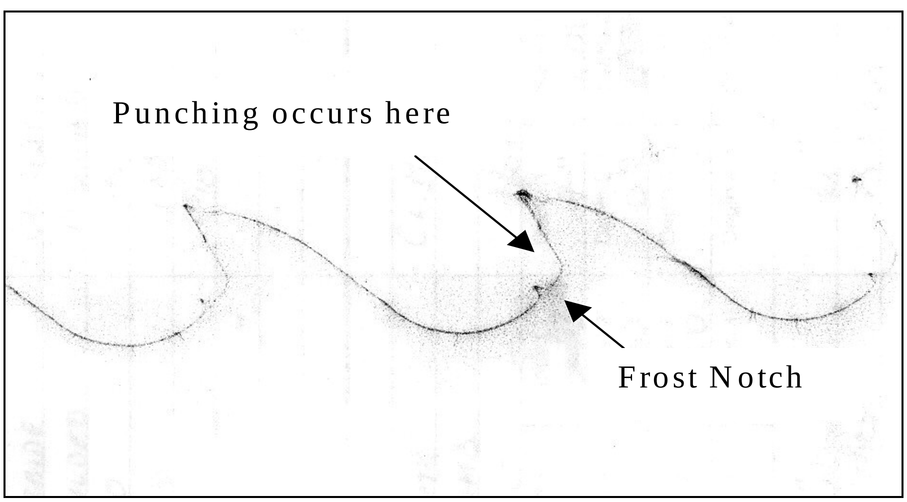

Figure 7: Typical bandsaw tooth rubbing with frost notch.

Where available, sawing accuracy information (standard deviation within board, between board and total) can also be found in Appendix II. A summary the total sawing variation for the different bandmill types is shown in Table 2. The results indicate that the larger 6' primary twin and quad bandmills using heavier blades are performing worse than the other machines. This is unexpected and likely a result of a limited sample size.

Table 2: Total sawing deviation for different bandmill classes and saw plate thicknesses.

Machine Type	Number of Machines	Wheel Diameter (ft)	Plate Thickness (in.)	Avg. Total Sawing Deviation (in.)
Head Rig	1	6	0.065	0.018
Head Rig	1	8	0.095	0.035
Twin/Quad	2	5	0.065	0.029
Twin	2	6	0.065	0.014
Twin/Quads	6	6	0.072	0.032
Twin Resaw	2	5	0.065	0.026
Single Resaw	1	6	0.065	0.024

5.4 Circular Gang and Shifting Edgers

Section C of the survey covered machine, blade and operating parameters of circular saw machines. All of the survey respondents provided information for this section resulting in information for 50 machines. Of these 50, there were four board edgers, one Hew Saw, one headrig, and six circular twin/quad headrigs used for sideboard removal in chipping canters. The remaining machines included 38 gang saws, fourteen of which are capable of curve sawing cants. Survey results for circular saws are given in Appendix III.

Gang edgers and curve-sawing edgers break down cants into boards using either a single or double arbor configuration. Because of their large number of sawlines, these machines often present the largest opportunity to improve mill recovery by minimizing the saw kerf. Figure 8 shows the wide range of kerfs for the surveyed machines. The machines, with either single or double arbors, are classed by the maximum depth of cut per saw. The number of machines in each class is shown beside each average value. Due to the nature of chipping canters, saw plate thickness used for these machines is quite large to help resist cant movement resulting in correspondingly heavy kerf widths.

The majority of the circular saw machines in the survey use carbide saw tips with tip lengths varying from 0.375" to 0.5". Five machines (from three different mills) use Stellite™ tips.

Feed speeds for each class of machines at their maximum depths of cut can be seen in Figure 9. There is a very large range of speeds being used indicating that some mills are doing a better job of maximizing throughput on the largest depths of cut than others. Quite often however, there are other factors that limit feed speeds such as machine design and condition, cant control issues, plate thicknesses or mill flow issues. The feed speeds for chipping canters are given for maximum depths of cut that vary from 4 to 9 inches per saw, however, actual feed speeds are often limited by the chipping heads. Two of these machines have top arbors that swing up and down so that the depth of cut is effectively equalized on both top and bottom saws, regardless of the cant size.

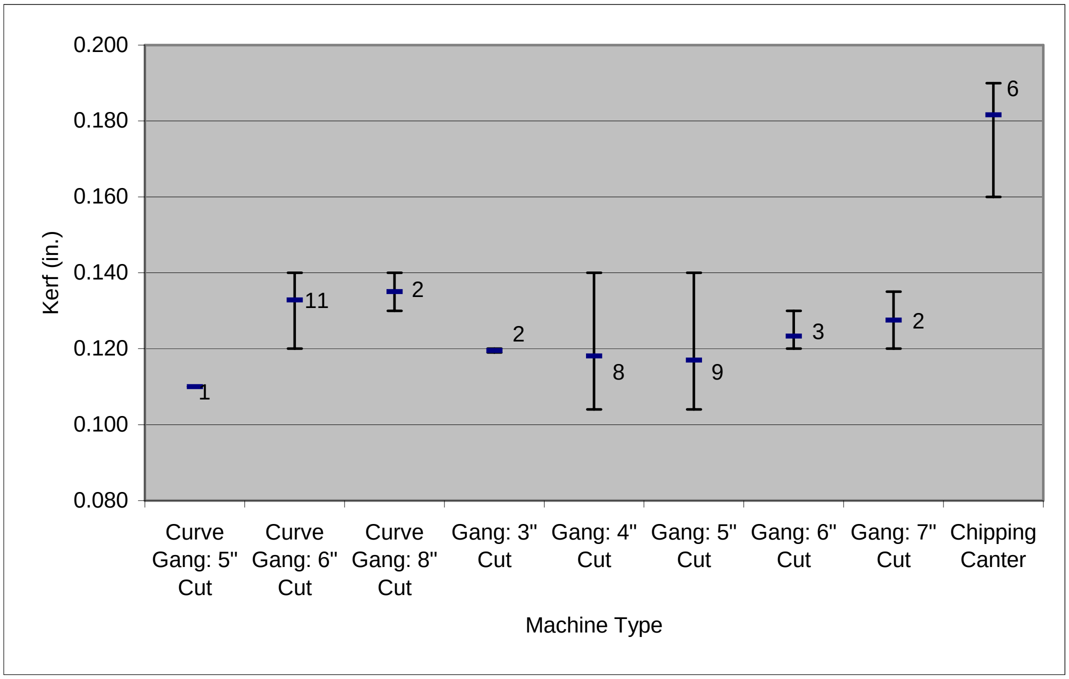

Figure 8: ***Kerf width (average, minimum and maximum) for different machine types.***

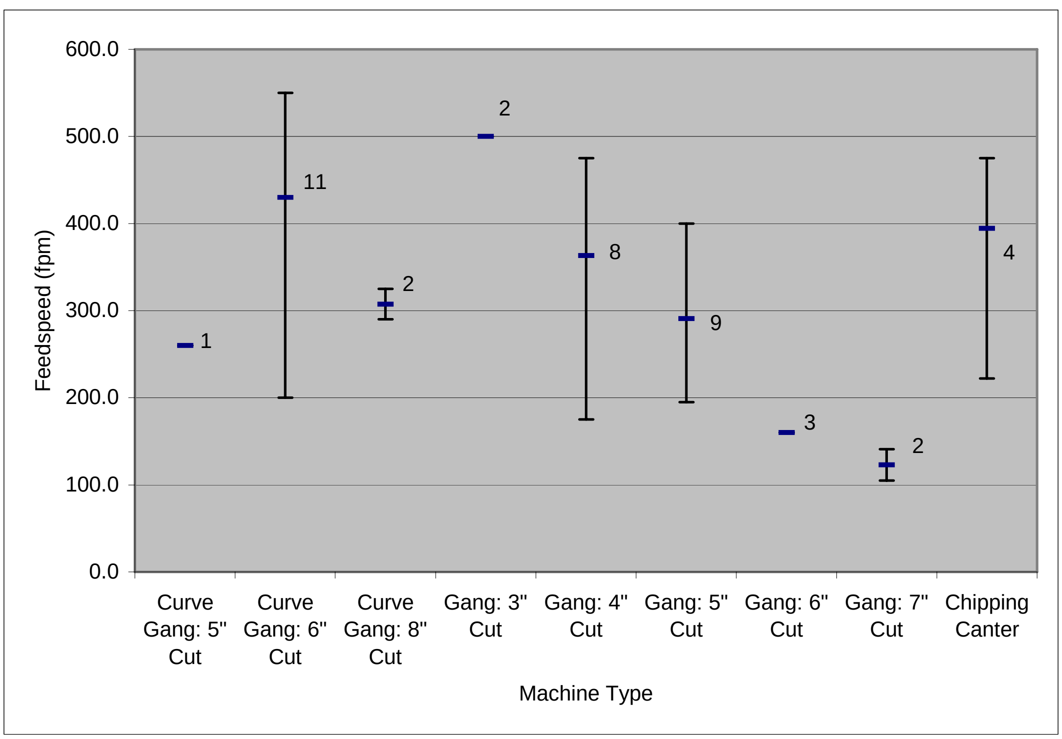

Figure 9: ***Feed speed at maximum cut depth for different machine types.***

At the minimum depth of cut, feed speeds are generally higher for all of the machine types (Figure 10). For most of the machines represented, the minimum depth of cut is typically 4 inches, however, some machines also cut 3-inch boards as shown under Depth 1 in the circular saw survey summary (Appendix III).

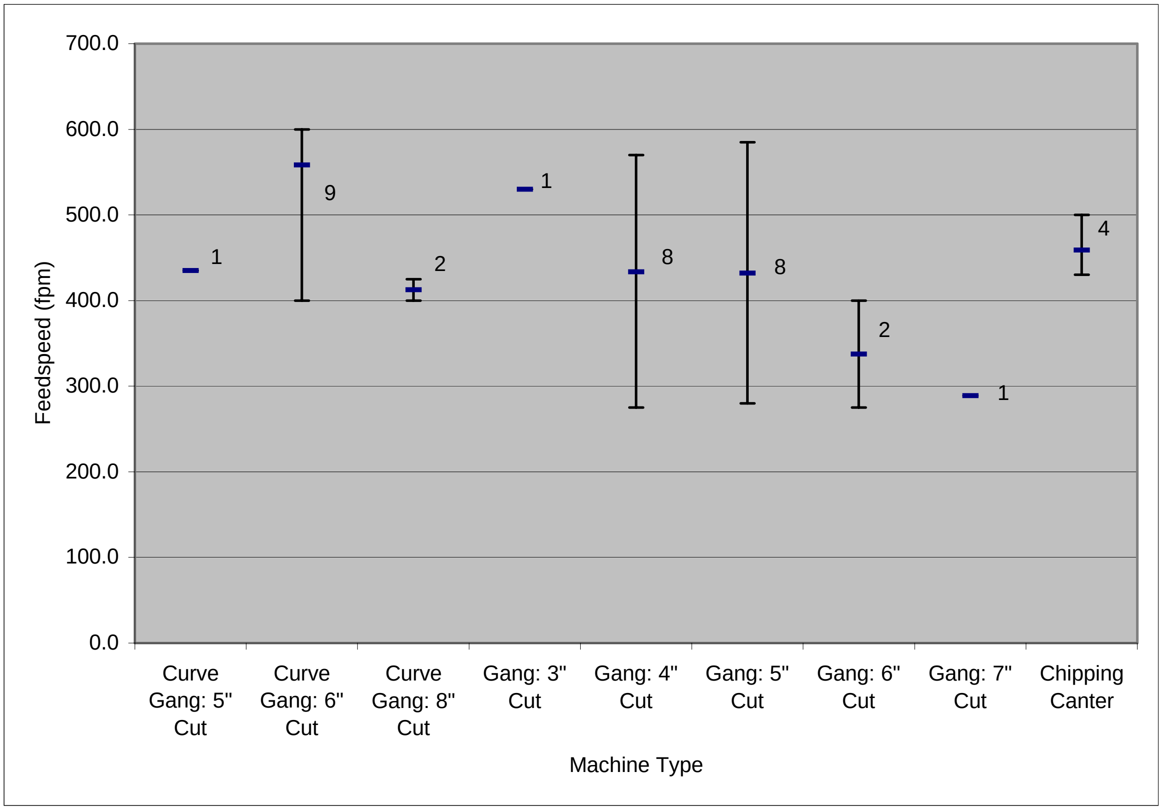

Figure 10: Maximum feed speed at minimum cut depth for different machine types.

Cutting accuracy, when provided, is also shown in the appendices. Approximately 42% of the mills did not provide sawing accuracy data and a number of the eight mills visited do not regularly measure boards for accuracy. Chipping canters appeared to have the worst cutting accuracy, which is likely to do with controlling small logs/cants at high speeds. The curve-sawing machines, for which accuracy data was provided, all had poorer sawing accuracies than the conventional straight saw gang edgers. Often single arbor (SA) gangs have a poorer cutting accuracy than double-arbor (DA) machines, as the saws are larger and less stiff for a given depth of cut. In addition, sawing variation measured for DA machines is typically lower than actual values because the edges of the board (where measurements are taken) are close to the guides. A comparison between SA and DA curve-sawing gangs was not possible as no accuracy data was provided for the two DA curve gangs in the survey.

5.5 Chipping Heads

The final section on the survey obtained information on chipping heads, knives and operating parameters. While not part of the original scope of the project, the opportunity was taken to collect this information as part of the sawing survey. As with sawing, the chipping process has been impacted by the increasing supply of MPB attacked wood, with knot tear-out and accelerated tool wear being of major concern. Data collected on chipping is included in Appendix IV.

The primary impact of chipping large volumes of MPB wood is a marked increase in knot tear out and a decrease in knife life. Many mills have seen knife changes double - from once a shift to twice a shift or more. Maintenance budgets have suffered and downtime has increased as a result.

Some mills have been experimenting with variable speed motors on the chipping heads in an attempt to maximize chip quality and minimize tear-out when cutting MPB wood.

6 Survey Conclusions

19 of 32 BC interior sawmills in the MPB affected region returned surveys. Information was provided on machine type, blade specifications, operating conditions and cutting accuracies for band and circular saw machines. Additionally, chipping data was obtained on head and knife type, geometry and knife operational life. Analysis of the survey results and data provide the following conclusions:

- Most of the mills surveyed are currently processing a high percentage of MPB attacked wood
- Grade out-turn of visual grade products has been reduced
- Other grades have been affected by cracks, pin-holes and sap rot.
- Increased saw and knife changes are a concern for most of the survey respondents
- Lumber breakage in machines and on decks and de-scramblers is reducing mill productivity and recovery.
- Some mills may benefit by reducing saw tooth pitch on primary breakdown bandmills to increase feed speeds.
- Very few of the mills surveyed have made any changes to the sawing process to optimize production of post-MPB attacked wood.
- There is a wide range of feed speeds being used for both bandsaws and circular saws indicating that for the majority of mills, there is some opportunity to improve production speeds.
- The benefit of using bandsaw frost notches year-round when cutting MPB wood should be investigated

Although, few mills have made specific changes to optimize the sawing process for post-MPB attacked wood, opportunities to improve the sawing process exist. With the large range of speeds being used by sawmills on machines cutting the same materials, changes to saw design, or departures from previous accepted practice may be warranted. The next phase of the project will be to optimize band and circular saw design with the goal of improving saw performance.

7 References

1. Lister, P. 1995 “Results of Sawing Performance Survey in Canadian Softwood Sawmills”, Forintek Canada Corp., Vancouver BC

Appendix I: Processing Post-MPB Wood Survey

Processing Post-MPB Wood Survey

Please fill out the following form as completely as possible. Items identified below with an asterisk are particularly important. Your input will be greatly appreciated. Mill and personnel names will NOT be identified.

Company: ______________________________

Division: ______________________________

Address: ______________________________

____

Your Name: ______________________________

Title: ______________________________

Phone Number: ________________ Fax Number: ________________

Email: ________________ Date: ________________

Please fax or mail your completed survey back to Forintek.

Mail to:
Attention: John White or John Taylor

Forintek Canada Corp.
2665 East Mall,
Vancouver, B.C.
Canada V6T 1W5
Phone: (604) 224-3221

Fax to: (604) 222-5690

Attention: John White or John Taylor

A. General Information

1. *Approximately what percentage of your log supply is Mountain Pine Beetle (MPB) attacked? (Percentage or Low/Medium/High)

2. How do the effects of post Mountain Pine Beetle (MPB) wood impact on your products or recovery?

3. *How does post-MPB wood affect your sawing processes?

4. *Have you made any specific changes to your saws or machine setup to minimize the impact of processing post-MPB wood? If so, what changes were made?

5. Did any of the changes you implemented improve the sawing process?

B. BANDMILLS: Machine, Blade and Operating Parameters

Parameter		Machine 1		Machine 2	
Machine Specifications:					
* Equipment make/type					
Diameter of wheels					
Blade Specifications:					
Total Width					
* Plate Thickness					
* Tooth Pitch (specify variable pitch pattern if applicable)					
Tip Type (swaged or stellite?)					
Kerf Width	Starting				
	Minimum				
* Radial Angle					
* Tangential Angle					
Operating Conditions:					
* Wheel Rotating Speed (rpm)					
Strain Level					
* Feed speed 1 (fpm)		Depth 1	Speed 1	Depth 1	Speed 1
* Feed speed 2 (fpm)		Depth 2	Speed 2	Depth 2	Speed 2
* Feed speed 3 (fpm)		Depth 3	Speed 3	Depth 3	Speed 3
* Feed speed 4 (fpm)		Depth 4	Speed 4	Depth 4	Speed 4
* Typical saw run time (hrs.)					
* Sawing Performance	Within Board (in.)				
	Between Board (in.)				
	Total Sawing Variation (in.)				

Items identified below with an asterisk(*) are particularly important.

B. BANDMILLS (Continued):

* Please include tooth rubbings in the spaces provided below:	
Tooth Rubbing From Machine 1:	Tooth Rubbing From Machine 2:

Items identified above with an asterisk(*) are particularly important.

C. CIRCULAR GANG AND SHIFTING EDGERS: Machine, Blade and Operating Parameters

	Parameter		Machine 1		Machine 2	
	Machine Specifications:					
	Equipment type					
*	Arbor Configuration					
	Number of Saws (per bank if applicable)					
	Number of banks (if applicable)					
	Feed system type					
	Arbor Size					
*	Arbor Style					
	Motor Horsepower per arbor					
	Blade Specifications:					
*	Diameter					
*	Plate Thickness (specify step thicknesses if stepped plate)					
	Pitch (variable/constant)					
*	Tip Material					
	Pre-formed or moulded tip?					
*	Kerf Width	Starting				
		Minimum				
	Length of Tooth Face or Tip					
*	Radial Angle					
*	Tangential Angle					
	Top bevel angle (if applicable)					
	Operating Conditions:					
	Cutting Mode (climb/counter cut)	Arbor 1				
		Arbor 2				
	Rim Speed (fpm) or Arbor RPM					
	Feed speed 1 (fpm)		Depth 1	Speed 1	Depth 1	Speed 1
*	Feed speed 2 (fpm)		Depth 2	Speed 2	Depth 2	Speed 2
*	Feed speed 3 (fpm)		Depth 3	Speed 3	Depth 3	Speed 3
*	Feed speed 4 (fpm)		Depth 4	Speed 4	Depth 4	Speed 4
	Maximum depth of cut					
*	Typical saw run time (hrs.)					

*	Sawing Performance	Within Board (in.)		
		Between Board (in.)		
		Total Sawing Variation (in.)		
		Avg. Step (in.). If not measured, state if an issue.		

Items identified above with an asterisk(*) are particularly important.

C. CIRCULAR GANG AND SHIFTING EDGERS (Continued):

* Please include tooth rubbings in the spaces provided below:	
Tooth Rubbing From Machine 1	Tooth Rubbing From Machine 2:

Items identified above with an asterisk(*) are particularly important.

D. CHIPPING HEADS: Head, Knife and Operating Parameters

	Parameter	Machine 1	Machine 2
	Machine Specifications:		
	Equipment Type		
	Head Type (eg. Drum or Conical)		
	Head Diameter		
	Head Location (eg. top, side, etc.)		
*	Number of knives per segment		
*	Number of segments		
	Chip Limiter (y/n)		
*	Facing Saw (y/n)		
	Feed system type (eg. sharp chain, spline, etc.)		
	Feed Speed (fpm)		
*	Head Speed (rpm)		
	Variable head speed?		
	Maximum chipping moment		
	Motor Horsepower per head		
	Knife Specifications:		
*	Knife Type		
	Knife width (in.)		
*	Hook angle		
*	Clearance angle		
*	Typical run time (hrs.)		
	Typical hones before discard (for disposable knives)		

Items identified above with an asterisk(*) are particularly important.

Appendix II: Bandsaw Survey Results

Mill Number	Machine Specifications:			Blade Specifications:										
	Type*	Equipment make/type	Wheel Diam. (ft)	Total Width	Plate Thickness		Tooth Pitch (Specify variable pitch pattern if applicable)	Tip Type (swaged or stellite?)	**Kerf Width**		**Tooth Geometry**			
					Gauge	Inches			Starting	Minimum	Hook* & Back	Frost notch*	Radial Angle	Tangential Angle
1	HR	McDonough Single Cut H/S	6	12	16	0.065	2.25	swaged	0.148	0.128		Y		
4	HR	Klamath, Head Rig	8	14	13	0.095	2.25	swaged	0.220	0.190		?		
10	HR	Albany D/C	8	15	13	0.095	2.5	swaged	0.194	0.175		Y		
11	TB-CC	Kockums Canter-Twin	5	10	16	0.065	2	swaged	0.138	0.127		Y		
19	QB-CC	CNS	5	9	16	0.065	2	swaged	0.140			Y +Punch	std. die	std. Die
10	TB-CC	Cancar Canter	5	10	16	0.065	2	swaged	0.140	0.120		Y		
13	TB	Twin Band, Letson & Burpee	5	10	16	0.065	1.75	swaged	0.145	0.135		Y		
15	QB-CC	Kockums 6' Quad	6	11	15	0.072	2	swaged	0.140	0.140	28,12	Y	0**	0**
19	QB-CC	USNR Quad	6	11	15	0.072	VP 1.75 7pattern (1.656 to 1.813)	swaged	0.140			Y +Punch	std. die	std. Die
7	TB-CC	Optimil (twins, 2-sided canter)	6	10	16	0.065	1.75	swaged	0.140	0.130		Y	8	3
7	TB-CC	Optimil (twins, 4-sided canter)	6	10	16	0.065	1.75	swaged	0.140	0.130		Y	8	3
12	TB-CC	Optimil twin band canter (large line)	6	10	16	0.065	1.75 variable	swaged	0.145		30	Y +Punch	8 x 3 x 38 Die	
12	TB-CC	Optimil twin band canter (small line)	6	10	16	0.065	1.75 variable	swaged	0.145		30	Y +Punch	8 x 3 x 38 Die	
8	QB	CSMI Quad	6	10	15	0.072	2	swaged	0.150	0.135	30	Y	8	3
19	QB-CC	Canter	6	12	15	0.072	2	swaged	0.150			Y +Punch	std. die	std. Die
3	TB-CC	Optimil	6	10	15	0.072	2.25	swaged	0.150	0.140		Y	3	8
2	TB-CC	Denis Comact	6	10	15	0.072	2.24	swaged	0.155	0.143		?	3	8
4	TB	Optimil, Twin band	6	10	15	0.072	1.75	swaged	0.155	0.140		?		
10	TB	Kockums-Cancar	6	10	15	0.072	2	swaged	0.165	0.148		Y	3	8
11	TB-R	Kockums Line-bar twin	5	10	16	0.065	2	swaged	0.138	0.127		Y		
18	TB-R	2 Kockums 5ft twins	5	10	16	0.065	1.75	swaged	0.140	0.125		Y		
3	TB-R	USNR	7	12	14	0.083	2.25	swaged	0.170	0.160		Y	3	8
1	H-SB-R	McDonough Horizontal Resaw	6	11	16	0.065	2.25	swaged	0.148	0.128		Y		

HR = Head Rig TB = Twin Bandmill QB = Quad Bandmill TB = Twin Bandmill SB = Single Bandmil H- = Horizontal -CC = Close coupled chipping -R = Resaw
Column Titles indicated with * were not survey questions

Mill Number	Operating Conditions:																
	Wheel Speed (rpm)	Blade Speed (fpm)	Strain Level (lbs)	Depth 1 (in.)	Feedspeed 1 (fpm)	Depth 2 (in.)	Feedspeed 2 (fpm)	Depth 3 (in.)	Feedspeed 3 (fpm)	Depth 4 (in.)	Feedspeed 4 (fpm)	Max. Depth of Cut*	Max F.S at Max DOC	Typical saw run time (hrs.)	Sawing Performance		
															Within Board (in.)	Between Board (in.)	Total Sawing Variation (in.)
1	530	10000	24000	4	320	22	230							4			0.018
4			14000	Manual										4	0.022	0.028	0.035
10	Summer 388, Winter: 285	Summer 9750, Winter 7160	Mechanical 40:1	Manual	400									8			
11		10500	15000	6	335	8	290	10	240	12	200	12	200	4	0.028	0.032	0.035
19		11000	12000	4	400			10	260			10	260	4			~0.020
10			14000	6	255	8	220	10	190	12	160	12	160	4-8hr			
13	570	8952	13600	min	300	max	100						100	4			
15		10771	20000	10	398	12	329	14	280	16	243	17	243	5			under 0.030
19		12000	21000	6	550			10	345			10	345	4			~0.030
7	536	10101	22000	9	280	11	265	12.5	220	15	175	15	175	4	not avail	not avail	not avail
7	536	10101	22000	7.2	340	9	300	10.8	200	12.5	220	12.5	220	8	not avail	not avail	not avail
12	583	11000	20000	4.7	360	11	300	14.5	240	21	100	21	100	8	0.007	0.01	0.013-0.016
12	648	12200	20000	4	390	7.2	330	10.5	270	16	200	16	200	8			0.012-0.015
8	600	11308	18000	4	360	9	280	12	180	20	100	20	100	8	0.038	0.028	0.43
19		11000	18000	6	400					12	280	12	280	4			~0.020
3	602	11345	24000	6"	425	Up to 14	250					14	250	8	?	?	?
2	550	10365	21,000	min	450	max	375							8	0.013	0.032	0.034
4	650	12250	14500	2.5	440	4.5	375	7	350	12.5	300	12.5	300	4	0.012	0.028	0.03
10	530	9988	15000	5.5	385	6.5	380	7.5	360	9	340	9	340	8			
11		10500	14000	6	335	8	290	10	220	12	220	12	220	4	0.023	0.03	0.032
18	850	13349	17500	4	310	6	310	8	280	10	240	12	190	4	0.017	.019 to 0.020	0.018
3	425	9344	34000	Manual										4	?	?	?
1	530	10000	23000	0-10	300	11-14	220	15-18	230	19-22	210	22	210	4	0.015	0.021	0.024

Column Titles indicated with * were not survey questions

Appendix III: Circular Survey Results

	Machine Specifications:								
Mill Number	Equipment type	Machine Type*	Arbor Configuration	Number of Saws (per bank if applicable)	Number of banks (if applicable)	Feed system type	Arbor Size	Arbor Style	Motor Horsepower per arbor
10	Maxi, Board Edger	BE	Edger	3	1	Roll & chain	#3	Retec	
10	Autopos Schurman Board Edge	BE	Edger	3	1	Constant	#3	Retec	
10	Schurman Board Edger	BE	Edger	1	2	Sharp chain	6.5"	Collared	75
11	Schurman 3-saw edger	BE	Edger	3	1	Hydraulic. Sharp chain	#3	Retec	200
17	Hew Saw VDA	CE	VDA	5	2 (5/4" & 2")	VFD	2.75" Eye	5.125" Collar	
7	COE 10" Curve Gang	C-GE	HDA	14/arbor			#3.5	37.5 Involute	600
3	McGehee 12" Curve Gang	C-GE	HDA	26 and 26	2		#3	Retec	T=600 B=600
9	6" Newnes curve gangs	C-GE	HSA	9	1	rolls & Bed chain	#3	37.5 Involute	200
4	6" McGehee Line 3 Curve	C-GE	HSA	5	1	chain	#3	Ultratech	400
2	McGehee Curve	C-GE	HSA	8	1	Electric	#3	Involute	
3	USNR Shape Saw	C-GE	VSA				#3	Retec	
15	6" COE VSS	C-GE	VSA	7	1	VFD	#3	37.5 Involute	400
16	DDM (1) 400 Large line Curve Saw	C-GE	VSA	8		VFD, guide bar	#2.5	Ultratech	200
16	DDM (2) 600 Small line Curve Saw	C-GE	VSA	8		VFD, guide bar	#2.5	Retec	200
18	Curve Saw Gang	C-GE	HSA	9	1	VFD	#3	37.5 Involute	600
19	USNR VSS 22"	C-GE	VSA	9		Curve Saw, VFD	#3	37.5 Involute	600?
19	USNR VSS 12"	C-GE	VSA	6		Curve Saw, VFD	#3	37.5 Involute	600?
3	McGehee 8" Curve Gang	C-GE	HSA	7 and 7	2		#3	Retec	600
11	Coe/Newnes Curve Gang	C-GE	VSA	7	1 to 2	Sharp chain & Side chains	#3	37.5 Involute	300
10	8" UKIAH	GE	VDA	4	2	roll	#3	spline	200
12	Optimil 6" VDA	GE	VDA	4	1	Electric	#3	Retec	
8	8" McGehee	GE	VDA	4 saws 2 banks	2	constant	#3	involute	200
1	8" Ukiah	GE	HDA	11	2	VFD	#3	37.5 Involute	300
5	McGehee 8" Curve Gang	GE	VDA	4/arbor	1	Rolls/spline	#3	Retec	200
14	USNR Curved Chipping 8"	GE	VDA	4/arbor	2 (1 spare)	VFD centre feed	#3	37.5 Involute	400
10	10" UKIAH	GE	VDA	9	2	Roll	#3	involute	2x250
10	A CNS 8" UKIAH	GE	VDA	5			#3	37.5 Involute	

	Machine Specifications:								
Mill Number	Equipment type	Machine Type*	Arbor Configuration	Number of Saws (per bank if applicable)	Number of banks (if applicable)	Feed system type	Arbor Size	Arbor Style	Motor Horsepower per arbor
13	Optimil	GE	VDA	8/arbor		Fixed spd	#3	Retec	250
18	COE/Newnes D/A	GE	DA	16 total	2	VFD	#3	37.5 Involute	600
7	Optimil 10"	GE	VDA	6/arbor - was 10	1		#3.5	37.5 Involute	500
6	Chip-N-Saw DLI 10"	GE	VDA	5 each side	1	Rolls	#3	Involute	250
15	Ukiah	GE	VDA	18 total	1	VFD centre feed	#3	37.5 Involute	400
8	10" Gang CAE	GE	VDA	10 Saws 2 banks	2	constant	#3	involute	350
12	Optimil 10" VDA	GE	VDA	10	1	Electric	#3	Retec	500
5	McGehee 10"	GE	VDA	7/arbor	1	rolls/spline	#3	Retec	500 (350+150)
13	McGehee	GE	HDA	15/arbor		VFD	#3	Retec	B=700, T=500
4	10" McGehee Line 2 VDA	GE	VDA	8	2	Rolls	#3	Involute	500
17	10 Gang	GE	VDA	12 total	1	VFD, centre feed	#3	Involute	300
1	12" Ukiah	GE	HDA	18	2	VFD	#4	37.5 Involute	400
10	A Canter Powel 12"	GE	VDA	9		HYD	#3	37.5 Involute	
19	Cancar gang	GE	VSA	6		Linebar, rim cutting	#4	Retec	
14	CNS	GE	VDA	7/arbor	1	VFD, centre feed w/ +/- 1" Offset	#3	37.5 Involute	350
6	Newnes 12"HDA Gang	GE	HDA	12 Top & Bottom	1	Rolls	#3	Involute	350
10	A Head Rig DAG, Sherman R	HR	HDA	10	2	110 FPM	#3	Delta	300
5	McGehee Twin Canter	T-CE	HDA	2/arbor	2	spline	#3	Retec	350
9	9" Comact Quad Canters	Q-CE	HDA	4 saws/bank (8)	2	spiked cabl/chain	#3	37.5 Involute	200
17	USNR CE	Q-CE	4 HA w/ top pivoting	8		VFD, spline	#3	Involute	200
15	Quad swing arbor (running as twin)	T-CE	4 HA w/ top pivoting	4 total (1/arbor)	1		#3	37.5 Involute	
16	Quad saw	Q-CE	4 HA	8 total (2/arbor)		VFD, guide bar	#3	Retec	200
18	Comact Quad	Q-CE	4 HA	8 total (2/arbor)		VFD	#3	37.5 Involute	

BE = Board Edger GE = Gang Edger C-GE = Curve Sawing Gang Edger CE = Chipping Edger T- = Twin Q- = Quad
Column Titles indicated with * were not survey questions

	Blade Specifications:													
Mill Number	Diam. (in.)	Plate Thickness (in)	Pitch (variable/constant)	Number of Teeth*	Tip Material	Pre-formed or moulded tip?	Kerf Width		Length of Tooth Face or Tip (in.)	Hook Angle*	Radial Angle	Tangential Angle	Back Clearance*	Top bevel angle (if applicable)
							Starting (in.)	Minimum (in.)						
10	22	0.100	Constant		Carbide	Pre-formed	0.140	0.125	0.5	22				
10	22	0.100	Constant		Carbide	Pre-formed	0.150	0.120	0.5			1 deg	8	
10	24	0.120	1.135” constant	66	Carbide	Pre-formed	0.170	0.150	0.5		0.011"	0.006"		10
11	22	0.110	Constant	66	Carbide	Pre-formed	0.160	0.135	0.375					
17	13.75	0.110	Constant	32	Carbide	Pre-formed	0.150	0.140	0.5		0.012"	0.008"		
7	18	0.075	Constant		Stellite	Triangle	0.110	0.100	0.25		3	5		
3	19	0.090	Constant	32	Carbide	Pre-formed	0.130	0.120	0.5		2	1.5		10
9	19	0.090	Constant		Carbide	Pre-formed	0.120	0.114	0.5		3	3		
4	19	0.100	Constant	46	Carbide	Pre-formed	0.125	0.115	0.438		3	2-7		10
2	19.5	0.100	Constant	42	Carbide	Pre-formed	0.130	0.115	0.5		3	4		N/A
3	19.5	0.100	Constant		Carbide	Pre-formed	0.140	0.130	0.5		2	1.5		10
15	19.5	0.100	Constant	44	Carbide	Pre-formed	0.124	0.116	0.5		2	3		0
16	19	0.100	Constant	46	Carbide	Pre-formed	0.136	0.130	0.5		0.003"	0.006"	8	0
16	19	0.100	Constant	46	Carbide	Pre-formed	0.136	0.130	0.5		0.003"	0.006"	8	0
18	20	0.100	Constant	56	Carbide	Pre-formed	0.140	0.128	0.375	30	0.004"			0
19	19.5	0.110	Constant (will try v.p.)	35	Carbide	Pre-formed	0.140	0.130	0.5		0.007"	0.004"		
19	19.5	0.110	Constant (will try v.p.)	35	Carbide	Pre-formed	0.140	0.130	0.5		0.007"	0.004"		
3	23	0.090	Constant	41	Carbide	Pre-formed	0.130	0.120	0.5		2	1.5		10
11	23	0.100	Constant	45	Carbide	Pre-formed	0.140	0.128	0.5					
10	15	0.080	1.03” Constant	46	Carbide	Pre-formed	0.120	0.104	0.438		0.013"	0.008"		10
12	16	0.083	Constant	36	Stellite	Pre-formed	0.119	0.107	0.188		0.008"	0.008"		0
8	15	0.070	Constant		Carbide	Pre-formed	0.110	0.100	0.375		1.5	1		
1	16	0.080	1.375” Constant	36?	Carbide	Pre-formed	0.110	0.102	0.375		2	2		0
5	17	0.090	Variable Gullets	50	Carbide	Pre-formed	0.104	0.096	0.438		0.0025"	0.0015"	0.0065"	
14	19	0.090	Constant	54	Carbide	Pre-formed	0.110	0.103	0.4375		~1-1.5	~1-1.5		0
10	17	0.090	1.165” Constant	46	Carbide	Pre-formed	0.126	0.110	0.438		0.013"	0.008"		10
10	15.5	0.090	Constant		Carbide	Pre-formed	0.140	0.120	0.375	25	0.008"	1 deg		
13	16.5	0.090	Constant		Stellite	Pre-formed	0.125	0.115	0.25		2	2		0

	Blade Specifications:													
Mill Number	Diam. (in.)	Plate Thickness (in)	Pitch (variable/constant)	Number of Teeth*	Tip Material	Pre-formed or moulded tip?	Kerf Width		Length of Tooth Face or Tip (in.)	Hook Angle*	Radial Angle	Tangential Angle	Back Clearance*	Top bevel angle (if applicable)
							Starting (in.)	Minimum (in.)						
18	15	0.090	Constant	38	Carbide	Pre-formed	0.120	0.108	0.375	30	0.004"			0
7	19	0.075	Constant & VP	32	Stellite	Triangle	0.110	0.100	0.25		3	5		
6	17	0.080	Variable	40	Carbide	Pre-formed	0.110	0.100	0.438		1.5	3		
15	17	0.080	Constant	50	Carbide	Pre-formed	0.110	0.105	0.5		2	3		0
8	17	0.080	Constant		Carbide	Pre-formed	0.110	0.100	0.375		1.5	1		flat
12	18.5	0.083	Constant	36	Stellite	Pre-formed	0.119	0.107	0.188		0.008"	0.008"		0
5	17	0.090**	Variable Gullets	50	Carbide	Pre-formed	0.104	0.096	0.438		0.0025"	0.0015"	0.0065"	
13	17.5	0.090	Constant		Stellite	Pre-formed	0.125	0.115	0.25		2	2		0
4	17	0.100	Constant	50	Carbide	Pre-formed	0.125	0.115	0.438		3	2-7		10
17	17	0.100	Variable 3 pitches	39	Carbide	Pre-formed	0.140	0.130	0.5	28	0.012"	0.008"		0
1	22	0.080	2.875" Constant	24	Carbide	Pre-formed	0.120	0.107	0.438		2	2		0
10	19	0.090	Variable		Carbide	Pre-formed	0.130	0.110	0.5	20	0.008"	1 deg		
19	27	0.090	Constant	48	Carbide	Pre-formed	0.120		0.5		0.007"	0.004"		
14	21	0.100	Constant	50	Carbide	Pre-formed	0.135	0.125	0.4375		~2-2.5	~2-2.5		0
6	20	0.090	Constant	18	Carbide	Pre-formed	0.120	0.110	0.375		1.5	3		
10	20	0.090	Constant		Carbide	Pre-formed	0.130	0.110	0.5	30	0.008"	1 deg		
5	22	0.120	Constant	60	Carbide	Pre-formed	0.160	0.155	0.375		0.0025"	0.0015"	8 deg	
9	24	0.150	Constant		Carbide	Pre-formed	0.190	0.180	0.5		3	3		
17	21	0.150	Constant	40	Carbide	Pre-formed	0.180	0.170 to 0.175	0.5	28	0.012"	0.008"		0
15	21	0.150	Constant	60	Carbide	Pre-formed	0.180		0.5		2	3		0
16	24	0.150	Constant	50	Carbide	Pre-formed	0.190		0.5		0.003"	0.006"		0
18	24	0.150	Constant	66	Carbide	Pre-formed	0.190	0.175	0.375	30&27	0.004"			0

Column Titles indicated with * were not survey questions
** Stepped saw plate

Forintek Canada Corp.

	Operating Conditions:																
Mill Number	Cutting Mode (climb/counter cut)		Rim Speed or Arbor RPM (fpm or rpm)	Depth of Cut 1 (in.)	Feed speed 1 (fpm)	Depth of Cut 2 (in)	Feed speed 2 (fpm)	Depth of Cut 3 (in)	Feed speed 3 (fpm)	Depth of Cut 4 (in)	Feed speed 4 (fpm)	Depth of Cut 5 (in)	Feed speed 5 (fpm)	Max. depth of cut (in) (both saws)	Single Saw Max DOC*	Feedspeed at Max DOC*	Typical saw run time (hrs.)
	Arbor 1	Arbor 2															
10	climb													2	2		8
10	climb		2475	2	600									2	2	600	8
10	climb		2550	2	1089									2	2	1089	8
11	climb		3300	1	900	2	900	3	450	4	450			4	4	450	16
17	counter	climb	1800?	4	475	6	475							7" Diam. Log	3		4
7	climb	climb		4	435	6	385	8	335	10	260			11	5	260	20-22
3	climb	climb	2400	4	400	6	400			Up to 12"	200	12	200	12	6	200	8
9	climb		3570											6	6		6
4	climb		3600	4	525	6	400							6	6	400	8
2	climb		3600	4	600	6	400							6	6	400	8
3	climb		3600											6	6		8
15	climb		3000	4	600	6	550 or 600							6	6	550	5
16	climb		2800	4	600	6	360							6	6	360	<8
16	climb		2800	4	600	6	360							6	6	360	<8
18	climb		3600	4	600	6	500							6	6	500	8
19	climb		3200	4	550	6	550							6	6	550	
19	climb		3200	4	550	6	550							6	6	550	
3	climb		2400	4	400	6	400	8	325					8	8	325	8
11	climb		2850	4	425	5	375	6	350	8	290			8	8	290	8
10	climb	climb	3138											8	3		8
12	climb	climb	2670	4	530	6	500							6	3	500	48
8	climb	climb		4	510									8	4		8
1	climb	climb	2900	4	275	4X6	230	4x8	175					8	4	175	4
5	climb	climb	3400	3	570	4	475	6	475	8	475			7.75	4	475	4
14	climb	climb	3200	4	450	6	450	8	400					8	4	400	5 to 6
10	climb	climb	2554											10	4		8

Mill Number	Operating Conditions: Cutting Mode (climb/counter cut)																
	Arbor 1	Arbor 2	Rim Speed or Arbor RPM (fpm or rpm)	Depth of Cut 1 (in.)	Feed speed 1 (fpm)	Depth of Cut 2 (in)	Feed speed 2 (fpm)	Depth of Cut 3 (in)	Feed speed 3 (fpm)	Depth of Cut 4 (in)	Feed speed 4 (fpm)	Depth of Cut 5 (in)	Feed speed 5 (fpm)	Max. depth of cut (in) (both saws)	Single Saw Max DOC*	Feedspeed at Max DOC*	Typical saw run time (hrs.)
10	climb	climb	2500	4	300	6	300	8	300					8	4	300	16
13	climb	climb	2775 (12000sfpm)	4	380	6	380	8	380					8	4	380	8
18	climb	climb	3600	4	550	6	500	8	450					8	4	450	8
7	climb	climb	2864	4	420	6	380	8	340	10	230			11	5	230	20-22
6	climb	climb	3400	4	405	6	405	8	370	10	195			10	5	195	5
15	climb	climb	3000	4	420	6		8		10	260			10	5	260	5
8	climb	climb		4	360	4	340	4	320					10	5		8
12	climb	climb	2800	4	530	6	500	8	420	10	320			10	5	310	24
5	climb	Climb	3400	4	585	6	585	8 (>6)	560	10	400			9.75(10)	5	400	4
13	climb	climb	2400 (11000sfpm)	4	280		150							10	5		8
4	climb	climb	2542			6	460	8	375	10	300			9.75(10)	5	300	8
17	climb	climb	1800?	4	456	6	418	8	380	10	340			10	5	340	4
1	climb	climb	1800	4-6x8		6x8	80	6x18	130					12	6		8
10	climb	climb	2350	4	275	6	275	8	275	10	225	12	160	12	6	160	8
19	climb		2800	4	400	6	400							8" used as 6"	6		
14	climb	climb	2550	4	289	6	286	8	283	10	247	12	217	14	7	141	141
6	climb	climb	2200			6	105	8	105	10	105	12	105	Bot 7.25,top 5.5	7.25	105	5
10	climb	climb	2100	4	110	6	110	8	110	10	110	12	110	12	6	110	8
5	climb	climb	2800	<=3	500	> 3	475							8.5	4.25	475	16
9	climb	counter	2400											9"	4.5		6
17	B=counter	T=climb		max	456	min	222							12.25	6	222	2
15	climb	climb												13	7.5		5
16	climb	climb	2400	4	430	6	360	600 to 430						18	9	430	<8
18	climb	climb	2400	all	450									<18	9	450	

Column Titles indicated with * were not survey questions

	Sawing Performance				
Mill Number	Within Board (in.)	Between Board (in.)	Total Sawing Variation (in.)	Avg. Step (in.). If not measured, state if an issue.	Additional Notes
10					
10					
10					
11	0.030	0.038	0.034	n/a	
17	n/a	n/a	n/a		
7	Not avail	Not avail	Not avail	Not	
3	?	?	?	Not an Issue	
9	0.019	0.040	0.043		
4	0.025	0.023	0.034	N/A	
2	0.018	0.019	0.027	N/A	
3					
15			~0.030	Bevelling an issue	
16	0.022	0.032	0.039		
16	0.024	0.036	0.044		
18	n/a	n/a	n/a	n/a	
19			~0.020	n/a	Quad bands for side boards
19			~0.020	n/a	No sideboards? (small log line)
3	?	?	?		
11	0.023	0.05	0.035	n/a	
10					
12				0.012	Approx. accuracy numbers
8	0.012	0.003	0.012	0.006	
1	0.004	0.003	0.005	0.005	
5	0.009	0.009	0.013	No issues	
14	0.006	0.005	0.008	Not unless wood dirty	
10					

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	Sawing Performance				
Mill Number	Within Board (in.)	Between Board (in.)	Total Sawing Variation (in.)	Avg. Step (in.). If not measured, state if an issue.	Additional Notes
10				0.005	
13					
18	0.007	0.008	0.01	Not an issue	
7	Not avail	Not avail	Not avail	No	
6	0.009	0.005	0.1		
15				0.03-0.04 step	
8	0.013	0.007	0.014	0.007	
12				0.008	Approx. accuracy numbers
5	0.009	0.008	0.012	No issues	
13					Feedspeed depends on width
4	0.01	0.008	0.013	Recurring issue	
17	n/a	n/a	n/a	Step improving	Accuracy not measured
1	0.005	0.006	0.007	0.011	
10				0.005	
19			~0.030	n/a	Saw bigger than required for 6" as machine is designed for 8"
14	0.013	0.011	0.017	Not an issue since increasing S/C	
6	0.007	0.004	0.007		
10				0.01	
5				No issues	
9	0.029	0.029	0.039	Not measured/no issue	
17	n/a	n/a	n/a	n/a	Accuracy not measured, feedspeed based on chipping volume
15					Feedspeed depends on stack height
16	0.025	0.05	0.052		Speeds depend on center cant and stack height. Most @ 600fpm, Accuracy for 4" sawn center cant
18					

Appendix IV: Chipping Survey Results

	Machine Specifications													
Mill Number	Equipment Type	Head Type (Drum or Conical)	Head Diameter	Head Location (top, side, etc.)	Number of knives per segment	Number of segments	Chip Limiter (y/n)	Facing Saw (y/n)	Feed system type (sharp chain, spline, etc.)	Feed Speed (fpm)	Head Speed (rpm)	Variable head speed?	Maximum chipping moment	Motor Horsepower per head
1	Chipping Canter	Conical	28”	Side Head	8	1	Y	N	Spline	505	828	No		200
1	Chipping Canter	Drum	16”	Top & Bottom	5 + 5	5 + 5	Y	n/a	Spline	505	T: 1330 B: 1331	No		200
2	Comact Canter	Conical	24” face plate	Side	8	N/A	N	N	Sharp chain	300 to 550	VFD	Yes		
2	McGeehee Tailing	Drum	12”	Side	4	4	N	N	Sharp chain	400 to 600	VFD	Yes		
3		Conical	26"	Side	3	6	Y	N	Sharp chain	450 max		Yes		200
3		Conical	22"	Side	2	6	N	N	Sharp chain	600 max		Yes		200
4	Optimil Line 2	Drum	20"	Side, top, bottom	3-top 4-bottom	7	N	N	Spline	240-475	1300-1800	Yes		Top: 200 Bottom: l50
4	Optimil Line 3 Canter	Conical	20"	Side	8	n/a	N	N	Sharp chain	400-500		No		
4	Newnes Line 3 Gang	Drum	12"	Side	4	3	N	N	Rolls	400-525		Yes		
5	Can Car CNS	Drum	B/s/t: 18.5/15/17.25	4 sides	4	Top & Btm: 6,Side: 6	N	N	Spline	530 avg	1380	No	2500 max.	300
5	Can Car CNS	Drum	B/s/t: 18.5/15/17.25	4 sides	4	Top & Btm: 6,Side: 4	N	N	Spline	570 avg	1380	No	2500 max.	250
6	DLI	Drum	20"	Bottom/top/ Side	4	6	Y	Y - top only	Step chain & Mini Spline	195-405	TH& SH: 2000 BH: 1800	No		Top: 260, Sides: 150
6	Carriage Drive C-Frame	Drum		Side	4	6	N	Y - side boards	Carriage	105-505	1800	No		Sides: 150
7	Optimil	Conical		Side			Y	N	Sharp chain	Var.	Var.	Yes	2600	200
7	Optimil	Drum	16"/15"/17.13"	Btm/Side/Top	8/8/8	7/9/7	N	N	Spline	Var.	Var.	Yes	1900	200
8	CSMI 24" canter	Drum	16"	Top, Side, Bottom	4	8	N	N	Mini spline	Variable	1150	No	5750	150
8	CSMI 12" Canter	Drum	16"	Top, Side, Bottom	4	5	N	N	Mini spline	Variable	1150	No	1600	150
9	Comact Quad Canter	Conical		Side/Top	6 & 8		N	N	Sharp chain	Variable	900	Yes	Variable	150
9	Newnes curve Gangs	Conical		Side	3	3	N	N	Sharp chain	Variable	1800	Yes	Variable	150

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	Machine Specifications													
Mill Number	Equipment Type	Head Type (Drum or Conical)	Head Diameter	Head Location (top, side, etc.)	Number of knives per segment	Number of segments	Chip Limiter (y/n)	Facing Saw (y/n)	Feed system type (sharp chain, spline, etc.)	Feed Speed (fpm)	Head Speed (rpm)	Variable head speed?	Maximum chipping moment	Motor Horsepower per head
10	Kockums Cancar	Drum	Top: 7.125, Btm: 10" Side/ Spline: 15"	Top, Bottom, Side, Spline	3	9	Y	N	Spline	385- 320	Top, Btm: 2850 Side: 1500 Spline: 2600	No		Top: 200 Btm: 150 Side: 150 spline: 150
10	Cancar	Drum	Btm 15"-1 7/8" Top/Side	Top, Bottom, Side	3	9	N	N	Spline	350	1800	No		Top: 200 Btm: 125 Sides: 125
10	A Canter Mark II 20"	Drum	17"	All	3	7	Y	N	Multi-Spline	100 - 300	1250	No	1 inch	150
10	A CNS Mark II 20"	Drum	17"	All	3	7	Y	N	2 X 4 spline	100 - 300	1200	No	1 inch	150
12	Optimil	Drum	16		4		Y	N	Spline	520 max	Var. to 1" chip	Yes	See Table	B&S: 200, T: 250
12	Optimil	Drum	16		4		Y	N	Spline	480 max	Var. to 1" chip	Yes	See Table	150
13	Optimil Canter	Drum	15	4 sides	3	Varies	N	N		280	1530	No		
14	CNS	Drum	14.875	Bottom	3	6	Y	N	Key		2000?	N	Until heads Stall	
14	CNS	Drum	15	Side	3	8	Y	N			1300?	N	Until heads Stall	
14	CNS	Drum	15	Top	2	5	Y	N			1600?	N	Until heads Stall	
14	USNR True flow head	Drum	22	Bottom	6	6	Y	N		7200sfpm?	1290	VFD/Fixed		
14	USNR True flow head	Conical	22?	Side	6		Y	N		7200sfpm?	?	VFD/Fixed		
14	USNR True flow head	Drum	22	Top	6	4	Y	N		7200sfpm?	1290	VFD/Fixed		
15	VDA Line	Drum	13	Top/Bottom	3	B=9	N	N				N		
15	VDA Line	Conical		Side								N		
15	VSS	Conical Side			2	8								
16	DDM Conical	Conical Side			2 (face/wing)	8		N	VFD, Press Rolls & Guide bar	360-600	Tied to FS	Y		
16	DDM Top/bottom	Conical T&B			2	6		N	VFD, Press Rolls & Guide bar	360-600	Tied to FS	Y		
17	DLI	Drum	15	Side	3	6	Y	N	Spline	222-456	1800?	No		200
17	DLI	Drum	15	Top/Bottom	3	8&9	Y	N	Spline	222-456	1800?	No		
18	CNS USNR	Drum	22	Bottom	4	13	N	N	Multi-Spline		1260	N		250
18	CNS USNR	Drum	15	Side	3	10	Y	N	Multi-Spline		1260	N		250
18	CNS USNR	Drum	22	Top	4	9	Y	N	Multi-Spline		1260	N		300

	Machine Specifications													
Mill Number	Equipment Type	Head Type (Drum or Conical)	Head Diameter	Head Location (top, side, etc.)	Number of knives per segment	Number of segments	Chip Limiter (y/n)	Facing Saw (y/n)	Feed system type (sharp chain, spline, etc.)	Feed Speed (fpm)	Head Speed (rpm)	Variable head speed?	Maximum chipping moment	Motor Horsepower per head
18	Comact TBL-III	Conical		Side	8		N	N	Sharp chain	450-650				
18	Comact TBL-III	Drum		Profile	6	2/side	N	N	Sharp chain	450-650				
19	USNR 12	Conical	36	Side	2	7	Cam, 3.5"	N	3"chrome bedplate	550	Var. for 1" chip L	Y		
19	USNR 22	Conical	48	Side	2	7	Cam, 3.5"	N	3"chrome bedplate	550	Var. for 1" chip L	Y		
19	USNR VSS	Drum		Top	4	6?		N		550 max vol. Limit	Var. for 1" chip L	Y		
19	USNR VSS	Drum		Bottom	4	6		N		550 max vol. Limit	Var. for 1" chip L	Y		

Mill Number	Knife Specifications						Additional Notes
	Knife Type	Knife width (in.)	Hook angle	Clearance angle	Typical run time (hrs.)	Typical hones before discard (for disposable knives)	
1	Iggesund	1.625	9	34	3	3	
1	Iggesund	1.625	9	34	3	3	
2	Key Knife	Face: 1.759 Hog: 9		0.020”	8	3	
2	Key Knife	2.625”		0.035”	8	3	
3	Key Knife	1x1.75/2x4.5	31	31	8	3	
3	Key Knife	1x1.75/1x7	31	31	8	3	
4	Key Knife	2.625			8	3	
4	Key Knife	1.75 X 9			24		
4	Key Knife	1.75			8	3	
5	Iggesund with Key Knife on bottom	Top& Btm: 2.5 Side: 3	32 deg		2hrs + (location dependant)	2-8 depending on location in heads	
5	Iggesund	Top& Btm: 2.5 Side: 3	32 deg		2hrs + (location dependant)	2-8 depending on location in heads	
6	USNR turn knife, Iggesund turn knife, Key Knife, turn knife	USNR: 2.065 Iggesund: 3.299 Key Knife: 2.062	USNR: 42; Iggesund: 35; Key Knife: 35	USNR 0.027	USNR - 4; Iggesund - 8; Key - 4.	4-5 hour	
6	USNR turn knife, Iggesund turn knife, Key Knife, turn knife	USNR: 2.065 Iggesund: 3.299 Key Knife: 2.062	USNR: 42; Iggesund: 35; Key Knife: 35	USNR 0.027	USNR - 4; Iggesund - 8; Key - 4.	4-5 hour	
7	Key Knife	1.75 & 9	31		20-22	4-5	
7	Key Knife	2.625	52		20-22	4-5	
8	Iggesund	3.3	30	23 deg	24 hr	1 hone	
8	Iggesund	3.3	30	23 deg	24 hr	1 hone	
9	Key Knife	2.625			20 hr	3x	
9	Key Knife	2.625			20 hr	3x	
10	Flat knife on top head & spline remover, dome top on bottom & sides	Flat: 2 Dome: 2 5/8	Flat 42 Dome-	Flat 35 Dome-	8hr	15	
10	Dome Top	Top/Btm: 2 1/16 Side: 2 5/8			8 hr	15	
10	Key Knife	2 5/8	30 deg		8 hr	6	
10	Key Knife	2 5/8	30 deg		8 hr	6 hones	
12	Key Knife HYII	2.625			8	10	

Mill Number	**Knife Specifications**						Additional Notes
	Knife Type	Knife width (in.)	Hook angle	Clearance angle	Typical run time (hrs.)	Typical hones before discard (for disposable knives)	
12	Key Knife HYII	2.625			8	10	
13	Key Knife	2.062			16	Depends on condition	
14	Key Knife HYII	2.625	See pictures		10		Approx 1" chip length
14	Key Knife	2.625	See pictures		10		Approx 1" chip length
14	Key Knife	2.625	See pictures		10		Approx 1" chip length
14	USNR Flat	2.625	47	0.049"(~7 deg)	20		0.928 chip length
14	USNR Flat				20		0.928 chip length
14	USNR Flat	2.625	47	0.049"(~7 deg)	20		0.928 chip length
15	Iggesund Turn Knife & Key Knife HYII	2			5	Igg. 1, Key Knife up to 4	
15	Iggesund Turn Knife	2			5	Key Knife up to 4	
15		2 & 9			10		
16	Key knife std				Once/day	Currently flat grinding (no hone)	
16	Key knife std						s
17	Dome Top	2.625	~50	~7			
17	Dome Top	2.125	~50	~7			
18	Key Knife	2.04	31		16	6 to 10	Same line
18	Key Knife	2.625	31		16	6 to 10	
18	Key Knife	2.625	31		16	6 to 10	
18	Key Knife	9	31		16	No there yet (new line)	Same line
18	Key Knife	5.625	31		32	No there yet (new line)	
19	Key Knife HYII	1.75 & 7	std		16	0 - facing 1 - hog	0.015" clearance to anvil
19	Key Knife HYII	5.5 & 5	std		16	0 - facing 1 - hog	0.015" clearance to anvil
19	Key Knife HYII	2.25			16	2	0.015" clearance to anvil
19	Key Knife HYII				16	2	0.015" clearance to anvil. Bottom head shifts laterally for 1x4, 2x4 or no board