

Safety Alert OF THE MONTH

January 2011

PLEASE PASS THIS ON TO PEOPLE AND ORGANIZATIONS IN BC'S FOREST INDUSTRY

On a cold morning in December a worker climbed into the cab of a John Deere processor in the South eastern part of the province. The thermometer read -22C, it was early morning and Christmas was a few short days away. The worker had completed an inspection of the equipment and started work for the day. He was working through the timber, multi-stemming, so he rotated the head backwards for better visibility, at this point it was thought the chain got pinched among the tops and broke.

The company had received a Safety Alert regarding chainshot and had held a safety meeting to discuss the issue, it was decided operators should not point the saw towards the cab during operation. Management had contacted the manufacturer to determine what additional guarding was needed but had not been given an answer. Following this meeting another operator in the company had a near miss where a piece of chainshot came through the window of the cab and struck the computer behind his head. At a follow up meeting the company owners decided to limit those who were allowed to run the processor. Operators were told if they had sawdust hitting the window, they were in the line of fire and would need to change their cutting technique.

There wasn't anything particularly unusual about that morning in December when the operator had rotated the head and it was indeed facing the cab when the chain broke, sending chainshot through the ½" lexan window and breaking his leg. While one can never completely avoid a chain break, you can avoid putting yourself in the line of fire by making it your personal rule to change the head position as soon as you see sawdust coming toward the window.

What is the Chain Shot phenomenon?

When a saw chain breaks, it can scatter linkages into the surrounding area at high speeds. Most commonly the chainshot moves along the plane of the saw, which can cause a hazard to the operator if the saw is aligned with the cab or the body if using a chainsaw.

Chainshot whistling through the air has as much kinetic energy as a bullet fired from a rifle!

Chainshot can happen on processing equipment or a manual saw. A chain breaks for a number of reasons including:

- Improper tension – chain too loose
- Improper chain maintenance or repair (hammered rivets)
- Damaged sprocket, bar and/or chain
- Improper bar and chain lubrication
- Defective chain
- Excessive chain speed – new chainsaws can drive chains faster than their design and harvesters can be adjusted to push chain to excessive limits.
- Keep in mind that many chains fail at the instant they are damaged so chain shot cannot be totally avoided.



Linkages from a failed chain



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How chain shot happens

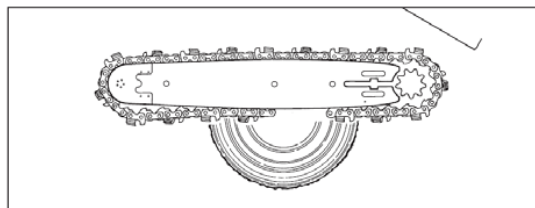
Chains on saws can travel 15,000 revolutions per minute (rpm). Higher chain speeds with attendant power input generally equates to faster cutting speeds but faster cutting speeds mean increased wear, shorter service life and increased chance of chain breakage and injury.



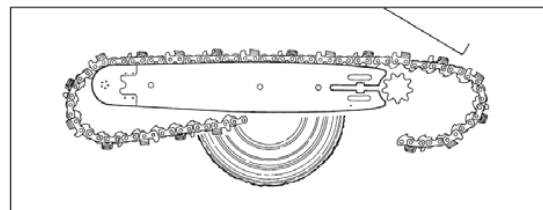
Chainlink embedded in a cab window

The Mechanical Harvesting Handbook (Oregon, 2004) explains the phenomenon of chain shot.

After a chain break

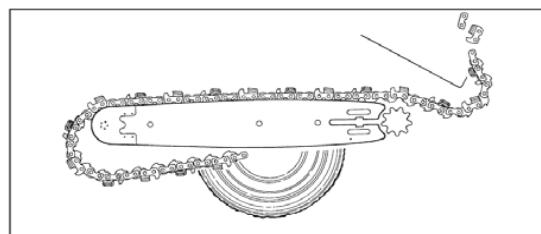


The free end of the chain begins to whip away from the breaks



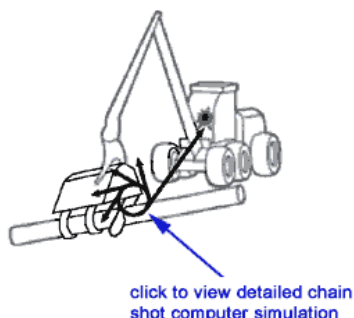
If the chain is not contained by the saw box or an energy-absorbing guard, the broken chain's free end can speed up rapidly and carry immense dynamic energy.

At the peak of the whip, chain parts may break loose and be ejected at high speed, especially if the free end of the chain strikes the saw box. Chain shot can cause chain parts to be thrown in many directions, especially along the plane of the saw bar.



Fragments have been measured at between **180 and 310 m/s** under laboratory simulated conditions

Chainshot can occur when chains are worn, damaged, repaired with used linkages or operated at speeds beyond the manufacturers recommendations.



The direct hazard to the equipment operator occurs when the plane of the saw bar is facing the cab, placing the operator in the line of fire should a chain failure occur.

Similarly, with a chainsaw, the operators body may be at risk if the chain were to fail.



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Is chain shot a common occurrence?

There has been a number of investigated chain shot incidents in British Columbia and internationally in the forest industry. Swedish researchers estimate that a chain shot might occur in 1 in every 50 chain breaks (Hallonborg 2002).

In BC a harvester operator sustained severe abdominal injuries when he was struck by a chain link that had passed through a ½” polycarbonate cab window.

Another worker was using a manual chain saw to cut a dead stump when the chain broke. The broken linkages flew through the air and struck another worker about 35’ away. The chain piece removed in life saving surgery had caused injuries similar to being shot by a bullet.



In addition, workers have reported near misses after nearly being struck by pieces of chain linkages released from equipment being operated up to 300’ away.

How to reduce the chance of chain shot occurring

There are a number of ways to protect yourself from being injured by chain shot including:

- Follow Manufacturers Guidelines For Use
- Installing proper guarding
- Positioning & Training
- Purchasing Decisions

Follow Manufacturers Guidelines For Use

- Keep the chain tensioned properly
- Don't repair the chain with used linkages or hammered rivets, often these contain small fractures that weaken the link and increased the possibility of breakage
- Inspect the saw for damage/wear to the sprocket, bar or chain
- Keep the bar and chain adequately lubricated
- Inspect the chain before replacing, even new chains can be defective
- Check the chain to make sure it is designed for the cutting speed of your saw
- Don't overpower the chain. Higher cutting speeds wear the chain faster and may contribute to chain breakages.

Install Proper Guarding

Consider fitting the saw or harvester head with a chain catcher. This device may reduce the whip like action that produces chain shot by absorbing the kinetic energy released from the chain breaking.



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Install Proper Guarding continued

Check to see windows are at least 1 ¼" thick polycarbonate, tests have shown that ½" was not thick enough to stop the penetration of chain shot. Findings showed that curved or larger windows were not more likely to fail but be particularly cautious if you operate at at lower temperatures (below -17C resulted in higher rates of failure of the panel windows).

Positioning & Training

While many operators cross cut the stems immediately in front to see if the cuts are being properly made this positions the saw blade toward the cab and directly places them in the line of fire should the chain break. Reposition the stem for crosscutting so the saw does not point towards the cab.

Pointing the saw blade at the cab is like pointing a loaded gun at yourself.

Workers on the ground around the cutting area should be sufficiently far (70m/230 ft) from the cutting and aware of the direction of the chain so they can be positioned on the opposite side to avoid being struck should the chain break.

Consider making these standard operating policies for existing workers and include this when training new workers so they can recognize the hazard and adjust their work practices accordingly. Ensure all workers know how to properly perform an inspection and are aware of the limitations of the equipment.

Purchasing Decisions

Perform a risk assessment when purchasing new equipment to consider if engineering designs can reduce the risk to the operator. Ask manufacturers what designs are in place to reduce risks to the operators.

Additional Resources:

[BC Forest Safety Council](#)- has a number of chainshot decals and warning labels available for interested companies. Digital versions also available for use. *Thank you to Oregon for allowing us to use their artwork for distribution.*

[The Chain Shot phenomenon](#) – A paper published by the Construction & Mining Equipment Industry Group outlining a study in preventing and minimizing the risks of chainshot.

[Oregon](#) - Forest equipment manufacturer with chain shot prevention information.

[WorkSafe BC](#) – Safety Alert on chainshot incident.

[WorkSafe BC](#) – Hazard Alert on near miss chainshot incident.

[WorkSafe Bc](#) – Video of chainshot incident

[ISO Standard](#) – Chainshot glazing & panel

[ISO Standard](#) – Chainshot guarding

