


Memorandum

To: Marley Hart, Executive Officer
Occupational Safety and Health Standards Board
Department of Industrial Relations

Date: April 19, 2016

From: Juliann Sum, Chief 
Division of Occupational Safety and Health

Re: Petition number 549 – Alternative presence-sensing technology for wood chippers

Petition 549 requested a change to the California Code of Regulations Title 8, sections 3424(c)(6) and 4299(d), to require a presence-sensing safety device for wood/brush chippers. The Occupational Safety and Health Standards Board (Board) granted the petition to the extent that the Division of Occupational Safety and Health (Cal/OSHA) identify and explore the existence of additional presence-sensing device technology for wood chippers. If technology is identified, the Board staff will convene an advisory committee meeting to discuss the merits of passive sensing devices (<http://www.dir.ca.gov/oshsb/documents/petition-549-propdecision-amended.pdf>). This memorandum will address the availability of presence-sensing safety devices, technology, or designs that are alternatives to the petitioner's ChipSafe system and whether an advisory committee should be convened.

As discussed in Cal/OSHA's evaluation of this petition, the ChipSafe system is the only passive presence-sensing safety device currently available for purchase that has been designed, manufactured, and produced for wood chippers. However, the following devices, technologies, and designs have been identified as plausible alternatives to the ChipSafe system if properly manufactured and adapted to wood chippers.

EXISTING SAFETY DEVICES

IndSafe Proximity Device

IndSafe is an Australian company that has developed a system similar to ChipSafe. Like ChipSafe, this system includes sensors mounted within the hopper chute that sense accessories worn by the operator. The primary difference between the two systems is the method of detection utilized. While ChipSafe detects the magnetic field of the magnets within the wearable accessories, the IndSafe system uses radio frequency identification (RFID) technology to detect RFID tags within the accessories. This system has been designed specifically for wood chippers, but is still currently in the prototype

phase. IndSafe has contracted with Invetech (<http://www.invetech.com.au>), an engineering and industrial product design company, to develop the device. Cal/OSHA is still in the process of researching the future availability of the product. Cal/OSHA will inform the Board when the research is complete.

Hit-Not Proximity Device

This system was designed for collision avoidance between pedestrians or workers and industrial trucks and other mobile equipment. A magnetic field generator mounted on the equipment produces a magnetic field that is detected by personal alarm devices (PADs) worn by pedestrians or employees. The fields are produced in two zones (warning and danger), activating the PADs to alarm with lights and audible warnings.

The PADs also communicate with sensors on the vehicle that alert the operator with audible and visible warnings. According to the sales and marketing director for the company, Jimmy Helms, the Hit-Not system could be adapted to function on a wood chipper including the ability to stop the infeed rollers. Mr. Helms also stated that MSHA has required that this technology be adapted to mining equipment. The cost of the Hit-Not system is approximately \$895. More information on the product is available at <http://www.hit-not.com>.

Nautilus Coal Buddy System

This is a magnetic field generation system similar to Hit-Not, originally designed to prevent collision and entanglement in continuous mining (CM) equipment. The system has an adjustable detection range of 3 to 33 meters and produces two magnetic field zones detected by proximity-detection devices (PDDs) worn by employees. An audible and visual warning is produced when the PDD is detected within the first zone and in the event that the close proximity danger zone is breached, the system disables the CM equipment. According to Nautilus president Jason Hart, it is possible for Coal Buddy to be adapted to stop the infeed rollers of a wood chipper. The cost of the Coal Buddy system is approximately \$10,000. More information is available at <http://www.nautilus-intl.com/proximity-detection/nautilus-coal-buddy-operators-proximity-detection-system-for-underground-coal-mines-operating-in-an-explosive-methane-gas-environment-class-i-div-ii/>

Vermeer Bottom-Feed Stop Bar

Vermeer wood chippers have come equipped with an emergency stop device for many years. This device is a pressure-sensitive stop bar located at the bottom edge of the chipper infeed hopper. Applying force to the bar shuts off power to the infeed mechanism, stopping the infeed wheels. The petitioner has expressed his opinion that this system should not be considered compliant with the petition request because, although passive, the system is not presence-sensing. The petitioner sent an article where the lower feed bar saved a person's life who became entangled and pulled towards the chipper infeed mechanism:

(<http://registerguard.com/rg/news/local/34054978-75/man-pulled-into-woodchipper-head-first-in-leaburg-friday-expected-to-survive.html.csp#>).

Vermeer holds a patent for the bottom feed safety bar, and the technology is not available to be installed on equipment from other manufacturers at this time. However, Vermeer representatives told Cal/OSHA that they would not object to other manufacturers using the Vermeer design. More information about the bottom feed stop bar is available on the following video: <https://youtu.be/E6WwhykZcUM?t=252>.



Pressure-sensing mats

Pressure-sensing mats could also be adapted to initiate or stop the infeed rollers of a wood chipper and are widely available from multiple manufacturers. These devices may not be a viable option, however, since they could present potential trip hazards and may be cumbersome to install, set up and remove at each work site. They also are behavior-based controls that place the responsibility on the operator to properly install and set up the mat at each work site.

PATENTS

In addition to the above-mentioned devices, the following United States patents were also identified as describing passive, presence-sensing, safety devices for wood chippers.

Patent US4260114

This patent describes a mechanical device that uses the weight of a chipper operator to release a guard that covers the infeed rollers. When weight greater than normal brush is sensed on the infeed table, a rod underneath the infeed hopper is actuated, releasing the guard and allowing it swing down from the top of the infeed chute and prevent entry

into the infeed wheels. The patent was issued on April 7, 1981, to the Asplundh Tree Expert Company and is available at: <http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=%2Fnetacgi%2FPTO%2Fsrchnum.htm&r=1&f=G&l=50&s1=4260114.PN.&OS=PN/4260114&RS=PN/4260114>. Cal/OSHA has requested further information on development of the product from Asplundh, but has not yet received any information.

Patent US5667152

This device incorporates magnetic metal sensors in the infeed hopper that detects metal impregnated gloves worn by the chipper operator. When the metal is detected by the sensors, a gate actuated by a hydraulic cylinder closes off the infeed chute. The patent was issued on September 16, 1997, and is available at :

<http://pdfpiw.uspto.gov/.piw?PageNum=0&docid=05667152&IDKey=51AC2B4A16CB&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnph-Parser%3FSect1%3DPTO1%2526Sect2%3DHITOFF%2526d%3DPALL%2526p%3D1%2526u%3D%25252Fnetacgi%25252FPTO%25252Fsrchnum.htm%2526r%3D1%2526f%3DG%2526l%3D50%2526s1%3D5667152.PN.%2526OS%3DPN%2F5667152%2526RS%3DPN%2F5667152>

Patent US6418004

This patent is associated with the IndSafe safety system mentioned above that uses RFID to detect the proximity of an operator wearing RFID-tagged wrist and/or ankle bands. When proximity is detected, a signal is sent to shut down the chipper infeed wheels. The patent was issued on July 9, 2002, and is available at:

<http://pdfpiw.uspto.gov/.piw?PageNum=0&docid=06418004&IDKey=BEF231049918%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnph-Parser%3FSect1%3DPTO1%2526Sect2%3DHITOFF%2526d%3DPALL%2526p%3D1%2526u%3D%25252Fnetacgi%25252FPTO%25252Fsrchnum.htm%2526r%3D1%2526f%3DG%2526l%3D50%2526s1%3D6418004.PN.%2526OS%3DPN%2F6418004%2526RS%3DPN%2F6418004>

Patent US7823813

This patent is associated with the bottom feed stop bar equipped on wood chippers manufactured by the Vermeer Manufacturing Company, as described above. The patent was issued on November 2, 2010, and is available at :

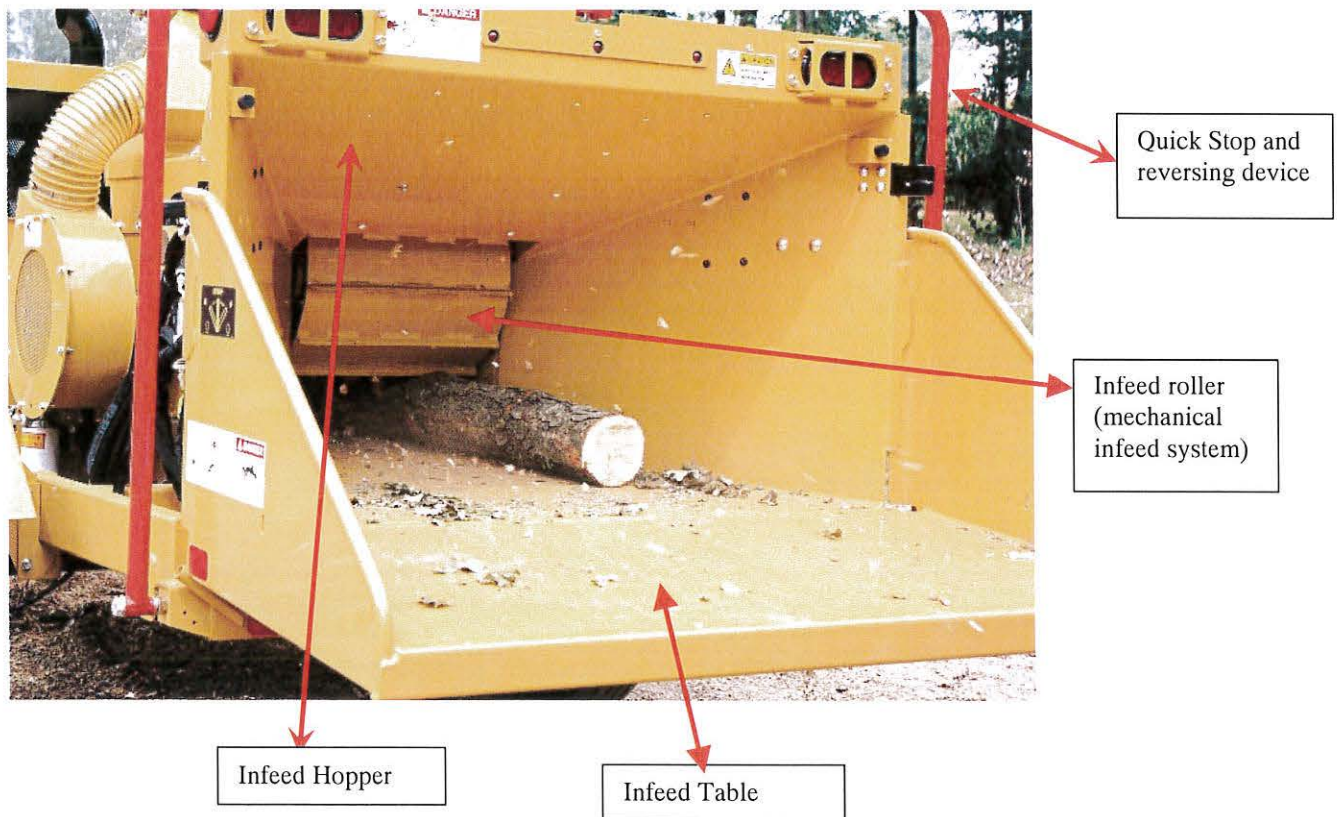
<http://pdfpiw.uspto.gov/.piw?PageNum=0&docid=07823813&IDKey=B4EF043F9D0D%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnph-Parser%3FSect2%3DPTO1%2526Sect2%3DHITOFF%2526p%3D1%2526u%3D%2Fnetacgi%2FPTO%2Fsearch-bool.html%2526r%3D1%2526f%3DG%2526l%3D50%2526d%3DPALL%2526S1%3D7823813.PN.%2526OS%3DPN%2F7823813%2526RS%3DPN%2F7823813>

**ALTERNATIVE METHODS TO INCREASE THE SAFETY OF WOOD CHIPPERS:
PASSIVE PROTECTION**

Physical Dimensions of the Infeed Hopper and Infeed Table

Rather than using presence-sensing technology, wood chipper accidents may also be prevented through passive means by improving the design of the chipper. The possibility of someone being pulled into a chipper can be minimized through changes to the physical dimensions of the chipper infeed hopper and infeed table.

The components of a wood chipper relevant to preventing accidents are the infeed hopper, infeed table, infeed rollers and a quick stop and reversing device, shown below.



Title 8 Requirements

Title 8 section 3424 requires an infeed hopper of at least 85 inches in length to reduce the possibility of a person being caught in the cutting blades of the chipper. The sides of the hopper must also be of sufficient height to prevent contact with the blades of the chipper. However, these requirements only apply to chippers without a mechanical infeed system.

Title 8 section 3424 Mobile Equipment

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(c) Brush Chippers.

(1) Each rotary drum tree or brush chipper or disk-type tree or brush chipper not equipped with a mechanical infeed system shall be equipped with an infeed hopper not less than 85 inches, measured from the blades or knives to ground level over the centerline of the hopper, and shall have sufficient height on its side members so as to prevent personnel from contacting the blades or knives of the machine during normal operations.

The majority of chippers have mechanical infeed systems and are not required to comply with the above requirement. Mechanical infeed systems on chippers consist of powered rollers that grab branches and pull them into the cutting blades. The rollers can also pull anything else into the blades. If a person's arm contacts the rollers, the arm and rest of the person's body can be pulled in by the mechanical infeed system.

Chippers without a mechanical infeed system require manual feeding of branches into the blade. With these types, if a hand is caught by the blade, the hand would be amputated, but the rest of the arm and body may not be drawn through the chipper blades. Only manual feed chippers must comply with Title 8 section 3424(c).

British Columbia Requirements

Unlike California, the Canadian province of British Columbia has established minimum physical dimensions for mechanical feed chippers, as well as manual feed chippers. The dimensions include the height and length of the infeed table. All types of chippers must also be designed such that someone on the ground is physically unable to contact the chipper blades or feed rollers.

A minimum height of the infeed table reduces the likelihood that someone may fall onto the table and be drawn into the chipper. A minimum length of the table provides more time and opportunity for the chipper to be shut down in case someone is on the feed table.

The advantage of requiring certain physical dimensions that reduce the likelihood of an accident is that no new technology is needed. In addition, it is a passive safety requirement that is not wholly dependent on behavior to prevent accidents. However, chippers would need to be manufactured differently to meet the minimum physical dimensions. Older chippers would need adapters if they are not exempted from the requirements. The British Columbia requirements are as follows:

Occupational Health and Safety Regulation

<http://www2.worksafebc.com/Publications/OHSRegulation/part12.asp#SectionNumber:12.70>

12.69 Self-feeding chippers

A self-feeding chipper must have a table or apron extending at least 1.5 m (5 ft) back from the rotor with sides sufficiently high to prevent a worker from reaching in and contacting the rotating knife.

12.70 Driven-feed chippers

(1) A driven-feed chipper must have

(a) a feed table that meets both of the following requirements:

- (i) the feed table, including the drop-down extension, if any, must extend at least 150 cm (59 in) from the nip point of the feed rollers;
 - (ii) the total distance from the nip point of the feed rollers to the ground must be at least 210 cm (82 in), as measured along the centre line of the feed table to the lip of the feed table and then vertically from the lip of the feed table to the ground,
- (b) side walls on the feed table, including any drop-down extension, and on the guard chute that are of sufficient height to prevent a worker who is standing on the ground from reaching the feed rollers, and
- (c) a feed control bar that is
- (i) located across the top and close to the feed end of the guard chute, and
 - (ii) designed so that a worker endangered by the feed rollers is able to stop or reverse the feed rollers both by
- (a) pushing the feed control bar to its forward travel limit, and
 - (b) pulling the feed control bar to its rearward travel limit.
- (2) No part of a person's body may be on the feed table or in the guard chute unless
- (a) the feed rollers have stopped, and
 - (b) the motor of the driven-feed chipper is turned off and locked out.
- (3) Despite subsection (1), a driven-feed chipper that is in use in British Columbia before February 1, 2012 may continue to be used if
- (a) the driven-feed chipper meets the requirements of subsection (1) (a) and (b),
 - (b) the feed control bar meets the requirements of subsection (1) (c) (i), and
 - (c) the feed control bar is designed so that a worker endangered by the feed rollers is able to stop or reverse the feed rollers by at least one of the means set out in subsection (1)(c)(ii).

United Kingdom (UK) Standards

The Health and Safety Executive (UK equivalent of OSHA) requires that operators of wood chippers be protected from contact with the infeed rollers by a combination of reach-distance guarding (created by the shape and dimensions of the infeed hopper and infeed table) and a correctly positioned quick stop bar that stops and reverses the infeed rollers.

The height of the lower edge of the infeed chute determines the size of the chute and how the quick stop bar is arranged. The detailed requirements for the design of wood chippers are contained in British Standard BS EN 13525:2005+A2:2009 – Forestry machinery – Wood chippers – Safety. The British standard is more complex than Title 8 or the British Columbia regulations.

**ALTERNATIVE METHODS TO INCREASE THE SAFETY OF WOOD CHIPPERS:
ACTIVE PROTECTION**

Improving the Quick Stop and Reversing Device

As discussed in Cal/OSHA's initial evaluation of petition 549, Title 8 section 3424 requires an activating lever to stop and reverse the mechanical infeed system of wood chippers as follows:

Title 8 section 3424 Mobile Equipment.

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(c) Brush Chippers.

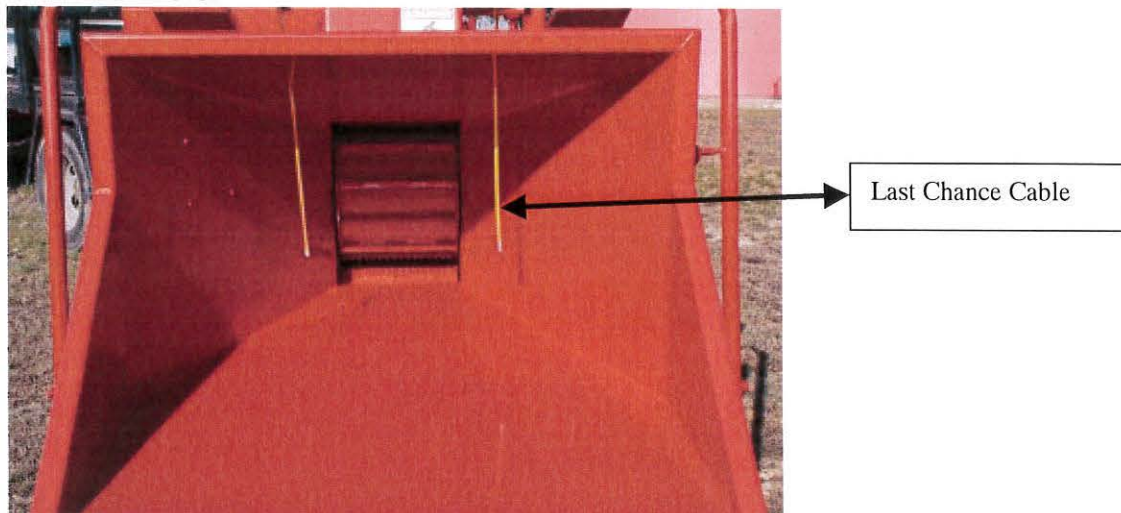
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(6) Each disk-type tree or brush chipper equipped with a mechanical infeed system shall have a quick stop and reversing device on the infeed. The activating lever for the quick stop and reversing device shall be located across the top, along each side of, and as close to the feed end of the infeed hopper as practicable and within easy reach of the operator

However, Title 8 does not provide specifications on the functioning of the activating lever. Depending on the manufacturer, some activating levers stop the chipper infeed system regardless of whether they are pushed or pulled, whereas other chipper activating levers only stop the infeed system when pushed. Activating levers that stop the infeed system regardless of the direction of movement provide greater protection than activating levers that function only in one direction. British Columbia requires activating levers that function whether they are pushed or pulled.

Last Chance Cables (Emergency Pull Ropes)

Last chance cables perform the same function as the quick stop and reversing device. They are located inside the infeed chute so that a worker who is being drawn into the chipper has one "last chance" to save his or her life prior to being dismembered. Bandit Industries, Inc. owns the patent for the cables, but makes retrofit kits available to other manufacturers.



CONCLUSION

Based on the research described in this memorandum, we conclude that technology that is alternative to the petitioner's ChipSafe system is potentially available. Although none of the presence-sensing systems identified are currently available for use to safeguard the infeed of wood chippers, the possibility exists for them to be adapted for such use. Alternative approaches to enhance the safety of wood chippers, such as installing bottom feed stop bars, increasing the physical dimensions of the feed table and infeed hopper, and improving emergency stop devices can be readily adapted by manufacturers in the near future without implementing presence-sensing technology.

Given the potential enhancement of safety for wood chipper operators, we reaffirm our recommendation that an advisory committee consisting of manufacturers of chippers, manufacturers of safety devices, employers, trade associations (e.g., Tree Care Industry Association, Association of Equipment Manufacturers), safety organizations, employees, and employee representatives be convened to advise on when and how to implement technology and designs that can provide passive and active protection on wood chippers. All technologies and designs as well as combinations of designs and technologies should be considered by the advisory committee.

cc: Jason Denning
Eric Berg