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Comment On: MSHA-2018-0016-0001
Safety Improvement Technologies for Mobile Equipment at Surface Mines, and for Belt Conveyors at Surface and Underground Mines.

Document: MSHA-2018-0016-0103
Comment from Paul Schulte, NIOSH

Submitter Information

Name: Paul Schulte
Organization: NIOSH

General Comment

NIOSH comments to MSHA Proposed Rule for Safety Improvement Technologies for Mobile Equipment at Surface Mines, and for Belt Conveyors at Surface and underground Mines

Attachments

NIOSH Comments to MSHA 12-21-18

Bellanca_PDSPerspectives_SMEPreprint

HaasRost_SME 2015_FINAL

0338-IEEEIAS-2012-Reyes-338-dbo0-08242016-44569

HaasDuCarme.CoalAge.Oct2015

NMBMS_Newsletter_Swanson

REYES_IEEE_Industry-Applications 12-18

AB91-COMM-10

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control and Prevention
National Institute for Occupational
Safety and Health
1090 Tusculum Avenue
Cincinnati, OH 45226-1998

December 21, 2018

MSAH Docket Office
Docket No. MSHA-2018-0016
Office of Standards, Regulations, and Variances
201 12th Street South, Suite 4E401
Arlington, VA 22202-5452

Dear Sir/Madam:

The National Institute for Occupational Safety and Health (NIOSH) has reviewed the Mine Safety and Health Administration (MSHA) Proposed Rule for Safety Improvement Technologies for Mobile Equipment at Surface Mines, and for Belt Conveyors at Surface and Underground Mines published in the *Federal Register* on June 26, 2018 [83 FR 29716]. Our comments are enclosed.

Please do not hesitate to contact me at 513/533-8302 if I can be of further assistance.

Sincerely,

for PAS

Paul A. Schulte, PhD
Director, Education and Information Division

Enclosure

AB91-COMM-10

National Institute for Occupational Safety and Health

Comments to the Mine Safety and Health Administration (MSHA)

Comments of the National Institute for Occupational Safety and Health on the Safety Improvement Technologies for Mobile Equipment at Surface Mines, and for Belt Conveyors at Surface and Underground Mines

Docket Number: MSHA-2018-0016; RIN-1219-AB91

December 21, 2018

Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

RFI Powered Haulage – NIOSH PMRD/SMRD response

A. Seatbelts

A1. *What are the advantages, disadvantages, and costs associated with a seatbelt interlock system?*

A1.1. ***Three-Point Seat Belt Restraint System.*** Although NIOSH cannot endorse this, it may be useful to know this promising technology is being used in surface coal mine equipment. This technology was chosen for one of NIOSH's 2017 Mine Safety and Health Technology Innovation Awards. During sudden jolts or rollover events, a driver can be tossed violently in a cab, even while restrained with a traditional lap belt. Injuries can occur, leaving some drivers with permanent damage. Peabody Energy Corporation launched an effort to better restrain drivers in their truck seats after an April 2016 event in which a truck load shifted dramatically, causing one of their haul truck operators to experience a lower back compression fracture. The company set out to prevent these types of injuries by designing a three-point seat belt with electronic controls that locks the driver in place when a sudden shift or potential rollover event is detected.

References

NIOSH [2017]. NIOSH Mine Safety and Health Technology Innovations Award. 2017 Award Winners. Three-Point Seatbelt Restraint System (Coal).
https://www.cdc.gov/niosh/mining/content/innovationsawards.html

A2. *Are seatbelt interlock systems available that could be retrofitted, and if so, onto which types of machines and how? What are the costs associated with retrofitting machines with these systems?*

A2.1. ***Seat Belt Interlock Technology.*** Seat belts are an effective technology proven to save lives in many industries including mining. Warning systems and enforcement have shown to increase awareness and the use of seat belts, ultimately reducing fatal and severe injuries that would have otherwise occurred by not properly wearing a seat belt. Human factors, policy, and enforcement related to increasing awareness and compliance with consistent and proper use of seat belts seem to be more significant factors to reducing seat belt related injuries than improving the functional performance of the seat belts themselves. However, seat belt related technologies such as warning systems and interlocks have demonstrated potential to improve safety compliance with wearing seat belts. Seat belts and related technologies such as warning systems and interlocks have the potential to reduce injuries and fatalities associated with mobile equipment accidents. Each technology should be thoroughly investigated and understood with regard to its performance benefits, limitations, reliability, liability, and feasibility of implementation.

References

30 CFR Seat Belt Regulations PART 56—SAFETY AND HEALTH STANDARDS—SURFACE METAL AND NONMETAL MINES, Subpart M—Machinery and Equipment. 56.14130 Roll-over protective structures (ROPS) and seat belts.

30 CFR Seat Belt Regulations PART 57—SAFETY AND HEALTH STANDARDS—UNDERGROUND METAL AND NONMETAL MINES, Subpart M—Machinery and Equipment. 57.14130 Roll-over protective structures (ROPS) and seat belts for surface equipment.

SAE J1040, Performance Criteria for Roll-Over Protective Structures (ROPS) for Construction, Earthmoving, Forestry, and Mining Machines. 1986.

SAE J1194, Roll-Over Protective Structures (ROPS) for Wheeled Agricultural Tractors. 1983.

30 CFR PART 77—MANDATORY SAFETY STANDARDS, SURFACE COAL MINES AND SURFACE WORK AREAS OF UNDERGROUND COAL MINES, Subpart E—Safeguards for Mechanical Equipment, 77.403-1, Mobile equipment; rollover protective structures (ROPS).

39 FR 24007, June 28, 1974. Redesignated and amended at 71 FR 16669, Apr. 3, 2006, Subpart R—Miscellaneous.

30 CFR PART 77.1710 Protective clothing; requirements.

Seat Belt Patents
See Appendix A for a list of 111 seat belt patents.

B. Collision Warning Systems and Collision Avoidance Systems

B6. *What are the advantages, disadvantages, and costs associated with collision warning systems and collision avoidance systems?*

B6.1. ***Proximity Detection Systems Fit.*** A 2018 NIOSH study explored the fit between proximity detection systems for mobile machines (mobile PDSs) and underground coal mines. Preliminary results from this study were published in the New Mexico Bureau of Mine Safety's 2018 August newsletter. Final results from the study are intended for publication in a 2018 SME conference preprint and a 2019 special edition of SME Mining, Metallurgy and Exploration. These findings may help to address the following questions on collision warning systems and collision avoidance. Preliminary results from the 2018 study on task-technology fit show factors that negatively and positively influence the fit between mobile PDSs and underground coal mines (i.e., advantages and disadvantages). More specifically, mine leaders evaluated the fit of mobile PDSs using nine dimensions of fit. The training and ease of use, locatability, system quality, authorization, and user experience dimensions were evaluated favorably. Safety, compatibility, task completion, and system reliability were evaluated less favorably. Additionally, mine leaders identified specific tasks, mine, and system characteristics that influence fit. For example, mine leaders shared how mine characteristics such as seam height, humidity, and the amount of steel used in a mine can influence fit.

References

Swanson LR, Bellanca J [2018]. Exploring fit to improve mine safety: A NIOSH project on mobile proximity detection systems. New Mexico Bureau of Mine Safety Newsletter, Aug Ed., 1–3.

B6.2. ***Mineworker Perceptions.*** A NIOSH study considered the unintended consequences of proximity detection systems on mobile equipment underground. This information provides a corollary to issues that may arise on the surface. In this study, mineworkers identified the following disadvantages of mobile PDSs: (1) making mining tasks more difficult, (2) creating additional safety concerns, and (3) increasing mineworkers' exposure and risk.

References

Bellanca J, Swanson LR, Helton J, McNinch M [2019]. Mineworkers' perceptions of mobile proximity detection systems. SME Annual Meeting.

B7. *Please provide information on how collision warning systems and collision avoidance systems can protect miners, e.g., warning, stopping the equipment, or other protection. Include your rationale. Include successes or failures, if applicable.*

B7.1. ***Task-technology Fit.*** Final results from the task-technology fit study include mine leaders' perceptions of how mobile PDSs can protect mineworkers. For example, mine leaders felt that mobile PDS could improve mineworkers' situational awareness. Additionally, the study includes mine leader perceptions related to challenges using and implementing mobile PDS in the underground coal mines. Final results from the study are intended for publication as a 2018 SME preprint and in a special edition of the Mining, Metallurgy & Exploration journal.

References

Swanson LR, Bellanca J [2018]. Exploring fit to improve mine safety: A NIOSH project on mobile proximity detection systems. New Mexico Bureau of Mine Safety Newsletter, Aug Ed., 1–3.

B7.2. ***Proximity Detection Systems.*** NIOSH studied worker perceptions and uses of proximity detection systems (PDS) and several advantages to worker protection were identified after integration of the technology had occurred. In its preliminary assessment, miners shared that, although they knew the PDS served to protect them on the job, until certain technological "bugs" were worked out, they perceived it as being riskier. For those companies who had integrated the technology later and experienced fewer issues, perceptions of the PDS being a protective technology were higher. The interviews also showed that situational awareness of the workers increased over time after being temporarily affected. This study showed the eventual success of technological change, but also showed that more work needs to be done up front to design and integrate the technology at mine sites.

References

Haas EJ, DuCarme AB [2015]. A different perspective: NIOSH researchers learn from CM operator responses to proximity detection systems. Coal Age. October. 34–35.

Haas EJ, Rost KA [2015]. Integrating technology: Learning from mine worker perceptions of proximity detection systems. Print Proceedings of the 144th Annual Society for Mining, Metallurgy, & Exploration Conference held in Boulder, CO, 15–18 February.

B11. *Please describe any differences between a surface coal environment and a surface metal and nonmetal environment that would influence your response to the questions above.*

B11.1. ***Proximity Detection for Underground Coal Mining Equipment.*** Although there are significant differences between surface haul trucks and underground coal mining equipment, there may be valuable lessons that can be learned from the extensive research that has been conducted for proximity detection for underground coal mining equipment. In particular, the research on underground proximity detection systems highlights the need for an evaluation of the technological readiness of safety interventions for surface haul trucks. NIOSH has a proposed research project aimed at assessing the technological readiness of safety interventions for surface haul trucks. As new technologies are introduced to mining, including safety interventions designed to prevent injuries involving haul trucks, it is critically important to determine how mature these technologies are. This will help to identify which interventions are likely to successfully impact the safety of miners and to identify the potential for negative unintended consequences of introducing a technology that has not been adequately proven. This methodology, once devised over the next project year, could be used to find differences in metal, non-metal and surface coal environments and their influence on appropriate technology choices and technology readiness. Design criteria and implementation guidance for these technologies in their environments would be the goals of this research.

E. Belt Conveyors

E18. *What technologies are available that could provide additional protections from accidents related to working near or around belt conveyors? Can these technologies be used in surface and underground mines?*

E18.1. NIOSH researchers studied the application of miniature monitors and sensors deployed in wireless networks to monitor the presence of miners in hazardous locations, the proper placement of machine guarding, and proper execution of lock-out/tag-out (LOTO) protocols when performing maintenance on conveyor systems. Current efforts are focused on improving accessibility of data from these devices to improve situational awareness and decrease the occurrence of unexpected startup of conveyor machinery. Maintenance activity and LOTO status, hazardous area access, and monitoring of machine guard installation is provided on a user-interface available on mobile devices such as tablets and smart phones. Text messaging and other notifications of alarms generated from

the system indicate when procedures are not followed or personnel are in hazardous locations. A prototype system is currently under evaluation at a sand and gravel operation.

References

Reyes MA et al. [2012]. Wireless machine guard monitoring system. Industry Applications Society Annual Meeting (IAS), 2012 IEEE.

Zhou C et al. [2017]. Industrial Internet of Things:(IIoT) applications in underground coal mines. Min Eng *69*(12):50.

E19. *Please provide information related to any experience with testing or implementing systems that sense a miner's presence in hazardous locations; ensure that machine guards are properly secured in place; and/or ensure machines are properly locked out and tagged out during maintenance. Please also include information and data on the costs and benefits associated with these systems.*

E19.1. Wireless machine guard monitoring and detection of personnel are two benefits afforded by leveraging emerging technologies to provide added mineworker protection. By simultaneous wireless monitoring of machine guard status and the presence of personnel in areas where structures and equipment obstruct the line of sight, mines can reduce the likelihood of traumatic accidents that historically have occurred where administrative controls and training may be insufficient. Further, these technologies may ultimately be used to monitor other operational and safety-related data to create a mine-wide network of information. The integration of such wireless safety technologies is expected to improve the safety of miners by providing additional protections against machine-related injuries.

References

Reyes MA [2014]. Averting the hazards using emerging technologies. Stone, Sand and Gravel Review. November/December. pp. 21–23.

Appendix A: Seat Belt Patents

US3359539A Seat belt ignition interlock and alarm
US3226674A Safety belt controlled vehicle electrical circuit
US3237710A Seat belt controlled warning system
US3859627A Starter interlock circuit for a seat belt utilization detector
US3875556A Positive seat belt indicator system
US4107645A Seat belt system with starter engine lock and alarm
US4614876A Vehicle passenger restraint system
US20060108167A1 Apparatus and method to encourage seat belt use
WO2016133914A1 System and method for preventing vehicle from starting when safety belt is not engaged
US3864668 Seat belt warning and ignition interlock system

US3729059A Seat belt safety system for motor vehicles
US3732538A Electronic vehicle seat occupant sensor
US3742448A Vehicle seat belt warning and control system
US3748640A Seat belt system for automotive vehicles
US3930555A Limited Transmission shifting control system
US3943376A Occupancy detector apparatus for automotive safety systems
US3960235A Transmission locking system
US4667336A Automatic detection of seat belt usage
US4885566A Apparatus for detecting the wearing of a seat belt assembly
US4887024A Person detecting device
WO1995000368A1 Device for detecting the presence of persons on seats
US5425431A Interlock control system for power machine
US5602734A Automobile air bag systems
US5802479A Motor vehicle occupant sensing systems
US5877707A GPS based seat belt monitoring system & method for using same
WO2001003980A1 Electronic control device for the operation of safety devices
US6442464B2 Process for the capacitive object detection in the case of vehicles
US6533057B1 Vehicle transmission shift safety system
EP1295759A2 Industrial truck with safety belt
US20030137411A1 Seatbelt usage detection system
US6794728B1 Capacitive sensors in vehicular environments
US20050212668A1 Ignition safety device and method therefor
US20070144811A1 Seat belt apparatus
US20130278409A1 Seat belt failure warning apparatus
US20160082920A1 Belt retractor and method for tightening an unused vehicle belt
US6362734 Method and apparatus for monitoring seat belt use of rear seat passengers
US3624601A Vehicle seatbelt warning and ignition control system
US3875556A Positive seat belt indicator system
US4849733A belt indicator system
US5260684A Warning system for a child's restraining seat for use in a passenger vehicle
US5483221A Seat belt usage indicating system
US5581234A Infant vehicle seat alarm system
US5804887A Safety device for a vehicle with a removable seat, especially a passenger seat
US6043736A Weighing apparatus, apparatus for detecting auxiliary-seat mounting direction, person-on-board protecting apparatus, and apparatus for giving warning about seating condition
US6204757B1 Seatbelt usage and safety data accounting system
US6215395B1 Apparatus and method for verifying seatbelt use in a motor vehicle
FR2839287A1 Interior and exterior indicator lights to show whether each occupant of vehicle has seat belt fastened, uses contacts on the seat belt locks to control two sets of indicator lights. one on the dashboard and the other inside the windscreen
EP1362752A1 Seat belt fastening reminder apparatus and the method thereof
US20040155765A1 Seatbelt use indicating apparatus and method
EP1493640A1 Seat belt alarm apparatus
US20050045404A1 Seatbelt reminder system
US20050046561A1 Seatbelt reminder system
US20050061568A1 Wireless seatbelt buckle switch harvesting energy and method therefor

US20050080533A1 Vehicle passenger seat sensor network
EP1595760A1 Device for signaling the fastening of safety belt
EP1640226A1 Seatbelt use-state warning device
US20060108167A1 Apparatus and method to encourage seat belt use
US20060125614A1 usage detection system
US20060208911A1 Child carseat alert system
FR2893289A1 Motor vehicle seatbelt fastening detection system comprises floor antenna, electrical switch in belt buckle and passive resonance circuit
US20070204442A1 Seat belt buckle
US20070221428A1 Belt buckle for a motor vehicle
US20070222572A1 Multiple passenger vehicle seat belt notification system with force feedback
US20070285219A1 Apparatus for reinforcing seatbelt usage in automobiles
US20080068149A1 Modular seatbelt minder
US20090015394A1 Device for detecting vehicle seat occupancy
US20090112408A1 Llc Intelligent arrangement buckle switch for seat belts
US20090132128A1 Occupant monitoring and restraint status system
US20090160616A1 Seat belt system
US20090195376A1 System and method for controlling a safety restraint status based on driver status
US20100114436A1 Operator restraint system
WO2010078582A1 Seatbelt usage indication
US7758118B1 Child seat restraint alarm system
US7812716B1 Seat belt status external monitoring apparatus and method
EP2298612A1 Seatbelt alarm issuing device, and seatbelt alarm issuing method
US20110074566A1 System and method of vehicle passenger detection for rear seating rows
US20110074565A1 Method and apparatus for in-vehicle presence detection and driver alerting
US20110186374A1 Seatbelt Use Promotion System and Method
US9266500B2 Method and evaluation system for supervising correct belt utilization
WO2017215874A1 Method and device for providing information relating to an activation process for activating a personal protection system of a vehicle
DE10258837B3 Release device for seat restraint protections in a motor vehicle having movable seat positions has a system bus to provide control and power to any position
DE102004025319A1 Seat condition indication system for e.g. aircraft, has sensor arrangements with seat-occupancy and belt sensors to detect occupancy and closed condition of safety belt of seats, respectively
DE102005009486B4 Belt system for a motor vehicle
US7642907B2 Wireless buckle-up detection using RF technology
DE102007019656B4 Motor vehicle with a device for installing a seat and method for driving relating to a vehicle occupant functional unit in a motor vehicle
DE102007060317B4 Method and device for monitoring of vehicle occupants
DE102007029650A1 Device for monitoring vehicle seating state, has readout unit to record state of sensor in wireless manner, where sensor records seat belt buckle-state and transducer converts seat belt buckle-state signals into resistance signal
DE102007044858A1 Safety arrangement for vehicle, particularly motor vehicle, has belt-receiving device for receiving belt latch of safety belt, where sensor device is provided for determining receiving condition of belt latch

DE102012006356A1 Motor vehicle, comprising a plurality of active or passive safety devices
DE202013005825U1 Information and warning device in a motor vehicle
DE102016220116A1 Apparatus and method for monitoring of a vehicle seat and vehicle with such a device
US6662094B2 Method of initially characterizing an occupant of a vehicle seat based on weight and seat belt tension
US6250672B1 Vehicle airbag restraint system with deactivation indicator
US6481750B1 Seat belt restraint system for vehicle occupants with automatic belt tension compensation
US7321306B2 Wireless system to detect presence of child in a baby car seat
US6442807B1 Airbag buckle assembly
US20050184489A1 Twin airbag apparatus
US20020056975A1 Method and apparatus for deployment of an air bag
US5954360A Vehicle occupant sensing apparatus and method
US5690356A Integrated switch for air bag deactivation
US20040117217A1 Financial incentive through insurance offerings for vehicles that utilize a safety system
US6196579B1 Rear impact occupant protection system
US6809640B1 Harness safety alarm
US6769716B2 Seat belt restraint system with movable lap belt guides
US20050092539A1 Method and apparatus for detecting improper installation of child seat in a vehicle
US5879024A Air bag deployment inhibitor circuit
US6357790B1 Apparatus for use with child a child seat in a vehicle having a seat belt webbing pretensioner
US5483221A Seat belt usage indicating system
US20050061568A1 Wireless seatbelt buckle switch harvesting energy and method therefor
US09773317 Method and apparatus for monitoring seat belt use of rear seat passengers
US09773317 Method and apparatus for monitoring seat belt use of rear