

Injury Risk to Those Who Operate Bulldozers at Mining Sites

By William J. Wiehagen, Alan G. Mayton, Jasinder S. Jaspal, and Fred C. Turin, NIOSH

There are a number of injury risks faced by those who operate off-highway equipment at surface coal, metal, and nonmetal mines. Research was conducted by NIOSH, Pittsburgh Research Lab to describe serious injuries sustained by dozer operators while doing common production tasks at mining sites. Serious injuries are those that resulted in either a fatality or lost-time injury. The injury data was obtained from accident records compiled by the Mine Safety and Health Administration. Eight hundred and seventy-three injury records¹ (1988-97) were examined. These injuries resulted in 18 fatalities and 31,866 lost workdays.

This article describes the key findings from this study along with a brief description of the method used to code and classify the accident data. This information could be useful to help safety professionals learn more about the kinds of specific injury risk faced by those who operate dozers and to explore ways to reduce the risk of injury.

From 1993 through 1997, there was a notable reduction (30%) in the number of serious injuries to dozer operators while performing common production tasks at surface mines. These safety improvements are in comparison to the baseline period (1988-1992).

Jolts and jars account for the largest number (604), and percentage (70%) of serious injuries while operating dozers. They account for 75% of the workdays lost. These incidents involved either (1) a rollover / fallover, (2) a vertical jar, or (3) a lateral jar. Vertical jars comprised the largest set (354 incidents) of jolting and jarring injuries. The employee was backing up the dozer in over half of these incidents. Backing up was also involved in 25% of the incidents where the dozer fell over an edge or rolled over, and about 40% of the cases involving a collision (a lateral jar).

Musculoskeletal injuries (MSI) were the second largest category of incidents. These injuries were principally due to twisting and turning in the seat and control usage. MSI's accounted for 155 injuries, 18% of the total. In all cases, there was no apparent impact to the dozer and many of these injury narratives implied that the injury could not be tied to a singular event - they occurred during the course of the shift.

Working near an edge carries significant risk for fatal injuries. Of 116 incidents where the dozer fell over an edge, rolled over, or fell into a hidden void, 14 (12%) resulted in fatal injuries. In cases where the dozer operator either jumped or was thrown out of the cab in a fallover or rollover, 7 out of 17 were killed. Overall, 14 of the 18 fatalities (80%) occurred while working near an edge or hidden void or on a steep slope. Job experience is an important factor - 5 of the 18 victims had 2 months or less of experience on the dozer.

How was the accident data summarized and analyzed?

We developed an injury classification system to code the narrative information that describes the circumstances surrounding the 873 injuries. The narratives are short summaries

¹We do not include lost time injuries while "*getting on and off the dozer*". Those incidents accounted for an additional 30% (875 lost time injuries) of serious injuries involving dozers, resulting in about 31,000 lost work days.

prepared by those who fill out the injury report at the mine site. A qualitative analysis was performed based on the review of the injury narratives. A few examples of the incident narratives include:

- ▶ *Tramming dozer, dozer slid on frozen ground. Went over highwall, dozer fell about 30 ft, and then rolled over. Rollover structure and seatbelt held; however, the employee apparently struck his face and fractured left cheekbone.*
- ▶ *Employee was dozing out a ramp on a bench with a dozer he got in close to a previous cut, and a large rock came out of the bank onto the track, causing the dozer to rock back and forth, jerking and straining his neck.*
- ▶ *Too much strain on back from turning in seat to back up. Too many hours on dozer.*
- ▶ *Injured claimed he was operating a dozer, ripping 2 ft of overburden from off of the Dorchester Seam. While ripping with the dozer, which caused a jerking motion and the operator turning in the seat to watch his ripper, he stated he strained his back.*

Injury records like those described above were coded and summarized by:

- ▶ Activity: (what task was being done? - e.g., blade / groundwork, ripping, tramming forward / backward, land clearing),
- ▶ Incident result: (what apparently happened to the dozer? - e.g., fallover / rollover, vertical jar, normal operations - no apparent impact to the dozer),
- ▶ Operator impact: (how was the operator injured? - e.g., jolted / jarred, MSI's, struck by an object),
- ▶ Contributing factors were identified and coded along two dimensions
 - Event: factors such as a rock slide, edge failure, or hidden void.
 - Severity: factors such as the use of a seat belt.

All of these injuries occurred to dozer operators *while performing common production tasks*. The majority (53%) of the lost time incidents occurred in 4 states - Kentucky, West Virginia, Pennsylvania, and California. Bituminous coal mining accounted for 62% of the total.

For the 855 lost time incidents, 57% resulted in injuries to the neck and back. On average, 37 days were lost for each injury. The median was 19 days. On one end of the distribution, 25% of the incidents resulted in 4 days or less of lost work time. On the other end, 25% of the incidents resulted in a loss of more than 45 days. Contributing factors could not be identified for 733 (84%) of the lost time incidents.

What can be done to further reduce the risk of injury while operating dozers?

Strategies to reduce the effect of jolting / jarring or fallover / rollover type incidents can include consideration of seating (methods to dampen the shock or isolate the operator from the shock), use of operator restraint devices, and training. In 12% of the incidents involving a roll over or a dozer falling over an edge, the operator died. Not wearing seat belts (or older equipment not having a ROPS or seat belt) contributed to 6 of the fatalities. For the 604 injuries

sustained from jolting or jarring, only 25 of the narratives provided information concerning whether or not the seat belt was in use at the time of the incident. From the analysis, there were many cases where the operator was jolted and struck against an object inside the cab. For many of these cases, one could surmise that the belt was not worn.

Further reductions in injury risk will require (1) more widespread use of seatbelts, (2) consideration (and maintenance) of the seat and suspension system, (3) research interventions to better assess the effect of alternative engineering designs to dampen or isolate the effects of shock and vibration and (4) continued attention on skilled performance - the integration of hazard awareness, recognition, and response with dozer operational skills.

For more detailed information, please see the NIOSH Publication 2001-126 (IC 9455) - "An Analysis of Serious Injuries to Dozer Operators in the U.S. Mining Industry". This and other NIOSH publications are available from:

NIOSH - Publications Dissemination

4676 Columbia Parkway

Cincinnati, OH 45226-1998

FAX: 513-533-8573

Telephone: 1-800-35-NIOSH

E-mail: pubstaft@cdc.gov

Web site: www.cdc.gov/niosh

Serious Incident Results By Operator Impact (Fatalities in Parentheses)

Incident Result	Operator Impact								
	Jolted / jarred	Landed outside of cab	Struck against an object inside cab	Struck by an object	MSI	Burned / contact with hot object	Asphyxiation or Drowning	Other/ Unknown	Total
Fall over / roll over / fall into void	31	17 (7)	61				7 (7)		116 (14)
Vertical Jar	306	3	45						354
Lateral jar (collision)	54		14			1 (1)			69 (1)
Lateral jar (lurch forward / backward)	22		6						28
Fire (external source)						2			2
Normal operations			4	39	155			14	212
Dozer struck by an object	12		10	33		1			56
Equipment failure	9	4	2	6		6		2	29
Unknown / Other	2	2						3 (3)	7 (3)
Total	436	26 (7)	142	78	155	10 (1)	7 (7)	19 (3)	873 (18)

Date 8/27/02

ROUTING AND TRANSMITTAL SLIP

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. GEORGE BOCKOSH, OD		
2. ROB TUCHMAN, OD		
3.		
4.		
5.		

X	Action	File	Note and Return
	Approval	For Clearance	Per Conversation
	As Requested	For Correction	Prepare Reply
	Circulate	For Your Information	See Me
	Comment	Investigation	Initial
	Coordination	Justify	

RE: PUBLICATION DISTRIBUTION

ATTACHED ARE 3 COPIES OF THE FOLLOWING PUBLICATION:

DATABASE RECORD NO.: 1509

TITLE OF PAPER: Injury risk to those who operate bulldozers at mining sites

PUBLISHED IN: National Safety Council Newsletter, 4 pp.

AUTHOR(S): William J. Wiehagen, Alan G. Mayton, Jasinder S. Jaspal, and Fred C. Turin

REPORTED IN MONTHLY REPORT: 8 2002
(month) (year)

FILLED IN PUBL. AVAILABILITY DATE
IN PUBL. DATABASE: 8/27/02
(mo./day/year)

SUBMITTED ORIGINAL TO DIANE FELICE
FOR POSTING IN CISS: 8/27/02
(mo./day/year)

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No. — Bldg.
Joy Lamars	226 152
	Phone No. 412-386-6472
	Fax No. 412-386-6764

5041-102

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206