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Analysis of Fatalities Related to Scoops and Tractors in Underground Bituminous Coal Mines, 1971-1973

**By R. R. McLellan and R. A. Speirer
Health and Safety Analysis Center, Denver, Colo.**

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Rogers C. B. Morton, Secretary

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James M. Day, Administrator

MASTER

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ANALYSIS OF FATALITIES RELATED TO SCOOPS AND TRACTORS IN UNDERGROUND BITUMINOUS COAL MINES, 1971-1973

by

R. R. McLellan¹ and R. A. Speirer²

ABSTRACT

Scoops and tractors are two of the three types of mining equipment which were most frequently involved in haulage fatalities that occurred from 1971 through 1973 in underground bituminous coal mines. During these years a total of 33 persons were killed while operating scoops and tractors, primarily in coal seams ranging from 27 to 48 inches in thickness. Seventy-four percent of the fatal injuries involved crushing of the head, neck, or chest while tramming in areas of restricted clearance and poor visibility. Most frequent causes identified in the investigation reports include: (1) failure to follow established operating practices, (2) poorly maintained equipment, (3) failure to be alert to the hazards of the job, (4) unsafe mining practices, and (5) poorly trained operators. Analysis of the accidents indicates that both labor and management are negligent in recognizing and eliminating the more obvious hazards associated with the operation of this equipment. Mines utilizing scoops and tractors should be the target of efforts to emphasize recognition of the particular operating hazards of this equipment and appropriate training of the equipment operators. The best way to reduce fatal accidents of this kind is to design workable and acceptable canopies which would greatly reduce the number of injuries to the head, neck, and chest.

INTRODUCTION

This report was prepared to analyze 33 fatal accidents involving the operation of scoops and tractors in underground bituminous coal mines. The number of fatal accidents (10 in 1971, 11 in 1972, and 12 in 1973) is sufficiently high to be considered critical. These mobile, low profile pieces of haulage equipment are designed for operation in low coal, where the inherent hazards of limited clearance and poor visibility, when compounded by carelessness and unsafe mining practices, can result in fatal injuries to the operators. The data and information utilized to complete this analysis are on record as accident investigation reports prepared by mine inspectors representing the Mining Enforcement and Safety Administration's (MESA) Coal Mine Health and Safety Districts in which the accidents occurred. The possibility

¹Chief, Branch of Special Studies.

²Geophysicist, Branch of Special Studies.

of modifying the operator's compartment to provide added protection has been investigated and recommended by personnel from Coal Mine Health and Safety District 4, Mt. Hope, W. Va. As of October 1974, two U.S. Bureau of Mines contracts were underway to conduct canopy and operator compartment studies, which are expected to include the scoop and tractor problem areas in low coal mining.

ANALYSIS

The following tables identify accident and injury trends based on data and information presented in 33 fatality investigations reports involving the operation of scoops and tractors. Seven general types of accidents that resulted in the 33 fatal injuries are presented in table 1. All of the accident types are related to crushing of the operator and usually involve injuries to the head, neck, or chest. The most frequent type of accident involves the operator being crushed between the roof or roof support and the vehicle.

TABLE 1. - Scoop and tractor fatalities by type of accident, 1971-73

Type of accident	Fatalities	Percent
Crushed between scoop or tractor and roof or roof support	12	36.4
Crushed between scoop or tractor and vehicle being pushed	5	15.2
Crushed by roof fall resulting from dislodged posts.....	5	15.2
Crushed by collision between scoop or tractor and other machine.....	4	12.1
Crushed between scoop or tractor and rib or post.....	4	12.1
Crushed under moving scoop or tractor.....	2	6.0
Crushed between scoop or tractor and trailer.....	1	3.0
	33	100.0

Table 2 lists the activity engaged in at the time that the accidents occurred. Twenty-six, or approximately 79 percent, of the fatalities were related to tramping. Ten of these fatalities involved striking the roof or roof support in areas of restricted clearance. Five of the fatalities involved roof falls caused by the operator knocking out permanent roof supports. The remaining 11 tramping fatalities involved striking ribs or posts, collisions with other equipment, and loss of control resulting in two roof collisions and one pedestrian type accident. Five fatal accidents occurred while attempting to push stalled equipment with the deck end of scoops or tractors. This unsafe practice can result in overriding of the operator's compartment and crushing of the operator by the vehicle being pushed.

TABLE 2. - Scoop and tractor fatalities by activity, 1971-73

Activity	Fatalities	Percent
Tramming:		
Hit roof or roof support.....	10	30.3
Knocked out roof supports.....	5	15.2
Hit rib or post.....	4	12.1
Collision with other equipment.....	4	12.1
Lost control (2 hit roof, 1 ran over self).....	3	9.1
Pushing stalled equipment.....	5	15.2
Loading tractor.....	1	3.0
Coupling trailer-tractor.....	1	3.0
	33	100.0

Table 3 lists eight major categories of causes for the 33 fatal accidents and how often each was cited in the investigation reports. The major categories were named a total of 92 times as primary or contributing causes. The greatest single cause is the failure of the equipment operator to follow established operating practices; however, in consideration of the total problem, the accident causes appear to be divided nearly equally between labor at 46.8 percent and management at 45.6 percent with the remaining 7.6 percent attributed to design deficiencies. Of particular note is the inherent hazards of even following established operating practices when they involve operation of a 30-inch high scoop or tractor in an area having a 32-inch seam height with the operator's unprotected head protruding around the side of the machine in an effort to see the roadway.

TABLE 3. - Scoop and tractor accidents by cause, 1971-73

Cause	Times cited as primary or contributing cause ¹	Percent
Failure to follow established operating practices.....	26	28.3
Poorly maintained equipment.....	14	15.2
Failure to be alert to job hazards.....	13	14.1
Unsafe mining practices.....	12	13.0
Poorly trained operators.....	11	12.0
Design deficiencies of equipment.....	7	7.6
Failure of supervisor to instruct workers....	5	5.4
Failure of equipment operator to follow instructions.....	4	4.4
	92	100.0

¹ 92 primary and contributing causes for 33 fatal accidents.

Typical examples of each of the above major categories are:

1. Failure to follow established operating practices--tractor operator was crushed while attempting to push stalled tractor with deck end.

2. Poorly maintained equipment--scoop was operated with faulty brakes.
3. Failure to be alert to job hazards--operator trammed in direction opposite to line of vision.
4. Unsafe mining practices--mine management permitted existence of overhanging brows in haulage areas.
5. Poorly trained operators--victim had no training in operation of scoops and tractors.
6. Design deficiencies of equipment--cramped space in operator's compartment.
7. Failure of supervisor to instruct workers--supervisor permitted passengers to ride on equipment having no safe riding facilities.
8. Failure of equipment operator to follow instructions--operator trammed through unfamiliar haulage route contrary to supervisor's instructions.

As indicated in table 4, the head, neck and chest were involved in 24, or 72.8 percent, of the accidents. This percentage implies that workable and acceptable protection for the upper body would significantly reduce the number of fatalities regardless of certain acts of negligence or carelessness on the part of the equipment operator or of the mine operator. A Bureau of Mines research and development contract H0242033, Optimized Operator's Compartments, and contract H0346102, Low Coal Canopy Studies, are expected to provide guidelines and recommendations for safety improvements of scoop and tractor operator compartments.

TABLE 4. - Scoop and tractor fatalities by part of body injured, 1971-73

Part of body	Fatalities	Percent
Head ¹	10	30.3
Head and chest ¹	9	27.3
Torso.....	6	18.1
Internal injury.....	3	9.1
Neck ¹	3	9.1
Chest ¹	2	6.1
	33	100.0

¹Head, neck, and chest injuries resulted in 24 fatalities, or 72.8 percent, of total.

A total of 14, or 42 percent, of the fatal injuries occurred to workers who were not classified as scoop or tractor operators. Table 5 identifies the number and types of occupations involved in the 33 accidents and indicates that the usage of the equipment is so widespread among the various occupations that training in equipment operation and in hazards recognition generally may be inadequate.

TABLE 5. - Scoop and tractor fatalities by occupation, 1971-73

Occupation	Fatalities	Percent
Scoop and tractor operator.....	19	57.7
Continuous miner operator.....	3	9.2
Electrician.....	2	6.1
Roof bolter operator.....	1	3.0
Assistant foreman.....	1	3.0
Belt maintenance man.....	1	3.0
Continuous miner operator helper.....	1	3.0
Brattice man.....	1	3.0
Mine examiner.....	1	3.0
Fire boss.....	1	3.0
Coal drill operator.....	1	3.0
Maintenance man.....	1	3.0
	33	100.0

Although the actual amount of job experience that a victim had in operating a scoop or tractor sometimes is difficult to determine, table 6 indicates that at least eight, or 24.2 percent, of the victims had less than 1 year of experience. The data are not normalized with respect to the total number of operators that are distributed among each category of job experience; however, the table provides a guideline for the concentration of corrective effort when total fatalities are considered.

TABLE 6. - Scoop and tractor fatalities by job experience, 1971-73

Years job experience	Fatalities	Percent
<1	8	24.2
1-2	5	15.2
2-3	4	12.1
3-4	1	3.0
4-5	-	-
>5	5	15.2
Unknown	10	30.3
	33	100.0

Although table 7 utilizes data that are not normalized, the relatively high number of fatalities that occurred during the first year of employment indicates either that the greatest number of operators fall within the first-year time frame or that there actually is a disproportionate number of fatalities for first-year employees. Regardless of the lack of normalized data, the fact that 13, or 39 percent, of the fatalities occurred during the first year of employment automatically isolates an area where concentration of corrective effort may produce the greatest results for the time spent.

TABLE 7. - Scoop and tractor fatalities
by years at mine, 1971-73

<u>Years at mine</u>	<u>Fatalities</u>	<u>Percent</u>
<1	13	39.4
1-2	3	9.1
2-3	4	12.1
3-4	3	9.1
4-5	-	-
>5	6	18.2
Unknown	4	12.1
	33	100.0

Table 8 illustrates the distribution of fatalities by years of mining experience utilizing data that are not normalized. Again, the lack of normalized data does not prevent identification of an experience category where corrective action is needed, that being the first year at the mine. Even more critical is the fact that 19, or nearly 58 percent, of the victims had over 5 years of mining experience; thus indicating that a high degree of general mining experience is no great deterrent to the occurrence of fatal injuries related to the operation of scoops and tractors.

TABLE 8. - Scoop and tractor fatalities
by year mining experience,
1971-73

<u>Years mining experience</u>	<u>Fatalities</u>	<u>Percent</u>
<1	5	15.2
1-2	-	-
2-3	4	12.1
3-4	1	3.0
4-5	2	6.1
>5	19	57.6
Unknown	2	6.1
	33	100.1

Summarizing the influence of operator experience upon the number of fatal accidents as illustrated in tables 6, 7, and 8, the greatest number of fatalities for any single year category occurred during the first year at a mine regardless of job or mining experience. The next greatest number occurred during the first year of job experience. The amount of mining experience appears to have minimal influence toward reduction of fatalities as for example, 57.7 percent of the fatalities occurred to workers having over 5 years of experience. Employees having less than 1 year of job experience and less than 1 year of employment at the mine are within the two experience categories that have the greatest numbers of fatalities presently associated with scoops and tractors. Unfavorable experience factors compounded by one or more of the factors that are listed in table 3 provide ample prerequisites for an accident.

A distribution of fatalities by seam thickness is presented in table 9. Twenty-seven, or 81.8 percent, of the total number of fatalities occurred in seams ranging from 27 to 48 inches in thickness. The remaining six occurred in relatively high coal seams ranging from 52 to 88 inches in thickness.

TABLE 9. - Scoop and tractor fatalities
by seam thickness, 1971-73

Seam thickness, inches	Fatalities	Percent
27-28	3	9.1
32-33	3	9.1
36-37	5	15.2
38-39	4	12.1
40-42	7	21.1
44-48	5	15.2
52-57	4	12.1
84-88	2	6.1
	33	100.0

CONCLUSIONS

The data presented in this report identify three areas where improvements can be made to reduce fatal injuries in the operation of scoops and tractors in low coal. Many of the hazards are typically inherent in low coal mining operations; however, they can be reduced by placing added emphasis upon three areas of responsibility involving labor, management, and equipment manufacturers.

Available data indicate that labor and management are equally responsible for over 92 percent of the causes involving fatal accidents. Scoop and tractor operators appear to be inadequately trained to (1) follow established operating practices, (2) be alert to the hazards of the job, and (3) follow instructions. Mine management is slack in (1) equipment maintenance, (2) following safe mining practices, (3) establishing training programs, and (4) providing adequate supervision. Scoop and tractor manufacturers need to be convinced that a workable and acceptable modification to the operator's compartment from the standpoint of location, visibility, and overhead protection could be the single factor that will save the most lives regardless of the deficiencies of the operator or the management.