TO: Director, National Institute for Occupational Safety and Health

FROM: California Fatality Assessment and Control Evaluation (FACE) Program

SUBJECT: Equipment operator dies when ejected from and run over by a pavement compactor in California.

SUMMARY
California FACE Report 98CA014

A 46-year old male equipment operator (decedent) died after being run over by the rear wheels of his pavement compactor during an asphalt paving job. The decedent was being followed by a co-worker driving another pavement compactor. The transmission of the co-worker's compactor was taken out of gear by the co-worker in an attempt to shift to first gear. The co-worker was not able to successfully re-engage the transmission**.** This caused the co-worker's compactor to freewheel and increase its downhill speed. The co-worker's compactor struck the decedent's compactor in the right rear. The decedent was ejected from his compactor which then ran over him. Neither the decedent nor the co-worker were wearing a seatbelt. None of the seatbelts provided were functional. The co-worker had not operated this type of compactor prior to the day of the incident and had not been trained in or oriented to its use. The CA/FACE investigator concluded that, in order to prevent future occurrences, as part of their Injury and Illness Prevention Program (IIPP) employers should:

- ensure seatbelts are functional and that employees wear them at all times when they operate seatbelt-equipped vehicles.
- ensure operators of construction equipment are properly trained in its use.
- develop a formal, written equipment operation training program.

In addition, heavy machinery manufacturers should:

- design a machine's seatbelt system with interlocks that prevent the operation of the machine if seatbelts are not used.

INTRODUCTION

On October 1, 1998, at 11:30 a.m., a 46-year old male equipment operator was fatally injured when he was run over by the wheels of his pavement compactor. The decedent's compactor was struck by a runaway compactor which caused him to be ejected. The rear wheels of the decedent's compactor ran over his head. The CA/FACE investigator learned of this incident on October 6, 1998 from the local legal office of the Division of Occupational Safety and Health, California Department of Industrial Relations (Cal/OSHA). On October 9, 1998, the CA/FACE investigator traveled to the incident site where he photographed the site and measured the grade

of the roadway. On October 15, 1998, the CA/FACE investigator traveled to the site where the compactors were impounded. He met with representatives of all three employers involved, the Cal/OSHA investigator, a representative of the district attorneys office, and representatives of the insurance companies involved. He also inspected and photographed the compactors. On January 6, 1999, the Cal/FACE investigator traveled to a site where the compactor that struck the decedent's compactor was inspected and given operational tests.

The employer of the decedent, employer B**,** a construction contractor, had been in business for approximately 75 years at the time of the incident. The company had an average of 325 employees with only the decedent working on site at the time of the incident. The decedent had worked for the company for 22 years and had worked at the site of the incident for one day. Three types of safety meetings were held weekly, tailgate meeting for line employees, a superintendent's safety meeting, and a staff safety meeting. The employer had a written safety program that complied with applicable regulations. They also had a full-time safety manager**.**

The employer who owned the compactors, employer A**,** a paving contractor, had been in business for approximately 20 years at the time of the incident. The company had 80-90 employees with 15 working on site at the time of the incident. This employer had worked at the site of the incident for 2 days. This company has a written safety program and a part-time safety manager.

The employer of the co-worker who was operating the following compactor, employer C, a rock, sand, gravel, asphalt and redimix producer, had been in business for approximately 14 years at the time of the incident. The company had 1800 employees with 4 working on site at the time of the incident. The co-worker had worked for the company for 3 months and had worked at the site of the incident for less than 4 days. He had not received specific training on the compactor he operated and did not receive orientation for the machine at the job site.

INVESTIGATION

The site of this incident was an east-west residential street which was being repaved with asphalt using two pavement compactors to compact the asphalt. There are concrete curbs/gutters and sidewalks on either side of the street. There is a slight "S" curve in the area of the incident. The street is located on a steep grade of approximately 11%.

There were three employers involved in this incident. Both pavement compactors belonged to employer A. The decedent (employee #1) was employed by employer B, but loaned to employer A for the asphalt paving job. The operator of the other pavement compactor (employee #2) was employed by employer C, but loaned to employer A for the asphalt paving job. When employee #2 arrived at the job site he was asked by an employee of employer A if he knew how to operate the compactor and stated that he did.

Both pavement compactors were rated at 28,950 pounds and were identical models. They consisted of a front tractor which included the engine and operator stations. There were two stations for the operator, one on the right side and one on the left. Each station had a seat that faced toward the center of the machine. Each seat was directly under a roll over protective structure (ROPS). The compactor's service brake was activated by a common pedal from either seat. To apply the brakes from the left-hand seat, the pedal was pushed toward the right-hand side of the compactor. From the right-hand seat, the pedal was pushed toward the left side of the

compactor.

In addition, there was a single, floor-mounted transmission range selector near the left hand seat. It consisted of a first or low gear, neutral, second gear, neutral and third or high gear. It was not synchronized, constructed of straight-cut gears, and, therefore, could only be placed in gear when stopped and the throttle in the low speed idle position. The transmission does not operate with a manual clutch.

The tractor portion of each compactor had six (6) tires in the front. The rear portion of the machine was an articulating trailer that had seven (7) tires. The tires were the components of the machine that performed the compaction function. There were no brakes on the front six wheels, but the rear wheels had four (4) 12-inch by 2-inch brake drums located, if numbering the tires 1 through 7 left to right, on wheels 2 and 3, and 5 and 6. Wheels 1, 2 and 3 are interlocked with a common axle and, likewise, wheels 5, 6 and 7 are interlocked. When the brakes are applied forcefully, these 6 wheels lock up. The parking brake used a small, 7 1/4-inch**,** brake drum located at the rear of the transmission.

On the day of the incident compactor #1 (employee #1, the decedent) was being followed downhill by compactor #2 (employee #2). The job supervisor passed employee #2 and informed him that one of his compactor's wheels was locked up and causing a gouge in the newly laid asphalt. Employee #2 let up on the brakes to free the offending wheel. In order to keep his speed down without applying the brakes so heavily, employee #2 attempted to change his compactor's transmission from second gear into first gear. He stated that he was “pretty sure” he had it all the way into first gear, but that the shifter immediately “popped out of gear”. In tests of the compactor after the incident, which replicated many of the conditions at the time of the incident, the transmission never “popped out of gear.” The transmission was only able to be disengaged after the shift lever was forcefully kicked.

The co-worker had attempted the gear change at the top of the hill. Once the transmission was disengaged, the compactor began to roll down the hill. The co-worker stated he then tried to force the shift lever back into first gear but could not. Post-incident testing of the compactor confirmed the difficulty of performing this task. Unless the compactor is at a virtual standstill the gears are not able to be switched.

The co-worker stated he then tried to apply the brakes, but that they would not hold. During post-incident testing, the compactor was not tested on a hill. However, during testing it was accelerated to fourteen miles per hour and then brought to a halt within 31 feet using it’s brakes. During the tests, forcefully applying the brakes would easily lock the wheels and leave skid marks. No skidmarks could be found at the incident site in the path of travel of the runaway compactor.

The co-worker stated that after he tried to use the brakes he stood up and began to yell to warn others that he could not stop. He continued to pick up speed. According to employee #2 and other witnesses at the site, the compactor achieved a speed of between 15 to 30 miles per hour.

An employee of the job's contractor (which owned the compactors)was driving his pickup truck downhill at about 10 miles per hour when he was passed by the run away compactor. He saw employee #2 waving and yelling that he could not stop. Two dump truck drivers also noticed him waving and yelling. One of the drivers stated that it appeared that the decedent was trying to steer the compactor, but could not. Post-incident testing revealed no problems with the steering.

The decedent's compactor was moving slowly near the north side curb. He was seated in the left hand seat. As he continued downhill, his compactor was struck in the right rear of the trailer portion by the front of the runaway compactor. Some witnesses stated that the runaway compactor struck the decedent's compactor twice while others indicate that there was only one impact. The impact caused the decedent's compactor to jacknife (fully articulate). As the right side of the decedent's compactor closed between the trailer and the tractor, the left side open up in a "V" shape. The decedent was thrown from his seat and landed on the sidewalk with his head nearest the curb. As his compactor remained in motion, the now exposed wheels of the trailer portion came up over the curb. The decedent's head was caught between the trailer's #1 and #2 tires.

Compactor #2 stopped when it struck the decedent's compactor. Employee #2 got out of his compactor to attempt to help the decedent. As part of the rescue effort, employee #2 got back into his compactor to back it across the street. He stated that it would not stay in place, so a large truck was parked in front of it to keep it from rolling downhill. Meanwhile, a truck-mounted crane was moved into place to attempt to lift compactor #1 off of the decedent.

At this time, 11:40 a.m., the fire department personnel arrived and found the decedent without spontaneous respirations and pulse on arrival. Death was pronounced by the paramedics at 11:45 a.m.

CAUSE OF DEATH

The death certificate stated the cause of death to be multiple blunt force injuries.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: As part of their Injury and Illness Prevention Program (IIPP), employers should ensure seatbelts are functional and that employees wear them at all times when they operate seatbelt-equipped vehicles.

Discussion: In this incident, each of the four (4) operator's seats of the two compactors involved were equipped with seatbelts. None of the four seatbelts were functional. In the case of the seat in which the decedent was sitting, the left hand seat of compactor #1, the seatbelt was missing the male portion and, therefore, could not be buckled. Employees should be instructed to operate equipment, such as the compactors used in this incident, only if the seatbelts are functional so they can be worn at all times during the operation. If the decedent had a seatbelt that functioned and if he had worn it, he would stayed in the seat when stuck by the other pavement compactor and this fatality would not have happened.

Recommendation #2: As part of their IIPP, employers should ensure operators of construction equipment are properly trained in its use.

Discussion: In this incident, an employee of the general contractor asked employee #2 if he had known how to use the compactor before he allowed him to operate it. He did not test employee #2 or ask for proof of competence (i.e. license, certificate, etc.). Employee #2 admitted after the incident that he had not been trained to use the specific type of compactor in the incident, and that he had last used a compactor fifteen years earlier. The details of the incident and the post-incident

testing suggest the operator was not completely familiar with the use of this type of compactor. He was not able to successfully shift gears, and the lack of skid marks at the incident site may mean he did not apply the brakes forcefully. These are two probable events in the chain of events that led to the victim's death. Employers need to ensure that when sending an employee to a job site that they are adequately trained to perform all the jobs for which they are assigned. In addition, the site employer, if unfamiliar with the employee, needs to ensure the employee can properly perform assigned tasks by subjecting the employee to testing. In the case of machinery, orientation is necessary if the machine is not exactly like those the employee has operated before. Orientation, and/or refresher training, may also be necessary if the employee has not operated the exact type of machine for some time.

Recommendation #3: As part of their IIPP, employers should develop a formal, written equipment operation training program.
Discussion: In this incident the operator was unfamiliar with the operation of the compactor. In this type of situation training should given before allowing the operation of the machine. In order to train each new operator or those needing refresher training, a formal program should be developed so that training is complete and consistent. A portion of such training should include emergency situations, such as the runaway that occurred in this incident.

In addition, heavy machinery manufacturers should: design a machine's seatbelt system with interlocks that prevent the operation of the machine if seatbelts are not used.

Discussion: Operators may neglect to fasten their seatbelts when operating machinery of the type involved in this incident. The pavement compactor was equipped with a roll-over protective structure (ROPS). It is unlikely that an operator would be seriously injured if a ROPS vehicle rolled over with the operator in his/her seat with his seatbelt properly fastened. This suggests that manufacturers should install interlocks which prevent the starting or operation of the vehicle until the operator properly fastens the seatbelt. Since the decedent's pavement compactor received only minor to moderate damage and did not rollover **(see exhibit 6)**, it is likely that the operator would not have been seriously injured if he would have had his seatbelt properly fasten and remained in the vehicle.

References:

Barclays Official California Code of Regulations, Vol. 9., Title 8, Industrial Relations. South San Francisco, CA, 1998.

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FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The California Department of Health Services, in cooperation with the California Public Health Foundation, and the National Institute for Occupational Safety and Health (NIOSH), conducts investigations on work-related fatalities. The goal of this program, known as the California Fatality Assessment and Control Evaluation (CA/FACE), is to prevent fatal work injuries in the future. CA/FACE aims to achieve this goal by studying the work environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

NIOSH funded state-based FACE programs include: Alaska, California, Iowa, Kentucky, Maryland, Massachusetts, Maryland, Minnesota, Missouri, Nebraska, New Jersey, Ohio, Oklahoma, Texas, Washington, West Virginia, and Wisconsin.

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Additional information regarding the CA/FACE program is available from:

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