



High-visibility Clothing Alone Fails to Protect Workers From Being Struck by Vehicles

Reviewing U.S. injuries/fatalities, air carrier data and international airport surveys, a study by the U.S. Federal Aviation Administration found an industry consensus favoring comprehensive apron-safety programs at airports. Conspicuity of workers often was not a factor in accidents.

—
FSF Editorial Staff

Between January 1985 and August 2000, 11 people were killed when they were struck by vehicles while working on U.S. airport aprons (ramps), the U.S. Federal Aviation Administration (FAA) said in a report to the U.S. Congress.¹ For the study, FAA defined “struck-by injury” as an occupational injury, fatal or nonfatal, to a worker struck by a vehicle on an airport apron. (Injuries to people other than those who normally work on an airport apron, such as aircraft passengers, were excluded by this definition.) Two of the fatalities occurred between 1995 and 2000 (Table 1, page 2). The report said, “Increased emphasis on ramp safety by the airline industry and airports could be a contributing factor to the decline in ‘struck-by’ injuries.”

The objectives of FAA’s study were to count struck-by injuries, to determine the seriousness of struck-by injuries and to determine if “reflective safety vests or other actions should be required to enhance the safety of such workers.” Researchers’ review of U.S. data sources and non-U.S. data sources, however, found that the absence of comprehensive nonfatal injury data impeded their efforts to determine accurately the number and severity of nonfatal struck-by injuries.

As a result, the report said that the FAA study could not show quantitatively the effectiveness of high-visibility clothing in preventing struck-by injuries. Nevertheless, the report said that



the consensus of opinion from international airlines and airports was that an overall apron-safety program that includes high-visibility clothing “would enhance the occupational safety of airport apron workers.”

Among categories of people working routinely in the vicinity of moving vehicles on airport aprons are cargo handlers, fuelers, servicers of aircraft lavatories, servicers of aircraft water systems, catering support workers, snow-removal workers, government representatives, people providing other services to aircraft and related equipment servicers and aviation maintenance technicians.

FAA defined high-visibility clothing as “garments that increase the conspicuity of the wearer” and listed as examples “vests, jackets, bib/jumpsuit coveralls, trousers or harnesses.”

The study cited contextual data from the U.S. Bureau of Labor Statistics (BLS), which said that 6.9 percent of all U.S. job-related fatalities in 1998 resulted from workers being struck by vehicles. The largest number that year — 81 (19.6 percent) of 413 total fatalities — occurred in the transportation/public utilities industry. One fatality (0.2 percent) occurred that year in the air transport segment of the transportation/public utilities industry, the report said. By comparison, the construction industry ranked second among all the industries measured with 103 (24.9 percent) of total fatalities among workers struck by vehicles .

Table 1
Nine Fatal Struck-by Injuries¹ at U.S. Airports, 1985–2000

Date	Local Time	Type of Worker	Accident Description	Causal Factors Reported
Oct. 24, 1998	NR	Aviation support worker	A worker was struck in the back by a fuel truck that was backing up after fueling an airplane.	Fuel truck did not have a spotter
March 27, 1997	1840	Airline wingwalker	A wingwalker was run over by the moving aircraft when he moved forward to retrieve a headset cord used to communicate with the aircraft flight crew during pushback.	Inattention
July 25, 1994	0005	Aviation support worker	An equipment operator backed into the coworker directing him, crushing the worker against a parked piece of equipment.	Inattention
July 11, 1991	0055	Airport inspector	A loading truck on an airport construction project backed over a construction inspector.	Noise, communication
March 15, 1991	1927	Airline worker	A service vehicle struck an employee walking from an airplane in the passenger crosswalk.	Inattention
Dec. 18, 1990	NR	Airline wingwalker	A tug used to push a jet into taxi position backed over a wingwalker.	NR
Nov. 14, 1988	NR	Air freight/delivery worker	A motorized vehicle used to deliver packages and pick up packages struck an employee.	NR
Nov. 7, 1988	2000	Airline wingwalker	A fuel truck struck a wingwalker who was wearing a yellow rain slicker [water-repellant coverall] and raising lighted wands to signal vehicular traffic to stop for an aircraft.	Weather was rainy and foggy; poor visibility
Nov. 20, 1986	0620	Aviation support worker	A forklift struck an employee.	Obstructed view, inattention

NR = Not reported

¹The U.S. Federal Aviation Administration defined “struck-by injury” as an occupational injury, fatal or nonfatal, to a worker struck by a vehicle on an airport apron.

Source: U.S. Federal Aviation Administration and U.S. Occupational Safety and Health Administration

The FAA report said, “The data suggest that airline industry workers actually sustain significantly fewer struck-by injuries than workers in most other industries.” Airports Council International–North America (ACI–NA), which represents about 150 airport operators in the United States and Canada, provided to FAA survey data from an August 2000 questionnaire. ACI–NA received responses from 60 airport operators (representing 68 airports). Among other questions, the survey asked airport operators about workers struck by vehicles and the role of high-visibility clothing.

Analysis of the answers showed the following results:

- Fifteen ACI–NA respondents reported 84 struck-by injuries (all nonfatal) between 1994 and 1999;
- Sixty-nine struck-by injuries (82 percent) occurred at six airports, five of which were large-hub airports² (with 60 struck-by injuries);
- Large-hub airports reported 80 percent of the struck-by injuries, medium-hub airports reported 18 percent, small-hub airports reported 2 percent, and non-hub airports reported none;

- Eighteen struck-by injuries occurred at one airport; and,
- Respondents recommended training, awareness, the use of high-visibility clothing and reduced vehicle speed as the best methods of improving apron safety.

Comparison of the ACI–NA survey data and supplemental data from several air carriers with FAA-compiled data did not identify any fatal struck-by injuries other than those in the BLS database and the FAA database, the report said. Analysis of available information about each fatal struck-by injury led to the following conclusions:

- “Lighting conditions may have been a factor in at least six of the fatal accidents. All accident summary reports that listed the time of the fatal injuries showed the accident occurred during darkness or low-light conditions;
- “Five of the nine fatally injured workers identified in the [U.S. Occupational Safety and Health Administration (OSHA)] database were killed by a vehicle backing up — an activity during which an operator’s field of vision is limited;

- “Follow-up information on the Nov. 7, 1988, fatality [in which a fuel truck struck a wingwalker who was wearing a yellow slicker (water-repellant coverall) and holding lighted wands to direct vehicular traffic in rain and fog, Table 1] found that OSHA determined that high-visibility clothing might have helped the worker; [and,]
- “Due to the nature of the accident, it is doubtful that high-visibility clothing would have made any difference in the March 27, 1997, fatality in which an aircraft backed over an employee [who had moved forward to retrieve a headset cord during pushback, Table 1].”

Three fatal struck-by injuries since 1985 (Table 2) — all during aircraft pushback — were identified in the data compiled by FAA researchers.

“On two occasions, an aircraft struck the ... worker,” the report said. “The third worker was killed after being struck by the tug used in pushing back the aircraft.”

Accident reports from the U.S. National Transportation Safety Board (NTSB) provided the following additional details (two NTSB accidents were not recorded in the OSHA database, the report said):

- On March 27, 1997, [a] wingwalker for a major airline was killed after being run over by an airplane that he was helping to push back. The wingwalker walked in front of the nose gear to retrieve the headset cord used for radio communication with the flight crew;
- On Dec. 8, 1992, [a] worker was using a 15-foot (4.6-meter) headset cord, which restricted his ability to remain clear of the aircraft nose wheel, tug and tow bar. The tug operator said that he saw, in his peripheral vision, the accident worker fall but could not stop the tug before it struck the worker. The probable cause was the lack of adequate clearance between the wingwalker and the tug; and,

- On July 12, 1989, the nose-gear tires of the aircraft rolled over the accident worker’s upper body after the worker stumbled as he walked behind the nose gear. The probable cause was failure of the ramp guide to follow safety procedures; a contributing factor was the worker’s overconfidence.

Two major U.S. air carriers, several nonmajor air carriers and airports provided to FAA researchers supplemental information and data about nonfatal struck-by injuries (Table 3, page 4).

“None of the airlines interviewed, including [the major air carriers that provided FAA access to proprietary data], thought that struck-by injuries were the most pressing occupational safety hazard for apron workers, and most stated that preventing or reducing struck-by [injuries] should be considered as part of an overall ramp-safety program,” the report said.

FAA’s study evaluated separately data provided by the two major air carriers, identified as Airline A and Airline B, both of which required apron workers to wear high-visibility clothing and experienced struck-by injuries (or accident types that included struck-by injuries).

In a 3.5-year period, Airline A had 42 struck-by injuries (all nonfatal), an average of 12 per year. More than 76 percent of the injuries involved the workers’ legs or feet; in six struck-by injuries, the workers’ feet were injured by wheels of vehicles operated by other workers. Tugs were the vehicle type most often involved in the 42 struck-by injuries (aircraft were not counted as vehicles by Airline A; Figure 1, page 5).

The FAA report said, “Though Airline A serves airports of all sizes, all injuries in [its] database were sustained at large-hub airports. ... High-visibility clothing would probably not have made any difference in at least eight (19 percent) of the occurrences, which included such accidents as a driver accelerating rather than braking, equipment malfunction, and workers whose feet were run over because [the workers] left the equipment they were operating in gear when they got out. For the remaining 34 accidents, the data were not sufficiently detailed to determine if the injured workers were wearing high-visibility

Table 2
Three Fatal Struck-by Injuries¹ During Pushback at U.S. Airports, 1985–2000

Date	Airline	Location	Accident Description
July 12, 1989	American Airlines	San Juan, Puerto Rico, U.S.	A ramp worker was killed by an aircraft on pushback.
Dec. 8, 1992	USAir	Flushing, New York, U.S.	During pushback, a ground worker was struck by a tug and killed.
March 27, 1997	Delta Air Lines	New York, New York, U.S.	During pushback, the nose gear of the aircraft struck and killed a wingwalker.

¹The U.S. Federal Aviation Administration defined “struck-by injury” as an occupational injury, fatal or nonfatal, to a worker struck by a vehicle on an airport apron. Data from the March 27, 1997, accident also appear in Table 1.

Source: U.S. Federal Aviation Administration and U.S. National Transportation Safety Board

Table 3
Five Nonfatal Struck-by Injuries¹ at U.S. Airports, 1985–2000

Date	Airline	Location	Accident Description
Nov. 6, 1989	America West	Phoenix, Arizona	During pushback, a ground handler walked under the fuselage and stumbled. Because the tug driver was unable to stop, the airplane nose-gear wheel ran over the worker, seriously injuring him.
March 21, 1992	United Airlines	Phoenix	During pushback, the airplane nose-gear wheel ran over the ramp agent; one of the agent's legs was crushed and severed.
March 27, 1992	American Airlines	Hayden, Colorado	During pushback, the airplane nose-gear wheel ran over a ramp agent's foot and leg on pushback; the agent was injured seriously.
Nov. 13, 1992	Delta Air Lines	Atlanta, Georgia	During pushback, a ground worker was injured seriously when he became entangled in the left main gear; the worker's legs were run over by a main-gear wheel.
Dec. 22, 1996	Sun Country Airlines	Las Vegas, Nevada	During pushback, the airplane struck a ramp worker; the worker sustained serious injuries.

¹ The U.S. Federal Aviation Administration defined "struck-by injury" as an occupational injury, fatal or nonfatal, to a worker struck by a vehicle on an airport apron.

Source: U.S. Federal Aviation Administration

clothing or if a failure to wear high-visibility clothing played a role in their accidents. In at least one accident, in which a worker's foot was injured, the worker was in the process of putting on her safety vest when the accident occurred."

In 1999 and the first nine months of 2000, Airline B had 21 worker injuries involving vehicles (all nonfatal), an average of one per month. Some of these injuries, however, did not meet the definition of struck-by injury used in the FAA study. Eleven occurred in 1999 and 10 occurred in the first nine months of 2000.

Other supplemental data were provided by ACI from surveys of international members. The report said, "While [ACI] information provided insight into overall apron safety, it did not separate struck-by injuries from other causes of apron worker injuries."

The report contained the following conclusions:

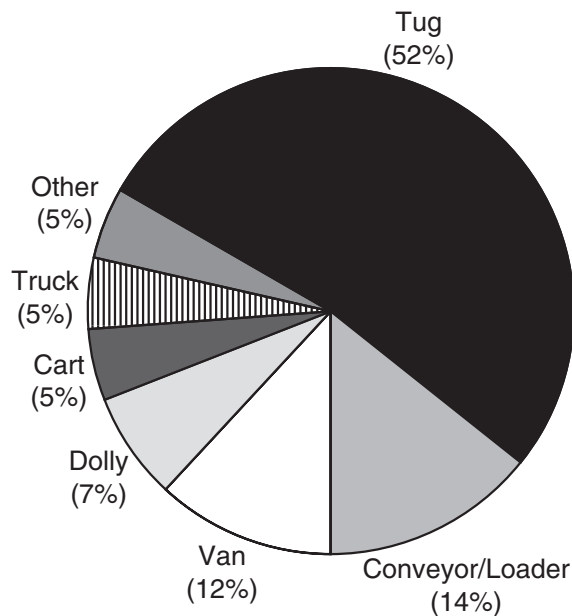
- "Using a rough comparison of average [struck-by] injuries per airport, the FAA determined [that] the lowest rate of injuries (where there was more than one airport reporting) occurred where all tenants required high-visibility clothing;
- "The largest number of injuries per operator occurred at large hubs where there were no high-visibility clothing requirements; [and,]
- "Supplemental data seem to suggest that instituting high-visibility-clothing requirements at all large-hub airports can prevent injuries. This conclusion, however, is somewhat weakened by the data provided by [Airline A and Airline B].

No U.S. regulations currently govern design or performance specifications for three conspicuity classes of high-visibility clothing used on a voluntary basis by employers of airport apron workers, the report said. The American National Standards Institute (ANSI) publishes a standard for high-visibility clothing. For example, FAA researchers found that several major U.S. air carriers have implemented company policies requiring apron workers to wear high-visibility clothing, and one large-hub airport said that its survey of 12 major airlines identified seven airlines that required reflective belts and reflective lettering on shirts and jackets, and five airlines that had no high-visibility clothing requirements, the report said.

"ANSI identified airport baggage handlers and ground crew in Conspicuity Class 2, along with roadway construction workers, utility workers, survey crews, railway workers, school crossing guards, high-volume parking personnel, emergency response personnel, law enforcement personnel and accident site investigators," the report said. "Conspicuity Class 2 is used when the work environment requires greater visibility during inclement weather conditions, there are complex backgrounds, employees are performing tasks that divert attention from approaching vehicular traffic, traffic or moving equipment speeds exceed 25 miles per hour [40 kilometers per hour], or work activities take place in or near proximity to vehicle traffic. Currently, there are no specific OSHA regulations for the aviation industry requiring airport apron workers to wear high-visibility clothing."

The U.S. National Safety Council, in its *Aviation Ground Operation Safety Handbook*, also recommends high-visibility clothing and night-hazard clothing for airport apron workers, the report said.

**Vehicles in 36 Nonfatal Apron Injuries¹
Reported by a Major U.S. Air Carrier²
January 1997–April 2000**



¹ The U.S. Federal Aviation Administration (FAA) defined “struck-by injury” as an occupational injury, fatal or nonfatal, to a worker struck by a vehicle on an airport apron. This air carrier’s data did not fit this definition but provided insights into which types of vehicles caused injuries to apron workers.

² The air carrier was not identified.

Source: U.S. Federal Aviation Administration

Figure 1

FAA researchers also found that among U.S. air carriers voluntarily adopting high-visibility clothing requirements for apron workers, there were variations in policies, procedures and requirements. In contrast, some other countries for many years have had standardized requirements for apron workers to wear high-visibility clothing.

“Several [non-U.S.] international airports require high-visibility clothing, and a European standard has been established,” the report said. “The British Airport Authority (BAA) in OSI/13/99, *Use of Personal Protective Equipment Airside*, requires that airport apron workers wear high-visibility clothing at all times in areas where aircraft and vehicles maneuver. The U.K. Health and Safety Executive (HSE) ... established high-visibility-clothing standards in British Standard EN 471, *High Visibility Clothing*. By risk assessment and personal protective equipment regulation, the HSE requires high-visibility clothing for airside employees. To enforce the requirements, the BAA established policy OSI/48/97, *The Handling of Airside Infringements*. Five recorded failures to wear protective clothing and equipment results in a fine [equivalent to about US\$80].”

Several opportunities to improve U.S. data collection and to support additional types of analysis of struck-by injuries were identified in the study.

“FAA determined that, in conjunction with its own database, the databases of the BLS and OSHA contained the most comprehensive [U.S.] data on fatal and nonfatal struck-by injuries; however, data on nonfatal injuries from these sources were limited,” the report said. “The level of detail contained in the FAA [databases] and OSHA databases made it difficult to determine if the reported injuries met the struck-by definition of this report.”

For future studies, the International Safety Equipment Association (ISEA) in 1999 recommended the addition of a site code that would indicate an airport as the accident site in the BLS databases. This improvement to U.S. data collection “would assist employers, health and safety professionals, the government and suppliers in determining risk exposures for employees in the air transportation system,” the report said.

Further research also should be conducted to determine how regulatory sanctions under other worker-protection requirements³ and lawsuits — which may affect an employer’s duty of care and common industry practices to address safety risks in the workplace — influence the voluntary adoption of additional safety measures.♦

[FSF editorial note: This article, except where specifically noted, is based on Office of the Associate Administrator for Airports, Federal Aviation Administration, U.S. Department of Transportation, *Report to Congress: Injuries and Fatalities of Workers Struck by Vehicles on Airport Aprons*, July 2002.]

Notes

1. The study was required by Section 520 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR 21). “AIR 21 is a three-year bill that will increase aviation investment by US\$10 billion over current levels, with the lion’s share [majority] of the funding going to radar modernization and much-needed airport construction projects,” said an April 5, 2000, news release published by the office of U.S. Rep. E.G. “Bud” Shuster (Ninth Congressional District, Pennsylvania), who was then chairman of the Committee on Transportation and Infrastructure of the U.S. House of Representatives.
2. The U.S. Federal Aviation Administration (FAA) classifies passenger-service airports by percent of total U.S. enplanements. A large-hub airport has 1.00 percent or more of total enplanements; a medium-hub airport has 0.25 percent to 0.99 percent; a small-hub airport has 0.05 percent to 0.24 percent; and a non-hub airport has less than 0.05 percent.

3. The FAA report said that two federal laws — 29 CFR 1910.132(a) and the General Duty Clause, Section 5(a)(1) of the Occupational Safety and Health Act — recently were enforced on an airport apron by the U.S. Occupational Safety and Health Administration (OSHA) after an accident in which high-visibility clothing might have prevented struck-by injuries. For example, OSHA's report on one air carrier's violation of 29 CFR 1910.132(a) said, "Protective equipment, including personal protective equipment for eyes, face, head and extremities, [and] protective clothing, was not provided and used where necessary by reasons of hazards of processes or environment encountered in a manner capable of causing injury: Reflective safety vests were not required to be worn by flight crews while they were exposed to potential contact with vehicular traffic while wearing dark clothing at night."

Further Reading From FSF Publications

FSF Editorial Staff. "Improved Understanding of Human Factors Could Reduce Foreign Object Damage." *Aviation Mechanics Bulletin* Volume 50 (July–August 2002).

FSF Editorial Staff. "Airports Record 5,526 Apron Incidents/Accidents in 2000." *Flight Safety Digest* Volume 21 (January 2002): 13–15.

Duke, Thomas A.; FSF Editorial Staff. "U.S. Air Carrier Accidents, 1997–1999, Involve Turbulence, Ground Operations and Approach-and-landing Problems." *Flight Safety Digest* Volume 20 (June 2001): 35–44.

FSF Editorial Staff. "Airfield Driver Training, Enforcement Help Prevent Aircraft-vehicle Collisions." *Airport Operations* Volume 26 (September–October 2000).

FSF Editorial Staff. "Flight Attendant Training Helps Prevent Injuries in Aircraft Ramp-area Collisions." *Cabin Crew Safety* Volume 35 (May–June 2000).

FSF Editorial Staff. "Miscommunication Leads to Three Fatalities During Ground Deicing of Aircraft." *Airport Operations* Volume 23 (November–December 1997).

Chamberlin, Roy; Drew, Charles; Patten, Marcia; Matchette, Bob. "Ramp Incidents Take Toll in Equipment Losses and Personnel Injuries." *Airport Operations* Volume 22 (September–October 1996).

Want more information about Flight Safety Foundation?

Contact Ann Hill, director, membership and development,
by e-mail: hill@flightsafety.org or by telephone: +1 (703) 739-6700, ext. 105.

Visit our Internet site at www.flightsafety.org.

We Encourage Reprints

Articles in this publication, in the interest of aviation safety, may be reprinted, in whole or in part, but may not be offered for sale, used commercially or distributed electronically on the Internet or on any other electronic media without the express written permission of Flight Safety Foundation's director of publications. All uses must credit Flight Safety Foundation, *Airport Operations*, the specific article(s) and the author(s). Please send two copies of the reprinted material to the director of publications. These restrictions apply to all Flight Safety Foundation publications. Reprints must be ordered from the Foundation.

What's Your Input?

In keeping with FSF's independent and nonpartisan mission to disseminate objective safety information, Foundation publications solicit credible contributions that foster thought-provoking discussion of aviation safety issues. If you have an article proposal, a completed manuscript or a technical paper that may be appropriate for *Airport Operations*, please contact the director of publications. Reasonable care will be taken in handling a manuscript, but Flight Safety Foundation assumes no responsibility for material submitted. The publications staff reserves the right to edit all published submissions. The Foundation buys all rights to manuscripts and payment is made to authors upon publication. Contact the Publications Department for more information.

Airport Operations

Copyright © 2003 by Flight Safety Foundation Inc. All rights reserved. ISSN 1057-5537

Suggestions and opinions expressed in FSF publications belong to the author(s) and are not necessarily endorsed by Flight Safety Foundation. Content is not intended to take the place of information in company policy handbooks and equipment manuals, or to supersede government regulations.

Staff: Roger Rozelle, director of publications; Mark Lacagnina, senior editor; Wayne Rosenkrans, senior editor; Linda Werfelman, senior editor; Rick Darby, associate editor; Karen K. Ehrlich, web and print production coordinator; Ann L. Mullikin, production designer; Susan D. Reed, production specialist; and Patricia Setze, librarian, Jerry Lederer Aviation Safety Library

Subscriptions: One year subscription for six issues includes postage and handling: US\$240. Include old and new addresses when requesting address change. • Attention: Ahlam Wahdan, membership services coordinator, Flight Safety Foundation, Suite 300, 601 Madison Street, Alexandria, VA 22314 U.S. • Telephone: +1 (703) 739-6700 • Fax: +1 (703) 739-6708