



REPORT TO CONGRESS

Injuries and Fatalities of Workers Struck by Vehicles on Airport Aprons

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I. Executive Summary

Section 520 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21) required the Federal Aviation Administration (FAA) to conduct the study described below and report the results to Congress by April 5, 2001:

The Administrator shall conduct a study to determine the number of persons working at airports who are injured or killed as a result of being struck by a moving vehicle while on an airport tarmac, the seriousness of the injuries to such persons, and whether or not reflective safety vests or other actions should be required to enhance the safety of such workers.

A review of the FAA, Occupational Safety and Health Administration (OSHA), and Bureau of Labor Statistics (BLS) of the U.S. Department of Labor (DOL) databases found that between 1985 and August 2000, 11 workers were fatally injured when struck by vehicles on airport aprons. Of the 11 fatalities, only two occurred between 1995 and 2000. Increased emphasis on ramp safety by the airline industry and airports could be a contributing factor to the decline in “struck by” injuries.

The lack of comprehensive nonfatal injury data makes it impossible to determine accurately the number and severity of nonfatal struck by injuries. The data suggest that airline industry workers actually sustain significantly fewer struck by injuries than workers in most other industries. According to 60 airport operators responding to an August 2000 Airport Council International–North America (ACI-NA) questionnaire, 84 struck by injuries, none of which were fatal, occurred between 1994 and 1999 at their airports; 98 percent of the reported injuries were at large or medium hubs. Questionnaire respondents reported that ramp safety could be most improved through training, awareness, the use of high visibility clothing, and reduced speed.

A major airline that requires workers to wear high visibility clothing averaged 12 struck by injuries annually over a 3½-year time period. It appeared that high visibility clothing would have made no difference in at least 19 percent of the injuries; no determination could be made about the impact of high visibility clothing in the remaining 81 percent of the incidents.

Determining whether high visibility clothing would have prevented or reduced the severity of struck by apron accidents was difficult. Insufficient detail in accident descriptions and the recent implementation by airlines and airports of high visibility clothing requirements for workers cloud cause/effect analysis. None of the accident reports addressed whether the victim was wearing high visibility clothing.

The analysis of struck by fatalities and injuries conducted as part of this study was inconclusive as to the effect high visibility clothing would have had in preventing these accidents. However, the information provided by the airlines and airports suggests that an overall ramp safety program that includes high visibility clothing would enhance the occupational safety of airport apron workers.

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II. Introduction

A. Background

Airport aprons are unique and potentially hazardous work environments. Servicing, maintaining, and supporting aircraft operations require all-weather efforts and minimal aircraft turnaround time by cargo handlers, fuelers, lavatory and water system servicers, catering support, snow removal workers, Government representatives, aircraft and equipment servicers, maintenance workers, and others. Work is fast paced to meet airline schedules. Aprons are congested, noisy, and packed with a diverse fleet of vehicles, traveling at a variety of speeds.

In 1998, the BLS, the Nation's keeper of information on workplace fatalities and injuries, reported that 6.9 percent of all job-related fatalities nationwide resulted from workers being struck by vehicles. The largest number of fatalities occurred in the highway and street construction industry; air transportation, meanwhile, exhibited one of the lowest fatality rates. The possibility of being struck by vehicles on the airport apron, however, is one of the occupational hazards that face apron workers, and until this report, there was little quantification or analysis of “struck by” injuries to these workers.

B. Purpose

The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21) required the FAA to study injuries to airport apron workers who were struck by a vehicle and to investigate actions that could enhance apron worker safety. Section 520 of AIR-21 states the following:

The Administrator shall conduct a study to determine the number of persons working at airports who are injured or killed as a result of being struck by a moving vehicle while on an airport tarmac, the seriousness of the injuries to such persons, and whether or not reflective safety vests or other actions should be required to enhance the safety of such workers.

C. Scope

Though airport apron workers suffer occupational injuries from a variety of causes, this report considered only those injuries, fatal and nonfatal, to workers struck by a vehicle on an airport apron. For brevity, such injuries are referred to as “struck by” injuries. The report identifies possible remedial occupational safety actions that might prevent or reduce the number or severity of struck by injuries and evaluates safety vests or high visibility clothing only in terms of their general effectiveness. It was not the charge or intent of this report to evaluate design, performance specifications, and visibility requirements for specific high visibility garments— aspects of HVC that American National Standards Institute (ANSI), Inc., standards, *American National Standard for High-Visibility Safety Apparel*, thoroughly address¹.

¹ ANSI is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system.

III. Approach

A. Injury Data Review

1. General

In this report, the FAA establishes common definitions for terms contained in AIR-21, reviews standards and requirements, identifies and searches available Federal databases for injury information, investigates other sources of data to fill information gaps, and evaluates common industry practices.

2. Definitions

As the first task, the FAA established definitions for the terms listed in AIR-21 since definitions vary within and between agencies. In the DOL, OSHA established definitions and recordkeeping guidelines for the injury and illness data logged by the BLS. However, these terms did not always match those used within the Department of Transportation (DOT) by the FAA or the Federal Highway Administration (FHWA).

This report includes the OSHA definition of “vehicle,” rather than the FHWA definition, because it is consistent with the BLS and OSHA data used. Terms such as “tarmac” and “safety vest” have no established Federal definitions, so the FAA extrapolated definitions from other Federal definitions and industry terminology. In addition, the terms airport “apron” or “ramp” take the place of “tarmac,” and “high visibility clothing” substitutes for “safety vests” since high visibility clothing comprises any of a variety of garments that increases the conspicuity of the wearer. The definitions used in this report appear in Appendix A.

3. Review of Standards and Requirements

The FAA reviewed Federal safety and health requirements, standards, and regulations to identify possible sources of data, jurisdictional issues, and current safety requirements applicable to apron workers.

4. Databases

The FAA determined that in conjunction with its own database, the databases of the BLS and OSHA contained the most comprehensive national data on fatal and nonfatal struck by injuries; however, data on nonfatal injuries from these sources were limited. The report makes use of 1985 through August 2000 data from these sources as well as OSHA accident investigation report summaries of fatal injuries, which the author reviewed in detail for similarities, potential trends, and actions that could be taken to enhance worker safety.

Data on nonfatal injuries were more difficult to obtain. The level of detail contained in the FAA and OSHA databases made it difficult to determine if the reported injuries met the struck by definition of this report. Reported BLS data made use of the occupational structure of the DOL’s *Standard Occupational Classification Manual*, which provides different levels of aggregation (Major Group, Minor Group, Broad Occupation, and Detailed Occupation) as well as occupational titles and definitions. While the levels of data aggregation were not sufficiently

detailed to quantify struck by injuries on airport aprons, the FAA used the BLS injury data to make relative comparisons with other industries.

Some contend that to be useful, injury and illness data must be reported in greater detail. In a statement issued by the International Safety Equipment Association (ISEA) at the FAA's Airport Worker Safety Public Hearing on December 10, 1999, for example, ISEA argued that the BLS data for struck by injuries were inadequate due to the absence of a "site" code for airports. ISEA suggested that improved data quality would assist employers, health and safety professionals, the Government, and suppliers in determining risk exposures for employees in the air transportation system.

5. Supplemental Data Sources

In the absence of comprehensive national data on nonfatal injuries of apron workers, the FAA evaluated information from a variety of other sources from which injury occurrence rates and severity could be assessed. The FAA contacted several major airlines, airports, air carriers, and smaller airlines during the course of this study and asked them to provide corporate data. There were no standard reporting criteria, so the amount and format of data varied substantially with the source. Each supplemental data source was evaluated separately. The report incorporates data as it was provided, and with only a few exceptions, the information was not verified. The supplemental data sources asked that individual companies and airports remain anonymous; therefore, data are provided without mentioning either the location or source or are presented in a consolidated form.

One major airline, referred to as "Airline A," allowed the FAA to view, analyze, and evaluate internal data specifically related to employees who suffered struck by injuries between 1997 and mid-2000. Other airlines, including a major airline referred to as "Airline B," provided information on the number of injuries that occurred between 1999 through May 2000.

The Airports Council International (ACI)—a nonprofit, international organization whose mission is to foster cooperation among its member airports and governmental, airline, and aircraft manufacturing organizations to improve aviation worldwide—provided supplemental injury and accident information. ACI has a membership of 550 airports operators; these members operate over 1,442 airports in 165 countries and territories. Through member surveys, ACI has evaluated all aspects of airport apron safety, including accident trends and apron safety-related activities initiated by airports, and has tracked the number of incidents and accidents involving worker injuries and damage to aircraft or equipment.

In June 1997, ACI adopted a resolution on apron safety that in part called for reporting all incidents and accidents occurring on the movement area to the airport operator. In 1999, ACI expanded their annual "Survey of Apron Incidents/Accidents" to include data for a full calendar year. ACI defines "accident" in terms of both injuries and aircraft damage and "incident" as an occurrence other than an accident that could affect safe aircraft operation. The 1999 data, released in September 2000, contained information from 341 airport operators around the world. While this information provided insight into overall apron safety, it did not separate struck by injuries from other causes of apron worker injuries.

Airports Council International–North America (ACI–NA), the largest region of the worldwide ACI, represents approximately 150 airport operators in the United States and Canada. In August 2000, ACI–NA sent member airports in the United States a “Questionnaire on Workers Being Struck by Vehicles on Airport Aprons and High Visibility Clothing” (Appendix B). This survey, the results of which ACI–NA allowed the FAA to review, addressed issues relevant to the charge of AIR-21.

Sixty airport operators returned surveys. Since some members represented airport systems with more than one airport, the data encompassed a total of 68 airports in the United States. During data evaluation for this report, the FAA chose to consider each questionnaire as reporting for an airport rather than a system, a method believed acceptable since none of the airport systems reported more than two injuries. In the evaluations requiring airport size, the FAA reported the questionnaire results based on the largest airport in the system.

B. Occupational Safety and Health Requirements, Practices, and Enhancements

The FAA sought to identify recommendations of recognized safety and health organizations and current industry practice, nationally and internationally. The ACI–NA questionnaire provided insight from the perspective of airport operators relative to suggestions for improving the safety of airport apron workers. The FAA examined information specific to the effectiveness and applicability of high visibility clothing to the aviation industry and in other industries.

C. High Visibility Clothing and Other Safety Enhancements for Apron Workers

The author conducted a literature review of high visibility clothing —garments designed to make wearers stand out from their surroundings. High visibility clothing may include vests, jackets, bib/jumpsuit coveralls, trousers, or harnesses.

Highway safety experts have conducted much of the high visibility clothing research on pedestrians. Studies at the University of Michigan concluded that reduced visibility contributes significantly to pedestrian accidents at night. In addition, the Virginia Transportation Research Council found that fluorescent colors enhanced the daytime conspicuity of highway worker’s clothing. Safety professionals recommend different types of clothing depending on lighting conditions, job responsibilities, and background.

Appendix C contains the results of the high visibility clothing review, which addresses the following sources: the ANSI’s *American National Standard for High Visibility Safety Apparel*, adopted June 1, 1999; DOT requirements; the OSHA General Duty Clause and personal protective equipment requirements; an OSHA opinion regarding high visibility clothing for apron workers; results from the ACI–NA “Struck By” Questionnaire; high visibility clothing requirements at O’Hare International Airport and Midway Airport; British requirements; U.S. Air Force requirements; and National Safety Council recommendations.

IV. Regulatory and Jurisdictional Considerations

Section 4 (b)(1) of the Occupational Safety and Health Act of 1970, Public Law 91-596 (OSH Act), allows other Federal agencies to prescribe or enforce standards or regulations affecting occupational safety or health. On July 2, 1975, the FAA exercised this authority in 40 FR 29114,

“Notice of Occupational Safety or Health Standards for Aircraft Crewmembers.” The FAA claimed exclusive responsibility for prescribing and enforcing occupational safety and health standards for U.S.-registered civil aircraft in operation. The term “in operation” was defined as the time from when a crewmember, preparatory to a flight, first boards an aircraft to the time when the last crewmember leaves the aircraft after the completion of that flight, including stops on the ground during which at least one crewmember remains on the aircraft, even if the engines are shut down.

On December 10, 1999, the FAA held a public meeting on “Occupational Safety and Health Issues for Airline Employees.” The Federal Register notice for the meeting (64 FR 56275, October 19, 1999), dated October 4, 1999, listed several specific issues impacting apron workers on which the FAA sought comments. In August 2000, the FAA and OSHA issued a joint Memorandum of Understanding (MOU) to enhance safety and health in the aviation industry. The MOU states, “*With respect to other aviation industry employees, such as maintenance personnel and ground support personnel, OSHA has been enforcing, and will continue to enforce, OSHA requirements to the extent allowed under Section 4(b)(1) of the OSHA [sic] Act.*” The MOU established a process for the FAA and OSHA to develop a procedure for coordinating and supporting enforcement of the OSH Act with respect to the working conditions of employees in aircraft in operation (other than flight deck crew), for resolving jurisdictional questions, and for review of the 1975 notice. In December 2000, the FAA/OSHA Aviation Safety and Health Team released their first report, *Application of OSHA’s Requirements to Employees on Aircraft in Operation*. This report addresses recordkeeping and other issues but nothing specifically related to struck by injuries or high visibility clothing.

V. Findings

A. Fatal Injuries

1. OSHA Database

Between 1985 and August 2000, the OSHA database reported nine fatal job-related struck by injuries to workers on airport aprons, only two of which occurred after 1995. With one exception, the OSHA data reviewed for this report did not specify the airport’s location. Table 1 provides a summary listing of the fatalities. Using the OSHA accident investigation reports, which varied in detail, the FAA reviewed the following types of information: lighting conditions, employee information, type of vehicle striking workers, type of accident, and possible causes.

Using the limited information provided by the accident reports, we evaluated each fatality to determine the possible impact that high visibility clothing might have had in preventing or reducing the severity of each accident and found the following:

- 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 OSHA database were killed by a vehicle backing up—an activity during which an operator’s field of vision is limited.

- None of the OSHA accident reports listed whether the fatally injured worker was wearing high visibility clothing, making it difficult to determine the impact such clothing might have had on the accidents. Since many companies over the past several years have required or enforced existing company policies requiring that apron workers wear high visibility clothing, some of the fatally injured workers may have been wearing high visibility clothing when struck.

Table 1
Summary of Fatal Struck By Injuries to Workers on Airport Aprons
1985 through 1999
from the OSHA Database

Date/ Local Time if Known	Employer Information	Description of Accident	Possible Cause/ Contributing Factors
10/24/98 Time not reported	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.
3/27/97 6:40 PM	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's flightcrew during push back.	Inattention
7/25/94 12:05 AM	Aviation Support Worker	An equipment operator backed into the coworker directing him, crushing the worker against a parked piece of equipment.	Inattention
7/11/91 12:55 AM	Inspector for Airport	A loading truck on an airport construction project backed over a construction inspector.	Noise, communication
3/15/91 7:27 PM	Airline Worker	A service vehicle struck an employee walking from an airplane in the passenger crosswalk.	Inattention
12/18/90 Time not reported	Airline Wingwalker	A tug used to push a jet into takeoff position backed over a wingwalker.	
11/14/88 Time not reported	Air Freight/Delivery Worker	A motorized vehicle used to deliver and pick up packages struck an employee.	
11/07/88 8:00 PM	Airline Wingwalker	A fuel truck struck a wingwalker wearing a yellow rain slicker and raising lighted wands to signal vehicular traffic to stop for an aircraft. Weather was rainy and foggy.	Poor visibility
11/20/86 6:20 AM	Aviation Support Worker	A forklift struck an employee.	Obstructed view, inattention

Source: OSHA Accident Search Detail

- Followup information on the November 7, 1988, fatality found that OSHA determined that high visibility clothing might have helped the worker.
- 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.

2. FAA Database

The FAA database listed three struck by fatalities since 1985 (Table 2). In all cases, the accidents occurred during aircraft pushback. On two occasions, an aircraft struck the fatally injured worker. The third worker was killed after being struck by the tug used in pushing back the aircraft. Reports from the National Transportation Safety Board (NTSB) provided additional information on these fatalities, which are described below.

Both the FAA and OSHA databases listed the March 27, 1997, fatality of a wingwalker for a major airline who died after being run over by an aircraft he was helping to push back. A pilot's visibility relative to apron workers on the ground is extremely limited, so radio communication is used. The wingwalker was killed when he walked in front of the plane's nose gear to retrieve the headset cord used in radio communication with the flightcrew. High visibility clothing would probably not have made any difference in this accident.

The OSHA database did not contain the other two accident reports. In both cases, the worker stumbled while the aircraft was being pushed back. In the San Juan, Puerto Rico, accident on July 12, 1989, the NTSB reported that the nose gear tires of the aircraft rolled over the worker's upper body after the worker stumbled as he walked behind the nose gear for at least the second time. NTSB cited the probable cause as failure of the ramp guide to follow normal safety procedures and a contributing factor as the worker's over confidence in his personal ability. It is unlikely that high visibility clothing would have influenced the outcome of the accident.

According to the NTSB, the worker killed on December 8, 1992, was using a 15-foot headset cord, which restricted his ability to stay clear of the nosewheel, tug, and towbar. The tug operator reported seeing the worker fall in his peripheral vision and being unable to stop the tug before it struck the worker. NTSB cited the lack of adequate clearance between the wingwalker and the tug as a probable cause of the accident. The tug operator saw the worker fall, so it does not appear that high visibility clothing would have had any impact on the outcome.

3. BLS Database

Table 3, which uses 1998 BLS data specific to workers struck by vehicles, compares fatal injuries of airport workers to those of other industries. According to the OSHA database, there was one struck by fatality reported on an airport apron in 1998; however, a single fatality was not enough to meet the BLS reporting criteria. Of the total 413 job-related struck by fatalities in 1998, the Transportation and Public Utilities industry accounted for 19.6 percent (81 fatalities). Although this was the second-highest percentage, following construction with 24.9 percent (103 fatalities), reported for an industry that year, the air transportation group represented only a fraction or 0.2 percent (1 fatality) of the total.

Table 2
Summary Reports of Fatal Struck By Injuries Since 1985
from the FAA's Accident Investigation Database
of Ramp/Gate Accidents

Date	Airline	Location	Accident Summary
07/12/89	American	San Juan (SJU)	A ramp worker was killed by an aircraft on pushback.
12/08/92	USAir	New York (LGA)	A ground worker was fatally hit by a tug on aircraft pushback.
03/27/97	Delta	New York (JFK)	On pushback, the nose gear of an aircraft struck and killed a wingwalker.

Source: FAA's Accident Investigation Database of Ramp/Gate Accidents

4. Input from Airlines

The supplemental database from a major airline, Airline A, covered injuries occurring in calendar year 1997 through mid-2000. Data were consistent with OSHA and FAA databases and did not reveal any additional fatalities. Discussions with several other airlines similarly did not reveal any additional fatalities unaccounted for in the Federal databases.

5. ACI Survey Information

The 310 airport operators responding to the 1999 ACI "Survey of Apron Incidents/Accidents" reported 11 fatal apron accidents worldwide, none of which occurred in the United States. This is consistent with the FAA and OSHA databases. In 1999, ACI recorded a total of 4,893 apron accidents and incidents among the 23,476,235 aircraft movements worldwide for a total of one incident per 4,798 aircraft movements or one fatality for every 2,134,203 movements.

6. ACI-NA "Struck By" Questionnaire

Airport operators responding to the August 2000 ACI-NA questionnaire reported three fatal struck by injuries between 1994 and 1999. The FAA contacted the two airport authorities reporting the deaths and concluded that one fatality was the same as the July 11, 1991, death reported in the OSHA database. In the cases of the two other deaths, the airport authority verified that two apron workers had been killed in separate incidents, but neither worker was struck by a vehicle. Consequently, these deaths were not included in this report; the number of struck by fatalities remained unchanged by this data.

7. Summary of Fatal Injuries

In summary, there were nine struck by fatalities included in the OSHA database between 1985 and August 2000. For this same period, the FAA database contained three fatal injuries to workers who were struck and killed during pushback of an aircraft. Only one of these injuries was contained in the OSHA database; the other two were not. Using these two data sources, the FAA identified 11 fatal struck by injuries since 1985, only two of which occurred after 1995.

Table 3
Total Job-Related and Struck By Fatalities
Reported by the Bureau of Labor Statistics for 1998:
Fatalities for Selected Industries

Industry	Total Fatalities in Industry	Struck By Fatalities in Industry [†]	% of Fatalities in Industry Division, Group, or Subgroup Due to Struck By Events
Total	6,026	413	6.9
Agriculture, Forestry, and Fishing (SIC Division A)	831	48	5.8
Mining (SIC Division B)	146	-*	-*
Construction (SIC Division C)	1,171	103	8.8
Heavy Construction, Except Building Construction (SIC Group 16)	271	71	26.2
Highway and Street Construction (SIC 1611)	104	45	43.3
Other Subgroups	167	26	15.6
Other Groups	900	32	3.6
Manufacturing (SIC Division D)	694	31	4.5
Transportation and Public Utilities (SIC Division E)	909	81	8.9
Railroad Transportation (Group 40)	17	4	23.5
Trucking and Warehousing (Group 42)	562	56	10.0
Water Transportation (Group 44)	52	8	15.4
Air Transportation (Group 45)	74	-* (1)	-* (1.4)
Scheduled Air Transportation (SIC 4512)	8	-	-
Air Courier (SIC 4513)	13	-*	-*
Nonscheduled Air Transportation (SIC 4522)	41	-*	-*
Airports, Flying Fields, and Services (SIC 4518)	10	-* (1)	-* (10.0)
Other Subgroups	2	0	0.0
Communications, Electric, Gas, and Sanitary Service (Group 48)	83	9	10.8
Other Groups	121	4	3.3
Wholesale Trade (SIC Division F)	228	9	3.9
Retail Trade	569	23	4.0
Finance, Insurance, and Real Estate	92	-*	-*
Services	757	51	6.7
Public Sector	598	65	10.9
Other Divisions	31	2	6.5

*BLS states that data was not listed because it did not meet the publication criteria. Numbers in parentheses were added based on an OSHA fatality report shown in Table 1. [†] Bold added by author for emphasis.

Note: BLS reports that percentages may not add up to 100 because of rounding.

Source: BLS Table of Fatal Occupational Injuries
Resulting from Transportation Incidents and Homicides by Industry, 1998
Table A-2, reported 8/4/99

In one of the fatal accidents listed in the OSHA database, OSHA investigators determined high visibility clothing might have prevented or lessened the severity of the injury. The circumstances of the three fatal injuries in the FAA database (one of which also appeared in the OSHA system) seem to indicate that high visibility clothing would have made no difference to the outcome of those accidents. No determination could be made about the impact of high visibility clothing on the remaining seven accidents in the OSHA database.

B. Nonfatal Injuries

1. OSHA, FAA, and BLS Data Sources

Standard, comprehensive data from OSHA were not available to assess accurately nonfatal injuries to airport apron workers who had been struck by a vehicle. Though the BLS maintains data of nonfatal lost-time injuries by event and industrial classification, the database distinguishes the struck by injuries only by the broad industry categories. The air transportation industry (Group 45) was responsible for only 1 percent (1 fatality) of the 81 fatalities within the transportation and public utilities category (Table 3). Assuming the industry was responsible for an equal number of nonfatal injuries, of which BLS reported there were 1,268 in 1998, there would have been about 100 nonfatal injuries nationwide to air transportation workers (including air couriers), and of these, only a fraction would have been struck by vehicles in parking lots or nonroadway areas.

Table 4 contains accident summaries from the FAA database. In every case, an aircraft struck the worker. There was insufficient detail in the database to determine conclusively if high visibility clothing would have made a difference, but given the cockpit crew's constrained field of vision, the FAA concluded it was unlikely that high visibility clothing would have prevented or reduced the severity of injuries.

Table 4
Summary of Nonfatal Struck By Injuries Since 1985
from the FAA's Accident Investigation Database
of Ramp/Gate Accidents

Date	Airline	Location	Accident Summary
11/06/89	America West	Phoenix, AZ	On aircraft pushback, a ground handler walked under the fuselage and stumbled. With the tug driver unable to stop, the nose gear ran over the worker, seriously injuring him.
03/21/92	United	Phoenix, AZ	On aircraft pushback, a ramp agent was run over by the nose gear, crushing and severing a leg.
3/27/92	American	Hayden, CO	The nose wheel ran over an agent's foot and leg on pushback. The worker was seriously injured.
11/13/92	Delta	Atlanta, GA	On pushback, a ground worker was seriously injured when he became entangled in the left main gear. The worker's legs were run over.
12/22/96	Sun Country	Las Vegas, NV	On pushback, a DC-10 hit a ramp worker. The worker sustained serious injuries.

Source: FAA's Accident Investigation Database of Ramp/Gate Accidents

2. Supplemental Data from Airlines

A number of airlines were contacted for information on struck by injuries. None of the airlines interviewed, including Airlines A and B, thought that struck by injuries were the most pressing occupational safety hazard for apron workers, and most stated that preventing or reducing struck by accidents should be considered as part of an overall ramp safety program.

3. Supplemental Data from Airline A

Airline A, a major airline, allowed the FAA to review approximately 3½ years of struck by injury information in their database. During the time period in which the data was gathered, Airline A required apron workers to wear high visibility clothing at all times; however, compliance with this company policy varied.

Forty-two injuries, an average of 12 per year, met the struck by criteria of the report. Airline A's data did not list the time of occurrence, employee duties, or possible causes, so the FAA could not correlate the data with the findings from the OSHA and BLS databases.

Airline A tracked injury information in terms of insurance costs. Thirty-six percent of the claims were less than \$500 and nearly 20 percent were over \$5,000. Two claims exceeded \$100,000. Over 76 percent of the injuries were to the legs or feet; in six of the accidents, worker's feet were injured when coworkers ran over them. In general, the most costly injuries were those to a worker's abdomen, chest, or back.

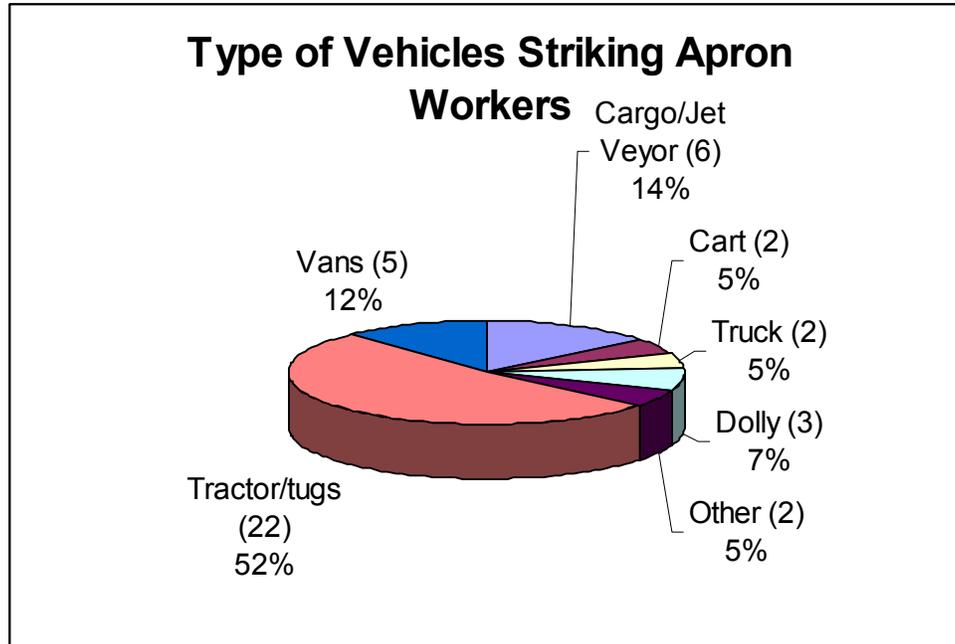
Figure 1 shows a distribution of injuries based on the types of vehicles striking the worker.² A tractor (also referred to as tug) was most frequently the striking vehicle. In general, it appeared workers struck by larger vehicles suffered more serious injuries in terms of cost.

Airline A does not define an aircraft as a vehicle; therefore, any incidents of workers being struck by aircraft would not be reflected in the data. Since the FAA database does not list any workers struck by aircraft during this timeframe, the author concluded that Airline A probably did not experience any such accidents. Under the OSHA definition, dollies are not considered vehicles, yet dollies were responsible for injuries in 7 percent of the cases reported by Airline A.

In the 42 nonfatal accidents reported by Airline A, high visibility clothing would probably not have made any difference in at least 8 (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 they 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 clothing or if a failure to wear high visibility clothing played a role in their accidents. In at least 1 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.

² The term "cargo/jetveyor" used in Figure 1 is used by airlines to describe cargo/baggage conveyors and loaders.

Figure 1
Types of Vehicles Involved in Nonfatal Struck By Injuries
1997 through April 2000
from the Airline A Supplemental Database



Dollies are not considered a vehicle by the OSHA definition that was adopted for this report.

Source: Accident summary information
from a major airline that asked to remain anonymous

Though Airline A serves airports of all sizes, all injuries in the database were sustained at large hub airports.³ Not surprisingly, the greatest numbers of injuries were reported at the airports where the airline has hub operations.

4. Supplemental Injury Information from Airline B

Airline B, a major airline that requires apron workers to wear high visibility clothing, reported that with a workforce of approximately 50,000 workers, there were 11 vehicle-related accidents on airport aprons that resulted in lost work time in 1999 and 10 accidents reported in the first three quarters of 2000. Not all of these accidents, however, met the struck by criteria defined in this report. The most costly injury, for instance, involved a nonstruck by injury in which a driver fell from a belt loader that then proceeded, unmanned, to hit an object that forced a dolly into another worker.

³ The FAA classifies passenger service airports in terms of percent of total national enplanements. A large hub airport enplanes 1.00 percent or more; a medium hub, 0.25 to 0.99 percent; a small hub, 0.05 to 0.24 percent; and a nonhub, less than 0.05 percent.

None of the 21 reported accidents were fatal. A representative of Airline B reported 100-percent compliance with the high visibility clothing requirements.

5. ACI Survey

The 1999 ACI “Survey of Apron Incidents/Accidents” included all apron injuries, regardless of cause, reported by 310 airports worldwide. In that calendar year, there were 172 severe injuries and 1,228 minor injuries, which is less than one apron worker injury for every 16,000 aircraft movements. This study also examined data from the month of November 1999 and found that in terms of overall accident and incident rates, the incident rate at smaller airports, those with fewer than 6,000 movements, was 18 percent lower than that of larger airports. The rate for damage to equipment and facilities was 48 percent lower at the smaller airports, but the rate for damage to aircraft was 36 percent higher. The data were too general to draw conclusions regarding the impact of high visibility clothing on these incidents.

6. ACI-NA “Struck By” Questionnaire

Sixty U.S.-member airport operators of ACI-NA responded to the “Struck By” Questionnaire, though not every airport answered every question. Of the respondents, 87 percent reported that they tracked injuries and deaths occurring on their airport aprons. Though eight airports, including three nonhubs, two small hubs, three medium hubs, and one large hub, reported they did not track injuries, all provided data. Of these nontracking airports, six reported no injuries; two medium hub airports reported one and nine injuries, respectively.

There were no struck by injuries reported by 45 airport operators. The remaining 15 respondents reported a total of 84 injuries between 1994 and 1999. The most struck by injuries reported by a single airport, 18, occurred over a 5-year period for an average of 3.6 injuries per year.

a. Airport Size

Airport operators responding to the ACI-NA “Struck By” Questionnaire represented 15 large hubs, 17 medium hubs, 17 small hubs, and 11 nonhubs. Eighty percent of the reported injuries in the survey occurred on the aprons of large hub airports, 18 percent at medium hubs, 2 percent at small hubs, and none at nonhubs. The increased activity at large and medium hub airports often necessitates more complex apron configurations.

Of the 84 injuries, 69 (82 percent) occurred at only six airports—five of which were large hubs and one was a medium hub that reportedly did not track injuries. At the five large hub airports, 18, 14, 11, 9, and 8 injuries occurred.

b. Significance of Struck By Injuries to Overall Safety

The ACI-NA “Struck By” Questionnaire asked airport operators, “How would you rate workers being struck by vehicles on your airport in terms of overall safety concerns?” Table 5 summarizes the operators’ responses.

There appears to be a relationship between the number of injuries per airport and the significance airport operators attribute to the problem. In general, those operators experiencing higher numbers of injuries rated the problem as more significant.

c. High Visibility Clothing

The ACI-NA “Struck By” Questionnaire provided yes/no response boxes for the question, “Does your airport require safety vests or other high visibility clothing?” A followup question asked under what conditions the clothing must be worn. Table 6 shows the survey results for high visibility clothing by airport size and number of injuries.

Since the survey did not address when the high visibility clothing requirements went into effect, the FAA could not determine whether the airport operators enacted requirements in response to accidents or if injuries occurred despite the high visibility clothing.

The ACI-NA “Struck By” Questionnaire asked airport operators if tenants, such as airlines, required high visibility clothing. Table 7 compares injuries with tenant requirements. Over 57 percent of the airport operators reported that all or most of their tenants had requirements for high visibility clothing. Using a rough comparison of average injuries per airport, the FAA determined the lowest rate of injuries (where there was more than one airport reporting) occurred where all tenants required high visibility clothing.

Table 5
Summary of Airport Operator Responses
Rating Apron Struck By Injuries in Terms of Overall Safety Concerns
by Airport Type and Number of Injuries
from the ACI-NA “Struck By” Questionnaire

Rating	HUB Size				Totals
	Large	Medium	Small	Non	
Extremely Serious	1	1	1	0	3
Total Injuries Reported	(9)	(9)	(0)	-	(18)
Avg. Injuries per Airport	9	9	0	-	6
Serious	1	1	0	0	2
Total Injuries Reported	(0)	(0)	-	-	(0)
Avg. Injuries per Airport	0	0	-	-	0
Moderate	4	1	1	0	6
Total Injuries Reported	(32)	(0)	(0)	-	(32)
Avg. Injuries per Airport	8	0	0	-	4
Fatalities	(1)	(0)	(0)	-	(1)
Important, Not Critical	4	6	8	4	22
Total Injuries Reported	(15)	(3)	(2)	(0)	(20)
Avg. Injuries per Airport	3.75	.5	.25	0	.9
Not Significant	4	8	7	7	26
Total Injuries Reported	(11)	(3)	(0)	(0)	(14)
Avg. Injuries per Airport	2.75	.375	0	0	.53
Totals	14	17	17	11	59

Source: ACI-NA “Questionnaire on Workers Being Struck by Vehicles on Airport Aprons and High Visibility Clothing,” August 2000

Table 6
Summary of Injuries According to High Visibility Clothing Requirements
of Airport Operators and Airport Size
from the ACI-NA “Struck By” Questionnaire

	Total Airport Operators	Total Responding	No High Visibility Clothing Requirements	Night/ Low Visibility	By Job	Encouraged	Always
Large Hub	15	14	8	4	0	1	1
Injuries	-	-	(44)	(23)	-	(0)	No data
Fatalities	-	-	(0)	(1)	-	(0)	
Medium Hub	17	17	15	1	0	1	0
Injuries			(5)	(9)	-	(0)	-
Small Hub	17	17	13	0	1	0	3
Injuries	-	-	(2)	-	(0)	-	(0)
Nonhub	11	11	8	2	0	0	1
Injuries	-	-	(0)	(0)	-	-	-
Total	60	59	44	7	1	2	5

Source: ACI-NA “Questionnaire on Workers Being Struck by Vehicles on Airport Aprons and High Visibility Clothing,” August 2000

Table 7
Summary of Injuries at Airports with Tenant Requirements for
High Visibility Clothing
from the ACI-NA “Struck By” Questionnaire

Types of Tenants Requiring High Visibility Clothing	# of Airports	Total Injuries	Percent of Total Injuries	Avg. Injuries per Airport
All	16	14	16.7	.88
Large	2	2	2.3	1
Medium	4	10	11.9	2.5
Small	6	2	2.3	.33
Non	4	0	0	0
Most	21	41	48.8	1.95
Large	7	39	46.4	5.57
Medium	7	2	2.3	.28
Small	4	0	0	0
Non	3	0	0	0
Some	25	29	34.5	1.32
Large	5	26	31.0	5.2
Medium	6	3	3.5	0.5
Small	7	0	0	0
Non	4	0	0	0
None	1	0	0	0
Small	1	0	0	0
Total	60	84	100	-

Source: ACI-NA “Questionnaire on Workers Being Struck by Vehicles on Airport Aprons and High Visibility Clothing,” August 2000

ACI-NA also surveyed airport operators about compliance with high visibility clothing requirements by asking, “What do you estimate to be the compliance rate of workers regarding high visibility clothing requirements?” Table 8 summarizes the responses by airport size.

The ACI-NA “Struck By” Questionnaire also asked airports whether they could detect a decrease in injuries as a result of workers wearing high visibility clothing. Survey results are summarized in Table 9.

VI. Conclusions

Airport aprons are complex work environments with a variety of safety hazards, one of which is the risk of being struck by a vehicle. There were 11 fatal struck by injuries reported since 1985. Fatal struck by injuries among airport apron workers did not appear to be higher than those in most other industries, and the number of persons killed on airport aprons from this cause has been declining.

The time of the accident was included in 6 of the 11 fatal accident reports. All 6 of these fatalities occurred during darkness or low-light conditions. In addition, 7 of the fatal accidents involved a worker being struck by a vehicle backing up. This would lead one to presume worker conspicuity played a role in these accidents.

With only a few exceptions, no conclusions could be drawn from the available data on whether high visibility clothing could have helped prevent the accidents. The OSHA accident reports generally did not address the worker’s clothing; however, in the November 7, 1988, fatality, OSHA determined that poor visibility was a factor and was prepared to cite the airline for failing to provide high visibility clothing to the worker. The three fatality reports contained in the FAA database did not address the worker’s clothing either, but supplemental information on circumstances of these accidents provided by the NTSB led the FAA to conclude that high visibility clothing would not have prevented these fatalities.

Only 8 percent (5) of the 60 airport operators responding to an August 2000 ACI-NA questionnaire on struck by injuries and high visibility clothing said they believed that struck by injuries were an “extremely serious” or “serious” problem.

Table 8
Summary of Airport Operator Opinions of Worker Compliance
with High Visibility Clothing Requirements
from the ACI-NA “Struck By” Questionnaire

	Excellent	Good	Fair	None
Large Hub	3	10	2	0
Medium Hub	4	7	5	0
Small Hub	4	6	6	0
Non Hub	5	5	1	0
Total	16	28	14	0

Source: ACI-NA “Questionnaire on Workers Being Struck by Vehicles on Airport Aprons and High Visibility Clothing,” August 2000

Table 9
Airport Operator Opinions About
Impacts of High Visibility Clothing by Tenant Requirements
from the ACI-NA “Struck By” Questionnaire

Tenants Requiring High Visibility Clothing	Decrease in Injuries Observed	No Decrease in Injuries Observed	Don't Know	Not Applicable	Total
All	4	8	1	1	14
Most	3	7	1	2	13
Some	1	14	0	4	19
None	0	0	0	0	0
Total	8	29	2	7	46

Source: ACI-NA “Questionnaire on Workers Being Struck by Vehicles on Airport Aprons and High Visibility Clothing,” August 2000

Lack of comprehensive data prevented a quantified analysis of nonfatal struck by injuries, but airport operators and airline safety officials did not rate these injuries as the most pressing safety concern of apron workers. Officials of both airports and airlines stated that preventing or reducing struck by accidents should be considered as part of an overall ramp safety program.

Supplemental data from airlines and airport operators indicate that struck by injuries are more likely to occur at large and medium hub airports where apron configuration and activities are more complex. The largest number of injuries per operator occurred at large hubs where there were no high visibility clothing requirements.

This 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 Airlines A and B.

Though Airline A, a major airline, required workers to wear high visibility clothing, the airline still experienced 42 injuries over a 3½-year period. All of these injuries occurred at large hubs. While the data indicate that high visibility clothing probably would not have had any impact in 19 percent of the accidents, the data for the remaining 81 percent of the injuries were not sufficiently detailed to determine if the injured workers were either wearing high visibility clothing or, as in the case of the worker injured while putting on her safety vest, if failure to wear high visibility clothing played a role in the accident.

Another major airline, Airline B, similarly continued to experience accidents despite the enactment of high visibility clothing requirements. During 1999 and the first three quarters of 2000, Airline B experienced 21 accidents. Although not all of these accidents met the struck by criteria of this report, nonfatal injuries still occurred despite complete compliance with company high visibility clothing requirements.

The analysis of struck by fatalities and injuries conducted as part of this study was inconclusive as to the effect high visibility clothing would have had in preventing these accidents. However, the information provided by the airlines and airports suggests that an overall ramp safety

program that includes high visibility clothing would enhance the occupational safety of airport apron workers.

Appendix A
Definition of Terms from Section 520 of the
Wendell H. Ford Aviation Investment and Reform Act for the 21st Century

For the purposes of this study, the FAA defined terms contained in Section 520 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century. This appendix includes definitions for all underlined terms in the Act.

The Administrator shall conduct a study to determine the number of persons working at airports who are injured or killed as a result of being struck by a moving vehicle while on an airport tarmac, the seriousness of the injuries to such persons, and whether or not reflective safety vests or other actions should be required to enhance the safety of such workers.

(1) Working at airports (airport workers): Any worker employed by an airline, ground service handling company, airport, or any other organization who is involved in or concerned with any aspect of aircraft servicing or support and whose duties require their attendance on, in, and about the airport apron areas.

(2) Injured: Any injury, such as a cut, fracture, sprain, or amputation, that results from a work-related event or from a single instantaneous exposure in the work environment that involves lost worktime, medical treatment other than first aid, restriction of work or motion, loss of consciousness, or transfer to another job. [Bureau of Labor Statistics (BLS)—Occupational Safety and Health Definition]

(3) Killed: Any fatal occupational injury that results in the death of the worker regardless of the time between injury and death or the length of the illness. (BLS—Occupational Safety and Health Definition)

(4) Struck by: The event whereby pedestrians or other nonvehicle occupants are hit by vehicles or other powered industrial mobile equipment where at least one vehicle was in regular operation and the impact was caused by a traffic accident or forward/backward travel of the vehicle. Injuries associated solely with the use of nontransport components of mobile equipment, such as rising forklifts, are not considered. [Occupational Safety and Health Administration (OSHA) Definition]

(5) Vehicle: Any highway vehicles—autos, buses, motorcycles, RV's, other nonpowered highway vehicles; air, rail, or water vehicles; offroad powered vehicles—ATV's, golf carts, snowmobiles; plant and industrial powered vehicles and tractors-forklifts, tractors, and other powered carriers; powered mobile industrial or construction equipment—loaders, bulldozers, backhoes, etc.; and powered mobile agricultural equipment—harvesters, combines, mobile planters, etc. The definition does not include nonpowered industrial vehicles—dollies, carts, wheelbarrows; nonhighway mobile equipment; and wheelchairs—motorized and nonmotorized, stretchers, and wagons. (OSHA Definition)

(6) Airport tarmac: For purposes of this report, the term airport **apron** will be substituted for airport tarmac. An airport apron is a defined area, on a land airport, intended to accommodate aircraft for purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance. The term **ramp** is often used interchangeably with apron. (FAA Glossary Definition for Apron)

(7) Reflective Safety vests: For purposes of this report, the term high visibility clothing will be substituted for safety vest. High visibility clothing is apparel capable of visually signaling the wearer's presence.

Appendix B
ACI-NA Questionnaire on
Workers Being Struck by Vehicles on Airport Aprons
and High Visibility Clothing

Airport Name and Location:

Name of Person Completing the Survey:

Phone:

How would you rate workers being struck by vehicles on your airport apron in terms of overall safety concerns?

Extremely serious problem

Important, but not critical

Not significant at this airport

Serious problem

Moderate concern

Does your airport track injuries and deaths that occur on your airport apron?

Yes

No

In calendar years 1994 through 1999, how many workers were killed on your airport apron by being struck by a moving vehicle?

In calendar years 1994 through 1999, how many workers were nonfatally injured on your airport apron by being struck by a moving vehicle?

Does your airport require safety vests or other high visibility clothing?

Yes

No

If so, under what conditions must clothing be worn? E.g., nighttime only, etc.

If your airport does not require high visibility clothing, do airport tenants such as airlines require high visibility clothing?

All Most Some None

What do you estimate to be the compliance rate of workers regarding high visibility clothing requirements?

Excellent Good Fair None

Have you seen a decrease in the numbers or seriousness of injuries from workers being struck by vehicles since the institution of high visibility clothing requirements?

Yes

No

In your opinion, does high visibility clothing significantly decrease the risk of apron workers being struck by vehicles?

Yes

No

In your opinion, what action would most improve the safety of workers on airport aprons?

Please provide any comments, suggestions, or study input here.

Appendix C

Discussion of High Visibility Clothing Relative to Apron Workers

There are no Federal regulations covering the design and performance specifications for high visibility clothing. In response to manufacturer and consumer needs, the ANSI adopted the first U.S. standards, *American National Standard for High-Visibility Safety Apparel*, on June 1, 1999. The standard, ANSI 107-1999, addresses performance requirements for both daytime and nighttime conditions, colors, retroreflection, placement of materials, physical properties of background materials, and test methods.

The standard identifies three classes of high visibility clothing dependent upon occupational exposures. 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. 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 mph, or work activities take place in or near proximity to vehicle traffic.

The ANSI standards are being widely adopted by the 44,000 local jurisdictions concerned with meeting the highway safety standards of the *Manual on Uniform Traffic Control Devices* (MUTCD). The MUTCD defines the standards used by Government officials nationwide to install and maintain traffic control devices on all streets and highways. The MUTCD is published by the U.S. DOT, FHWA, under 23 Code of Federal Regulations (CFR) Part 655, Subpart F.

The MUTCD, section 6E, requires that flaggers, persons who provide temporary traffic control when permanent traffic control is not available, wear high visibility clothing in both daytime and nighttime situations. Retroflective garments are required at night. Section 6D-3 of the MUTCD states that construction workers close to the vehicular travel way should be attired in bright, highly visible clothing in the manner described for flaggers. Guidance rather than a standard covers the construction workers.

Currently, there are no specific OSHA regulations for the aviation industry requiring airport apron workers to wear high visibility clothing. However, OSHA has used the personal protective equipment requirements codified at 29 CFR 1910.132(a) and the General Duty Clause, section 5(a)(1), of the OSH Act to cite airlines for violations. For example, OSHA cited an airline for willful violation of both provisions in 1998, after a pilot in Ohio suffered serious but nonfatal injuries when struck by a vehicle while waiting for a crew bus on an airport apron. The violation under 29 CFR 1910.132(a) states:

Protective equipment, including personal protective equipment for eyes, face, head, and extremities, 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:

- a) *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.*

The OSHA citation under the General Duty Clause states,

Section 5(a)(1) of the Occupational Safety and Health Act of 1970: the employer did not furnish employment and a place of employment which were free from recognized hazards that were causing or likely to cause death or serious physical harm to employees in that employees were exposed to the potential of being struck by forklifts and other vehicular traffic while waiting to catch or walking to transport buses... One feasible method of abatement among others, is to provide barriers or shields to protect employees as they waited for or walked to the transport buses.

Several major airlines have implemented company policies requiring apron workers to wear high visibility clothing. Two airlines established the policies as part of negotiated settlements with OSHA following a fatal injury to an apron worker. A large hub airport responding to the ACI-NA “Struck By” Questionnaire stated that a survey of 12 major airlines—including Airtran, American, Comair, Continental, Delta, Midway, Northwest, Southwest, TWA, United, and US Air—found that 7 airlines used reflective belts and reflective lettering on shirts and jackets; 5 airlines did not have any high visibility clothing requirements.

Many of the above airlines were contacted as part of this study. There was no standardization of the various corporate policies. Of the airlines requiring high visibility clothing, some required it in all lighting conditions, others only at night. The type and standards of high visibility clothing varied from vests worn over clothing to retroreflective material integrated into the garment.

Airlines also reported varying worker compliance rates with the high visibility clothing requirements. Two airlines stated that it was excellent, while another said they were meeting worker resistance, especially during hot weather conditions.

One airline, not currently requiring high visibility clothing, mentioned that a future such requirement might be necessary if their insurance company felt that high visibility clothing had become an industry norm. In this case, the airline reported, the insurance company and regulatory officials might determine that a company not providing high visibility clothing had not acted prudently and within standard safe industry practices.

Union/management issues were cited as the main reasons that one airline had not implemented a policy for high visibility clothing.

The Chicago Department of Aviation adopted reflective vest rules and regulations for O’Hare International and Midway Airports. In a April 6, 1999, memorandum informing airport tenants of the requirements, Mary Rose Loney, commissioner of aviation, stated that the purpose was to enhance the visibility and safety of personnel working in the secured ramp areas and to promote the safe operation of ground equipment and vehicles.

The requirements, adopted in the Chicago Municipal Code, state

Effective June 1, 1999, all Ramp Service Personnel employed by an Airline, a ground service handling company, or any other organization that is involved in or concerned with any aspect of aircraft servicing in the secured areas...at O'Hare International and Midway Airports will be required to wear "REFLECTIVE SAFETY VESTS" at all times in the performance of their assigned duties.

Chicago established comprehensive minimum requirements for vest materials and construction that specify color, luminance, fluorescent trim, snaps, design variations, and other design elements. According to airport officials, Chicago adopted the vest requirement at the urging of the Mayor of Chicago who noticed that ramp workers at European airports wore high visibility clothing. Officials said that data were not yet available to analyze the effectiveness of the requirement in terms of reduction of the number or severity of struck by injuries to workers. However, they intuitively believe the program has been a success and that high visibility clothing is an important preventative safety measure.

Officials report that one reason the program has been successful is the inclusion of enforcement provisions and penalties for noncompliance. A first offender may be fined up to \$100 for failure to wear a vest. The fine for a second offender is up to \$200 and up to \$500 could be charged for each subsequent violation. Airport police provide enforcement.

Several international airports require high visibility clothing, and a European standard has been established. 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 Health and Safety Executive (HSE), the British equivalent of OSHA, 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 of £50.

The HSE considers aircraft marshallers and movement controllers as special circumstances and concludes that they need to be distinguished from other workers wearing high visibility clothing as pilots taxiing aircraft can easily see them.

Safety officials with the U.S. Air Force do not consider vehicles striking apron workers as a serious safety problem. Their records indicated no struck by injuries or fatalities in the past 2 years. Ramp workers during daytime operations wear battle dress. Reflective clothing is required at night.

Air Force officials speculate that military struck by accidents might be fewer because airfield access is more restricted than at civil airports, and ground crews do not have to conform to the demands of scheduled service.

In its *Aviation Ground Operation Safety Handbook*, 4th edition, the National Safety Council (NSC) recommends high visibility and night-hazard clothing for airport ramp workers.⁴ NSC states that the garments are necessary and should be required for those employees exposed to traffic hazards.

⁴ The NSC is the nation's leading advocate for safety and health. Founded in 1913 and chartered by the United States Congress in 1953, its mission is to “educate and influence society to adopt safety, health and environmental policies, practices and procedures that prevent and mitigate human suffering and economic losses arising from preventable causes.”

Appendix D
Summary of Responses from the ACI-NA “Struck By” Questionnaire:
Suggested Actions to Improve Worker Safety on Airport Aprons

- Training in situational awareness for drivers and workers on ramp
- I don't think reflective clothing is helpful during the day (if a vehicle driver cannot see a 5 or 6 foot tall person—I doubt reflective clothing will help). However, there may be some value to reflective clothing during hours of darkness.
- Above listed high visibility clothing with conscientious employees
- On going and continual refresher training
- Reward/fine program for reporting safety violations to airport
- Roving safety patrol on the ramp
- More reflective material on GSE
- Reduced speed for tugs, etc.
- Over time, a more quantified response can probably be made upon review of data
- Combination of high visibility clothing, high awareness, and cautious driving
- Training
- Reduced speed
- Safe backing program
- Conducting frequent safety meetings with employees to increase awareness
- We have an excellent SIDA training program.
- Safety training and awareness
- Reducing speed limits
- Restricting vehicles from certain locations
- Requiring stronger strobes on vehicles
- During night-time hours, require all ramp workers to wear orange vests—discipline those who don't.
- Wearing of high visibility clothing and a training program
- Wearing high visibility vests
- Training of vehicle operators
- Reduced speed
- Training and education
- Training and education program by their respective management and safety personnel
- Employee awareness of safe working habits
- Being more alert and observant of driving rules
- Being seen
- Better and safer driving techniques
- Increased requirements for spotters
- Slowing down in congested ramp areas
- Training and recurrent training on vehicle and equipment backing procedures
- Airlines, fuelers, caterers, contractors, FAA, and airports need to train their personnel to be knowledgeable of the various activities that take place on the aprons. Employees who work on the aprons must take a personal responsibility to keep the apron areas safe.
- Standard uniforms should include reflective markings
- Awareness training

- Spotters for vehicles that are moving in reverse
- Have all tenants integrate high visibility strips on the uniform belts, shirts, and jackets.
- Good lighting, good marking
- Airport and tenant training
- Better education and training on the issue
- Compliance with safety restrictions (i.e., speed of vehicles, use of designated lanes, etc.)
- Minimize vehicle on DOA to essential only
- Safety program aimed at employees from companies
- Effective driver training program
- Enforcement of rules and regulations on apron
- Reflective safety vests (high visibility clothing)
- Uniform commitment by all managers and supervisors to support ramp safety actively
- Safety training-recurrent
- Slowing down
- Staying within marked roadways; not cutting corners
- Adherence to rules and regulations governing speed limits and traffic flow
- Make sure vehicle speed limits are set and enforced.
- Continue safety awareness
- Reduction of speed of vehicles moving on ramp aprons; employee paying attention to driving and slowing down. High speed turn around of aircraft (load/unload of passengers and luggage).
- Paying attention
- Thorough training on safety matters
- Supervisions of safety personnel
- Enforcement by airport of safety rules
- High visibility clothing and safety training
- Constant reminders about the dangers associated with working on airport aprons
- Training
- Adherence to safety procedures
- Observance of speed limits
- Good supervision
- Ticket speeders
- Awareness
- Training drivers and strictly enforcing speed limits in congested areas
- Low (5mph) driver speed limits
- Situational awareness

Note: Comments mentioning specific airports were omitted or rephrased to preserve the anonymity of the airport.

Source: August 2000 ACI-NA "Questionnaire on Workers Being Struck By Vehicles on Airport Aprons and High Visibility Clothing"

Appendix E
Summary of Responses for
Comments, Suggestions, or Study Input
to the ACI-NA “Struck By” Questionnaire

- As indicated by our results of the survey, the use of high visibility clothing is apparent and therefore need not be regulated.
- [At an airport with 11 injuries,] unsafe speed or unsafe backing were the major causes for most of these incidents.
- When high visibility gear is worn, injury and death are less likely than without it.
- Some airline employee clothing has reflective material which improves their safety level when worn.
- Training of vehicle operators was mentioned as a very important factor (awareness of what is going on around them, etc.).
- In most cases, the 8-10 accidents could have been avoided or significantly reduced if the site had been surveyed first and personnel had been briefed on the upcoming activity.
- A survey of 12 major airlines revealed that 5 did not have any requirements for high visibility clothing. The remaining 7 airlines utilize reflective belts, reflective lettering on shirts and jackets. The survey included Airtran, American, Comair, Continental, Delta, Midway, Northwest, Southwest, TWA, United, and US Air.
- Vests are super for use day or night.
- Increase visibility and prevent injuries.
- Vests are expensive and the better the vest, the higher the costs. Do not count on carriers going nationwide buying [the] best.
- Safety, security checks, SIDA driving, etc., vests—all keep adding on more areas
- Based on information furnished, the incident rate for this type of accident on the aprons of our airport is zero for the 5-year period 1994–1999. The three items mentioned above [three preceding bullets] significantly contribute to this.
- I reviewed this recently for our employees—OSHA does not require reflective clothing unless we choose to interpret it under the General Duty Clause. We will eventually require it for all of our employees; however, some of our employees are already required.
- Obviously, the level of activity related directly to the level or risk. At a small airport—such as ours, it is fairly simple to monitor activity and our ample space avoids issues that go with high levels of concentration.
- FAA is once again trying to go stupidly beyond their regulatory mandate.

Note: Comments mentioning specific airports were omitted or rephrased to preserve the anonymity of the airport.

Source: August 2000 ACI-NA “Questionnaire on Workers Being Struck By
Vehicles on Airport Aprons and High Visibility Clothing”

Appendix F Sources of Information

Airports Council International–North America (ACI–NA) Headquarters, Technical Affairs Department, Washington, DC

American Airlines Safety Department, DFW International Airport, TX

British Standards Institution, London, United Kingdom

City of Chicago, Department of Aviation, Chicago, IL

Continental Airlines, Ground Safety and Risk Management Department, Houston, TX

Delta Airlines, Corporate Safety Department, Atlanta, GA

Department of Census of Fatal Occupational Injuries, Bureau of Labor Statistics, Washington, DC

Federal Express, Safety Department, Memphis, TN

International Safety Equipment Association, St. Paul, MN

Minnesota Department of Transportation, St. Paul, MN

National Safety Council, Itasca, IL

National Transportation Safety Board, Washington, DC

Northwest Airlines, Safety Department, Eagan, MN

OHSA Headquarters, Washington, DC
OSHA Region 6, Dallas, TX
OSHA Field Office, Harrisburg, PA
OSHA Field Office, Fort Worth, TX

Southwest Airlines, Safety Department, Dallas, TX

Texas A&M University, National Work Zone Safety Information Clearinghouse, College Station, TX

Texas Transportation Institute, Information and Technology Exchange Center, Austin, TX

U.S. Air Force, Flight Standards Agency, Washington, DC

United Airlines, Safety Department, Chicago, IL

US Airways, Safety Department, Arlington, VA

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