

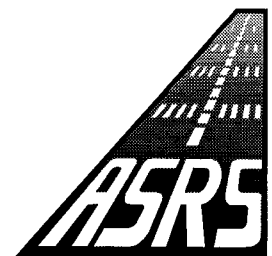
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***Airport Ramp Safety and Crew
Performance Issues***

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Airport Ramp Safety and Crew Performance Issues

by Roy Chamberlin, Charles Drew, Marcia Patten, and Robert Matchette¹

ABSTRACT

This study examined 182 ramp operations incident reports from the Aviation Safety Reporting System (ASRS) database, to determine which factors influence ramp operation incidents. It was found that incidents occurred more often during aircraft arrival operations than during departure operations; incidents occurred most often at the gate stop area, less so at the gate entry/exit areas, and least on the ramp fringe areas; and reporters cited fewer incidents when more ground crew were present. The authors offer suggestions for both airline management and flight crews to reduce the rate of ramp incidents.

BACKGROUND AND MOTIVATION

Airport ramp safety has been given much attention recently in reports and papers by organizations including the Flight Safety Foundation, International Society of Air Safety Investigators (ISASI), the United Kingdom Flight Safety Committee (UKFSC) and the Airports Association Council International (AACI). In spite of the efforts put forth by safety organizations and air carrier safety departments, damage to aircraft and ground equipment, and injury to ground personnel continue to occur during ramp operations. In addition to the human hazard posed by these incidents, they also incur a substantial operating cost. A speaker at a recent UKFSC seminar states the equipment damage and loss worldwide as the dollar equivalent of fifteen Boeing 747-400s.²

During the period 1986-1994, the Aviation Safety Reporting System (ASRS) received almost 1,000 reports describing ramp operations incidents and the human factors that contributed to these events. A detailed examination of ASRS database reports was undertaken to further identify the major types of damage and areas of risk in ramp operations, and the flight crew and ground crew performance errors that contributed to these events.

OBJECTIVES AND SCOPE

Objectives

Specific research objectives were as follows:

- Identify the area of operations in which damage is most likely to occur: ramp entry or exit area, gate entry or exit area, or gate stop area.
- Determine the kinds of damages that occur and their causes.
- Assess the role of environmental factors such as lighting, ramp markings, and surface conditions.
- Assess the role of ground equipment positioning and operations problems in ramp incidents.
- Identify the flight crew and ground crew performance errors that contribute to ramp incidents.
- Recommend enhancements to current ramp procedures to reduce the number of ramp incidents.

Scope

Initial data retrieval included 373 reports from all types of aviation operations. Specific screening criteria were used to review each report for its relevance to the study objectives. To be included in the final study set, an incident had to meet each of the following criteria: 1) involve a ramp operation of an FAR 121 or 135 aircraft or a 2-crew corporate aircraft; 2) reference damage to aircraft or ground equipment, or injury to flight or ground personnel or passengers; and 3) directly involve the flight crew (that is, the flight crew occupied the cockpit at the time of the incident, and their actions or inactions may have contributed to the incident). The research team applied the screening criteria listed above to the initial report set, and selected 182 reports as a final study set. Other types of ramp safety incidents were considered beyond the scope of this study.

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² This damage estimate was cited in the closing remarks by Harry Hopkins, the former chairman of the United Kingdom Flight Safety Committee (UKFSC), at the committee's annual seminar held in November, 1994. The focus of the 1994 seminar was "Ramp Accidents: The Problem, the Key, and the Cure."

APPROACH

Properties of ASRS Data

The ASRS database contains approximately 60,000 full-form records covering the past eight years. ASRS data are influenced by a number of both reporter and researcher biases, thus limiting the kinds of statistical analyses that can be performed. However, the large numbers of reports available over a period of years make it possible to discern general patterns with a relatively high degree of reliability.

Method

The research team developed a coding instrument that underwent several revisions during its development, and was finalized following an interrater coding test. Data were tabulated and analyzed. The findings are presented in the discussion that follows.

FINDINGS AND DISCUSSION

Setting the Stage

As expected relative to the selection criteria, 80% of the reports were from Part 121 primary air carriers, and 87% of the incidents occurred during passenger-carrying operations. Nearly all the reporters were flight crew; only one report from a ground crew member was in the study set.

Specific questions were asked to determine to what extent environmental factors influenced the occurrence of ramp incidents. The time of day, month of the year, location (city and state), and weather conditions referenced in the study set generally mirrored the distribution of those factors in the nearly 60,000 full-form records in the ASRS database. Overall, environmental factors do *not* appear to be directly relevant to the reported ramp incidents

When and Where

At first glance, one might expect an even distribution of incidents during arrivals and departures. However, in the study set, the aircraft was making its arrival at the time of the incident in 58% of the reports³ and its departure in 35% of the reports. Arrival or departure procedures—or lack of them—may account for this disparity.

On arrival, ramp procedures may be less clearly defined. The flight crew is often no longer in contact with ATC once the aircraft transitions to the company gate area, and the flight crew communications with ground crew are likely to be primarily visual (i.e., involving the use of hand or light signals).

In contrast, departure operations tend to be controlled by procedures and checklists. The flight crew is often in radio contact with ATC before any aircraft movement begins from the gate. In addition, there is more likely to be verbal communication with the ground crew just prior to a departure procedure.

As shown in Figure 1, the Ramp Entry or Exit Area, the area adjacent to a taxiway and leading to or from a company ramp, was the site of the incident in 18% of the reports. Aircraft operating in this area are usually in communication with and under the control of ATC. Another 39% of the incidents occurred at the Gate Entry or Exit Area, where taxi lines converge, leading into or out of the gate area. In this area, an aircraft is less likely to be in communication with some controlling agency, and may now be relying on a company ramp control procedure or ground crew input for guidance. The largest percentage of the incidents, 43%, occurred within the Gate Stop Area, that is, within 20 feet of the nosewheel parking line. At this point, the flight crew is usually relying entirely on visual signals for clearance from equipment and for final taxi instructions. This guidance may be in the form of hand signals from ground crew personnel or signals from parking or guidance light systems mounted on the terminal building.

³ Many coding questions permitted multiple responses, reflecting the fact that a single ASRS reporter often cited more than one situation or one factor contributing to the reported incident. Reports might also fail to reference certain factors. Thus, for most of the data presented in the remainder of this paper, total percentages for a specific issue may exceed or fall below 100% based on 182 incident reports.

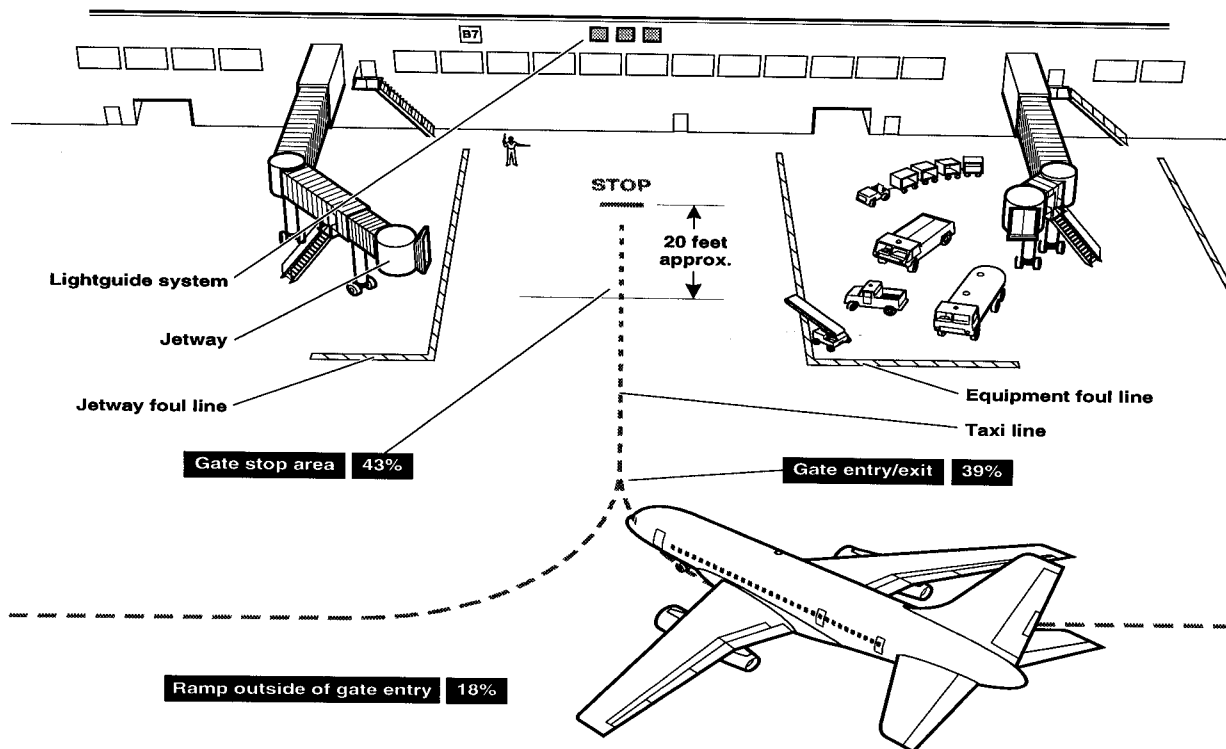


Figure 1. Generic Airport Ramp (ASRS Ramp Study Incident Frequencies Noted)

It is interesting to note that there were more incidents in the gate stop area during arrival (48% of reports) than during departure (31% of reports). A possible explanation is that there are more obstacles to encounter when entering what is usually a progressively more congested area next to gates and terminal buildings. Further, it was noted that there were fewer incident occurrences (13% of reports) on the ramp fringe areas during arrivals than during departures (30% of reports). This may be related to the large number of pushback, power-out, and power turn procedures during departures.

Damage Occurrence

Ground equipment, and by association, ground personnel, appear to be most vulnerable to damage or injury in ramp operation incidents. Ground equipment in general was the clear "loser" in the reported incidents, as depicted in Figure 2. Damage to ground equipment occurred most often in the gate stop area, less so in the gate entry/exit areas, and rarely on the ramp fringes.

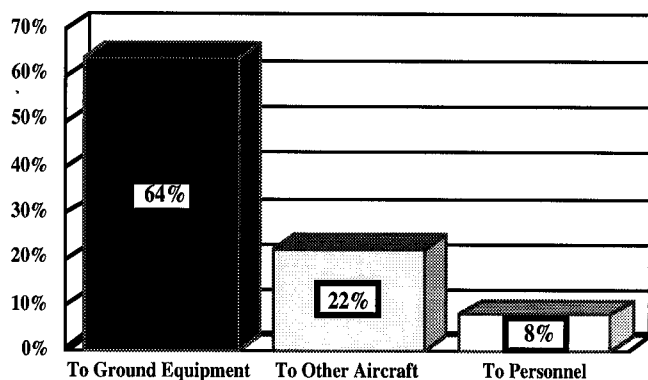


Figure 2. Types of Ramp Damage and Injury

potentially large financial loss to the company in flight delays, employee lost-time, insurance, medical, and other costs.

Damage to another aircraft was cited in 22% of the reports. Interestingly, other aircraft were usually damaged in the ramp and gate entry/exit areas, where the taxiing aircraft were sharing a common maneuvering area and were likely to be in radio contact with a controlling agency. Damage at the gate stop area was less common.

Injury to personnel was reported in 8% of the incidents, and two-thirds of those injured were specified as ground crew members. Fortunately, this is a small percentage. Although it is not a substantial-looking number, it obviously represents a substantial impact in the lives of the persons who were injured. This number also represents a

Contributing Factors

The Main Players. Reporters stated that they were provided with ground personnel for ramp guidance in 64% of the incidents. Ground crew members included:

- a *marshaller*, who is the “PIC” of the ground crew and has primary responsibility for correct signals being passed to the flight crew. The marshaller usually has received specific training for this position. The marshaller coordinates with wingwalkers, tug drivers and other ground personnel, and is stationed in front of the aircraft, giving hand signals to the flight crew for left, right and stop movements.
- a *wingwalker*, whose function it is to ensure wing clearance from obstacles. The wingwalker may or may not have received formal training for this position.
- a *tug driver*, who pushes the aircraft away from the gate and into position for taxi, or tows the aircraft to the gate. The tug driver should be watching both the aircraft and the other ground personnel during the tow or push operation.
- a *chock handler*, who sets or removes chocks from the aircraft wheels. The chock handler position may be covered by a marshaller or a tug driver.

Marshalers were reported as present in 56% of the incidents, and one or more wingwalkers as present in 17% of the incidents. According to reporters, marshalers were not present, but *should have been*, in 12% of the incidents. Based on this recommendation from flight crews, it appears that the presence of a marshaller might have had a positive effect in the 13% of incidents in which no ground crew member was present (see Figure 3). Reporters in 26% of the incidents also stated that wingwalkers *should have been* present. In 20/20 hindsight, many reporters, like this Captain, clearly recognized the value of wingwalkers:

“My aircraft made contact with another company aircraft. There was only one marshaller directing me and no one watching the wing...[The marshaller later] stated that he did not even see that the wings had collided...Had there been a wingwalker in the congested parking area, this incident would not have occurred.” (ASRS Report No. 260065)

Are More Ground Crew Better? Figure 3 shows the number of ground crew personnel present at the time of the reported incident. These numbers may suggest that “more are better,” but this is not always the case. A small four- or six-passenger Part 135 aircraft on a spacious ramp may have little need for a large ground crew. On the other hand, a Boeing 747 making its way into a crowded gate may require three, four, or more ground personnel to navigate safely. In practice, many companies assign only one or two ground crew to an aircraft, at the most. However, the fact remains that the study set contained few reports that cited three or more ground crew as being present.

Ground Crew Performance Issues.

Reporters attributed error to the ground crew personnel in more than half the incidents (104 reports), but also blamed themselves almost as frequently (75 reports). Of the 104 incidents attributed to the ground crew, specifically 75% were directed at marshalers. Considering the marshaller’s PIC-of-the-ramp status, it is not surprising that the marshaller was singled out when an incident occurred. Other errors involving ground crew included the following:

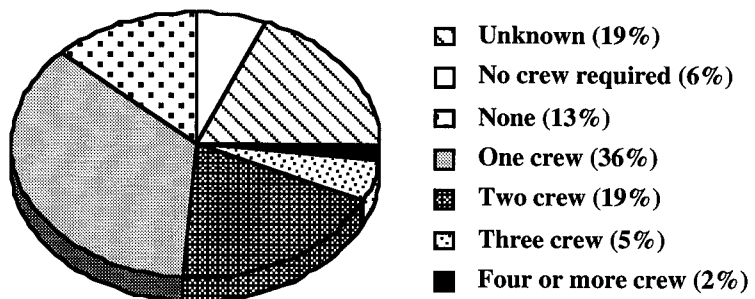


Figure 3. Number of Ground Personnel at Time of Incident

Improper “Come-Ahead.” It is interesting to note that in 85% of the reported incidents, the reporter’s aircraft was moving at the time of the incident, and that 80% of these movements (125 of 155 reports where the aircraft was moving) were considered “normal.” In many of these incidents, however, the flight crew reported that a ground crew member was still signaling “come ahead,” even *after* the aircraft had come into contact with an item of ground equipment. A report excerpt from a Part 135 operator illustrates:

“Taxiing to the right of the taxi line...marshaler was on FO’s side... lighting was poor...a truck was adjacent to another truck...I felt I had at least 3 feet of wing tip clearance...[then] I could see the wing tip coming off the back of the truck...the marshaler was still giving me straight ahead...” (ASRS Report No. 258353)

Improper positioning of ground equipment. Reporters stated that ground equipment was sometimes parked outside its marked areas and encroached on aircraft movement areas. Some reporters also noted that aircraft support vehicles approached the aircraft before it had stopped and the crew had given a signal (usually by turning off the aircraft’s rotating beacon).

Improper taxi or parking instructions. Although not specifically related to ground crew performance, taxi lines, stop lines, and lead-in lights were also cited as contributing factors to incidents. Some reporters specifically recommended making the wingwalker position mandatory for all ramp operations, to supplement the mechanical systems.

In 24% of the reports, parking guidance was cited as an issue related to ramp congestion. The combination of ramp congestion and lack of staffing were the precursors to this Captain’s experience of hitting a cargo loader:

“...returned to the gate...single marshaler...we had just passed through some congested areas on the other side of the airport and figured we had had practice at judging how close things were to the wing tip...misplaced confidence...” (ASRS Report No. 201610)

Flight Crew Performance Issues. Many flight crew members referenced difficulty in seeing poorly-maintained paint lines and poorly-placed light systems used for self-parking as contributing to incidents. Others reports referenced the crew’s inability to accurately judge whether ground equipment was parked outside the aircraft movement area. Other incident precursors mentioned by flight crews included:

- Distraction by cockpit duties, ATC or company communications, checklists, or fatigue;
- Failure to use adequate cockpit coordination skills;
- Inappropriate response to schedule pressure or demand for on-time performance;
- Continuation of an operation even when something didn’t look right, or was blatantly wrong;
- Failure to request a tug to get into or out of a tight parking place.

Communications Issues. Reporters were receiving some sort of ramp guidance—verbal, visual, or both—in 79% of the incidents. Reporters stated that they were using visual communication (hand signals, taxi lines, or guide light systems) in 61% of the reported incidents, and verbal communication (with ATC, company ramp control, or ramp personnel) in 24% of the incidents. The low incidence of verbal communications might be notable, except that in 36% of the reports, reporters indicated that verbal communication was *not required* in the operation. Overall, however, 52% of the reporters stated that the communication—either verbal or visual—with the guidance personnel was poor.

Procedural Issues. Air carrier operational procedures were reported as contributory in 34% of the incidents. Some reports cited instances of a crew’s failure to follow such established policies or procedures as use of checklists, use of salutes, a verbal statement of “clear right,” and other basic operational procedures. Other reports referenced a *lack* of established procedure. Reporters offered suggestions for filling the gap—for example, that simulator training of ramp operations and pushback procedures be instituted for pilots, and that both flight crews and ground crews be exposed to parallel training (that is, each group receiving the same information and training that is provided for the other). Parallel training would promote a clearer understanding of each other’s responsibilities and expectations during ramp and gate operations. In the following report, a towing procedure, new to the flight crew, paved the way for a ramp incident:

“Tow crew did not follow their checklist (unknown to us that they even had one for that situation), and did not challenge us to switch off hydraulic pressure to nosewheel. We overlooked it (new situation, no checklist or SOP for it). Result was broken tow bar connection to nosewheel.” (ASRS Report No. 264610)

RECOMMENDATIONS FOR REDUCING RAMP OPERATION INCIDENTS

There are a number of actions that air carrier management can take to reduce ramp incidents. The following recommendations are based on the findings presented above and on suggestions from a panel of highly-experienced ASRS analysts:

- Provide additional scenario-based training for ground crews, using some of the incident reports available from the ASRS database;

- Require certification for the marshaler and wingwalker positions;
- Maintain paint lines, taxiway markings, and light guidance systems in highly visible condition;
- Establish and enforce speed restrictions and communication procedures for vehicle drivers.

Ultimately, however, the responsibility for safe operation of the aircraft rests with the flight crew. Therefore, regardless of any actual or assumed inadequacy on the part of management or the ground crew, it is up to the flight crew to take action to prevent incidents. A review of data findings suggests these considerations for flight crews:

- Perform a flight crew briefing of the gate entry or exit procedure. Follow the established procedure for operation at that gate. Reaffirm cockpit coordination techniques.
- All flight crew members should maintain an outside scan during aircraft movement. They should be critical of their own perception of ground equipment clearance. Any portion of the operation that doesn't "feel right" probably isn't!
- Be particularly wary of faded or painted-over foul lines, the use of orange cones to mark foul lines or taxi lanes, and reflections on light guidance systems.
- If no taxi guidance is provided, a "no taxi" situation exists. Flight crew should wait for clear and specific guidance from the person identified as having the authority and responsibility for marshaling the aircraft. If the marshaler is lost from sight, a "no taxi" situation again exists. Use of wingwalkers is recommended if ramp congestion is even a remote consideration.
- Recognize that ground crews may be unable to communicate verbally with each other or with vehicle drivers.
- Finally, as a member of the United Kingdom Flight Safety Committee phrased it, players in the ramp movement ballet should remember that "during ramp operations, everything is all right until it isn't all right!"