



AEROSPACE INFORMATION REPORT

AIR1589™**REV. C**Issued 1980-03
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Superseding AIR1589B

Aircraft Damage Caused by Ground Support Equipment

RATIONALE

The definition of the scope of this document is no longer valid. In addition, statistical information is outdated and needs to be revised with the most current information.

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1. SCOPE

Incidents where a piece of ground support equipment or personnel damages an aircraft under the control of ground or maintenance operations that requires corrective action by aircraft maintenance personnel. Operations include, but are not limited to servicing, line maintenance, heavy maintenance, and aircraft movement, e.g., marshalling/pushback/tow/reposition/taxi.

1.1 Purpose

This SAE Aerospace Information Report (AIR) summarizes aircraft damage, coupled with contributory factors, caused by ground support equipment (GSE). It also offers recommendations in reducing exposure to aircraft damage.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR1375	Minimum Safety Requirements for Special Purpose Airline Ground Support Equipment
ARP1247	Aircraft Ground Support Equipment - General Requirements
ARP1287	SAE Standards for Use in the Design of Aerospace Vehicular Ground Equipment
ARP1558	Interface Protection - Ground Equipment to Aircraft
ARP4084	Aircraft Ground Service Connections Locations and Type

2.1.2 IATA Publications

Available from International Air Transport Association, Publications Assistant, 800 Place Victoria, P.O. Box 113, Montreal, Quebec H4Z 1M1, Canada, Tel: 1-514-874-0202, www.iata.org.

Airport Handling Manual

AHM Chapter 6- Management and Safety

AHM 910	Basic Requirements for Aircraft Ground Support Equipment
AHM 913	Basic Safety Requirements for Aircraft Ground Support Equipment
AHM 914	Compatibility of Ground Support Equipment with Aircraft Types
IATA IGOM	Chapter 4 - Aircraft Handling Procedures

2.1.3 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 10842 Aircraft Ground Service Connections - Locations and Types

ISO 7718-1 Passenger Doors Interface Requirements for Connection of Passenger Boarding Bridge or Passenger Transfer Vehicle Part 2: Upper Deck Doors

ISO 7718-2 Passenger Doors Interface Requirements for Connection of Passenger Boarding Bridge Part 2 Upper Deck Doors

2.1.4 Airlines for America (A4A) Publications

Available from Airlines for America (A4A), 1301 Pennsylvania Avenue, NW, Suite 1100, Washington, DC 20004, Tel: 202-626-4000, www.airlines.org.

SG 903 Guidelines for Incident Investigations and Best Practices for Prevention

3. GENERAL

The quantity of ground support equipment (GSE) required on the ramp to support air carrier operations continues to increase every year. The size and technical complexity of the aircraft and associated ground equipment also continues to increase. Additionally, to maximize the revenue potential for the air carriers, aircraft ground times are kept to a minimum.

The combination of these factors along with often overcrowded airport ramps contribute to serious safety concerns for the world's air carriers every day. Economic losses from aircraft damage caused by ground support equipment continue to amount to millions of dollars annually.

Airlines for American (A4A) Ground Safety Committee and IATA's historical incident data exchange reveals that the type of GSEs causing aircraft ground damage has not changed over the years and the top list includes belt loader, passenger boarding bridge, cargo loader, and maintenance equipment. Research has determined that there is also a significant contributory factor in damage to aircraft as a result from non-compliance with standard operating procedures and the incompatibility of ground support equipment with aircraft.

Each aircraft type has specific areas on its structure which, by location, are particularly susceptible to damage by ground support equipment and therefore, to avoid damage, must receive special consideration. These areas include wings, flap track fairings, nose gears, engine cowlings, fuselage, doors, wing-to-body fairings, sensors, antennae, drain masts, etc.

In order to achieve maximum efficiency and cost-effectiveness, ground support equipment is generally cross-utilized over a variety of aircraft types; however, in so doing, the equipment itself often becomes incompatible with the particular type of aircraft being serviced.

This universality of use poses significant hazards in aircraft/mobile ground support equipment interface.

4. SUMMARY OF AIRCRAFT DAMAGE AND CONTRIBUTORY FACTORS - BY TYPE OF GROUND SUPPORT EQUIPMENT

4.1 Belt Conveyors

Potential areas of belt loader damage are the cargo compartment door, door sill, surrounding fuselage, and engine cowling. A4A damage data from 2017 to 2020 identified the Boeing 737 and 757 fleet types as having the highest frequency of door sill and fuselage damage; approximately 70% of all reported. Boeing 737 had the highest cargo compartment door damage; approximately 60%.

The following are examples of contributing causal factors:

- a. Belt loader not properly positioned to the aircraft (laterally and vertically).
- b. Belt loader positioned inside of cargo compartment.
- c. Aircraft settling or movement.
- d. Inadequate or no equipment check prior to use.
- e. Control lever/pedal selection error.
- f. Belt loader wheels not chocked.
- g. Operators misjudging the width of the boom in relation to the size of the aircraft door opening.
- h. Operators depressing the accelerator pedal instead of the brake pedal.
- i. Units positioned on an angle and wheels are not straight when being removed from aircraft.
- j. The length of the side safety railing in relation to the curve of the aircraft fuselage.
- k. Inadequate guarding.
- l. Excessive speed when mating to aircraft.

4.2 Passenger Boarding Bridges (PBB)

Potential areas of passenger boarding bridge damage are the aircraft's boarding doors, door hinges, door sill, surrounding fuselage area, flight control sensors, gust lock, evacuation slide bustle cover, ground power and air-conditioning receptacles, and engines. Contributory factors include:

- a. Improper bridge operation (over 50% of the incidents fall in this category).
- b. Equipment malfunctioning automatic levelling devices being most prevalent.
- c. Interference with sensors and probes located close to the aircraft door. Refer to ISO 7718-1 and ISO 7718-2.
- d. Retraction of the PBB while GPU and/or PCA are still connected to the aircraft.
- e. Aircraft rollback.
- f. Excessive speed when docking to the aircraft.

4.3 Container/Pallet Loaders

Potential areas of container loader damage are the cargo compartment door, door sill, threshold locks, surrounding fuselage, and interior panels. Nearly all the incidents occur as the units are positioned into or removed from the cargo compartments of the aircraft. Other damage is incurred when the aircraft doors are closed and make contact with the platform or railings of the loader. The following are examples of contributing causal factors:

- a. Guard rails, folding wings, and operator platforms not properly retracted, extended, or lowered.
- b. Cargo loader not properly positioned to the aircraft.
- c. Cargo loader deck height too high for aircraft cargo door operations.
- d. Aircraft settling or movement.

- e. The size of the units in conjunction with the restricted maneuvering area in which they operate.
- f. Incorrectly configured “wings” or “extensions” utilized on the forward platform to enable the unit to mate with the sill of the aircraft.
- g. Position of guiderails and side safety rails that protrude into the arc of travel when opening/closing aircraft doors.
- h. Incorrect height of loader during closing and opening of aircraft doors.
- i. Excessive speed when docking to the aircraft.

4.4 Ramp Tractors

This extremely mobile piece of equipment makes contact with various parts of the aircraft: engines, wings, and fuselage. It is worth noting that, in general, there is not an operational necessity for this equipment to get particularly close to the aircraft. Contributory factors include:

- a. Operators maneuvering the units too close to the aircraft.
- b. Excessive speed within the silhouette of the aircraft.
- c. Vehicles left unattended with the engine running or left in gear with either not having parking brakes set or the parking brakes having inadequate holding capability, allowing the vehicle to roll into the aircraft.

4.5 Baggage/Cargo Carts and Dollies

Damage occurs when baggage carts/cargo dollies are pushed or towed into position at the cargo compartments and make contact with fairings, engine cowlings, and the fuselage. Unit load devices (ULDs) being transported on container/pallet dollies also comes into contact with fairings and the fuselage when being positioned to the loaders at the aircraft. Of significance is the high number of incidents resulting from carts/dollies “running away.” Contributory factors include:

- a. The height of covered carts and of dollies with ULDs in relation to fairings, engines, and fuselage appendages.
- b. The tracking and turning radius of these units when maneuvering around aircraft.
- c. Units having poorly maintained brakes being moved by wind, jet blast, or the slope of the ramp.
- d. Tow hitch couplers are not properly engaged or do not have positive locking mechanisms.

4.6 Catering/Cleaning Trucks

The majority of accidents with this equipment occur during final positioning at the aircraft with both the catering door and surrounding fuselage area being damaged. Other damage is caused when the units are backed away from the aircraft and the trailing edge of the wing is struck. Contributory factors include:

- a. Restricted visibility from the operator’s position when approaching/departing the aircraft caused both by the height of the unit as well as extension platforms fitted over the operator’s cab.
- b. Position of platform side guardrails that protrude into the arc of travel when opening/closing aircraft doors.
- c. Excessive speed within the silhouette of the aircraft.

4.7 Passenger Stairs/Steps

The final positioning of this equipment at an aircraft has problems, particularly on wide-body aircraft. As a result, damage is incurred to the doors and surrounding area. Damage is also caused when the equipment is driven in an elevated condition and contact is made with aircraft wings. Settling of aircraft onto the upper platform of the stairs is also a significant cause of damage. Contributory factors include:

- a. Restricted visibility from the operator's position when approaching/departing the aircraft caused both by the height of the unit and the platform fitted over the operator's cab.
- b. Position of platform side panels that protrude into the arc of travel when opening/closing aircraft doors.
- c. Excessive speed.

4.8 Pushback/Tow Tractors, Tow Bars

Most accidents with this equipment combination occur during the push back phase of the operation as a result of tow bars or shear pins breaking and the tow bar or tractor striking the nose gear assembly or gear doors. Contributory factors include:

1. Actions by the equipment operator:
 - a. Shifting into the wrong gear.
 - b. Applying too much gas during hook-up or start of push out.
 - c. Foot slipping off the brake pedal.
 - d. Excessive maneuvering past the aircrafts nose gear limitations.
 - e. Excessive speed.
2. Utilizing the inappropriate capacity tractor and/or tow bar for the task to be performed.

4.9 Ground Power Units

Damage is generally confined to the aircraft connection points and the immediate surrounding area. Contributory factors include:

- a. The failure to remove cables from connection points before the units are driven away from the aircraft.
- b. The failure to perform a pre-check of the unit.

4.10 Lavatory/Water Service Vehicle/Cart

The general design of this equipment normally requires that they be reversed into the servicing position. Damage is incurred to areas adjacent to the servicing panel or under the fuselage on wide-body aircraft. Contributory factors include:

- a. The failure to utilize a guide person when backing up to the servicing position on the aircraft.
- b. Inadequate clearance/distance devices installed.
- c. The failure to disconnect servicing hoses before moving the unit away from the aircraft.
- d. The failure to perform a pre-check of the vehicle/cart.

4.11 Fueling Vehicle

The majority of incidents with this equipment occurred during the positioning of the units at the aircraft when contact was made with engines and wings. Vehicles moving during the fueling process or with elevated operator platforms not being lowered are other causes of damage. Contributory factors include:

- a. The size and height of the vehicles.
- b. The failure to utilize a guide person when backing off the aircraft.
- c. The failure to disconnect servicing hoses before moving the unit away from the aircraft.
- d. The failure to perform a pre-check of the vehicle.

4.12 Other

Just about all types of other GSE become involved in damage to aircraft but not at the same frequency as the GSE outlined above. A notable exception to this, however, is passenger coaches/buses and automobiles/vans which when put into a combined category make them the ninth highest pieces of GSE involved. Damage caused by this equipment is principally to aircraft wings and engines.

5. PRINCIPAL CONTRIBUTORS

In summary, main contributing factors include:

- a. Operator training and qualifications.
- b. Operating procedures.
- c. Equipment designed to work the aircraft but also be able to operate in the working conditions (e.g., weather, ramp congestion, etc.).
- d. Maintenance condition/equipment malfunction.
- e. Work/environmental conditions.
- f. Aircraft size and shape/design.
- g. Management involvement/oversight and routine violations.

6. RISK MITIGATIONS

6.1 Operator Training and Qualifications

Every operator of GSE should be adequately trained on the equipment that they will be using. Emphasis in the training should be on safe working practices, the safety features on GSE, and the actual work environment. Additionally, operators should be made aware of the consequences that an incident causing damage to an aircraft can have. Basic training programs should be both classroom-based and practical (hands-on) and should include a functional check-out/qualification process on each piece of GSE. Recurrent/refresher training is as important as basic training.