

# Statistical Summary of Commercial Jet Airplane Accidents Worldwide Operations 1959 - 2001

1959

2001



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# Introduction

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The accident statistics presented in this document apply to worldwide commercial jet airplanes that are heavier than 60,000 pounds maximum gross weight with the following exceptions:

- Airplanes manufactured in the Commonwealth of Independent States (CIS) (former Soviet Union) are excluded because of the lack of operational data.
- Commercial airplanes in military service are excluded.

The following airplane types are included:

|          |           |                |                |       |          |        |          |             |
|----------|-----------|----------------|----------------|-------|----------|--------|----------|-------------|
| 717      | DC-8      | A300           | BAe 146        | F-28  | Concorde | L-1011 | BAC 1-11 | Comet 4     |
| 707, 720 | DC-9      | A300-600       | RJ-70/-85/-100 | F-70  |          |        |          | Trident     |
| 727      | DC-10     | A310           |                | F-100 |          |        |          | Caravelle   |
| 737      | MD-11     | A320, 319, 321 |                |       |          |        |          | Mercure     |
| 747      | MD-80/-90 | A330           |                |       |          |        |          | CV-880/-990 |
| 757      |           | A340           |                |       |          |        |          | VC-10       |
| 767      |           |                |                |       |          |        |          |             |
| 777      |           |                |                |       |          |        |          |             |

Airplane flight time and departures are primarily obtained from airplane and engine manufacturer compilations. Flight operations data for non-Boeing-manufactured airplanes is augmented by the AirCraft Analytical System (ACAS) electronic database that is published by AvSoft, Limited, of Rugby, England.

Accident data are obtained, when available, from government accident reports. Otherwise, information is solicited from operators, manufacturers, various government and private information services, and press accounts. Definitions related to development of statistics in this book are primarily based on corresponding International Civil Aviation Organization (ICAO) terms as explained in the next section. Some variations to the ICAO definitions are applied to facilitate the purposes of this document.

# Definitions

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Events in this publication are classified according to the following definitions. These definitions are consistent with those of the National Transportation Safety Board (NTSB) and International Civil Aviation Organization (ICAO).

**Airplane accident:** An occurrence associated with the operation of an airplane that takes place between the time any person boards the airplane with the intention of flight and such time as all such persons have disembarked in which:

- Airplane sustains substantial damage.
- Death or serious injury results from:
  - Being in or upon the airplane.
  - Direct contact with the airplane or anything attached thereto.
  - Direct exposure to jet blast.

**Hull loss:** Airplane damage that is substantial and is beyond economic repair. Hull loss also includes events in which:

- Airplane is missing.
- Search for the wreckage has been terminated without it being located.
- Airplane is substantially damaged and inaccessible.

**Substantial damage:** Damage or structural failure that adversely affects the structural strength, performance, or flight characteristics of the airplane and would normally require major repair or replacement of the affected component. Substantial damage is not considered to be:

- Engine failure or damage limited to an engine if only one engine fails or is damaged.
- Bent aerodynamic fairings.
- Dents in the skin.
- Damage to landing gear.
- Damage to wheels.
- Damage to tires.
- Damage to flaps.

**Fatal accident:** An accident that results in fatal injury.

**Fatal injury:** An injury that results in death within 30 days as a result of an accident.



# Definitions (continued)

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**Serious injury:** An injury sustained in an accident that:

- Requires hospitalization for more than 48 hours that begins within 7 days of the date of injury.
- Results in a fracture of any bone (except simple fractures of fingers, toes, or nose).
- Produces lacerations that result in severe hemorrhage or nerve, muscle, or tendon damage.
- Involves injury to any internal organ.
- Involves second or third degree burns over 5 percent or more of the body.
- Involves verified exposure to infectious substance or injurious radiation.

**Generation:** Airplane types are classified by generation groups in order of introduction to service as follows:

| <u>First</u> | <u>Second</u> | <u>Early Widebody</u> | <u>Current</u>    |
|--------------|---------------|-----------------------|-------------------|
| 707, 720     | 727           | 747-100/-200/-300/SP  | MD-80, -90        |
| DC-8         | BAC 1-11      | DC-10                 | 767               |
| Comet 4*     | DC-9          | L-1011                | 757               |
| CV-880/-990* | 737-100/-200  | A300                  | BAe 146           |
| Caravelle*   | F-28          |                       | A310              |
| Mercure*     | Trident*      |                       | A300-600          |
|              | VC-10*        |                       | 737-300/-400/-500 |
|              |               |                       | A320, 319, 321    |
|              |               |                       | F-100             |
|              |               |                       | F-70              |
|              |               |                       | 747-400           |
|              |               |                       | MD-11             |
|              |               |                       | A340              |
|              |               |                       | A330              |
|              |               |                       | 777               |
|              |               |                       | 737-600/-700/-800 |
|              |               |                       | 717               |
|              |               |                       | RJ-70/-85/-100    |

\* These types are no longer in significant commercial service.

# Terms and Exclusions

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**Regional identification:** Events are identified by operators' national domicile and by event location.

**Airplane collisions:** Events involving two or more airplanes are counted as separate events for each airplane. For example, total destruction of two airplanes in a collision is considered two separate hull loss accidents.

**Accident rates:** In general, this expression is a measure of accidents per million departures. Departures (or flight cycles) are used as the basis for computing rates, since there is a stronger statistical correlation between accidents and departures than there is between accidents and flight hours, or between accidents and the number of airplanes in service, or between accidents and passenger miles. Airplane departures data are continually updated and revised as new information and estimating processes become available. These form the baseline for the measure of accident rates and, as a consequence, rates may appear to vary between editions of this publication.

## **Excluded accidents:**

- Fatal and nonfatal injuries from natural causes.
- Fatal and nonfatal self-inflicted injuries.
- Fatal and nonfatal injuries of stowaways hiding outside the areas normally available to the passengers and crew.
- Experimental test flight accidents. (Maintenance test flights, ferry, positioning, training and demonstration flights are included).
- Nonfatal injuries resulting from atmospheric turbulence, maneuvering, loose objects, boarding, disembarking, evacuation, and maintenance and servicing.
- Nonfatal injuries to persons not onboard the airplane.

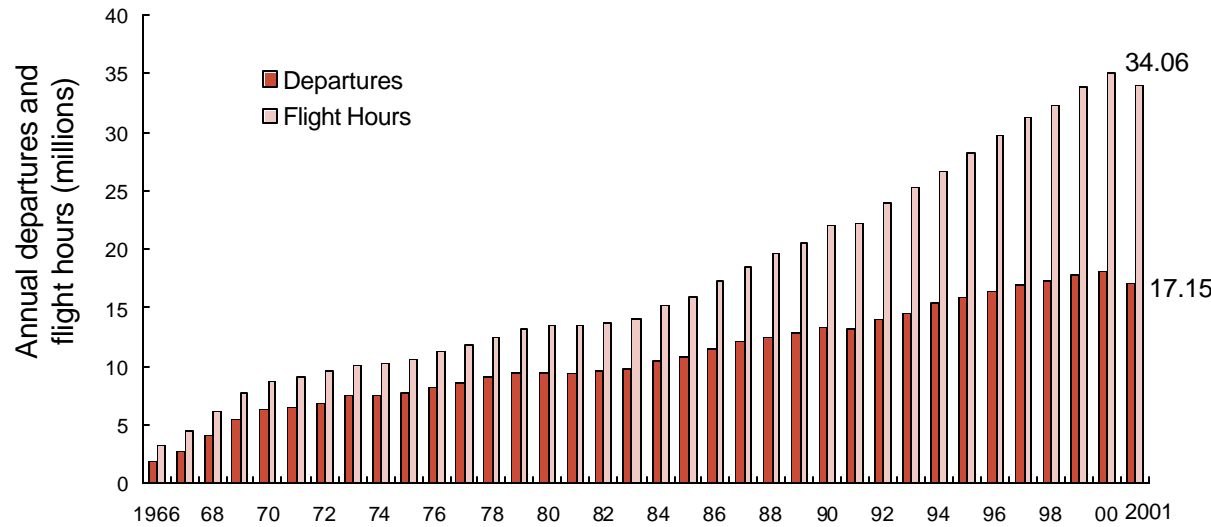
# Airplane Accidents

## Worldwide Commercial Jet Fleet - 2001

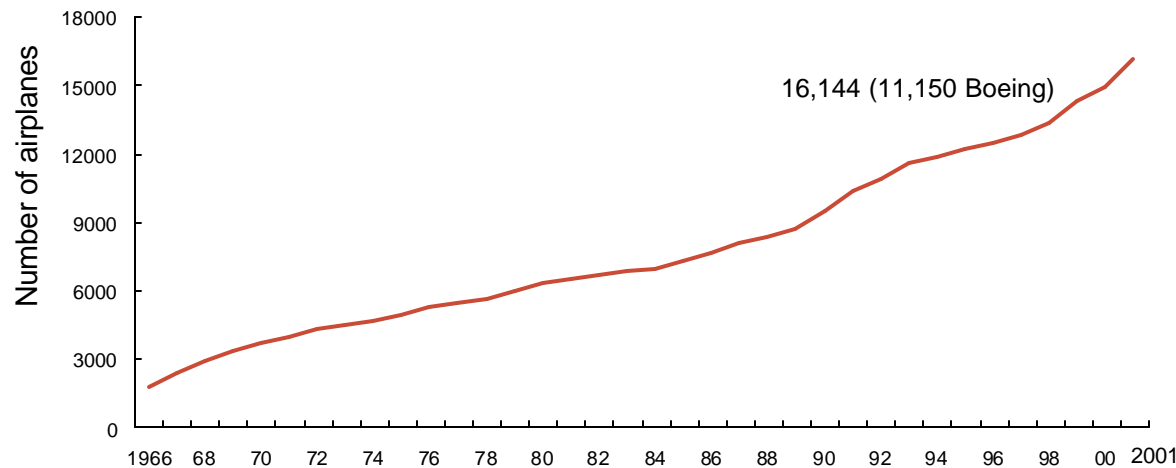
| Date      | Airline                | Airplane Type | Accident Location           | Hull Loss | Fatalities | Phase         | Description                            |
|-----------|------------------------|---------------|-----------------------------|-----------|------------|---------------|--|
| 05-Jan-01 | Air Gemini             | 727-100       | Dundo, Angola               | X         | 1          | Landing       | Crashed during landing                 |
| 09-Jan-01 | LAB                    | 727-200       | Buenos Aires                | X         |            | Landing       | MLG collapsed, wing damaged            |
| 31-Jan-01 | L.A. Suramericanas     | Caravelle 10R | El Yopal, Colombia          | X         | 1          | Landing       | Landed short after go around           |
| 07-Feb-01 | Iberia                 | A320          | Bilbao, Spain               | X         |            | Landing       | Hard landing, NLG collapsed            |
| 03-Mar-01 | Thai Airways           | 737-400       | Bangkok, Thailand           | X         | 1          | Parked        | Airplane destroyed by fire             |
| 06-Mar-01 | Federal Express        | DC-10-10F     | Boston, MA, USA             |           |            | Takeoff       | Fan blade/fire damage                  |
| 07-Mar-01 | Skymaster Airways      | 707-300C      | Sao Paulo, Brazil           | X         |            | Landing       | Hard landing, off runway               |
| 11-Mar-01 | Express One            | 727-200       | Pohnpei Is., Micronesia     | X         |            | Landing       | RMLG separated, LMLG collapsed         |
| 17-Mar-01 | Northwest Airlines     | A320          | Detroit, MI, USA            |           |            | Takeoff       | Tail strike, runway overrun            |
| 22-Mar-01 | Tunis Air              | A320          | Djerba, Tunisia             |           |            | Landing       | Landing overrun, NLG collapsed         |
| 23-Mar-01 | Luxor Air              | 707-300C      | Monrovia, Liberia           | X         |            | Landing       | Dragged engines 3 & 4                  |
| 04-Apr-01 | Canada 3000 Cargo      | 737-200F      | St. Johns, Newfoundland     |           |            | Landing       | Off runway excursion                   |
| 04-Apr-01 | Fine Air               | DC-8-62F      | Cali, Colombia              | X         | 2          | Landing       | NLG collapsed, (2 stowaway fatalities) |
| 10-May-01 | Angola Air Charter     | 727-100F      | N'zagi, Angola              | X         |            | Landing       | Landed short, RMLG collapsed           |
| 22-May-01 | First Air              | 737-200       | Yellowknife, NW Territories | X         |            | Landing       | Bounced hard landing                   |
| 23-May-01 | American Airlines      | F100          | Dallas, TX, USA             | X         |            | Landing       | RMLG separated                         |
| 06-Jul-01 | Air Transat            | L-1011-150    | Lyon, France                |           |            | Climb         | Hail storm damage in flight            |
| 17-Jul-01 | TAME                   | F28-4000      | Tulcan, Ecuador             |           |            | Landing       | Veered off runway                      |
| 01-Aug-01 | Yemenia                | 727-200       | Asmara, Eritrea             | X         |            | Landing       | Landing overrun                        |
| 24-Aug-01 | Air Transat            | A330          | Praia Da Vitoria, Azores    |           |            | Landing       | Dual engine flame-out - evac injuries  |
| 28-Aug-01 | Eagle Aviation         | BAC1-11       | Libreville, Gabon           |           |            | Landing       | Runway overrun                         |
| 06-Sep-01 | Aerpostal              | DC-9-51       | Port Of Spain, Trinidad     |           |            | Taxi          | Off runway, NLG collapsed              |
| 07-Sep-01 | HC Airlines            | 707-320C      | Lubumbashi, Congo           | X         |            | Landing       | Veered off runway, MLG failed          |
| 16-Sep-01 | Varig                  | 737-200       | Goiania, Brazil             | X         |            | Landing       | Runway offside excursion               |
| 18-Sep-01 | TAM                    | F100          | Belo Horizonte, Brazil      |           | 1          | Cruise        | Uncontained engine/passenger fatality  |
| 08-Oct-01 | SAS                    | MD-87         | Milan, Italy                | X         | 118        | Takeoff       | Runway incursion, w/Citation           |
| 14-Oct-01 | Jet Airways            | 737-400       | Chennai, India              |           |            | Parked        | Flight attendant fell from door injury |
| 17-Oct-01 | Pakistan International | A300-B4       | Dubai, UAE                  | X         |            | Landing       | Runway excursion gear collapsed        |
| 20-Oct-01 | Tunis Air              | A300-600      | Djerba, Tunisia             |           | 1          | Parked        | Flight attendant fell from door        |
| 12-Nov-01 | American Airlines      | A300-600      | New York City, NY, USA      | X         | 265        | Initial Climb | Crashed after takeoff                  |
| 24-Nov-01 | Crossair               | RJ100         | Zurich, Switzerland         | X         | 24         | Approach      | CFIT- Crashed 5.5 miles short          |
| 27-Nov-01 | MK Airlines            | 747-200F      | Port Harcourt, Nigeria      | X         | 3          | Landing       | CFIT - Landed short altimeter error    |
| 32        | Total Accidents        |               |                             | 20        | 417        |               |  |

# Departures, Flight Hours, and Jet Airplanes in Service\*

## Worldwide Operations 1966 to 2001



- 395.8 million cumulative departures (330.0 million on Boeing airplanes)
- 644.5 million cumulative flight-hours (546.5 million on Boeing airplanes)
- 7 Manufacturers - 33 significant types (13 Boeing) in service as of 12/31/2001



\*Certified jet airplanes greater than 60,000 pounds maximum gross weight, including those in temporary non-flying status and those in use by non-airline operators. Excluded are military airplanes and CIS-manufactured airplanes.





# Accident Summary by Type of Operation

## Worldwide Commercial Jet Fleet

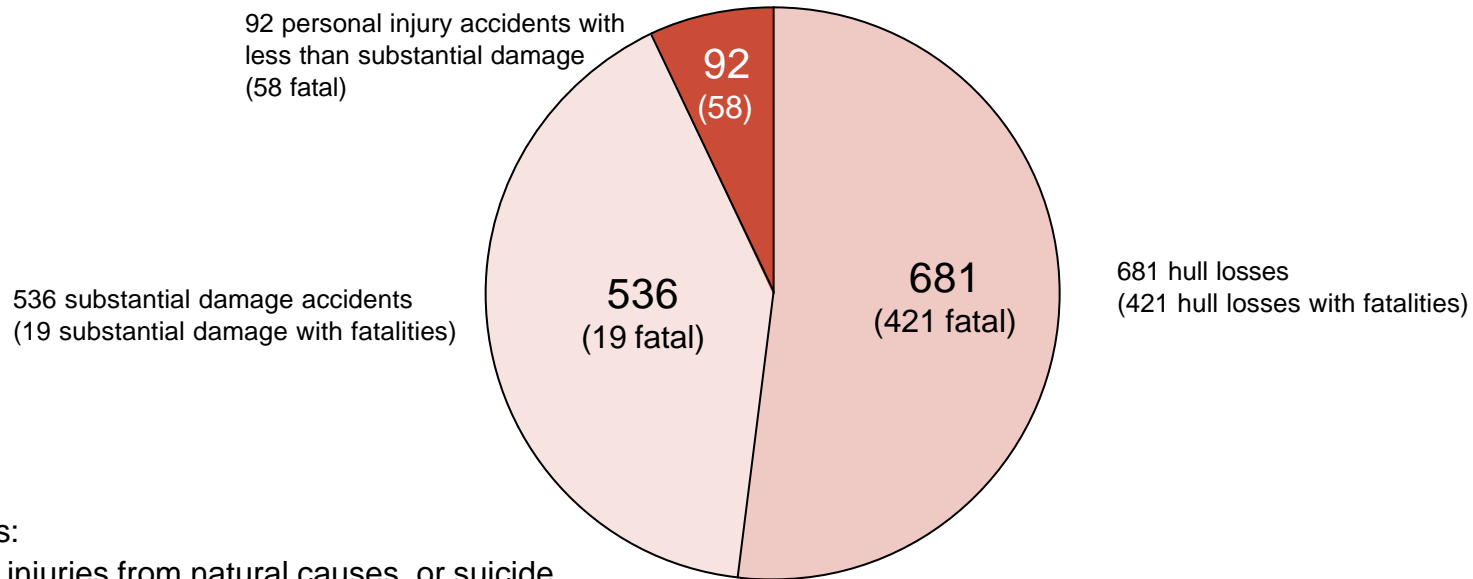
| Type of operation      | All Accidents |            | Hull loss and/or fatal accidents |            | Onboard fatalities |              |
|------------------------|---------------|------------|----------------------------------|------------|--------------------|--------------|
|                        | 1959-2001     | 1992-2001  | 1959-2001                        | 1992-2001  | 1959-2001          | 1992-2001    |
| Passenger              | 1,033         | 299        | 576                              | 166        | 24,283             | 6,621        |
| Cargo                  | 169           | 79         | 119                              | 57         | 217                | 59           |
| Ferry, test            | 103           | 15         | 62                               | 10         | 189                | 34           |
| Military service       | 2             | 0          | 2                                | 0          | 11                 | 0            |
| <b>Totals</b>          | <b>1,307</b>  | <b>393</b> | <b>758</b>                       | <b>233</b> | <b>24,700</b>      | <b>6,714</b> |
| US. & Canada operators | 445           | 92         | 219                              | 47         | 6,077              | 1,081        |
| Rest of the world      | 862           | 301        | 539                              | 186        | 18,623             | 5,633        |
| <b>Totals</b>          | <b>1,307</b>  | <b>393</b> | <b>758</b>                       | <b>233</b> | <b>24,700</b>      | <b>6,714</b> |

# Accident Summary by Damage and Injury

## All Accidents - Worldwide Commercial Jet Fleet - 1959 through 2001

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**1,307 accidents worldwide**



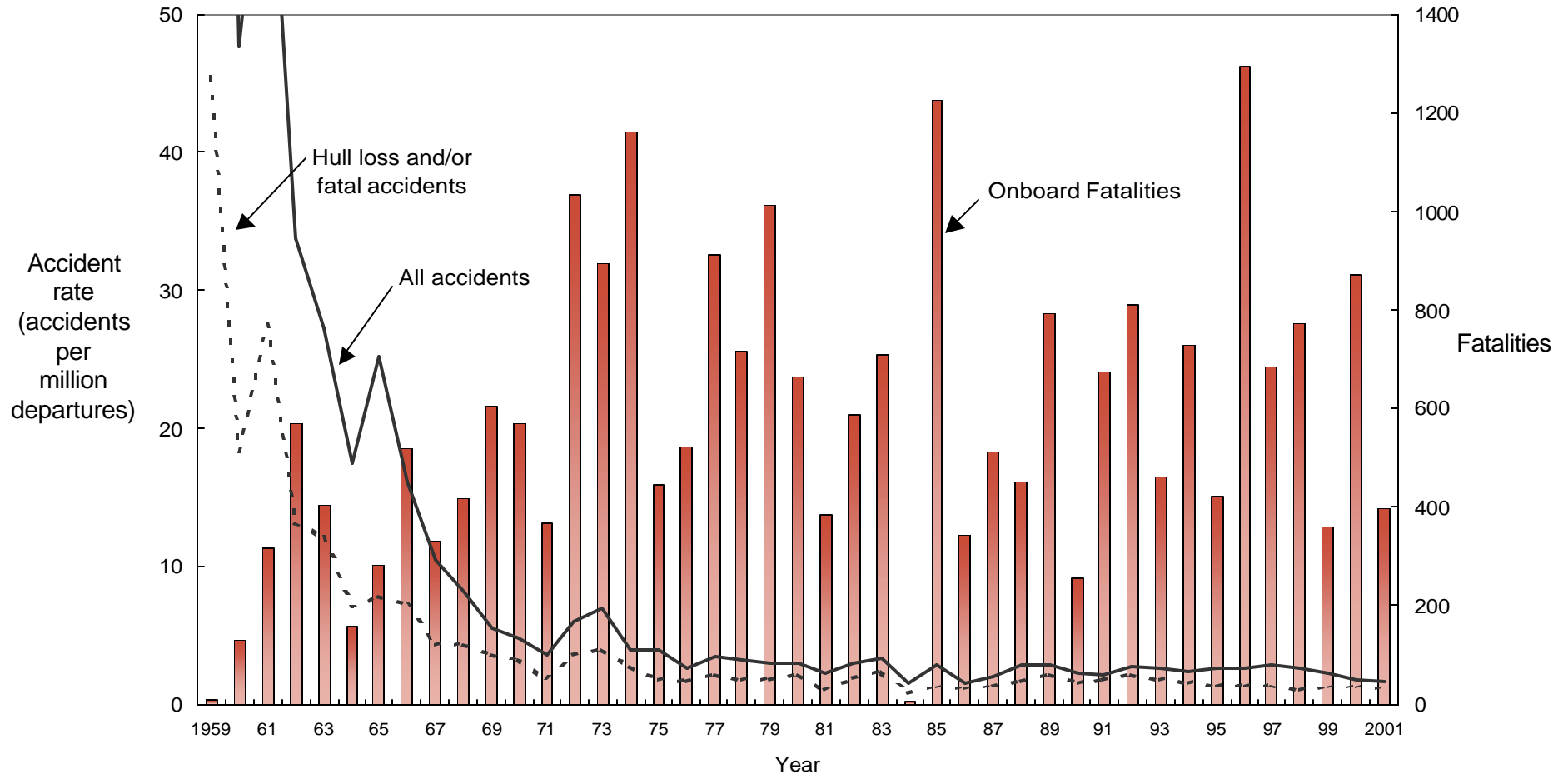
**Excludes:**

- Fatal injuries from natural causes, or suicide.
- Experimental test flights.
- Military airplanes.
- Sabotage, hijacking, terrorism, or military action.
- Non-fatal injuries involving:
  - Atmospheric turbulence, maneuvering, or loose objects.
  - Boarding, disembarking, or evacuation.
  - Maintenance or servicing.
  - Persons not onboard the airplane.



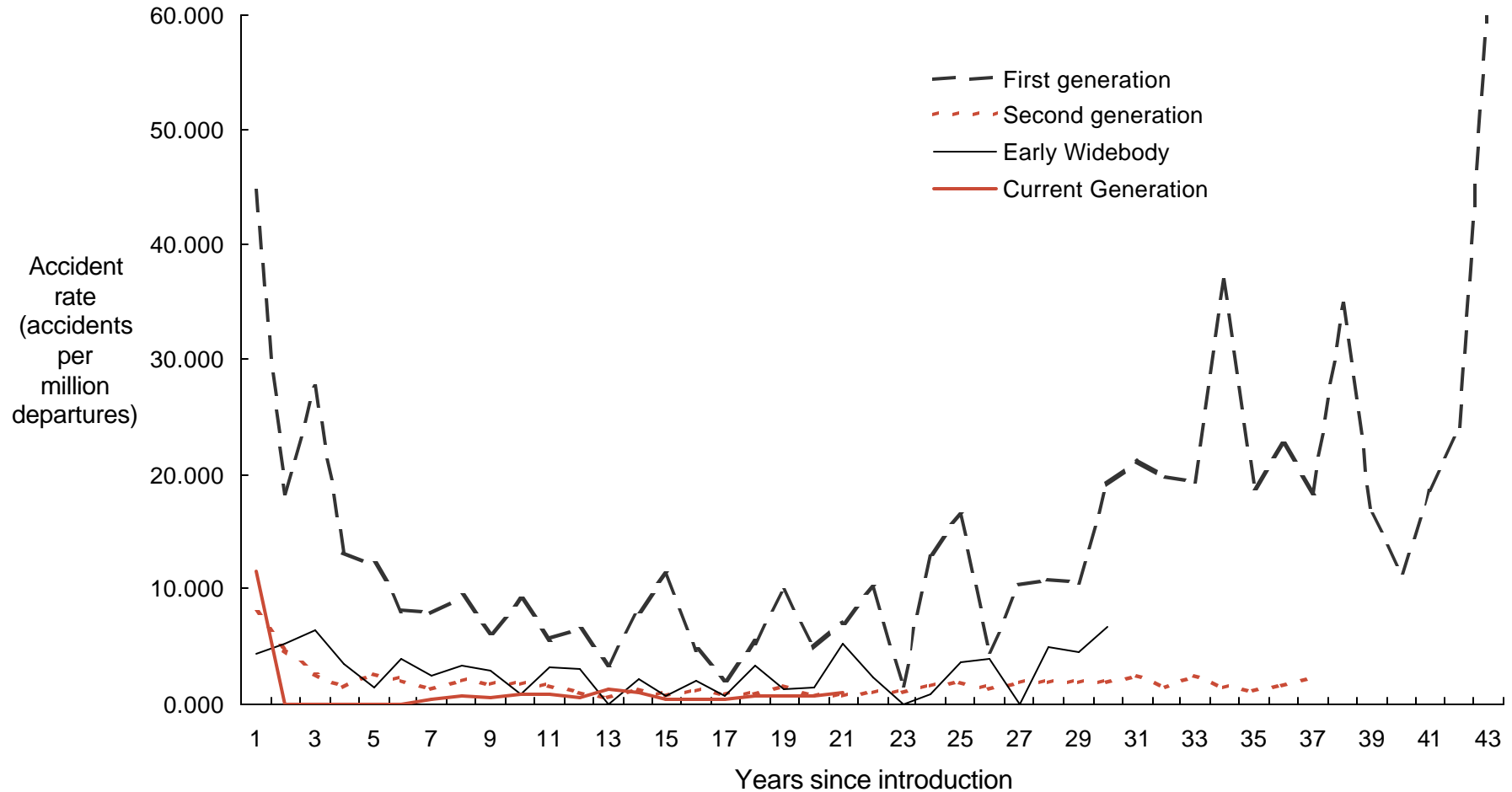
# Accident Rates and Fatalities by Year

All Accidents - Worldwide Commercial Jet Fleet - 1959 through 2001



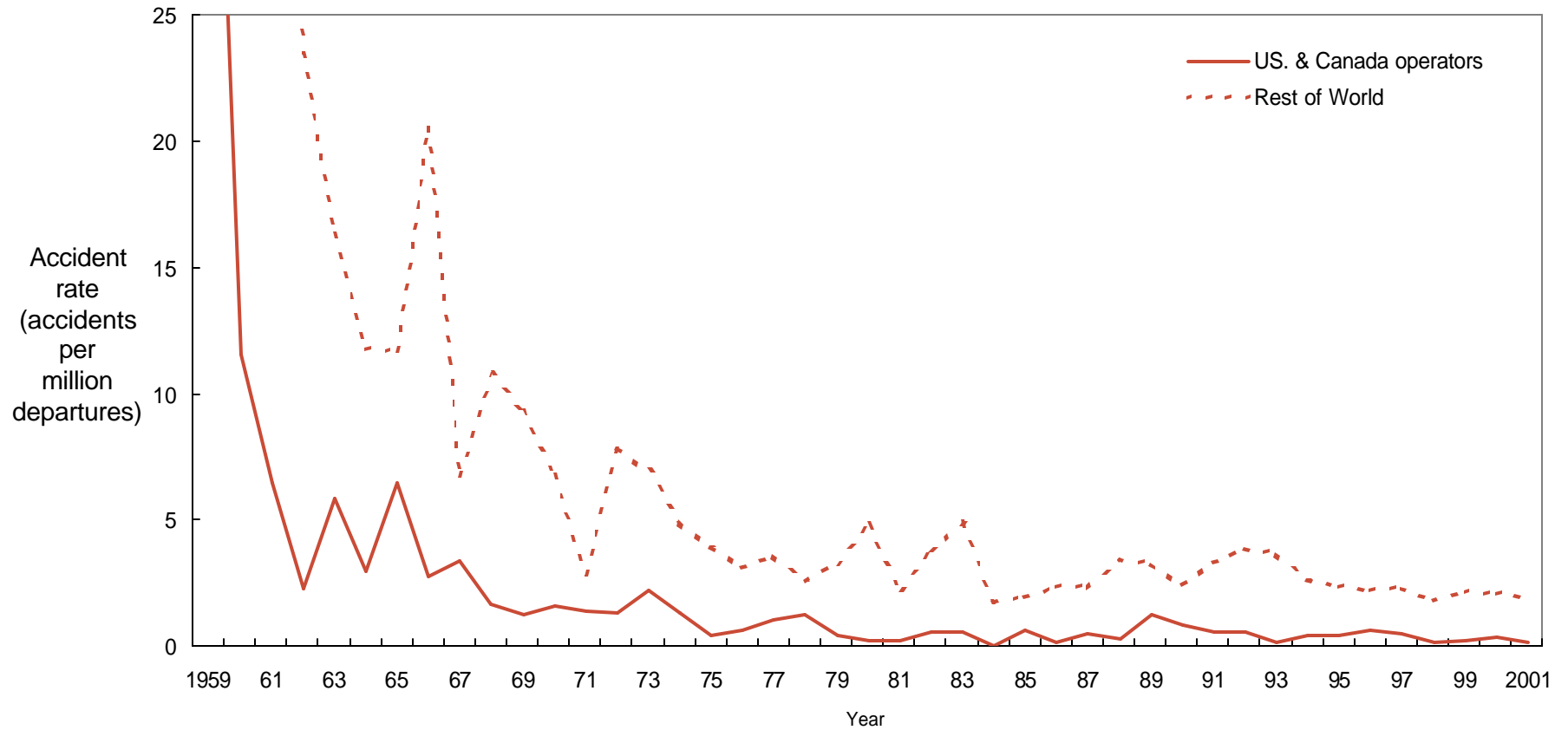
# Accident Rates by Years Following Introduction

Hull Loss and/or Fatal accidents - Worldwide Commercial Jet Fleet - 1959 through 2001



# U.S.A. and Canadian Operators Accident Rates

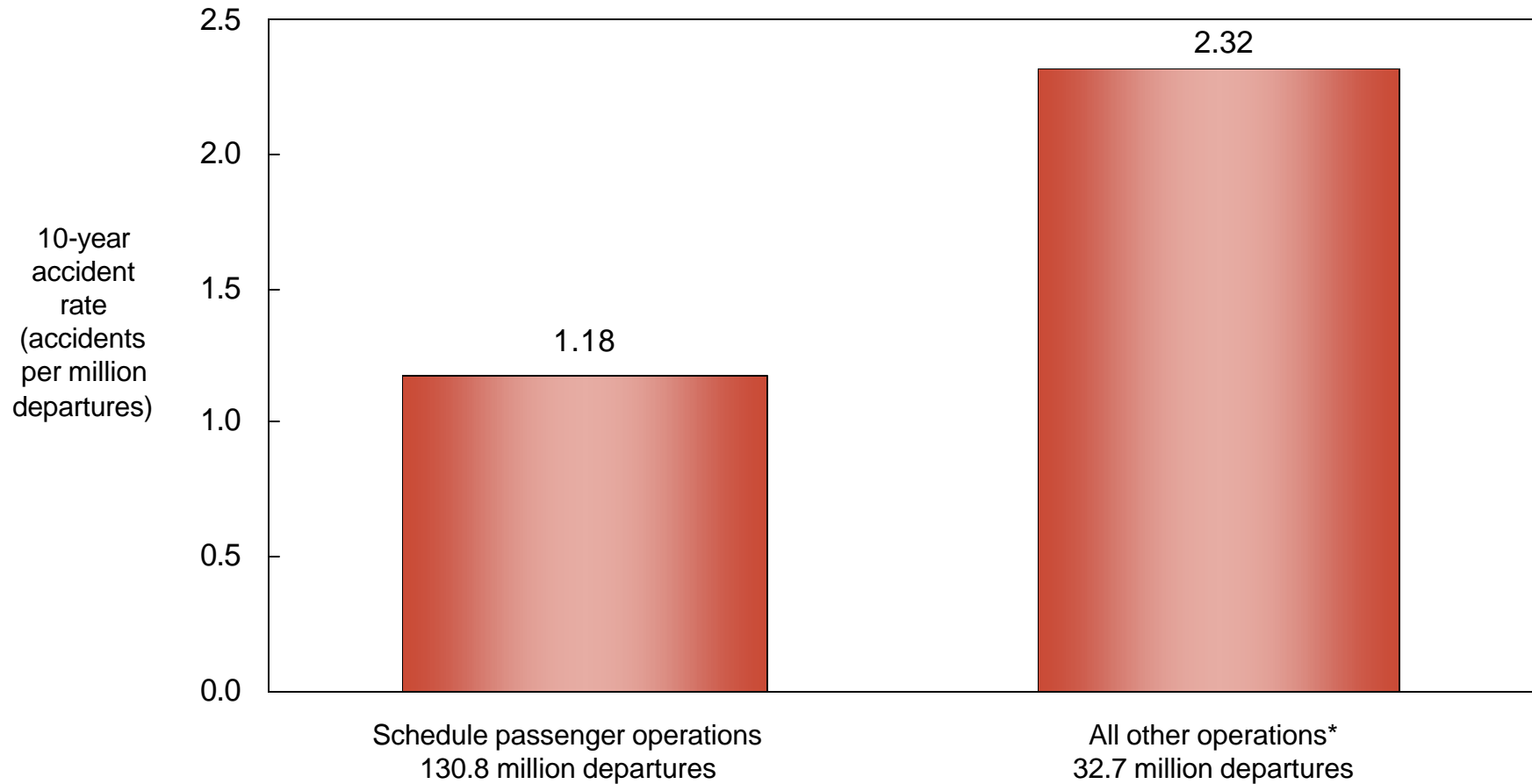
Hull Loss and/or Fatal accidents - Worldwide Commercial Jet Fleet - 1959 through 2001



# Accident Rates by Type of Operation

Hull Loss and/or Fatal accidents - Worldwide Commercial Jet Fleet - 1992 through 2001

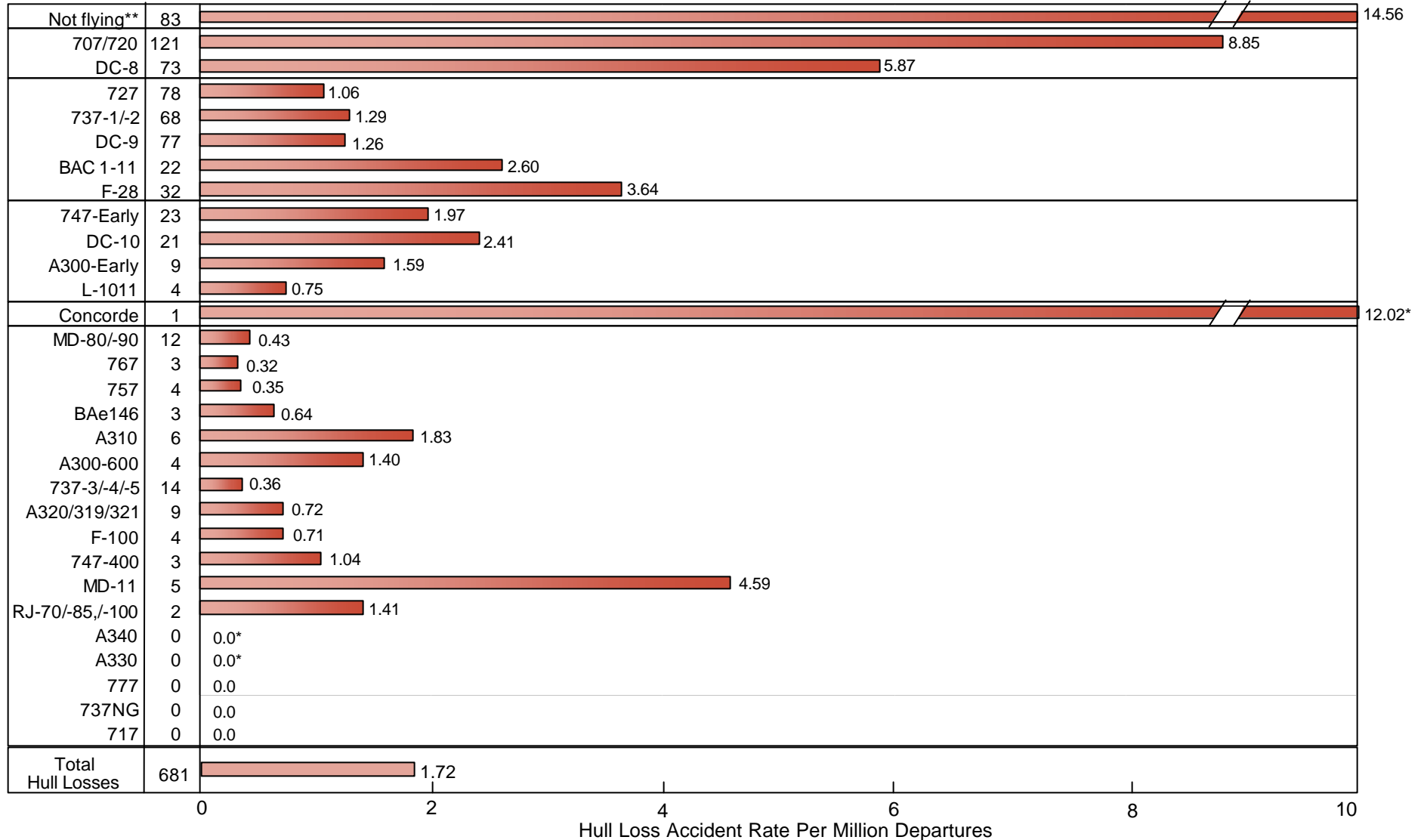
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\*Unscheduled passenger and charter, cargo, ferry, test, training, and demonstration.

# Accident Rates by Airplane Type

## Hull Loss Accidents - Worldwide Commercial Jet Fleet - 1959 through 2001



\*\* The Comet, CV880/990, Caravelle, Trident & VC-10 are no longer in commercial service, and are combined in the "Not Flying" bar.

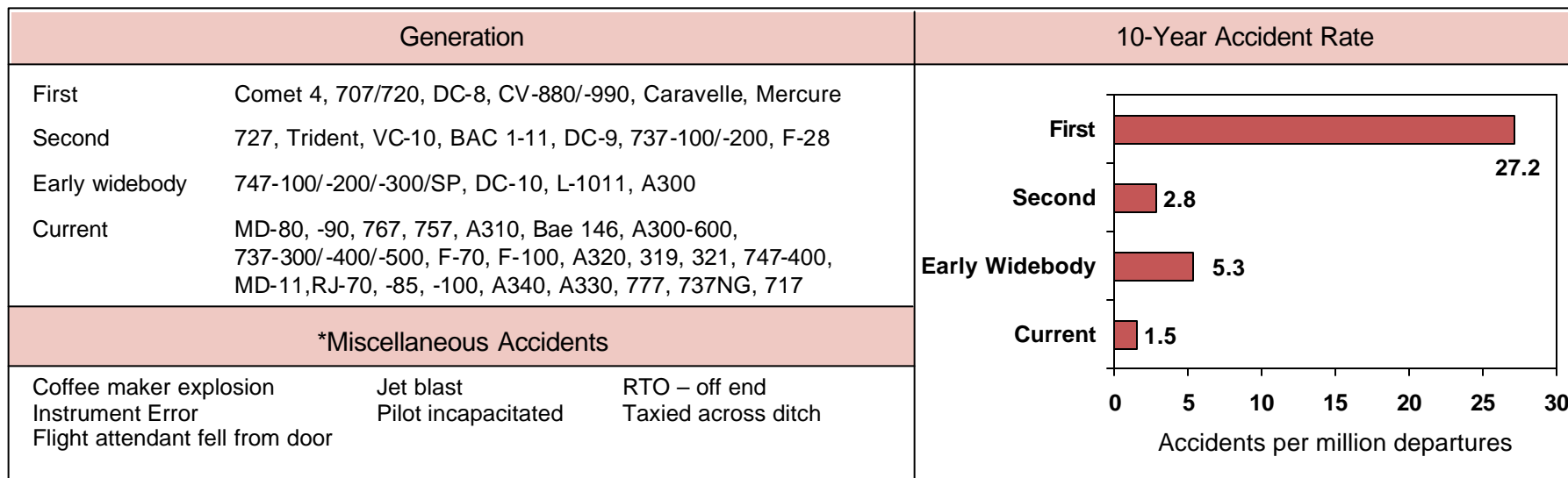
\* These types have accumulated fewer than 1 million departures.



# Accident Categories by Airplane Generation

All accidents - Worldwide Commercial Jet Operations - 1992 through 2001

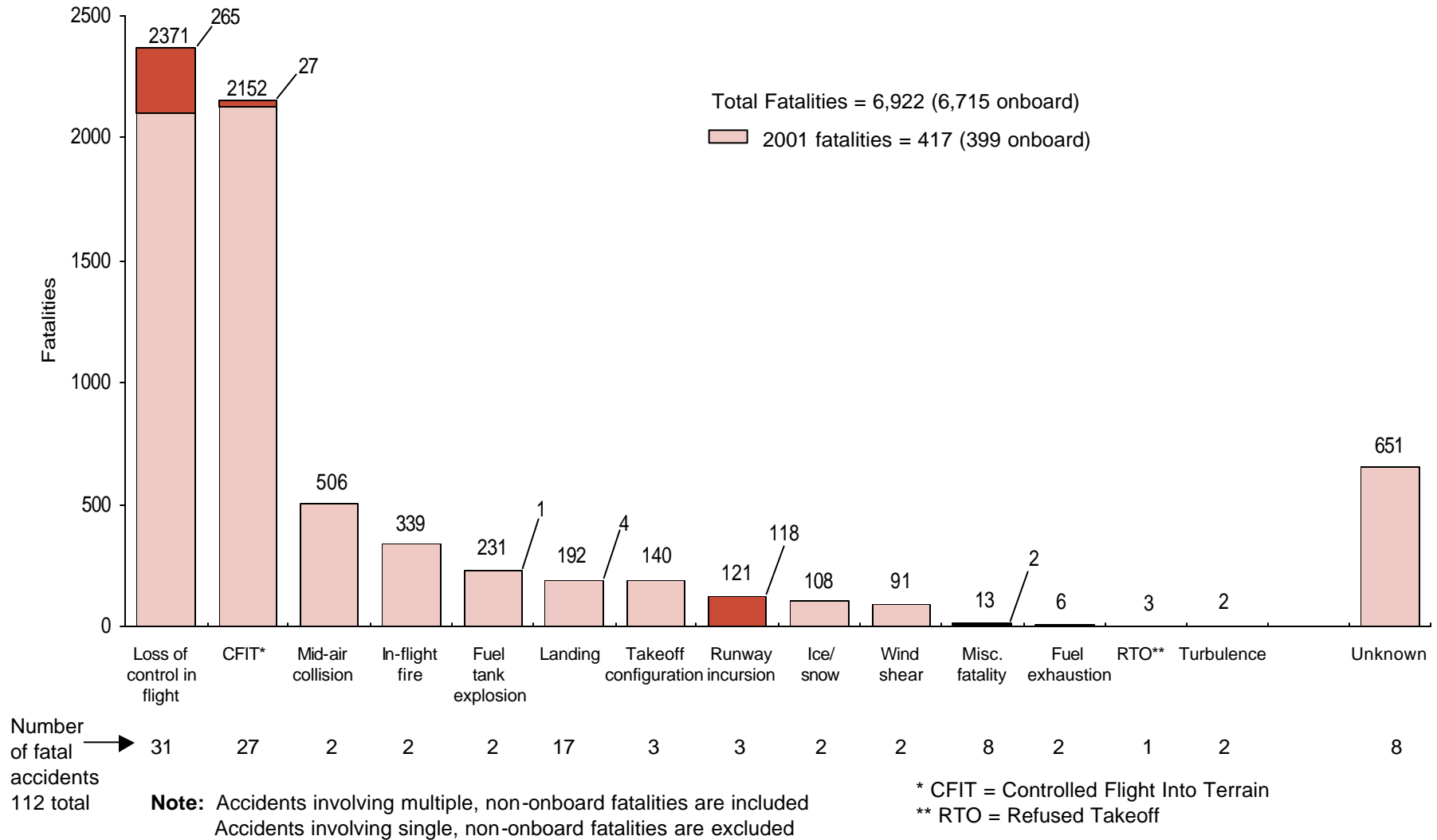
| Generation     | Landing                        |                 |                   |                |                     |                    |                    |              |              |                      |          |                            |           |                       |                 |                    |                  |             |                           |                  |                    |                    | Total |            |                |                |                    |         |     |
|----------------|--------------------------------|-----------------|-------------------|----------------|---------------------|--------------------|--------------------|--------------|--------------|----------------------|----------|----------------------------|-----------|-----------------------|-----------------|--------------------|------------------|-------------|---------------------------|------------------|--------------------|--------------------|-------|------------|----------------|----------------|--------------------|---------|-----|
|                | Controlled flight into terrain | Loss of control | Mid-air collision | In-flight fire | Fuel tank explosion | Off end on landing | Offside on landing | Hard landing | Landed short | Gear collapse/fallup | Ice/snow | Fuel management/exhaustion | Windshear | Takeoff configuration | Refused takeoff | Offside on takeoff | Runway incursion | Wing strike | Engine failure/separation | Ground collision | Ground crew injury | Boarding/deplaning |       | Turbulence | Miscellaneous* | Fire on ground | Aircraft structure | Unknown |     |
| First          | 5                              | 7               |                   | 1              |                     | 6                  | 3                  | 3            | 4            | 8                    |          | 1                          |           | 1                     | 1               |                    |                  | 2           | 3                         |                  |                    |                    |       |            | 1              | 1              |                    | 2       | 49  |
| Second         | 15                             | 8               | 1                 | 4              |                     | 18                 | 22                 | 15           | 10           | 11                   | 2        | 2                          | 1         | 1                     | 6               | 1                  | 1                | 1           | 1                         | 2                | 1                  |                    |       |            | 1              | 1              | 2                  | 3       | 130 |
| Early widebody | 4                              | 1               | 1                 | 1              | 1                   | 4                  | 3                  | 5            | 1            | 4                    | 1        | 1                          | 1         |                       | 3               | 3                  | 1                |             | 5                         | 3                | 1                  | 1                  | 1     | 2          | 3              | 2              |                    | 53      |     |
| Current        | 12                             | 16              |                   | 1              | 1                   | 24                 | 13                 | 35           | 2            | 14                   | 1        |                            | 1         | 1                     | 4               | 3                  | 8                |             | 3                         | 4                | 1                  | 3                  | 1     | 3          | 2              | 2              | 4                  | 161     |     |
| Total          | 36                             | 32              | 2                 | 7              | 2                   | 52                 | 41                 | 58           | 18           | 37                   | 4        | 4                          | 3         | 3                     | 14              | 7                  | 10               | 3           | 12                        | 9                | 3                  | 4                  | 2     | 7          | 7              | 6              | 9                  | 393     |     |





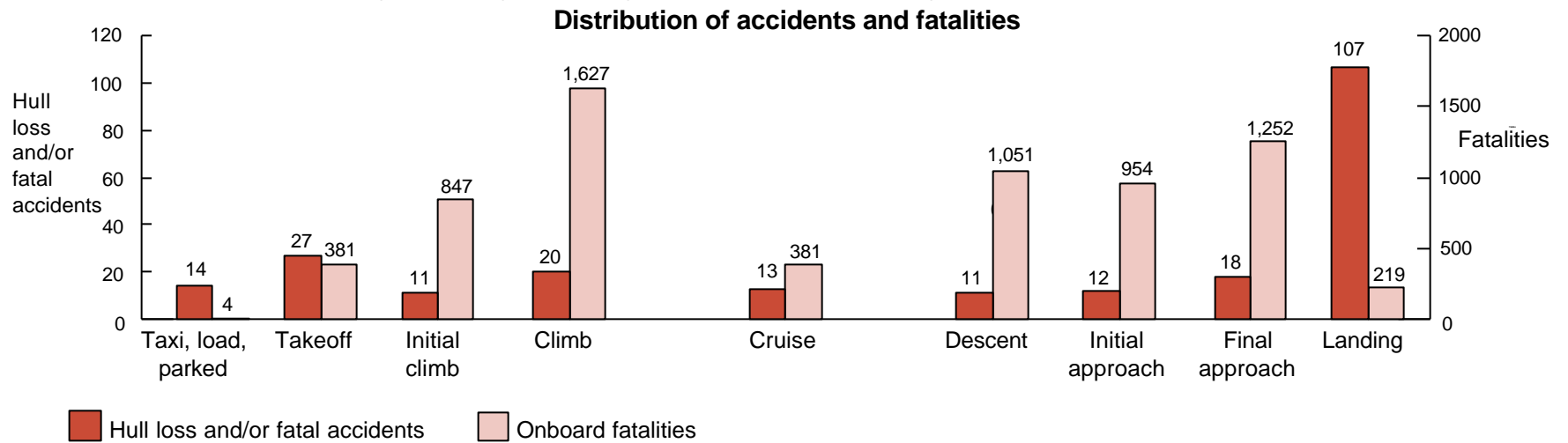
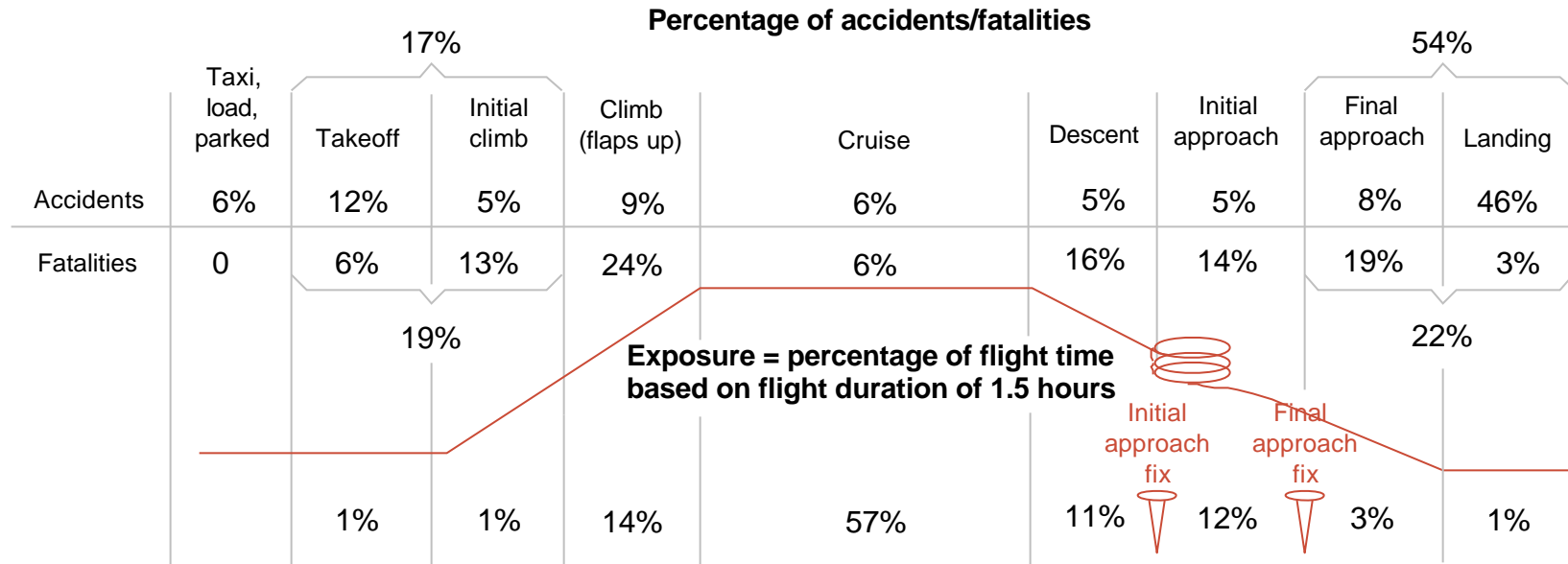
# Fatalities by Accident Categories

## Fatal Accidents - Worldwide Commercial Jet Fleet - 1992 through 2001



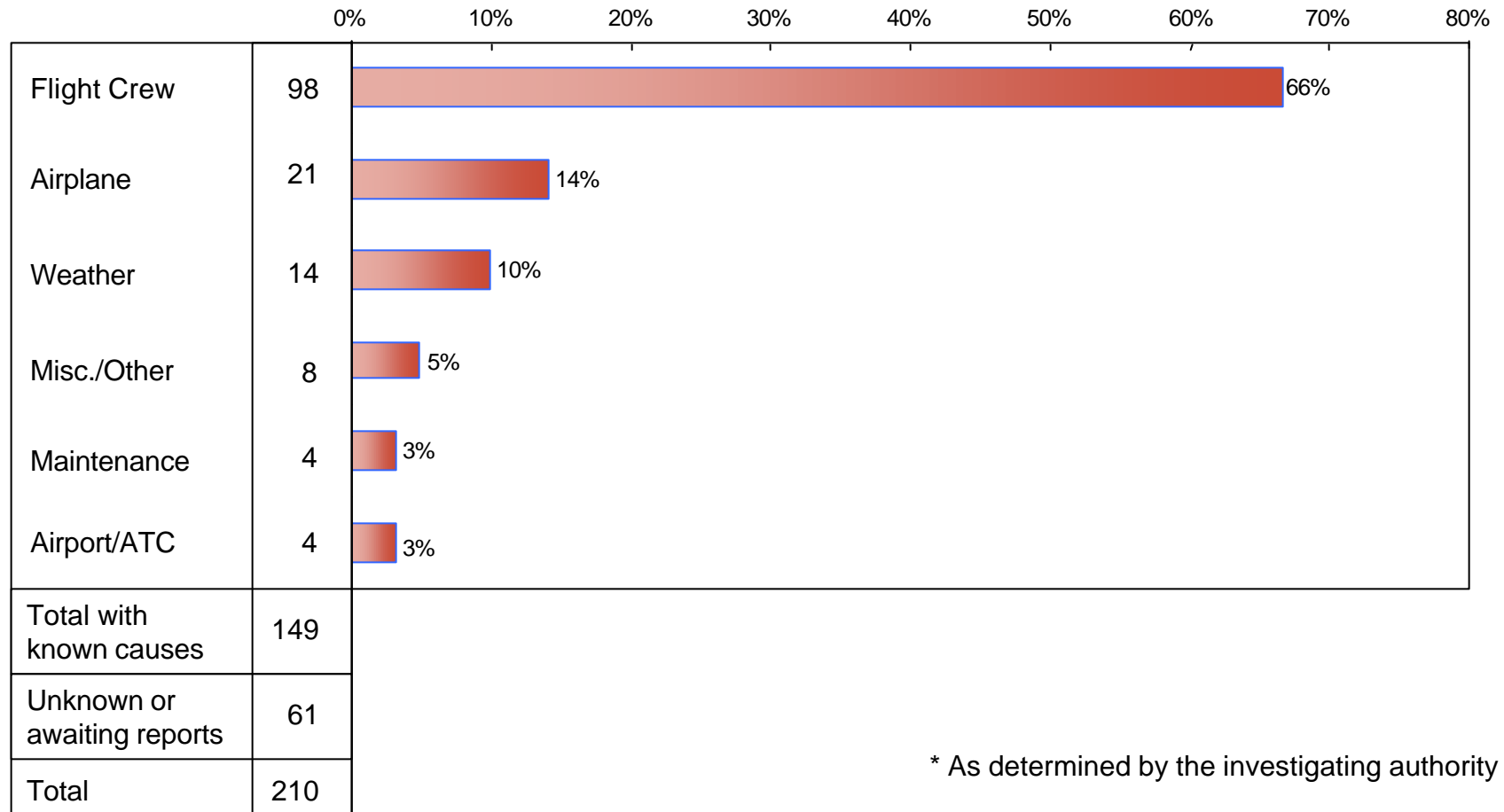
# Accidents and Onboard Fatalities by Phase of Flight

Hull Loss and/or Fatal Accidents - Worldwide Commercial Jet Fleet - 1992 - 2001



# Accidents by Primary Cause\*

Hull Loss - Worldwide Commercial Jet Fleet - 1992 through 2001



\* As determined by the investigating authority



# Excluded Events

## Worldwide Commercial Jet Fleet

The following 4 pages, Hostile Actions, and Non-Hostile Events are excluded from the statistical analysis in the preceding portions of the document and may not be a complete listing due to incomplete reporting.

# Hostile Actions

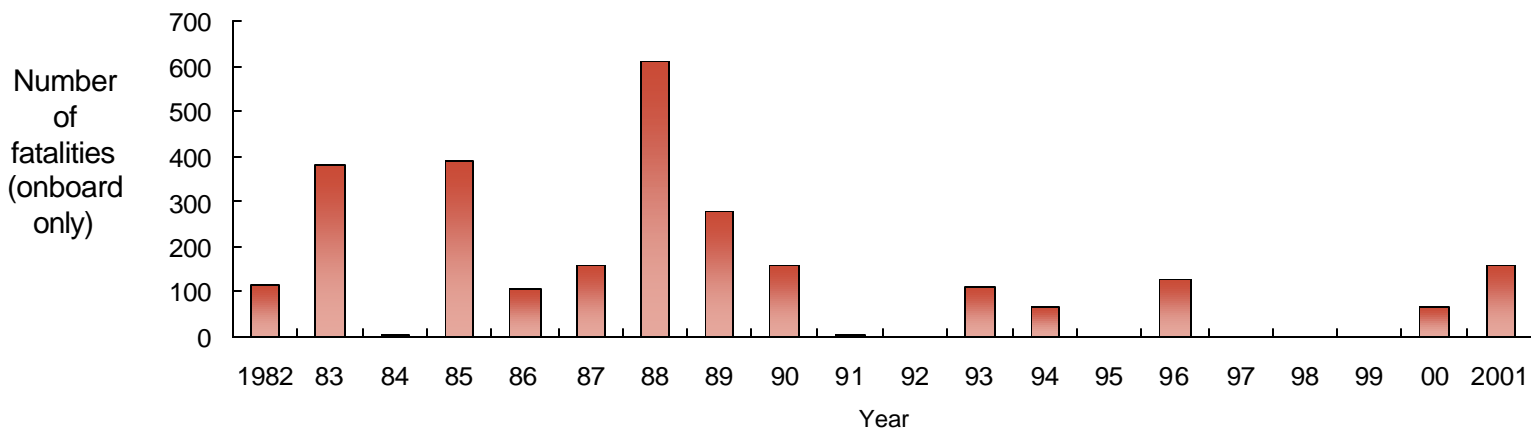
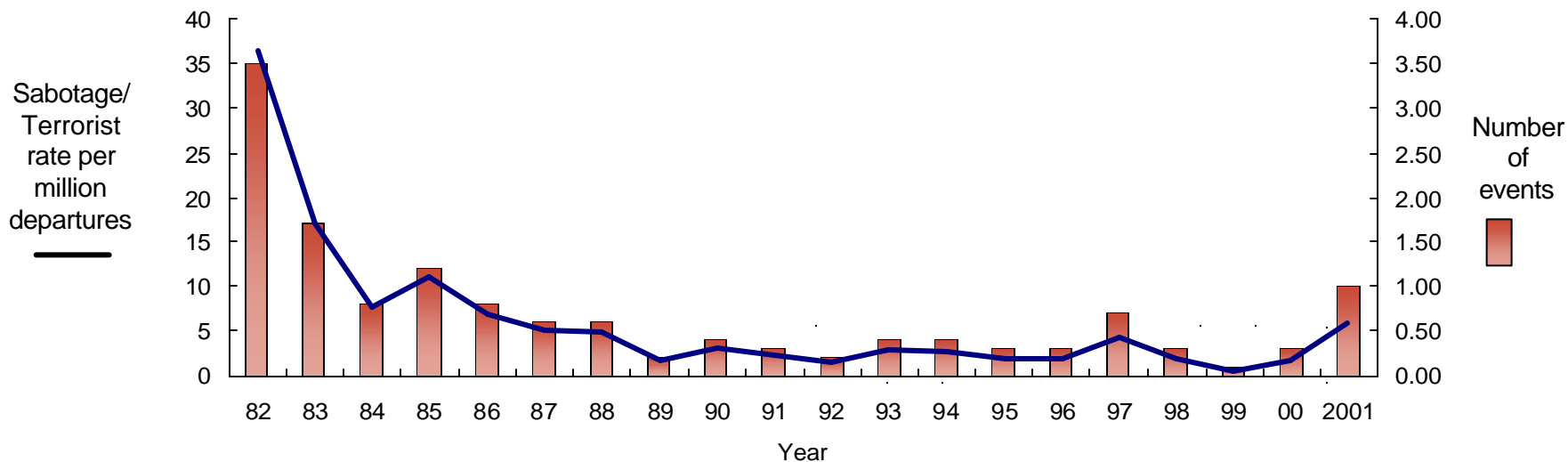
## List of 2001 Events

Events which occur as a result of a premeditated, overt act originating from terrorism, sabotage or suicide.

| Date      | Airline           | Airplane Type | Accident Location      | Hull Loss | Onboard | Description                                |
|-----------|-------------------|---------------|------------------------|-----------|---------|--|
| 24-Jul-01 | AirLanka          | A340          | Colombo, Sri Lanka     | X         | 0       | On ground military action                  |
| 24-Jul-01 | AirLanka          | A330          | Colombo, Sri Lanka     | X         | 0       | On ground military action                  |
| 24-Jul-01 | AirLanka          | A320          | Colombo, Sri Lanka     | X         | 0       | On ground military action                  |
| 24-Jul-01 | AirLanka          | A340          | Colombo, Sri Lanka     | X         | 0       | On ground military action                  |
| 24-Jul-01 | AirLanka          | A330          | Colombo, Sri Lanka     | X         | 0       | On ground military action                  |
| 24-Jul-01 | AirLanka          | A320          | Colombo, Sri Lanka     | X         | 0       | On ground military action                  |
| 11-Sep-01 | United Airlines   | 767           | New York City, NY, USA | X         | 65      | Hijacked and flown into World Trade Center |
| 11-Sep-01 | United Airlines   | 757           | Johnstown, PA, USA     | X         | 64      | Hijacked and crashed into ground           |
| 11-Sep-01 | American Airlines | 767           | New York City, NY, USA | X         | 92      | Hijacked and flown into World Trade Center |
| 11-Sep-01 | American Airlines | 757           | Arlington, VA, USA     | X         | 44      | Hijacked and flown into Pentagon           |
| 10        | Total Events      |               |                        | 10        | 265     |  |

# Hostile Actions

## Worldwide Commercial Jet Fleet — 1982 Through 2001



# Excluded Events

## Accidents Occurring in 2001

---

### Turbulence:

- Flight attendant injury – 7 events
- Passenger injury – 5 events

Evasive maneuver - 2 injury events

### Boarding:

- Passenger fell from portable stairs - Fatal

### Emergency evacuation:

- Passenger slide injury - 4 events

### Pushback:

- Tug overran aircraft - aircraft damage
- Towbar failed - aircraft overran tug - aircraft damage
- Tug stopped - gear collapsed - aircraft damage
- Wing walker injury

### Ground operations:

- Refueling Fire
- Service truck struck aircraft
- Aircraft Positioning - 2 damage events

# Excluded Events

## Accidents Occurring from 1992 through 2001

