STATISTICAL SUMMARY
AIR OCCURRENCES 2016

July 2017

Canada

Statistical Summary – Air Occurrences 2016 (Transportation Safety Board of Canada)

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Statistical Summary
Air Occurrences in 2016

This document is a summary of selected 2016 aviation safety data.

The TSB gathers and uses this data during the course of its investigations to analyse safety deficiencies and identify risks in the Canadian transportation system.

The 2016 data were collected according to the reporting requirements described in the TSB Regulations in force during that calendar year.

The statistics presented here reflect the TSB database at 29 March 2017. Since the occurrence data are constantly being updated in the live database, the statistics may change slightly over time.

Also, as many occurrences are not formally investigated, information recorded on some occurrences may not have been verified.

The following series of data tables associated with this annual summary can be found at http://www.bst-tsb.gc.ca/eng/stats/aviation/2016/ssea-ssao-2016.asp

- Reportable aviation occurrences 2007-2016
- Occurrences involving Canadian-registered aircraft 2007-2016
- Accident rates involving Canadian-registered aircraft (per hours flown) 2007-2016
- Aircraft accident rates in Canada (per movements) 2007-2016
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- Accidents involving Canadian-registered aeroplanes and helicopters by operation type 2007-2016
- Aircraft accidents by province/territory 2007-2016
- Accidents involving Canadian-registered aircraft by province/territory 2007-2016
- Reportable aircraft incidents 2007-2016
- Reportable incidents involving Canadian-registered aircraft 2007-2016
- Number of accidents involving aeroplanes by phase of flight and selected event category 2007-2016
- Number of accidents involving helicopters by phase of flight and selected event category 2007-2016

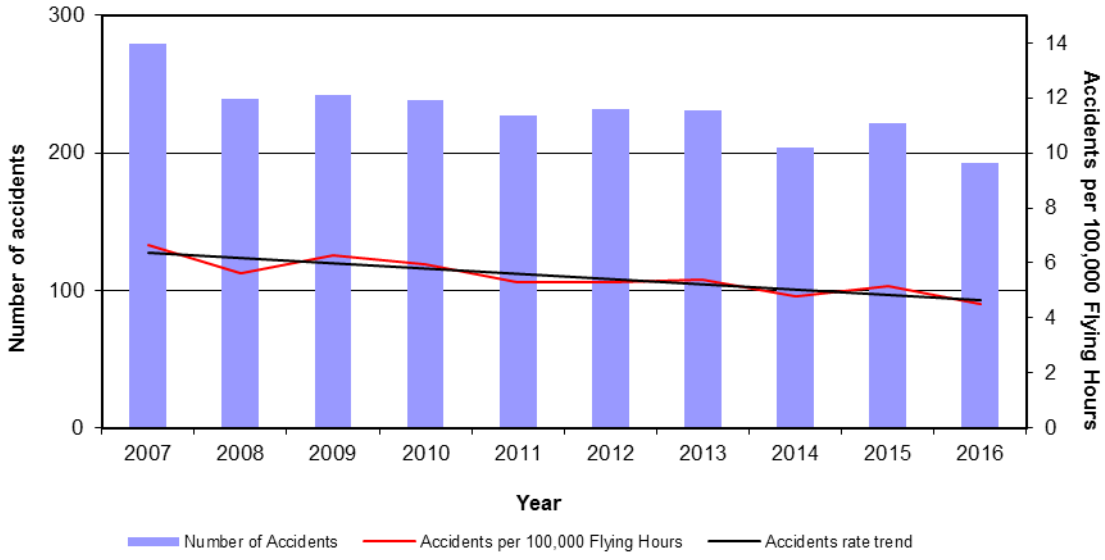
Accidents

Overview of accidents and fatalities

In 2016, a total of 229 aviation accidents were reported to the TSB, down from the previous year's total of 251, down 14% from the 5-year average of 265 and down 19% from the 10-year average of 283. Of the total, 199 involved Canadian-registered aircraft (excluding ultra-lights)[1], a 12% decrease from the previous year's total of 227, a 14% decrease from the 5-year average of 230, and a 19% decrease from the 10-year average of 244.

The 2016 estimate of flying activity is 4,301,000 hours[2], and the accident rate for Canadian-registered aircraft was 4.5 accidents per 100 000 flying hours, a decrease from the previous year's accident rate of 5.2. Analysis using linear regression indicates a statistically significant downward trend in accident rates ($p < .001$)[3] over the 10-year period from 2007 to 2016 (Figure 1). Similarly, the 2016 accident rate of 3.3 accidents per 100 000 aircraft movements decreased from the 2015 rate of 3.7 accidents per 100 000 aircraft movements, and that rate has also trended significantly downward ($p < .05$) over the same 10-year period.

Figure 1. Accidents and accident rates, 2007–2016



1 Ultra-light accidents will be presented separately in all subsequent discussion of occurrences involving Canadian-registered aircraft.

2 Source: Transport Canada

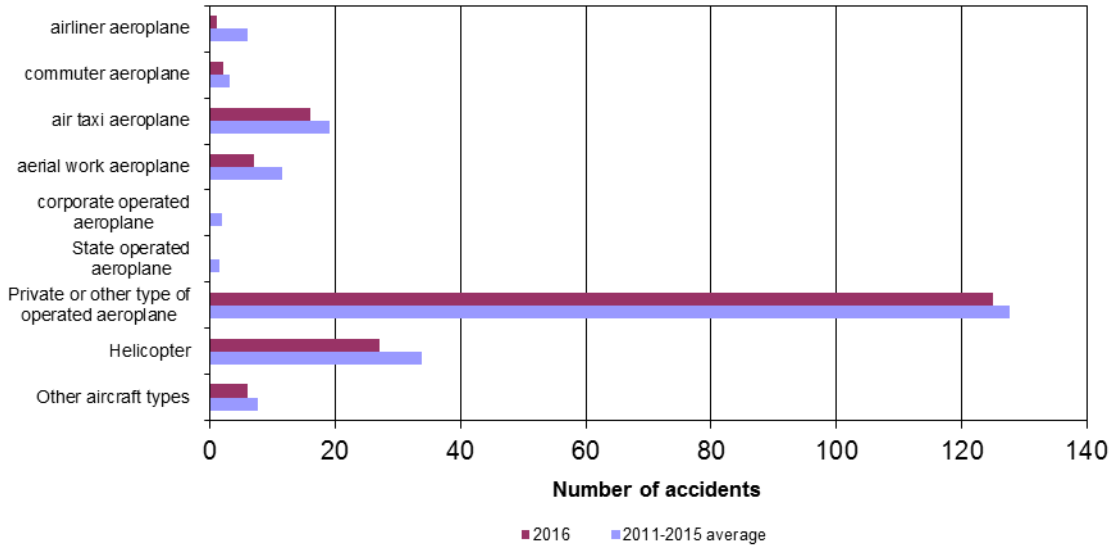
3 It is agreed by convention that, for a result to be considered statistically significant, its probability must be lower than 1 in 20 (that is, $p<.05$).

The 199 accidents involving Canadian-registered aircraft (Figure 2), included 166 accidents involving aeroplanes[4] (41 accidents involved commercially operated aeroplanes) and 27 accidents involving helicopters. The remaining six accidents involved 4 gliders, 1 gyroplane, and 1 rotary wing unmanned aerial system (UAS).

Of the 41 accidents involving 43 Canadian-registered commercially operated aeroplanes (1 airliner, 2 commuter aircraft, 16 air taxi, 7 aerial work, and 17 flight training) in 2016, 3 accidents resulted in a total of 5 fatalities. One fatal accident involved an air taxi, 1 involved aerial work, and 1 involved flight training.

A total of 125 accidents involved Canadian-registered private/other aeroplanes, 2% lower than the 5-year average of 128. In 2016, 18 such accidents resulted in fatalities, up from 13 in 2015, and up from the 5-year average of 13.

Figure 2. Accidents involving Canadian-registered aircraft, by aircraft type, 2016

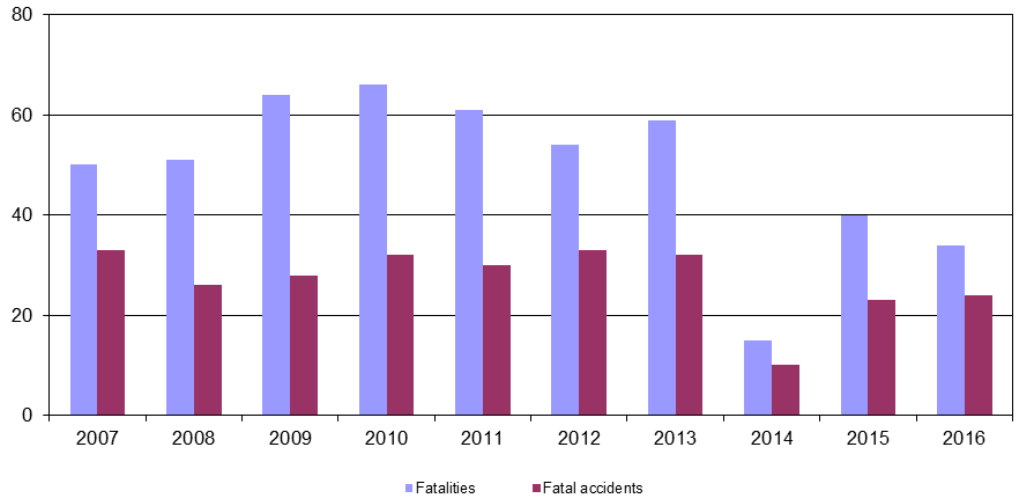


In 2016, 24 fatal accidents involved Canadian-registered aircraft other than ultra-lights (Figure 3), up slightly fromthe 2015 total of 23, but down from the 5-year average of 26 and the 10-year average of 28.

The number of fatalities (34), was lower than the 2015 total of 40, and lower than the 5-year average of 46 and the 10-year average of 51. The number of serious injuries (16) was lower than the 2015 total of 29, the 5-year average of 32, and the 10-year average of 36.

[4] As some occurrences involve more than one aircraft, readers are cautioned to note differences between the number of occurrences and the number of aircraft involved in occurrences. All Tables except Table 1 exclude ultra-light aircraft; all tables except Tables 1 and 4 also exclude balloons, gliders, gyrocopters, and UAVs, as does Figure 1.

Figure 3. Fatalities and fatal accidents, 2007–2016



In 2016, crew fatalities accounted for 56% of aircraft fatalities, and passenger fatalities accounted for 44%.

In 2016, 27 accidents involved Canadian-registered helicopters, down from the 5-year average of 34. two of these accidents were fatal, resulting in a total of 3 fatalities. Over the past 10 years, the highest proportion of helicopter accidents occurred during air transport operations (37%), pleasure/travel (18%), and training (8%).

In 2016, 22 accidents in Canada involved Canadian-registered ultra-light aircraft, a 12% decrease from the 5-year average of 25. Four of these were fatal accidents resulting in 4 fatalities in total.

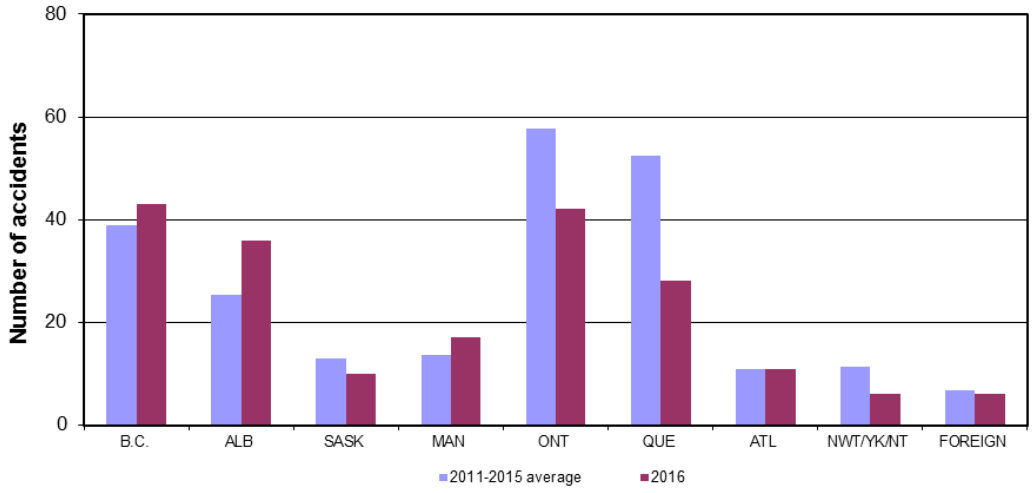
In 2016, 8 accidents involved foreign-registered aircraft in Canada, with 1 fatal accident resulting in a total of 7 fatalities.

Accidents by selected categories

Operation Type (Table 6): In 2016, aeroplane accidents occurred mainly on recreational flights (67%), training flights (12%), and air transport (9%). Helicopter accidents occurred mainly on recreational flights (33%) and air transport flights (26%).

Province (Table 8): British Columbia accounted for 22% of Canadian-registered aircraft accidents and incurred a 10% increase from its 5-year average, and Ontario accounted for 21% of Canadian registered aircraft accidents with a 27% decrease from its 5-year average. Alberta accounted for 18%, with a 42% increase from its 5-year average (Figure 4).

Figure 4. Accidents involving Canadian-registered aircraft, by province, 2016



Accident Events and Phases

Accidents may be analyzed in more detail by examining the nature and distribution of selected events contributing to an occurrence. Tables 11 and 12 show counts of accidents involving selected event types within each phase of flight.

Although a single accident may involve more than one event within a phase, that accident is only counted once in the phase total. Therefore, the total of events within a phase will not sum to phase event totals. For example, in the "take-off" phase, if an occurrence involves both "loss of control " and "power loss" events, the occurrence is counted in each event category, but only once in the phase total. As well, approximately 23% of aeroplane accidents and 25% of helicopter accidents involve events in more than one phase of flight (not including "post-impact"), so the accidents shown in Figure 5 and Figure 6 sum to more than the total of accidents.

In 2016, the distribution was similar to that of 2015. The greatest numbers of aeroplane accidents were associated with landing (65%) and take-off (27%) phases of flight, followed by en route (11%) and approach (10%) phases. The greatest numbers of helicopter accidents were associated with landing (57%), manoeuvering[5] (29%), takeoff (21%), and en route and approach (18% each) phases of flight. The figures below show the distribution of accidents per phase of flight for the period 2007-2016.

5 Manoeuvering (i.e., low altitude/aerobatic flight operations) does not occur on all flights.

Figure 5. Aeroplane accidents by event phase of flight, 2007–2016

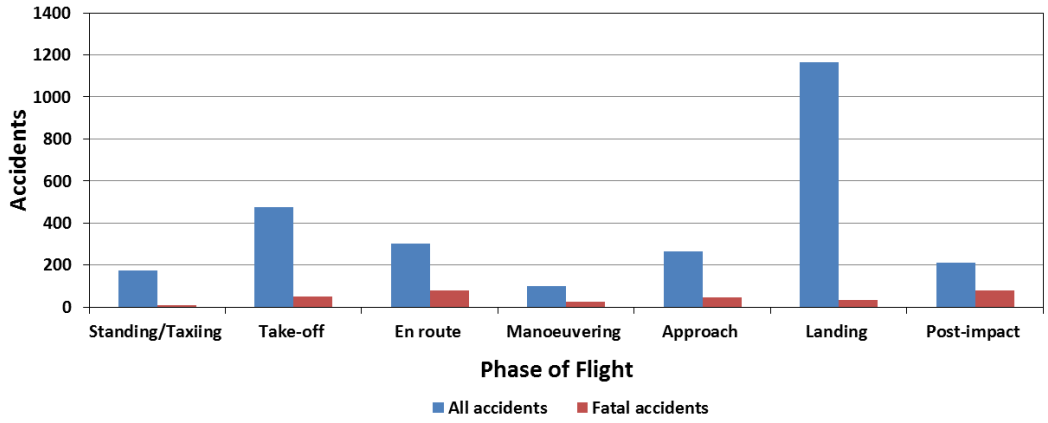
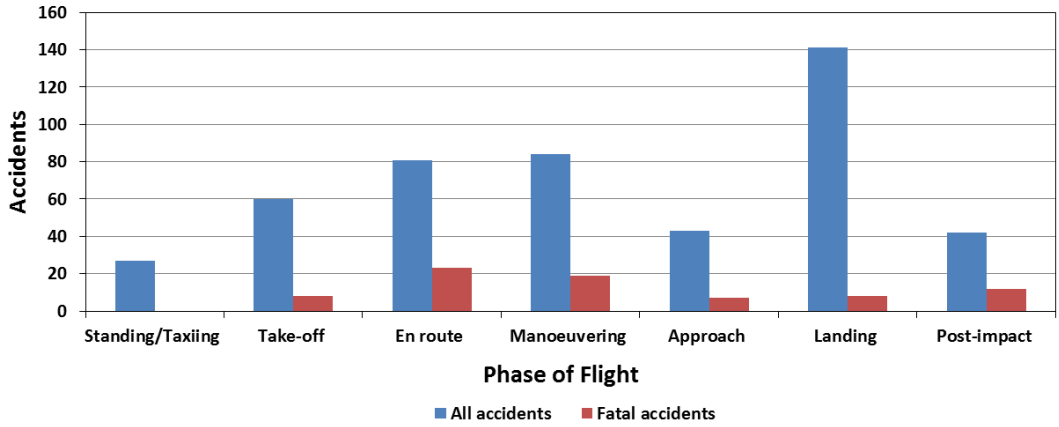


Figure 6. Helicopter accidents by event phase of flight, 2007–2016



From 2007 to 2016, of the 1166 aeroplane accidents with landing phase events, 21% involved collision with object, 21% involved missing or going off the runway, 21% involved landing gear collapse or retraction, and 19% involved a nosedown or overturning event. Of the 477 aeroplane accidents with take-off phase events, 28% involved collision with terrain, 28% involved collision with object, 26% involved loss of control, and 26% involved power loss.

Collision with terrain was the predominant event in fatal aeroplane accidents from 2007 to 2016. Collision with terrain was involved in 57% of the 49 fatal aeroplane accidents with takeoff phase events, 69% of 77 fatal aeroplane accidents with en route phase events, 77% of 26 fatal aeroplane accidents with manoeuvering phase events, 70% of 47 fatal aeroplane accidents with approach phase events, and 54% of 35 fatal aeroplane accidents with landing phase events.

From 2007 to 2016, of the 141 helicopter accidents with landing phase events, 26% involved a collision with object, 21% involved a hard landing, 21% involved collision with terrain, and 19% involved loss of control. Of the 84 helicopter accidents with

manoeuvering phase events, 49% involved collision with terrain, 33% involved loss of control, and 24% involvedoperations related event.

Collision with terrain was also the predominant event in fatal helicopter accidents from 2007 to 2016. Collision with terrain was involved in 6 of 8 fatal helicopter accidents with takeoff phase events, 17 of 23 fatal helicopter accidents with en route phase events, 12 of 19 fatal helicopter accidents with manoeuvering phase events, 3 of 7 fatal helicopter accidents with approach phase events, and 6 of 8 fatal helicopter accidents with landing phase events.

Incidents

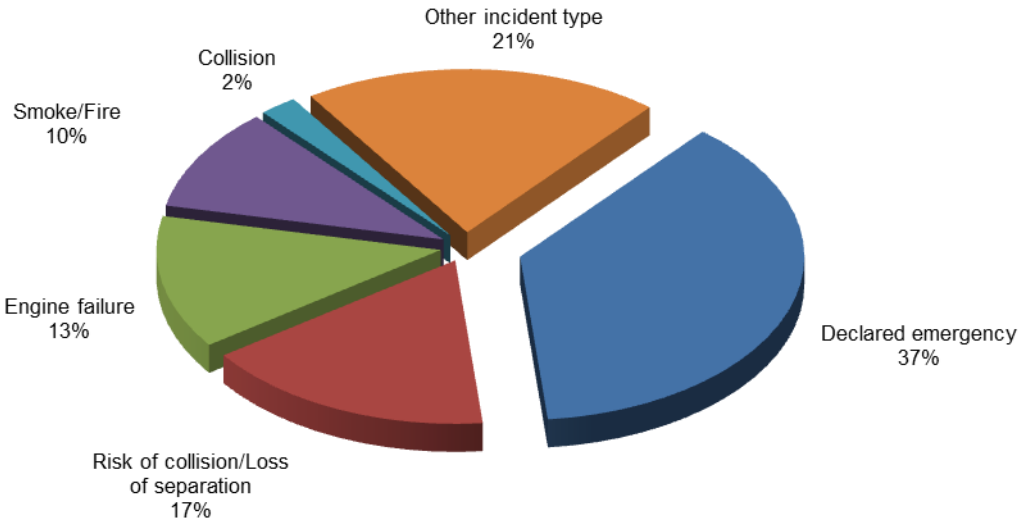
Overview of Incidents

Pursuant to TSB mandatory incident reporting requirements, 833 incidents were reported in 2016, with 737 involving Canadian-registered aircraft. This is a 4% increase from the 2015 total of 711, a 21% increase from the 5-year average of 610, and a 14% increase from the 10-year average of 645. On March 12, 2014, the TSB issued new regulations that changed the reporting requirements effective July 1, 2014. Under the new reporting requirements aviation incidents include aircraft having a maximum certificated take-off weight greater than 2 250 kg (formerly 5700 kg) and aircraft being operated under an air operator certificate issued under CARS Part VII.

In 2016, the most frequent incident types involving all Canadian-registered and foreign-registered aircraft were declared emergency (37%), risk of collision or loss of separation, (17%), and engine failure (13%) (Figure 7).

Figure 7. Reportable incidents

by type, 2016


Other incident type
21%
Collision
2%
Smoke/Fire
10%
Engine failure
13%
Declared emergency
37%
Risk of collision/Loss
of separation
17%

Definitions

The following definitions apply to aviation occurrences that are required to be reported pursuant to the *Canadian Transportation Accident Investigation and Safety Board Act* and the TSB regulations.

Aviation occurrence

- Any accident or incident associated with the operation of an aircraft, and
- Any situation or condition that the Board has reasonable grounds to believe could, if left unattended, induce an accident or incident described above.

Reportable aviation accident

An accident resulting directly from the operation of an aircraft where:

- a person is killed or sustains a serious injury as a result of:
  - being on board the aircraft,
  - coming into contact with any part of the r aircraft, including parts that have become detached from the aircraft, or
  - being directly exposed to jet blast, rotor down wash or propeller wash,

- the aircraft sustains structural failure or damage that adversely affects the aircraft's structural strength, performance or flight characteristics and would normally require major repair or replacement of any affected component, except for
  - engine failure or damage, when the damage is limited to the engine, its cowlings or accessories, or
  - damage limited to propellers, wing tips, antennae, tires, brakes, fairings or small dents or puncture holes in the aircraft's skin, or

- the aircraft is missing or inaccessible.

Reportable aviation incident

An incident involving an aircraft having a maximum certificated take-off weight greater than 2 250 kg, or of an aircraft being operated under an air operator certificate issued under Part VII of the *Canadian Aviation Regulations*, where:

- an engine fails or is shut down as a precautionary measure,
- a power train transmission gearbox malfunction occurs,
- smoke is detected or a fire occurs on board,
- difficulties in controlling the aircraft are encountered owing to any aircraft system malfunction, weather phenomena, wake turbulence, uncontrolled vibrations or operations outside the flight envelope
- the aircraft fails to remain within the intended landing or take-off area, lands with all or part of the landing gear retracted or drags a wing tip, an engine pod or any other part of the aircraft,
- a crew member whose duties are directly related to the safe operation of the aircraft is unable to perform their duties as a result of a physical incapacitation which poses a threat to the safety of persons, property or the environment,

- depressurization of the aircraft occurs that requires an emergency descent,
- a fuel shortage occurs that requires a diversion or requires approach and landing priority at the destination of the aircraft,
- the aircraft is refuelled with the incorrect type of fuel or contaminated fuel,
- a collision, a risk of collision or a loss of separation occurs,
- a crew member declares an emergency or indicates an emergency that requires priority handling by air traffic services or the standing by of emergency response services,
- a slung load is released unintentionally or as a precautionary or emergency measure from the aircraft, or
- any dangerous goods are released in or from the aircraft.

Collision

Collision means an impact, other than an impact associated with normal operating circumstances, between aircraft or between an aircraft and another object or terrain.

Risk of collision

Risk of collision means a situation in which an aircraft comes so close to being involved in a collision that a threat to the safety of any person, property or the environment exists.

Loss of separation

Loss of separation means a situation in which the distance separating two aircraft is less than the minimum established in the *Canadian Domestic Air Traffic Control Separation Standards*, published by the Department of Transport, as amended from time to time.

Serious injury

- a fracture of any bone, except simple fractures of fingers, toes or the nose,
- lacerations that cause severe hemorrhage or nerve, muscle or tendon damage,
- an injury to an internal organ,
- second or third degree burns, or any burns affecting more than 5% of the body surface,
- a verified exposure to infectious substances or injurious radiation, or
- an injury that is likely to require hospitalization.

ATS-Related Event

Any event related to the provision of air traffic control services including, but not limited to, failure or inability to provide service, emergency handling, or loss of in-flight separation.

Air Proximity Event

A situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their positions and speed have been such that the safety of the aircraft involved may have been compromised.

Operation

Operation means the activities for which an aircraft is used from the time any person boards the aircraft with the intention of flight until they disembark.

Operator

Operator has the same meaning as in subsection 101.01(1) of the *Canadian Aviation Regulations*.

Commercial Operators

Commercial operators include carriers that offer a "for-hire" service to transport people or goods, or to undertake specific tasks such as aerial photography, flight training, or crop spraying.

Airliner

An aeroplane used by a Canadian air operator in an air transport service or in aerial work involving sightseeing operations, that has a MCTOW of more than 8618 kg (19 000 pounds) or for which a Canadian type certificate has been issued authorizing the transport of 20 or more passengers.

Commuter Aircraft

An aeroplane used by a Canadian air operator, in an air transport service or in aerial work involving sightseeing operations, in which the aircraft is:

- a multi engined aircraft that has a MCTOW of 8618 kg (19 000 pounds) or less and a seating configuration, excluding pilot seats, of 10 to 19 inclusive;
- a turbo jet powered aeroplane that has a maximum zero fuel weight of 22 680 kg (50 000 pounds) or less and for which a Canadian type certificate has been issued authorizing the transport of not more than 19 passengers.

Aerial Work Aircraft

A commercially operated aeroplane or helicopter used in aerial work involving

- the carriage on board of persons other than flight crew members,
- the carriage of helicopter external loads,
- the towing of objects, or
- the dispersal of products.

Air Taxi Aircraft

A commercially operated aircraft used in an air transport service or in aerial work involving sightseeing operations, in which the aircraft is:

- a single engined aircraft;
- a multi engined aircraft, other than a turbo jet powered aeroplane, that has a MCTOW of 8618 kg (19 000 pounds) or less and a seating configuration, excluding pilot seats, of nine or less; or
- any aircraft that is authorized by the Minister of Transport to be operated under Part VII, Subpart 3, Division 1 of the *Canadian Aviation Regulations* (CARs).

State Operators

State operators include the federal and provincial governments.

Corporate Operators

Corporate operators include companies flying for business reasons.

Private Operators

Private operators include individuals flying for pleasure. Included are flights on which it is not possible to transport people or cargo on a “for-hire” basis.