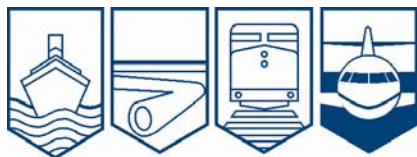




The Transportation Safety Board of Canada (TSB) is investigating this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability. Because the investigation is ongoing, the information provided is subject to change as additional facts become available.

The purpose of this communication is to update interested organizations and persons on the factual information gathered to date, to provide information regarding safety-related activities, and to provide information about further investigation activities. The analysis of the available factual information is still under way; consequently, it would be inappropriate to speculate as to the findings of the Board on this occurrence.



## Aviation Investigation Update

TSB Investigation Number A05H0002

16 November 2005

*Ce point sur l'enquête est également disponible en français.*

## *Synopsis*

On 02 August 2005, the crew of Air France Flight 358 (AF358), an Airbus 340-313, French registration F-GLZQ, serial number 289, conducted an approach to Runway 24L at the Toronto/Lester B. Pearson International Airport (LBPIA), Ontario, Canada. At 1602 eastern daylight time,<sup>1</sup> the aircraft landed long, overran the end of the runway and came to rest in a ravine just outside the airport perimeter. There were no reported dangerous goods on board the aircraft. An ensuing fire destroyed the aircraft. Two crew members and nine passengers received serious injuries.

## *Investigation Organization*

The Transportation Safety Board of Canada (TSB) was notified of the accident by air traffic control (ATC) services provided by NAV CANADA at LBPIA within minutes. The TSB Ontario regional office responded immediately by sending investigators to the site. The TSB deployed a major occurrence investigation team to the site within 12 hours of the accident.

The investigation management team is composed of one Investigator in Charge (IIC), one deputy IIC, and two investigator leads – operational and technical. The operational lead is in charge of the following groups: operations, aircraft performance, witness coordination, cabin safety, air traffic services, weather, and airport/emergency response services. The technical lead is in charge of the following groups: flight recorders, powerplants, structure, systems, photo/video, site manager, site safety, site survey, and maintenance/technical records.

The investigation team for the field phase of the investigation comprised 35 TSB investigators, supported by accredited representatives from the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA) of France and the National Transportation Safety Board (NTSB) of the United States, and 43 observers from the following entities: Transport Canada, the Federal Aviation Administration (FAA) of the United States, NAV CANADA, Air France, Airbus, General Electric, the Aircraft Accident Investigation Branch (AAIB) of the United Kingdom, Goodrich Corporation, the Peel Regional Police, and the Greater Toronto Airport Authority (GTAA). The field phase of this investigation was completed on August 16, when control of the site and Runway 24L were returned to the GTAA.

The post-field phase of this investigation is being conducted from the TSB Engineering Laboratory in Ottawa, Ontario, Canada. Selected team members travelled to France and visited the BEA, Air France, the Direction Générale de l'Aviation Civile (DGAC), Aéroports de Paris, and the Airbus manufacturer in Toulouse to gather further information related to the operations of the airline and the regulatory activities of the DGAC. The visit also provided an opportunity for the IIC to give a press conference to aeronautical specialists with the French press. Simulator flights were performed at the Airbus facility to assist the investigators in further understanding all the factors involved in this accident. Follow-up interviews were conducted with flight and cabin crews, as well as with several management personnel from Air France.

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<sup>1</sup> All times are in eastern daylight time (Coordinated Universal Time minus four hours).

## *Factual Information*

AF358 departed from Charles de Gaulle Airport, France, at 0753 with 12 crew members and 297 passengers on board. The flight to Toronto was uneventful, and, at 1556, the flight was cleared for an approach to Runway 24L. The co-pilot was assigned the pilot flying (PF) duties for the approach and landing. During the descent to the airport, the crew requested heading deviations from ATC on two occasions to avoid thunderstorm cells; these deviations were authorized.

### **Weather Data**

On 02 August 2005, the major weather influence in the Toronto area was a high pressure system extending from northern Hudson Bay, Canada, to eastern Kentucky, United States, and a low pressure system northeast of Québec, Quebec, Canada, associated with a weak surface trough extending along the St. Lawrence River and over southern Ontario.

The forecast issued by Environment Canada just before 0800 indicated a 30 per cent probability of thundershowers with a visibility of 2 statute miles (sm) and a ceiling at 2000 feet above ground level (agl) for the period between 1300 and 1800. After 1200, when thunderstorm activity was first observed in the vicinity of the airport, the forecast was amended to reflect the greater probability of thunderstorms for the next hour. The forecast was subsequently amended in a similar manner each hour as thunderstorms persisted in the observations.

Shortly after 1500, a significant meteorological forecast (SIGMET) was issued indicating that an organized line of thunderstorms had developed within 20 nautical miles (nm) either side of a quasi-stationary line from 20 nm west of Buffalo, New York, United States, to 50 nm southwest of Muskoka, Ontario, with maximum tops of 44 000 feet. The SIGMET was valid until 1915.

At 1500, one hour before the landing of AF358, there was a thunderstorm and heavy rain, with reduced visibility to 4 sm and a broken ceiling of 5000 feet at the airport. At 1600, the conditions were essentially the same with remarks of cloud-to-cloud lightning and lower visibility in the southwest-to-northwest quadrant. Surface winds at that time were 290 degrees true at 11 knots.

During the flight, the crew members requested and received several aircraft communications addressing and reporting system (ACARS) messages with meteorological updates as well as some updates from ATC. They changed their initial planned alternate airport, Niagara Falls, New York, United States, to Ottawa. At 1554, a lightning strike damaged the wind direction and speed indicating system in LBPIA's control tower for Runway 24L; this information was passed to the crew who had actual wind direction and speed relative to the aircraft position continually available on its flight management system (FMS). Storm activity was visible on the aircraft's weather radar – one to the north of Runway 24L and another one to the southwest. The crews of two previous aircraft that landed just before AF358 reported that braking action was poor, and one crew estimated that the surface wind near the runway was from 290 degrees magnetic at 15 knots, with gusts to 20 knots. This information was passed to AF358 by the tower controller.

At about the time that AF358 landed, a sharp boundary of rain associated with the thunderstorm moved approximately north to south over Runway 24L, accompanied by wind gusts and a change in surface wind strength and direction. Severe lightning and lightning strikes were also reported during this period. At 1604, the conditions observed at the weather site to the south of Runway 24L were winds 340 degrees true at 24 knots with gusts to 33 knots, severe thunderstorm activity over the airfield with a visibility of 1 sm in heavy rain, and a reported ceiling of 4500 feet agl.

### **Digital Flight Data Recorder Information**

During the final approach phase, the aircraft's FMS showed the wind coming from 300 degrees true at between 15 and 20 knots, with an approximate 8-knot headwind component. The crew changed the aircraft's automatic brake setting from the "low" to the "medium" position in view of the expected reduced runway friction conditions for the landing. The aircraft was aligned with the localizer and glide path. The approach speed was 140 knots, appropriate for the computed aircraft weight of 185 tonnes for the landing. The autopilot and auto-thrust systems were engaged for the approach. Both were disconnected at about 350 feet above ground, from which point the crew continued with the approach visually and landed in accordance with the airline's standard operating procedures (SOPs). The aircraft then went slightly above the glide path and arrived over the runway threshold at an estimated height of 100 feet; the normal height at that point is 50 feet. At that time, the indicated airspeed increased from 139 to 154 knots. During the flare, the aircraft entered a heavy shower area, and the crew's forward visibility was significantly reduced as they entered the downpour. The digital flight data recorder (DFDR) recorded wind veered to 330 degrees true, causing a tailwind component of approximately 5 knots. The runway became contaminated with at least ¼ inch of standing water.

The aircraft touched down approximately 4000 feet down the 9000-foot runway. The spoilers deployed automatically after touchdown and the DFDR recorded that the crew applied maximum pressure to the aircraft's brake pedals. The pressure remained constant until the aircraft departed the end of the runway surface.

The DFDR data show that the thrust resolver angle on the throttles' angular position began to change at 12.8 seconds after touchdown, and that the thrust reversers were fully deployed by 14 seconds. Maximum reverse thrust was observed on the engines 17 seconds after touchdown. The aircraft departed the end of the runway at a ground speed of 79 knots. It came to rest 1090 feet beyond the departure end of the runway. The DFDR data show that the aircraft landed with 7500 kg of fuel; 4500 kg of trip fuel was required to fly to Ottawa.

### **Aircraft Landing Performance Information**

The length of Runway 24L is 9000 feet (2743 metres). Based on the Air France A340-313 *Quick Reference Handbook* (QRH), page 34G, "Landing Distance Without Autobrake," the following minimum distances would be used to bring the aircraft to a complete stop. It should be noted that, for a dry runway condition, the QRH shows a correction factor of "0" for landing distances with or without reverse thrust; therefore, for a given wind condition, these numbers remain the same.

ACTUAL LANDING DISTANCE (from 50 feet above ground to complete stop)						
Runway Conditions	Dry		Wet		6.3 mm (1/4 inch) of water	
	metres	feet	metres	feet	metres	feet
No wind	1155	3788	1502	4927	1987	6519
5-knot tailwind	1264	4148	1682	5518	2265	7432
No wind, reversers operative	1155	3788	1397	4582	1768	5802
5-knot tailwind, reversers operative	1264	4148	1564	5132	2016	6614

### **Evacuation and Emergency Response**

After the aircraft stopped, flight attendants observed a fire outside the aircraft and gave the evacuation order. The airport's emergency response services (ERS) personnel and vehicles arrived on site within a couple of minutes of the aircraft coming to rest. Their primary task consisted of assisting with the evacuation of the passengers and crew to a safe area and the control of the rapidly intensifying fuel-fed fire, which eventually destroyed most of the aircraft fuselage. The firefighting/extinguishing capability of the foam-equipped ERS vehicles was initially severely hindered by the intense downpour from the thunderstorm, which caused dilution of the foam, rendering it less effective against that type of fire.

The aircraft is equipped with eight exit doors and associated evacuation slides. The two left rear exits were not opened due to the fire observed in that area immediately after the aircraft stopped. One right middle exit was opened, but was closed after the slide deflated after it came into contact with aircraft wreckage. One left exit was opened, but the slide did not deploy. The remaining four exits were commanded open by flight attendants, although the left forward slide was damaged. Many passengers took carry-on luggage with them as they evacuated the aircraft. The complete evacuation was effected in less than two minutes.

### **Aircraft Systems**

No significant anomalies of the aircraft systems have been found to date. Review of DFDR data has not revealed any system malfunctions. No problems were detected with the flight controls, spoilers, tires and brakes, or thrust reversers, based on a physical examination of the wreckage combined with a follow-up detailed DFDR review of parameters. The flight controls functioned as expected, spoilers were deployed on touchdown, the tires and braking system worked as per design, and the thrust reversers were found in the deployed position. Brake assemblies were pressure-tested, and more detailed teardown work was completed at the Messier-Bugatti-Goodrich facility in Troy, Ohio, United States. The main and alternate systems on brakes 2 to 8 were tested at the plant, and all passed the tests. Brake 1 could not be tested because of its damaged post-crash fire condition. This brake was disassembled and nothing was found to indicate that any pre-existing condition was present that would result in a failure or reduced capability of this unit.

## *Investigation Plan*

In the coming months, the investigation team will analyze this accident and other previous occurrences that have similar characteristics to better understand all the contributing factors at play in this accident. The normal TSB procedure during this analysis phase is to look at the man, machine and environment interface to determine whether these factors contributed to the accident. The investigation team continues to be supported by the BEA, the NTSB, and other observers.

When the investigation team's draft report is complete, it will be reviewed and approved by the Director, Air Investigations. The draft report will then be submitted to the Board for its approval and released as a confidential draft report to designated reviewers. The Board will consider the representations of the designated reviewers, and amend the report, if required. At the end of this process, the Board will issue the final investigation report to the public.

If at any time during an investigation, the TSB identifies a safety deficiency, it will issue a safety communication as quickly as possible to the government department and transportation industry entity best able to take safety action to mitigate the identified risks.