

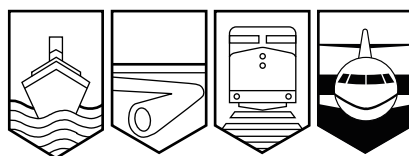
Transportation Safety Board  
of Canada



Bureau de la sécurité des transports  
du Canada

## AVIATION INVESTIGATION REPORT

A99W0234



### ENGINE FIRE

AIR CANADA

AIRBUS A320-211 C-FGYS

CALGARY INTERNATIONAL AIRPORT, ALBERTA

24 DECEMBER 1999

Canada

The Transportation Safety Board of Canada (TSB) investigated 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.

## Aviation Investigation Report

### Engine Fire

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### *Summary*

Air Canada flight ACA 201, an Airbus A320-211, was operating a scheduled passenger flight from Calgary, Alberta, to Vancouver, British Columbia. At approximately 0740 mountain standard time, the aircraft levelled off at 35 000 feet near Revelstoke, British Columbia. After level-off, the No. 2 engine surged twice. The pilot requested a routing back to Calgary with a gradual descent. On the descent, the engine anti-ice was turned on, and normal engine parameters were observed with auto-thrust selected. As the aircraft turned onto a seven-mile final, engine power increased during the extension of the landing gear and flaps. At approximately 60 per cent power, the No. 2 engine surged again. The pilot reduced thrust to idle on the No. 2 engine, applied maximum continuous thrust on the No. 1 engine, declared an emergency, and informed the in-charge flight attendant.

Airport aircraft firefighting (AFF) vehicles were called and were in position by the time the aircraft was two miles from the runway. After touchdown, an AFF vehicle followed the aircraft down the runway and noticed a 10-foot flame emanating from the No. 2 engine. The aircraft exited the runway and stopped on the taxiway. At this time, AFF told the ground controller that the No. 2 engine was on fire. The pilot commanded an evacuation and activated the fire bottles for both engines. Five of the six slides were used for the evacuation. The right over-wing exit was not used. AFF personnel applied foam to the exhaust cone of the No. 2 engine to extinguish the flames. Twenty minutes after evacuation, buses arrived to transport the passengers and the crew, all of whom were in the terminal 40 minutes after the evacuation commenced. There were no reported injuries and no external damage to the aircraft.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

The engine, model CFM56-5A1, is supported internally by five major bearings. When the TSB Engineering Laboratory examined the No. 2 engine (serial number 731417), it was determined that the No. 4 bearing (serial number RR13878), located on the high-pressure turbine section, had failed due to lack of lubrication. The reason for the lack of lubrication was not determined. The engine had a total time of 23 732 hours, with 10 647 cycles. The No. 4 bearing had a total time of 20 636 hours and had been in service for 2421 hours since its last inspection.

During the initial surging, small fluctuations on the engine gauges were observed on the flight deck. The in-charge flight attendant (IFA) was serving breakfast at the time and was in the cabin abeam the No. 2 engine nacelle. He described the surge as two loud bangs and saw a flash of light coming from the front of the engine. The tailpipe fire did little damage to the aircraft because the fire was in the exhaust duct of the engine. No fire detection systems are in the exhaust duct because the temperatures there are extremely high in normal operating conditions.

The Airbus A320 *Abnormal Procedures Manual* contains a checklist for continuous engine surging or stalling. The "ENG 1(2) STALL Check-list" calls for the suspected thrust lever to be reduced to idle and engine parameters observed. If the parameters are normal, engine anti-ice and wing ice devices are to be activated and the thrust lever is to be advanced slowly to see if the stall/surge will happen again. If the stall/surge does recur, the engine is to remain in a reduced thrust state. It was determined from the flight data recorder (FDR) that the flight crew did not complete the "ENG 1(2) STALL Check-list": the No. 2 engine thrust lever position did not change, and thrust continued to be controlled by the auto-thrust system.

The FDR showed no activation of any master warning or fire warning caution lights during the occurrence except for an electronic centralized aircraft monitoring message of a wheel brake that had heated up during the landing rollout.

The IFA was briefed that the landing would be normal; he was to prepare the cabin as usual. Dead-heading flight attendants were asked by the IFA to attend to two of the six exit areas. The four on-duty flight attendants, including the IFA, attended to the remaining four exit areas.

When the crew declared an emergency, the tower controller activated aircraft firefighting (AFF). The ground controller held all aircraft and ground traffic on the apron area to alleviate frequency congestion and to expedite the movement of AFF vehicles. Each AFF vehicle is equipped with a very high frequency (VHF) radio that has only one frequency, 121.9 megahertz; this is the ground control frequency used at Calgary International Airport. Using this frequency, AFF vehicles can contact the ground controller and the aircraft (if the flight crew has selected that frequency). All other air traffic taxiing to and from the active runways are also on this frequency. It is standard procedure for the AFF crew to first communicate with air traffic control (ATC) on the ATC ground frequency. Communications between AFF vehicles are accomplished via a separate ultra-high frequency (UHF) radio in each vehicle.

The call sign of the AFF vehicle that followed ACA 201 down runway 34 was "Red Five". Approximately 1 minute 30 seconds passed from the time Red Five first observed the flames from the No. 2 engine to the time it communicated with ground control. During that time, the

ground controller sent several transmissions to the other AFF vehicles to clear them across various runways and taxiways to pursue the landing aircraft. During these transmissions, Red Five attempted to call ground control; however, ground control did not reply to the transmission. ACA 201 had switched over to the ground frequency, and the transmission was recorded on the cockpit voice recorder (CVR) tape but was not recorded on the ATC tapes.

When Red Five first communicated with ground control that ACA 201 had an engine fire, the flight crew responded to that communication and commenced the "Severe Aircraft Damage Check-list". Thirteen seconds after that transmission, Red Five tried to contact ACA 201 crew by addressing them by their tail number, 219, but the crew of ACA 201 did not respond.

*Canadian Aviation Regulations* Standard 323.19 provides the standard for communication equipment for AFF vehicles. At the time of the occurrence, the standard did not mention direct communication between the AFF vehicles and the flight deck.

The flight crew's command to evacuate was recorded on the CVR public address system track only. AFF and Air Traffic Services were only made aware of the evacuation when the slides were deployed. There was no evacuate command recorded on the ATC tapes.

The aircraft's emergency lighting system consists of several lights located throughout the cabin, on the exterior of the aircraft, and on the evacuation slides. These lights have a lower luminous intensity than normal cabin lighting and are powered either through the aircraft's electrical system or separately through individual emergency power supply units. The IFA noted that the emergency lighting was not on during the evacuation and attempted to activate the system by using the remote switch on the forward flight attendant panel. According to the IFA, the emergency lights did not illuminate during this attempt. The switch itself is not illuminated or marked for low light situations. Another flight attendant did not recall if the emergency lighting was on, and another recalled that there were no interior lights. It was reported that the emergency light switch in the cockpit was in the armed position. This would cause the emergency lights to activate as soon as the main aircraft electrical power was turned off at the commencement of the evacuation as per the "Severe Aircraft Damage Check-list". It was reported that there were no defects in the emergency lighting system before or after the incident. The sky was getting brighter in the east, but the interior of the aircraft was described as dark. Civil twilight began at 0759 mountain standard time (MST),<sup>1</sup> with sunrise occurring at 0839. The evacuation commenced at approximately 0810.

The weather in Calgary on the morning of 24 December 1999 was described by the 0700 automatic terminal information service as follows: wind 300 degrees at 8 knots, visibility 15 statute miles, sky clear, temperature 9 degrees Celsius, dew point minus 10 degrees Celsius, and altimeter setting 30.30 inches of mercury.

## *Analysis*

During the initial stage of the No. 4 bearing failure, the low-pressure and high-pressure engine components temporarily turned at the same speed, causing the airflow to back up in the engine. This reversal of airflow produced the surges in cruise. The power increase during the approach

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<sup>1</sup> All times are MST (Coordinated Universal Time minus seven hours).

most likely contributed to the complete failure of the bearing, allowing the engine core to oscillate, which caused the destruction of an aft sump oil seal. The seal damage allowed oil to pass into the hot exhaust duct, which caused the exhaust duct fire on the landing rollout.

After the initial surge cleared, the engine parameters indicated normal at cruise thrust, and no caution lights were illuminated in the cockpit. With these indications, the crew did not anticipate that an emergency situation would arise so the "ENG 1(2) STALL Check-list" was not completed.

The initial radio communication of Red Five trying to contact ground control after ACA 201 was on taxiway C4 failed. The ATC tapes recorded no such transmission, yet the transmission was received by and recorded on ACA 201's CVR. The aircraft, which was between Red Five and the control tower's reception antenna, most likely blocked the transmission.

After the initial call to ground control about the fire, AFF attempted to call ACA 201 by using the tail number 219. However, flight crew rarely use tail numbers during flight operations, and hearing "219", which was not the call sign for ACA 201, would not have attracted their attention. The *Canadian Aviation Regulations* standard for AFF/flight crew communication provided limited guidance to AFF personnel and flight crew to ensure an accurate and effective means of communicating during emergency situations on the ground.

Emergency lighting is considerably dimmer than the normal fluorescent interior lighting. During the evacuation, standing passengers would have blocked many of the emergency lights, possibly resulting in the dark cabin described by the flight attendants. The investigation could not determine with confidence whether the emergency lights activated. The IFA could not positively identify the emergency light switch on the forward flight attendant panel because of the low light conditions.

The following TSB Engineering Laboratory Reports were completed:

LP 138/99—FDR/CVR Analysis

LP 008/00—Engine Failure.

*These reports are available upon request from the Transportation Safety Board of Canada.*

## *Findings as to Causes and Contributing Factors*

1. The No. 4 bearing failed due to lack of lubrication, which led to engine surge. The reason for the lack of lubrication was not determined.

## *Findings as to Risk*

1. The guidance in the *Canadian Aviation Regulations* standard concerning communication between aircraft firefighting personnel and flight crews during emergency situations on the ground was limited.
2. The emergency light button on the forward flight attendant panel is not illuminated or marked for low light situations, which may adversely affect cabin safety during emergency ground evacuations.

## *Other Findings*

1. The captain did not action the "ENG 1(2) STALL Check-list", because the surges in cruise were brief in nature and there were no other indications of engine trouble until the final approach.
2. The flight crew did not broadcast their evacuation intentions on an air traffic control frequency.
3. Aircraft firefighting personnel were not successful communicating with the flight crew on the VHF ground control frequency, initially because of frequency congestion and using the tail number rather than the call sign. Subsequently, it was because the crew had ordered and executed the evacuation of the aircraft.

## *Safety Action Taken*

The problem with the No. 4 bearing is a fleet-wide issue. CFM International, maker of the CFM56-series of engines, is testing a new material for the No. 4 bearing outer race. The new material is undergoing tests, and it was estimated that certification would be obtained by mid-to-late 2001.

The TSB Engineering Laboratory Report on the cause of failure (lack of lubrication) does not coincide with this solution. The TSB will be monitoring closely the results of CFM's lab tests on this particular bearing and the new material bearing and will determine if further safety action is required.

Transport Canada amended *Canadian Aviation Regulations* Standard 323.19 as follows:

- 2) Each aircraft fire-fighting vehicle shall be provided with communication equipment capable of communicating with at least:
  - (a) every other aircraft fire-fighting vehicle,
  - (b) the fire station exercising operational control as specified in the *Aerodrome Emergency Response Plan*,
  - (c) the air traffic services unit, community aerodrome radio station (CARS), authorized approach unicom, or where no ground radio station is provided on the airport or aerodrome, the aerodrome traffic frequency (ATF), and
  - (d) an aircraft in a situation of emergency using an established discreet frequency. **[amended 2001/06/01]**
- (3) A communication system shall be provided to ensure the prompt and dependable transmission of alarms and other essential emergency information. Direct communication shall be provided between the activating agency or authority, the fire station, and responding vehicles and between the responding vehicles and an aircraft in a situation of emergency using an established discreet frequency. **[amended 2001/06/01]**

(4) An alerting system for fire-fighting personnel, and/or other designated airport or aerodrome personnel shall be provided at a fire station and capable of activation from that station, or other designated agency.

(5) The requirements and responsibilities for the utilization of a discreet frequency between the aircraft fire-fighting service and the flight crew of an aircraft in a situation of emergency shall be detailed in an agreement on procedural operational arrangements between the air traffic services and the airport operator. **[amended 2001/06/01]**

In addition, the Civil Aviation Regulation Advisory Committee reviewed and adopted two notices of proposed amendments, NPA 2000-243 and 2000-244, at its meeting on 28 May 2001 regarding the Airport Emergency Planning Regulation and Standard.

Air Canada has amended the emergency evacuation procedures in its flight attendant manual. Standard procedure now calls for the flight attendant to select emergency lighting on at the commencement of the evacuation. Air Canada has also begun a feasibility study to determine a way to illuminate emergency lighting switches on the flight attendant forward panel.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 July 2001.*