



Final Report
by the Aircraft Accident
Investigation Bureau

concerning the incident

of the Cessna 750 Citation X aircraft, N999CX
on 20 March 2002
Zurich Airport

Ursache

Flugabbruch wegen kurz nach dem Start auftretendem Rauch in Kabine und Cockpit aufgrund einer defekten Dichtung am Fan-Lager des linken Triebwerkes.

Final Report

This report has been prepared solely for the purpose of accident/incident prevention. The legal assessment of accident/incident causes and circumstances is no concern of the incident investigation. Art. 24 of the Air Navigation Law)

Aircraft	Cessna 750 Citation X	N999CX
Operator	Codex Ltd, Lettstrasse 10, PO Box 1518, FL-9490 Vaduz	
Owner	Codex Ltd, Lettstrasse 10, PO Box 1518, FL-9490 Vaduz	

Pilots:	Commander	Citizen of Serbia and Montenegro, born 1968	
Licence	Airline Transport Pilot Licence, issued by the Federal Aviation Administration, U.S. Department of Transportation		
Flight experience total	3235:30	in the previous 90 days	43:30
	on incident type	1281:35	in the previous 90 days
			43:30

Pilots:	Copilot	Citizen of Serbia and Montenegro, born 1979	
Licence	Commercial Pilot Licence, issued by the Federal Aviation Administration, U.S. Department of Transportation		
Flight experience total	1901:40	in the previous 90 days	54:00
	on incident type	950:00	in the previous 90 days
			38:00

Place	Zurich Airport
Date and time	20 March 2002, approx. 07:40 UTC

Type of operation	Ferry flight following maintenance work
Flight phase	Climb
Accident type	Return to departure aerodrome because of smoke spreading in the cabin and cockpit

Injuries to persons

	Crew	Passengers	Others
Fatal	---	---	---
Serious	---	---	---
Minor or none	2	---	
Damage to aircraft	None		
Other damage	None		

History

Preliminary events and history of the flight

On Monday 18 March 2002, the Cessna 750 Citation X N999CX was flown from Geneva to Zurich, where a number of minor technical repairs were to be carried out in the maintenance works. On the occasion of this ferry flight (only the cockpit crew were on board), smoke appeared in the aft part of the cabin. However, it was possible to complete the flight without any further measures, with a normal landing in Zurich. The crew suspected the origin of the smoke in a failed display management unit (DMU), which is installed in the avionic compartment at the rear end of the cabin.

In the above-mentioned maintenance works, the computer box containing the failed DMU, was replaced on the following day, 19 March. Following this maintenance action it was tried to reproduce this smoke in static tests on the ground. With the cockpit displays switched on, supplied from the replaced DMU, a lengthy ground run with the engines at idle thrust was performed. However, no smoke could be detected in the cabin or in the cockpit either with bleed air from the APU (auxiliary power unit) or with bleed air from the engines.

On the morning of Wednesday, 20 March, the flight crew took over the aircraft from the maintenance company, who had declared it ready to fly (release to service). The flight crew took off at 07:34 UTC¹ with the N999CX on runway 32 of Zurich airport for a flight to Geneva. A few minutes after take-off, the flight crew realised that there was smoke in the cabin and shortly afterwards in the cockpit as well. The pilots put on oxygen masks and decided to return to Zurich airport. The corresponding checklist for COCKPIT/CABIN SMOKE OR FIRE was processed; after this the smoke production abated somewhat. However, smoke was continuing to be produced, both in the cabin and in the cockpit. The aircraft was guided by Zurich Sector Radar and Zurich Arrival onto the runway 16 instrument landing system and landed at 07:52 UTC.

The investigator was informed while the aircraft was still in the air. He arrived at the aircraft at 08:45 UTC; at that time it was already in the maintenance works.

Conclusions

Findings

- The crew had licences issued by the FAA (Federal Aviation Administration of the United States of America)
- On 18 March, i.e. two days before the incident, the aircraft was flown to Zurich to the maintenance works because of minor defects.
- According to the crew's statements, smoke was produced in the cabin for the first time during this flight.
- The aircraft N999CX was equipped with two engines of the type Rolls-Royce AE3007. On the left side was engine serial number CAE-330173, on the right side engine serial number CAE-330162 installed.
- Due to the failed display management unit (DMU), the crew suspected the origin of the smoke in the computer box of this DMU. They passed on their suspicion verbally to the responsible maintenance coordinator.

¹ Local time = UTC + 2h

- After having changed the suspect DMU and the consequent ground run's the maintenance company assumed to have solved the smoke problem.
- On 19 March, the day before the incident, the aircraft had been examined by the maintenance company. Static tests were carried out on the ground, during which the aircraft's two ACMs were operated both separately and together. All combinations of bleed air feed to the ACMs were tested, both with bleed air from the engines and bleed air from the APU. No smoke was produced during these tests. The static tests with bleed air from the engines were only carried out at idle power (the engines' idling speed). On the basis of these static tests the aircraft was released to service by the maintenance company.
- According to the crew's statements, smoke was produced as early as two minutes after take-off, initially in the cabin and then also in the cockpit.
- Six minutes after take-off, the crew, by now in contact with Zurich Sector Radar, requested radar vectors for an approach back to Zurich.
- After an enquiry from Zurich Sector Radar, the crew explained that they were returning because of smoke in the cabin and wished to clarify this with the maintenance company.
- After the crew informed Zurich Sector Radar of their intention to abort the flight, they were asked whether they were requesting landing priority; the crew replied in the affirmative.
- No emergency was declared.
- Processing the COCKPIT/CABIN SMOKE OR FIRE checklist did not realise any improvement in the situation.
- The N999CX aircraft was guided by Zurich Arrival onto the runway 16 instrument landing system (ILS 16), where it landed normally after a flight time of 18 minutes.
- The airport fire-fighting service was informed by air navigation services and was standing by at the runway during the landing.
- After the landing, the N999CX was able to taxi independently to the maintenance works.
- Examination of the ACMs revealed that both were badly contaminated; there were residues of both combusted and non-combusted oil.
- Both ACMs were replaced on the N999CX in the days after the incident. During the subsequent static tests, it became apparent that no smoke was produced in the case of bleed air feed from the right-hand engine or from the APU, but as soon as the left-hand engine was used for bleed air feed, smoke was produced in the cabin.
- After consultation with the engine manufacturer, Rolls Royce, the left-hand engine was kept shut down for 24 hours, and then an internal boroscope inspection was carried out. This showed that, due to a faulty fan (no 1) carbon seal, oil was spreading though the entire engine, burning on hot parts during operation and some was present in liquid form in the bleed air supply duct.
- According to the manufacturer's information, this leak had occurred because of a defective seal (fan carbon seal). At the time of the fault, the manufacturer was already offering a solution via a Service Bulletin (SB). The manufacturer described the improvement achieved with the Service Bulletin SB AE3007C-A-72-133 (Appendix 1) as *"an improved design carbon seal, including a new arch-bound segmented fan carbon seal assembly, a new fan carbon seal runner, a new fan carbon seal baffle and a new aft side fan Teflon lip seal."*

- According to the manufacturer's information, before this case several similar cases had occurred in which the above-mentioned seal construction was not functioning according to expectations.
- Switzerland was at the northern limit of a high-pressure area, the centre of which was near the Balearics. A cold front, which extended from Paris over Southern Germany to the Czech Republic, was primarily affecting the weather on the northern side of the Alps.
- Weather at Zurich airport at 08:10 UTC:
 - Clouds: 1-2/8 base 1700 ft/AGL, 5-7/8 base 3000 ft/AGL,
5-7/8 base 4500 ft/AGL
 - Weather: moderate rain showers
 - Visibility: 7 km
 - Wind: 250 degrees (varying 250 – 290 degrees), 16 knots,
gusting to 30 knots
 - Temp./dewpoint: +12 °C / +9 °C
 - Atmospheric pressure: QNH 1019 hPa
 - Hazards: moderate to strong turbulence in the take-off and approach
area
 - Position of the sun: Azimuth: 121°, elevation: 25°
 - Freezing level: at 7200 ft/MSL
- A flight data recorder (FDR) was not required nor installed. A cockpit voice recorder (CVR) was not required, but installed and was therefore analyzed. The CVR was copied to a audio tape. For linguistic and quality reasons it was not possible to produce a written protocol of its content.

Analysis

Technical aspects

The ACMs of aircraft type C-750 Citation X were known for the relatively short time between essential maintenance and overhauls. This is why the problem, after the exchange of the failed DMU, was sought primarily in the ACMs after the first occurrence of smoke during the flight on 18 March. The possibility that the origin of the smoke could have been in one of the engines was not considered.

The fault of this fan carbon seal had most probably already occurred during the flight from Geneva to Zurich on 18 March. It could very probably have been discovered before the release to service during a static test with higher engine power.

Operational aspects

After the smoke appeared, the crew took the necessary measures and took the decision to return to the departure aerodrome which was within a few minutes' range. As far as was possible given time constraints, they processed the appropriate COCKPIT/CABIN SMOKE OR FIRE checklist, though this did not produce any improvement because of the technical circumstances. The reduction in smoke production in the cabin was not related to the above-mentioned checklist, but probably occurred because of the reduction in power after the transition from a climb to level flight and then a descent.

Cause

The flight was aborted shortly after take-off because of smoke in the cabin and cockpit due to a faulty seal on the fan bearing of the left-hand engine.

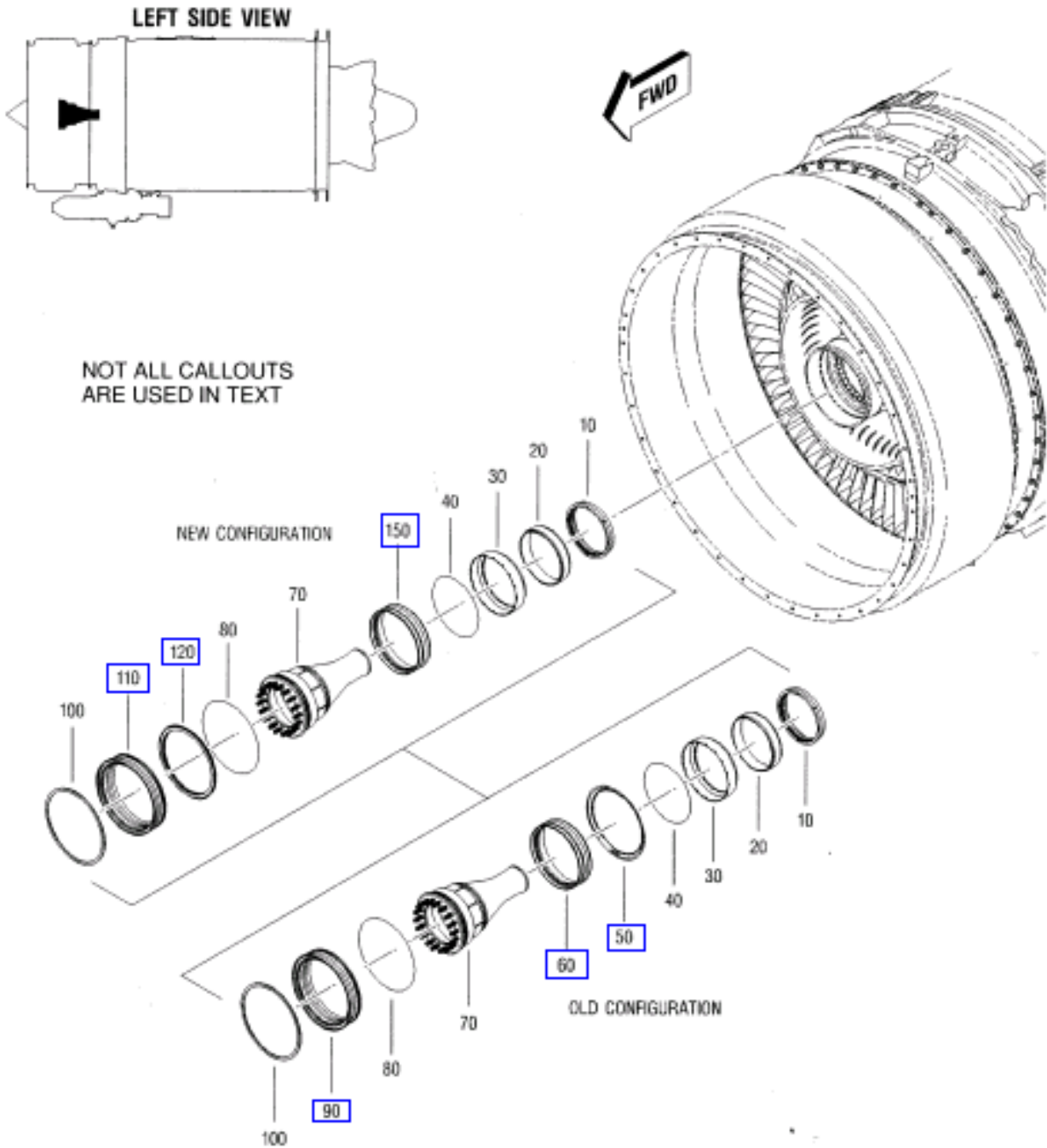
Berne, 2 December 2004

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Annex 1

Incident of the Cessna 750 Citation X N999CX aircraft on 20 March 2002



NTC398XQ

Fan Drive Shaft, Fan Carbon Seal, Fan Teflon Lip Seal, and Fan Carbon Seal Runner