

SOUTH AFRICAN



Section/division

Accident and Incident Investigation Division

Form Number: CA 12-12b

| |
|---|
| AIRCRAFT INCIDENT REPORT AND EXECUTIVE SUMMARY |
|---|

| | | | | | | |
|--|---|------------------------------|--------------------------|-----------------------------|-------------------------|-------|
| | | | | Reference: | CA18/3/2/0999 | |
| Aircraft Registration | ZS-SMJ | Date of Accident | 10 September 2013 | | Time of Accident | 1848Z |
| Type of Aircraft | Boeing 737-300 | | Type of Operation | | Commercial – Cargo | |
| Captain Licence Type | Airline Transport Pilot | Age | 41 | | Licence Valid | Yes |
| Captain Flying Experience | Total Flying Hours | 6 882,2 | | Hours on Type | 1 104,9 | |
| First Officer Licence Type | Airline Transport Pilot | Age | 30 | | Licence Valid | Yes |
| First Officer Flying Experience | Total Flying Hours | 4 478 | | Hours on Type | 43,9 | |
| Last point of departure | FACT – Cape Town International Airport, South Africa | | | | | |
| Next point of intended landing | FAPE – Port Elizabeth Airport, South Africa | | | | | |
| Location of the accident site with reference to easily defined geographical points (GPS readings if possible) | | | | | | |
| En route from FACT to FAPE, approximately 60 nautical miles from FACT at FL210. | | | | | | |
| Meteorological Information | Wind direction: 200°; Wind speed: 12kt; Visibility: >10km; Cloud: None; Temperature: 13°C; Dew point: 6°C; QNH: 1025 | | | | | |
| Number of people on board | 2 + 1 | No. of people injured | 0 | No. of people killed | 0 | |
| Synopsis | <p>On the evening of 10 September 2013, ZS-SMJ, a Boeing 737-300, serial number 23500, flight SA6836 operated by SAFAIR, departed from Cape Town International Airport (FACT) with the intention of landing at Port Elizabeth Airport (FAPE). While the aircraft was passing through flight level F170, several of the captain's primary flight instruments failed. The crew continued the climb to F210. The captain then smelt burning and noticed a significant amount of smoke emanating from behind and to the left of his seat. The smoke was coming from the circuit breaker panel and the crew noticed that circuit breakers C498 and C425 had popped. The crew declared a mayday with the terminal control area (TMA) and advised the controllers of the situation. The aircraft diverted back to FACT. Three to four minutes later, the smoke began to dissipate. A monitored approach and normal landing were carried on out on runway 01 with the aerodrome rescue and fire-fighting personnel on standby in the event of an emergency. No injuries were reported and the aircraft sustained no damage.</p> | | | | | |
| Probable Cause | | | | | | |
| Electrical system failure resulting in the aircraft returning to Cape Town, however the cause of the failure of the incident could not be determined | | | | | | |
| IARC Date | | Release Date | | | | |

CIVIL AVIATION
AUTHORITY

AIRCRAFT INCIDENT REPORT

Name of Owner : Safair Operations (Pty) Ltd
Name of Operator : South African Airways
Manufacturer : Boeing Aircraft Company
Model : 737-300
Nationality : South Africa
Registration Marks : ZS-SMJ
Place : Cape Town
Date : 10 September 2013
Time : 1848Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011), this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish legal liability**.*

Disclaimer

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

- 1.1.1 On the evening of 10 September 2013, ZS-SMJ, a Boeing 737-300, serial number 23500, flight SA6836 operated by SAFAIR, departed from Cape Town International Airport (FACT) with the intention of landing at Port Elizabeth Airport (FAPE).
- 1.1.2 While the aircraft was passing through flight level F170, several of the captain's primary flight instruments failed. The crew continued the climb to F210. The captain then smelt burning and noticed a significant amount of smoke emanating from behind and to the left of his seat. The smoke was coming from the circuit breaker panel and the crew noticed that circuit breakers C498 and C425 had popped.
- 1.1.3 The crew immediately declared a mayday with the terminal control area (TMA) and advised the controllers of the situation. The aircraft diverted back to FACT for a priority landing. The crew carried out the 'Smoke, fire or fume' checklist in the quick-reference handbook (QRH).
- 1.1.4 Three or four minutes later, the smoke began to dissipate. The captain's primary instruments remained unserviceable for the remainder of the flight.
- 1.1.5 The crew flew a 'monitored approach'. The first officer flew the approach to minimums (200ft for a CAT 1 approach on runway 01) and the captain then took control and landed the aircraft. This was a visual manoeuvre from minimums and

the standby instruments were working.

- 1.1.6 A normal landing was carried on out on runway 01 with the aerodrome rescue and fire-fighting (ARFF) personnel on standby in the event of an emergency. No injuries were reported and the aircraft did not sustain any damage.



Figure 1: Cape Town International Airport.

1.2 Injuries to Persons

| Injuries | Pilot | Crew | Pass. | Other |
|----------|-------|------|-------|-------|
| Fatal | - | - | - | - |
| Serious | - | - | - | - |
| Minor | - | - | - | - |
| None | 2 | 1 | 0 | - |

1.3 Damage to Aircraft

- 1.3.1 None.

1.4 Other Damage

- 1.4.1 None.

1.5 Personnel Information

1.5.1 Captain

| | | | | | |
|---------------------|---|---------------|-----------------------------------|-----|----|
| Nationality | South African | Gender | Male | Age | 41 |
| Licence Number | 02704172 72 | Licence Type | Airline Transport Pilot's Licence | | |
| Licence valid | Yes | Type Endorsed | Yes | | |
| Ratings | Instrument; Night; Flight Instructor Grade 2 and Approved Flight Examiner | | | | |
| Medical Expiry Date | 30 November 2013 | | | | |
| Restrictions | None | | | | |
| Previous Accidents | None | | | | |

Flying Experience

| | |
|----------------------------|---------|
| Total Hours | 6 882,2 |
| Total Past 90 Days | 126,3 |
| Total on Type Past 90 Days | 126,3 |
| Total on Type | 1 104,9 |

1.5.2 First Officer

| | | | | | |
|---------------------|----------------------|---------------|-----------------------------------|-----|----|
| Nationality | South African | Gender | Male | Age | 30 |
| Licence Number | 0270517485 | Licence Type | Airline Transport Pilot's Licence | | |
| Licence valid | Yes | Type Endorsed | Yes | | |
| Ratings | Night and Instrument | | | | |
| Medical Expiry Date | 30 September 2014 | | | | |
| Restrictions | None | | | | |
| Previous Accidents | None | | | | |

Flying Experience

| | |
|----------------------------|-------|
| Total Hours | 4 478 |
| Total Past 90 Days | 43,9 |
| Total on Type Past 90 Days | 43,9 |
| Total on Type | 43,9 |

***NOTE 1:** The first officer was under training at the time of the incident. He was released for line flying after completing his final base training on 15 August 2013. On the night of the incident, he was on the second leg of a twenty-sector line training module which was to be followed by a final line check.

1.6 Aircraft Information

1.6.1 Description

The Boeing 737-300 is known for its reliability and fuel efficiency. It is powered by two CFM 56-3B1 engines.

1.6.2 Airframe

| | | | |
|--|-------------------------|--------|--|
| Type | Boeing 737-300 | | |
| Serial Number | 23500 | | |
| Manufacturer | Boeing Aircraft Company | | |
| Date of Manufacture | 1986 | | |
| Total Airframe Hours (At time of Incident) | 51 644 | | |
| Last Phase Inspection (Date & Hours) | 30 April 2013 | 51 426 | |
| Hours since Last Phase Inspection | 218 | | |
| C of A (Issue Date) | 21 September 2010 | | |
| C of A (Expiry Date) | 20 September 2013 | | |
| C of R (Issue Date) (Present owner) | 13 September 2010 | | |
| Maximum Take-off Weight | 62 822kg | | |
| Maximum Landing Weight | 52 888kg | | |
| Airworthiness Directive Status | Complied with | | |
| Type of Fuel Recommended | Jet A1 | | |
| Fuel Used | Jet A1 | | |
| Operating Categories | Standard Part 121 | | |

1.6.3 The aircraft was issued with a certificate of registration on 13 September 2010. The South African Civil Aviation Authority (SACAA) airworthiness department inspected the aircraft and issued a certificate of airworthiness on 21 September 2010. From this date, the RSA owner, who was also the operator of the aircraft, used it on commercial air transportation operations. This was in accordance with civil aviation regulations (CAR), Part 121 of 2011.

1.6.4 All relevant aircraft documentation – certificate of registration, certificate of airworthiness, radio stations' licence, and mass and balance certificate – were inspected during the on-site investigation and found to be valid in accordance with the requirements of CAR, Part 121.

1.6.5 The aircraft maintenance documentation such as airframe logbooks, engine logbooks and work packs were obtained from the AMO and inspected.

- i. All maintenance entries made in the logbooks were appropriately certified in terms of CAR, Part 43 requirements.
- ii. All scheduled (phase inspection programme) and unscheduled (defects) maintenance was carried out in accordance with CAR, Part 42 requirements.

1.6.6 Engine No. 1

| | | | |
|--|---------------------|----------|--------|
| Type | CFM 56-3B1 | | |
| Serial Number | 723104 | | |
| Last Phase Inspection (A1 Check) (Date & Hours / Cycles) | 30 April 2013 | 42 398,6 | 36 172 |
| Hours & Cycles since New | 42 616 | 36 359 | |
| Hours & Cycles since Overhaul | TBO not yet reached | | |
| Maintenance Concept | A1 check | | |

Engine No. 2

| | | | |
|--|---------------------|----------|--------|
| Type | CFM 56-3B1 | | |
| Serial Number | 723199 | | |
| Last Phase Inspection (A3 Check) (Date & Hours / Cycles) | 30 April 2013 | 38 651,5 | 31 217 |
| Hours & Cycles since New | 38 868 | 31 404 | |
| Hours & Cycles since Overhaul | TBO not yet reached | | |
| Maintenance Concept | A1 check | | |

1.6.7 Maintenance

1.6.7.1 Inspection intervals for the wiring system in question are as per the original equipment manufacturing (OEM) electrical wiring interconnection system (EWIS) instructions for continued airworthiness (ICA), which forms part of various cards that call for inspections at intervals.

1.7 Meteorological Information

1.7.1 The following surface weather information at the time and place of the incident was obtained from the SA Weather Services.

| | | | | | |
|----------------|------|-------------|------|------------|-------|
| Wind direction | 200° | Wind speed | 12kt | Visibility | >10km |
| Temperature | 13°C | Cloud cover | None | Cloud base | None |
| Dew point | 6°C | | | | |

1.8 Aids to Navigation

1.8.1 The aircraft was fitted with the following navigational aids:

- Magnetic compass
- Panel-mounted Garmin GPS
- Mode S transponder
- ADF (automatic direction finder)
- DME (distance-measuring equipment)
- VOR (variable omni range) finder
- ILS (instrument landing system)

1.9 Communications

1.9.1 Communications between the FACT air traffic controller (ATC) and the crew were normal. The ATC recordings of the radio communications were consistent with the transmissions recorded.

1.10 Aerodrome Information

| | | |
|------------------------|---|-----|
| Aerodrome Location | Cape Town International | |
| Aerodrome Co-ordinates | S33°57'53" E018°36'06" | |
| Aerodrome Elevation | 151ft | |
| Aerodrome Status | Licensed | |
| Runway Designations | 01 | 19 |
| Runway Dimensions | 3 201m | 61m |
| Runway Designations | 16 | 34 |
| Runway Dimensions | 1 701m | 46m |
| Runway Used | 01 | |
| Runway Surface | Asphalt | |
| Approach Facilities | NDB, ILS, VOR, DME, runway lights and PAPIs | |

1.11 Flight Recorders

1.11.1 The aircraft was equipped with a Honeywell Solid State flight data recorder (FDR) and Honeywell solid-state cockpit voice recorder (CVR) as required by regulations.

1.11.2 The FDR and CVR were not removed for data downloading as the circuit breakers had been reset before the investigator-in-charge arrived at the scene.

1.11.3 An external examination of both recorders revealed that both units were in good condition.

1.11.4 Recorder Information

Flight data recorder (FDR):

| | |
|---------------|--------------|
| Type / Model | Honeywell |
| Part Number | 980-4700-003 |
| Serial Number | 1269 |

Cockpit voice recorder (CVR):

| | |
|---------------|-------------------------------|
| Type / Model | Loral Communications / FA2100 |
| Part Number | 2100-1020-00 |
| Serial Number | 199339 |

Quick access recorder (QAR):

| | |
|---------------|--------------|
| Type / Model | L3 QAR 201 |
| Part Number | QAR201-02-00 |
| Serial Number | 000452541 |

1.12 Wreckage and Impact Information

1.12.1 The aircraft landed safely at FACT and did not sustain any damage.



Figure 2: Aircraft parked at FACT after the incident.



Figure 3: ZS-SMJ cockpit.



Figure 4: P28 circuit breaker panel showing #1 central air data computer system.

1.13 Medical and Pathological Information

1.13.1 None.

1.14 Fire

1.14.1 No pre- or post-impact fire was reported.

1.14.2 The crew reported seeing smoke coming from behind and to the left of the captain's seat, where the circuit breaker panel is situated. The smoke dissipated within a few minutes.

1.15 Survival Aspects

1.15.1 The incident was considered survivable, as the aircraft landed normally, there was no damage to the cockpit or cabin area, and all occupants were wearing their safety harnesses.

1.16 Tests and Research

1.16.1 A contracted AMO (No. 001) carried out troubleshooting once the aircraft had landed at FACT. Technicians initially thought that the central air data computer auto-transformer T98 was the source of the burning smell and smoke. The circuit breakers C498 and C425 opened as designed, cutting off power to the affected circuit. It was suspected that the auto transformer became hot due to low resistance or a short circuit on the output 28 V_{ac}. The T98 transformer was replaced with a new component but this did not clear the fault on the failed instruments. There was no evidence of smoke during the testing phase. The circuit breakers did not pop during the test of the original transformer or of the replacement transformer. Examination of the replaced transformer also showed no signs of overheating or burning, and there was no related burning smell. Despite extensive efforts, technicians were unable to identify or duplicate the source of smoke with certainty.



Figure 5: The T98 transformer that was removed from the aircraft.



Figure 6: Circuit breakers C498 and C425.

1.16.2 Further troubleshooting traced a potential problem to plug D4449P, which was part of the original Boeing digital flight data recorder (DFDR) wiring for altitude/ airspeed excitation. The 28 V_{ac} output of transformer T98 provides the reference for the course and fine altitude synchro and the airspeed synchro outputs from the digital air data computer #1 previously used for the DFDR. The wires had been disconnected and tied back at the DFDR end to satisfy the requirements for a supplemental type certificate (ST00599SE). This was part of a DFDR upgrade involving the installation of a digital flight data acquisition unit. During the repair work, the wires were further isolated with end-capping and stowing as per Boeing standard practices to prevent a possible reoccurrence of the problem. Ground tests and isolation tests were carried out. The defect was no longer apparent and all systems operated normally. Technicians were unable to identify the source of smoke with any certainty, or duplicate it.

1.16.3 The P18 circuit breaker panel, the P6 circuit breaker panel, and the overhead P5 panel were opened to inspect for any signs of smoke damage, be it visibility or in terms of odour. None was found. Connectors in the P18 panel were removed and cleaned in case of any moisture or contamination. No defects were found. (It should be noted that these connectors had previously been removed during the initial investigation after the event.) The two circuit breakers (C498 and C425) that tripped during the flight were removed and sent to Megchem for extensive analysis.

1.16.4 The T98 transformer was returned to the AMO for inspection and investigation by the engineering department. No significant findings were noted. After the inspection, the transformer was load-checked for approximately six hours. No problems were observed, and there was no heat gain in the unit under normal load conditions.

1.17 Organisational and Management Information

1.17.1 This was a scheduled domestic cargo flight operating from FACT to FAPE.

1.17.2 The flight was conducted under the provisions of Part 121 of the CAR of 2011, as amended. At the time of the incident, the operator was in possession of a valid air

service licence as well as an air operating certificate (AOL CAA/S005D).

- 1.17.3 The aircraft was maintained by an approved AMO in possession of a valid approval certificate (No. 001).
- 1.17.4 The maintenance and testing on ZS-SMJ were carried out by appropriately licensed engineers in possession of valid company authorisations.

1.18 Additional Information

1.18.1 None.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 The Man

- 2.1.1 The captain was licensed and qualified for the flight in accordance with existing regulations. He was the holder of an airline transport pilot's licence and had a total of 6 882,2 hours, of which 1 104,9 were on type. The first officer was also the holder of an airline transport pilot's licence and had a total of 4 478 hours, of which 43,9 hours were on type. The first officer was under training at the time. He was released for line flying after completing his final base training on 15 August 2013. On the night of the incident, he was on the second leg of a twenty-sector line training module, which was to be followed by a final line check. Both the captain and first officer were in compliance with flight and duty time regulations.
- 2.1.2 While the aircraft was passing through FL17, several of the captain's primary flight instruments failed. Shortly thereafter, the captain smelt burning and noticed a significant amount of smoke emanating from behind and to the left of his seat. The crew immediately declared a mayday with the TMA and turned back for FACT. The crew completed the 'Smoke, fire or fumes' QRH checklist. The smoke dissipated a few minutes later, but the crew continued to FACT and landed uneventfully. The crew's prompt response, actions and statements indicated that their knowledge and understanding of the aircraft systems were adequate. They also adhered to the company operating procedures and requirements.

2.2 The Machine

- 2.2.1 Extensive troubleshooting was carried out on the aircraft after it landed at FACT. Technicians initially thought that the T98 transformer was the source of the burning smell and smoke. The circuit breakers C498 and C425 popped as designed, cutting off power to the affected circuit. A serviceable transformer was fitted to ZS-SMJ, but this however did not clear the fault on the failed instruments. There was also no evidence of smoke and the circuit breakers did not pop during the test of the original transformer or of the replacement transformer. Examination of the replaced transformer also showed no signs of overheating or burning, and no related burning smell.

- 2.2.2 The removed transformer was sent for further inspection and investigation. No significant findings were noted. The transformer was also load-checked for approximately six hours. No problems were observed and there was no heat gain in the unit under normal load conditions.
- 2.2.3 Further troubleshooting traced a potential problem to plug D4449P, which was part of the original Boeing DFDR wiring for altitude/airspeed excitation. Although two of these wires were suspected to be the cause of the low resistance or short circuit, the defect was no longer apparent and all systems operated normally.
- 2.2.4 The P5, P6 and P18 circuit breaker panels were also opened to inspect for any signs of smoke damage. None was found. Connectors were removed and cleaned in case of any moisture or contamination. The two circuit breakers that tripped during the flight were removed and sent to Megchem for further investigation. No fault could be found with the systems or components in the cockpit.
- 2.2.5 Despite extensive efforts, technicians were unable to identify or duplicate the source of smoke with certainty. Thus the contributory factor for the return of the aircraft to FACT could not be determined. The aircraft was placed on continuous monitored service and the event has not recurred.

2.3 The Environment

Fine weather conditions prevailed at the time of the incident and did not contribute to its cause.

3. CONCLUSION

3.1 Findings

- 3.1.1 The aircraft had a valid certificate of airworthiness and had been maintained in compliance with the regulations.
- 3.1.2 The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.
- 3.1.3 The aircraft was airworthy when dispatched for the flight.
- 3.1.4 The aircraft was structurally intact prior to and after the serious incident.
- 3.1.5 The flight was conducted according to the provisions of Part 121 of the CAR of 2011, as amended.
- 3.1.6 The operator was in possession of a valid air service licence as well as an AOC at the time of the incident.
- 3.1.7 The flight was conducted in accordance with the procedures in the company operations manual.
- 3.1.8 The captain was licensed and qualified for the flight in accordance with existing regulations.

- 3.1.9 The first officer was under training at the time of the incident.
- 3.1.10 The crew made an early decision to divert towards a suitable aerodrome while attempting to determine the extent of the emergency.
- 3.1.11 The crew declared a mayday as soon as the smoke was seen in the cockpit.
- 3.1.12 The captain's primary instruments remained out of commission for the remainder of the flight, resulting in the crew flying 'monitored approach'.
- 3.1.13 The FDR and CVR were not removed and sent for downloading.
- 3.1.14 Despite extensive testing, troubleshooting and research, the defect could not be re-simulated.

3.2 Probable Cause/s

- 3.2.1 Electrical system failure resulting in the aircraft returning to Cape Town; however the cause of the failure of the incident could not be determined.

4. SAFETY RECOMMENDATIONS

- 4.1 None.

Compiled by: Natasha Kisten-Skuce

.....

N. Kisten-Skuce

Date:

For: Director of Civil Aviation

Investigator-in-charge: N. Kisten-Skuce

Date:

Co-Investigator: J. Grobbelaar

Date: