AIRCRAFT SERIOUS INCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/3/2/1299		
Aircraft Registration	**ZS-DMI**	**Date of Incident**	10 December 2019		**Time of Incident**	0448Z	
Type of Aircraft	Boeing 737-400		**Type of Operation**		Air Transport Operation (Part 121)		
Pilot-in-command Licence Type	Airline Transport Pilot Licence		**Age**	46	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		15 791.0		Hours on Type	381.0	
Last Point of Departure	O.R. Tambo International Aerodrome (FAOR), Gauteng Province						
Next Point of Intended Landing	Port Elizabeth Aerodrome (FAPE), Eastern Cape Province						
Location of the incident site with reference to easily defined geographical points (GPS readings if possible)							
En route from FAOR to FAPE, Heilbron area (GPS position: 27°10'28.44" South 028°09'04.89" East)							
Meteorological Information	Surface wind: 050°/9kts, temperature: 13°C, dew point: 13°C, overcast and rain						
Number of People On-board	6 + 166	**No. of People Injured**	0	**No. of People Killed**	0		
Synopsis							

On Tuesday morning 10 December 2019 at approximately 0436Z, a Boeing 737-400 aircraft with registration ZS-DMI departed O.R. Tambo International Aerodrome (FAOR) using Runway 03L on a scheduled domestic flight to Port Elizabeth Aerodrome (FAPE) with 6 crew members and 166 passengers on-board.

The aircraft was initially cleared to climb to 28 000 feet (flight level 280 [FL280]) by the radar controller. The first officer (FO) was the pilot flying (PF), and the pilot-in-command (PIC) was the pilot monitoring (PM). At approximately 0448Z the crew declared an emergency by broadcasting Mayday Mayday Mayday, stating at first that they had fire in the cockpit; two seconds later, the PIC said that it was smoke and not fire. The smoke was emanating from behind the instrument panel on the left side. The crew requested an air turn back to FAOR, which was accommodated by the radar controller, and the aircraft was cleared to turn right and descend with no speed restrictions. The cockpit crew referred to the Quick Reference Handbook (QRH) emergency for fire, smoke and fumes.

The aircraft landed safely on Runway 03L at FAOR and taxied to the parking bay where the passengers disembarked normally. No person was injured during the serious incident.

The investigation revealed that during the climb phase, the water drain pipe connected to the overhead cockpit drip pan became dislodged and water dripped onto the aircraft's instrumentation panel, causing smoke in the cockpit.

SRP date	8 September 2020	Publication date	9 September 2020

Abbreviation	Description
AIID	Accident and Incident Investigations Division
AMM	Aircraft Maintenance Manual
AMO	Aircraft Maintenance Organisation
AMSL	Above mean sea level
AOC	Air Operating Certificate
ARFF	Aerodrome Rescue and Fire-fighting
ATNS	Air Traffic and Navigation Services
ATPL	Airline transport pilot licence
ATC	Air Traffic Control
CAA	Civil Aviation Authority
CAVOK	Ceiling and Visibility OK
C of A	Certificate of airworthiness
C of R	Certificate of registration
CVR	Cockpit voice recorder
FAOR	OR Tambo International Aerodrome
FAPE	Port Elizabeth Aerodrome
FDR	Flight data recorder
FL	Flight level
FO	First Officer
ft	Feet
IFR	Instrument Flight Rules
kt	Knot
METAR	Meteorological aeronautical report
PF	Pilot Flying
PM	Pilot Monitoring
PIC	Pilot-in-command
QRH	Quick reference handbook
ROC	Rate of climb
ROD	Rate of descent
RSA	Republic of South Africa
SAWS	South African Weather Services
SSR	Secondary Surveillance Radar
UHF	Ultra-high frequency
VHF	Very high frequency
Z	Zulu (Term for Universal Coordinated Time - Zero hours Greenwich)

Reference number	**:** CA18/3/2/1299
Name of the Owner	**:** Safair Operations (Pty) Ltd
Name of the Operator	**:** FlySafair
Manufacturer	**:** Boeing Aircraft Company
Model	**:** 737-400
Nationality	**:** South African
Registration markings	**:** ZS-DMI
Place	**:** En route from FAOR to FAPE, abeam Heilbron
Date	**:** 10 December 2019
Time	**:** 0448Z

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 (CAR) 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 apportion blame or liability****.*

Any person who has information concerning this serious incident should contact the Accident and Incident Investigations Division (AIID) on AIIDinbox@caa.co.za

Investigation process:

The AIID of the South African Civil Aviation Authority (SACAA) was informed about an aircraft serious incident involving a Boeing 737-400 that occurred after take-off from Runway 03L at FAOR on the climb out passing FL280 on 10 December 2019. The serious incident was reported to AIID on the same day.

The AIID has appointed an investigator-in-charge with an investigation team. Notifications were sent to the State of Manufacture and Design, namely, the United States of America. The State has not appointed an accredited representative to the investigation. The AIID will lead the investigation and issue the final report.

Notes:
1. Whenever the following words are mentioned in this report, they shall mean the following:

- *Incident — this investigated serious incident*
- *Aircraft — Boeing 737-400 involved in this serious incident*
- *Investigation — the investigation into the circumstances of this serious incident*
- *Pilot — the pilot/s involved in this serious incident*
- *Report — this serious incident report*

2. Photographs and figures used in this report were obtained from different sources and may be adjusted for the sole purpose of improving clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or the addition of text boxes, arrows or lines.

Disclaimer:

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

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1 On Tuesday morning 10 December 2019, a Boeing 737-400 with registration ZS-DMI, performing flight FA369 departed O.R. Tambo International Aerodrome (FAOR) at 0436Z on a scheduled domestic flight to Port Elizabeth Aerodrome (FAPE). On-board the aircraft were 6 crew members and 166 passengers. The aircraft was operated under instrument flight rules (IFR) by day and the weather conditions were reported to be overcast with a cloud base of 200 feet (ft) above ground level (AGL), with rain. The flight was conducted under the provisions of Part 121 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2 After take-off from Runway 03L, the aircraft continued with the climb out as per radar vectors. The aircraft was cleared to climb to 28 000ft (flight level 280 [FL280]) while still within the Johannesburg flight information region (FIR). At 04:48:20Z (radar display time) the PIC broadcasted a Mayday Mayday Mayday, stating at first that they had fire in the cockpit; two seconds later, the PIC said it was smoke in the cockpit, and not fire. The smoke was emanating from behind the instrument panel on the left side (pilot-in-command side). The crew immediately referred to the Quick Reference Handbook (QRH) emergency checklist items for – smoke, fire and fumes in the cockpit, which is attached to this report as Annexure A.

1.1.3 After referencing the QRH, the PIC requested an air turn back to FAOR, which was accommodated by the radar controller. The aircraft was cleared to turn right and descend to FL110, with no speed restrictions. At 04:50:39Z, the PIC communicated again with the radar controller. From the audio that was made available to the investigator, it could be determined that the PIC had his smoke goggles on, which included an oxygen mask (see Figure 10). From the same audio that followed immediately thereafter, it could be heard that the FO confirmed with the PIC that he also had his oxygen mask on. A brief period later, the PIC addressed the passengers via the public announce (PA) system that the aircraft is returning to FAOR due to a technical difficulty. By this time, the smoke in the cockpit had subsided.

1.1.4 An uneventful landing followed, and the aircraft was taxied to the allocated parking bay where the passengers disembarked normally. There were no injuries reported

during the serious incident, and damage to the aircraft was limited to the dislodged drip pan tubing.

1.1.5 The serious incident occurred during daylight en route from FAOR to FAPE overhead Heilbron area (Free State Province) at a geographical position: 27°10’28.44” South 028°09’04.89” East.

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	2	4	166	-

1.3. Damage to Aircraft

1.3.1 Damage was limited to the dislodged tubing. During an assessment of the aircraft by maintenance personnel following the serious incident, no evidence of damage was observed to the instrumentation/avionics of the aircraft.

1.4. Other Damage

1.4.1 None.

1.5. Personnel information

1.5.1 Pilot-in-command (PIC)

Nationality	South African	Gender	Male	Age	46
Licence Number	0270292196	Licence Type	Airline Transport Pilot Licence		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument				
Medical Expiry Date	31 July 2020 (Class 1)				
Restrictions	Must wear corrective lenses				
Previous Incidents	None				

Flying experience:

Total Hours	15 791.0
Total Past 90 Days	158.0
Total on Type past 90 Days	67.0
Total on Type	381.0

1.5.2 First Officer (FO)

Nationality	South African	Gender	Male	Age	44
Licence Number	0270488422	Licence Type	Airline Transport Pilot Licence		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument, Flight Instructor Grade II				
Medical Expiry Date	31 January 2020 (Class 1)				
Restrictions	Annual Lipogram				
Previous Incidents	None				

Flying experience:

Total Hours	6 025.0
Total Past 90 Days	165.0
Total on Type Past 90 Days	43.0
Total on Type	150.9

1.6. Aircraft Information

1.6.1 The Boeing 737-400

Source: https://en.wikipedia.org/wiki/Boeing_737_Classic

"The Boeing 737 are short- to medium-range, narrow-body jet airliners. Produced by Boeing Commercial Airplanes from 1984 to 2000, the 737 Classic includes three variants, comprising the -300, -400, and -500 series, and can seat between 145 and 188 passengers. Improvements over the previous generation of 737 aircraft included CFM International CFM56 high-bypass-ratio turbofan engines, upgraded avionics, and increased passenger capacity (in the -300/-400 models). The first model of the Classic series, the 737–300, entered service in 1984. It was followed by a stretched model, the 737-400, which entered service in 1988."

Figure 1: The aircraft ZS-DMI. (Source: www.Planespotters.com)

1.6.2 Airframe

Type	Boeing 737-400	
Serial Number	24165	
Manufacturer	Boeing Aircraft Company	
Year of Manufacture	1989	
*First Flight for this Aircraft	8 May 1989	
Total Airframe Hours (at time of incident)	80 896.61	
Last Inspection	80 762.00	11 November 2019
Hours Since the Last Inspection	107.61	
C of A (issue date)	14 December 2017	
C of A (expiry date)	31 December 2020	
C of R (issue date) (Present owner)	14 November 2017	
Operating Category	Standard Transport (Aeroplane)	

Engine No. 1

Type	CFM56-3C-1
Serial Number	727431
Hours Since New	52 212.71
Hours Since Overhaul	Modular assembly

Engine No. 2

Type	CFM56-3C-1
Serial Number	857115
Hours Since New	74 443.49
Hours Since Overhaul	Modular assembly

1.6.3 Operating history of the aircraft:

Registration	Country	Delivered
G-BPKC	United Kingdom	May 1989
N690MA	United States of America	March 1992
VT-JAI	India	April 1996
VT-SIH	India	August 1999
N758BC	United States of America	August 2002
EI-DDK	Russia	December 2003
ZS-DMI	South Africa	November 2017

Source: www.Planespotters.net

1.7. Meteorological Information

1.7.1 The weather information below was obtained from the Meteorological Aeronautical Report (METAR) that was issued by the South African Weather Service (SAWS) for FAOR on 10 December 2019 at 0430Z.

FAOR 100430Z 05009KT 4000 RA OVC002 13/13 Q1020 TEMPO 3000=

Wind direction	050˚	Wind speed	9kts	Visibility	4000
Temperature	13˚C	Cloud cover	Overcast with rain	Cloud base	200ft
Dew point	13˚C	QNH	1020		

1.8. Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA) for the aircraft type. There were no records indicating that the navigation system was unserviceable prior to or during the serious incident.

1.9. Communication

1.9.1 The aircraft was equipped with standard communication equipment as per the minimum equipment list approved by the Regulator. There were no recorded defects prior to or during the serious incident flight.

1.9.2 The aircraft was in radio communication with Johannesburg Area West on the very high frequency (VHF) 126.70 megahertz (MHz), as well as radar on the frequency 124.50 MHz. The PIC was responsible for the radio work and the FO was the pilot flying (PF). The crew declared a Mayday at 04:48:20Z. A transcript of the communication between the cockpit crew of ZS-DMI and the radar controller is attached to this report as Annexure B.

1.10. Aerodrome Information

Aerodrome Location	OR Tambo International Aerodrome (FAOR)	
Aerodrome Co-ordinates	26°08’01.30” South 028°14’32.34” East	
Aerodrome Elevation	5 558 feet above mean sea level	
Runway Designations	03L/21R	03R/21L
Runway Dimensions	4 421 x 60 m	3 405 x 60 m
Runway Used	03L	
Runway Surface	Asphalt	
Approach Facilities	DVOR; UHF DME; ILS LOC; ILS GP CAT II; ILS/DME, Runway lights	
Aerodrome Status	Licensed	

Note: The aerodrome chart for FAOR is attached to this report as Annexure C.

1.11. Flight recorders

1.11.1 The aircraft was equipped with flight data recorder (FDR) and a cockpit voice recorder (CVR). Neither of these units were removed from the aircraft to be downloaded as it was deemed not necessary for this investigation.

1.12. Wreckage and Impact Information

1.12.1 The aircraft-maintained flight and, following the Mayday call by the crew, they assessed the situation and informed radar control that they would be returning to FAOR.

1.13. Medical and Pathological Information

1.13.1 The PIC was issued a Class 1 aviation medical certificate on 12 April 2019 with an expiry date of 31 July 2020.

1.13.2 The FO was issued a Class 1 aviation medical certificate on 29 January 2019 with an expiry date of 31 January 2020.

1.14. Fire

1.14.1 The PIC indicated to the radar controller when he declared the Mayday call that there was fire in the cockpit; two seconds later, the PIC said it was smoke in the cockpit and not fire. The smoke was emanating from behind the left side of the cockpit instrument panel. At no stage during the flight was there a fire that needed to be extinguished by the crew.

1.15. Survival Aspects

1.15.1 The serious incident was considered survivable as no damage was caused to the cockpit or cabin structure of the aircraft. The cockpit crew fitted their respective smoke goggles, which incorporated oxygen masks as the smoke was limited to the cockpit area. The crew did not deploy the oxygen masks in the cabin area.

1.16. Tests and Research

1.16.1 Tubing installation for overhead drainage of water in the cockpit

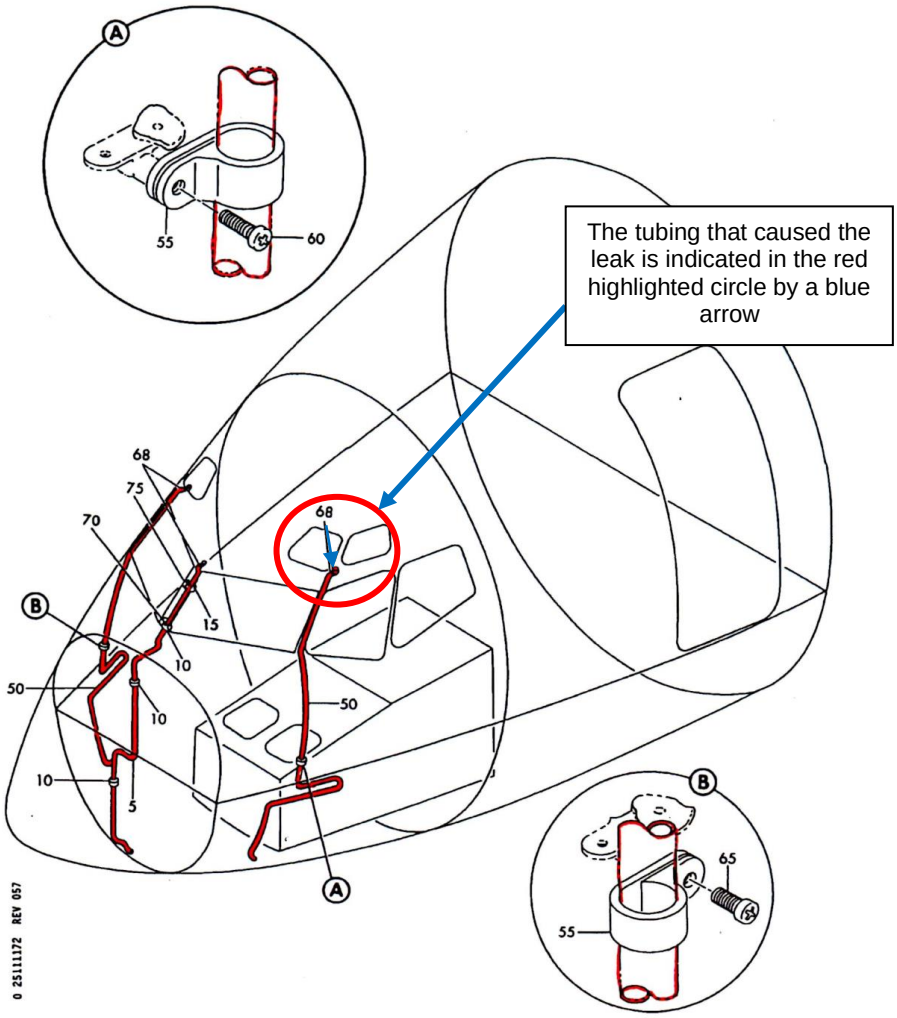
The Boeing 737-300/400/500 illustrated parts catalogue (see Figure 2) provides the reader with the schematic diagram of where the tubing is located in the cockpit to ensure that any contamination/water is drained to the atmosphere. It should be noted that the tubing on the left side (when viewed from inside the cockpit) drains water directly to the atmosphere via a drain valve. The tubing on the right and centre beam is interconnected while the plumbing routes to the drain valve. These drain valves are located on the lower fuselage and could be seen in Figure 9. The tubing routes from drip pan inside the cockpit down the fuselage to the respective drain valves located on the lower forward fuselage of the aircraft (see Figure 8). It

should be noted that these drain valves are open when the aircraft is on the ground, once in-flight and the aircraft is pressurised, these drain valves close automatically. The drip pan is an assembly which is bolted to the structure above the overhead instrument panel to insulate the area and ensure drainage. The unit consists of a moulded plastic pan with insulation blankets attached to it. Condensation collected on the outboard side of the drip pan drains through tubing into the aircraft drain system.

1.16.2 The Boeing 737-300/400/500 Task Card No. 53-401-13-01, Control Cabin – Components calls for:

"Visually check all systems, components, and installation in the control cabin (Zones 101 & 102) for defects/damage, general appearance/cleanliness, loose & missing fasteners/knobs/switches, cracks, corrosion, degradation of protective coatings, correct storage, legibility of markings, evidence of overheat (where applicable), freedom of operation, excessive looseness/wear, evidence of moisture & lint accumulation, condition and security.

TASK 05-41-01-212-804, Control Cabin, Zonal Inspection (1) Do the zonal inspection, paying particular attention to the following: (d) B31-00-00-B Instrument Panel Connections including Wiring, Tubing & Clamps behind the following Instrument Panels: (1) Captain's, (2) First Officer's, (3) Centre, (4) Pilot's & Co-pilot's Lightshield, (5) Forward Overhead, (6) Aft Overhead."

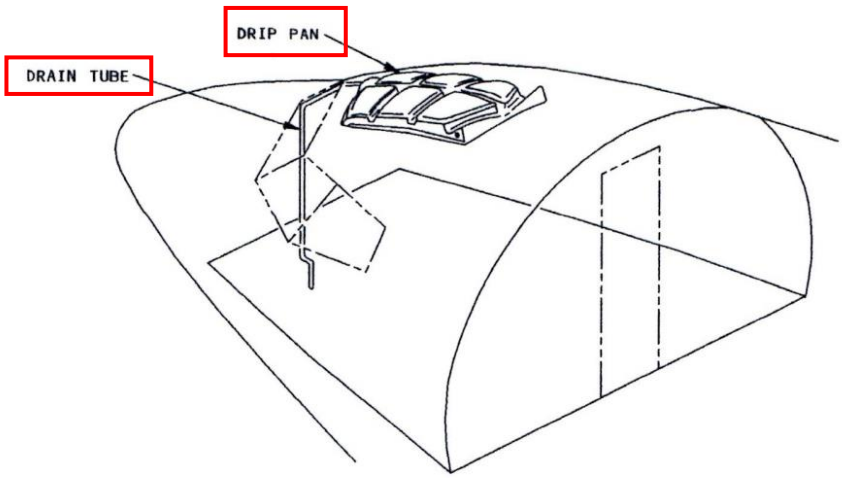


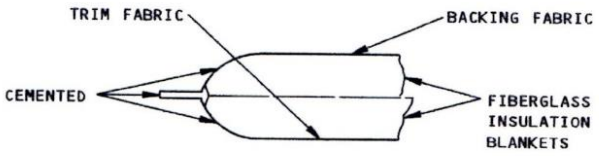
TUBING INSTL-CONT CAB. OVERHEAD DRAIN
FIGURE 72
25-11-11-72

TRX
JUL 12/07

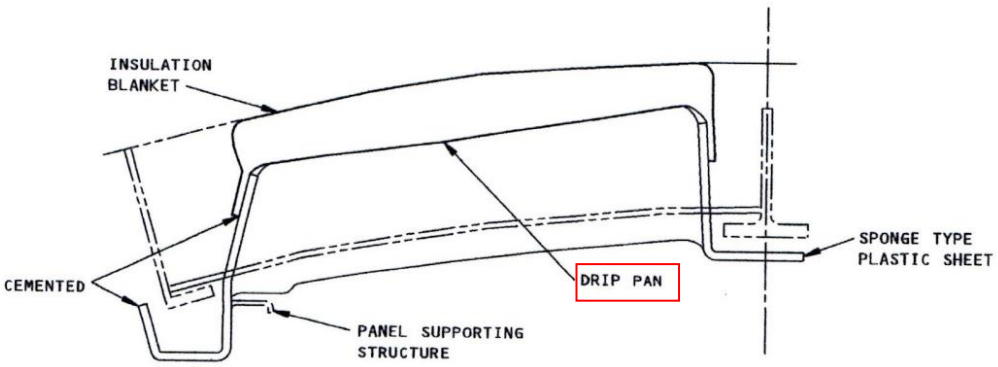
25-11-11-72
PAGE 0

Figure 2: Schematic of the tubing installation of the overhead cockpit drip pan (water drainage).





DRIP PAN INSULATION BLANKET TYPICAL SECTION



DRIP PAN INSTALLATION TYPICAL SECTION

101037 S00041215518_V1

Control Cabin Drip Pan
Figure 3/25-10-00-990-807

Figure 3: Schematic of the overhead cockpit drip pan and tubing (water drainage).

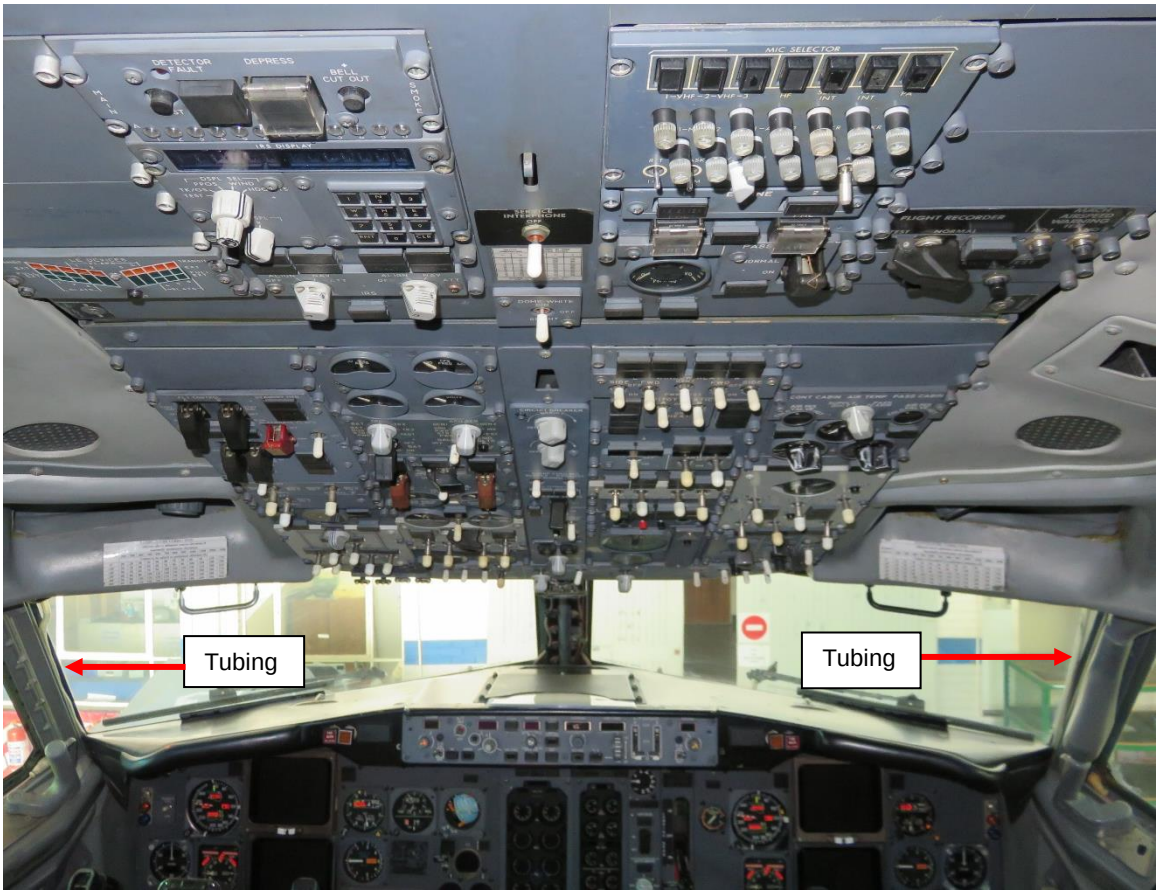


Figure 4: Cockpit of a Boeing 737-400 with the tubing (drain pipes) visible on both sides (see red arrows).

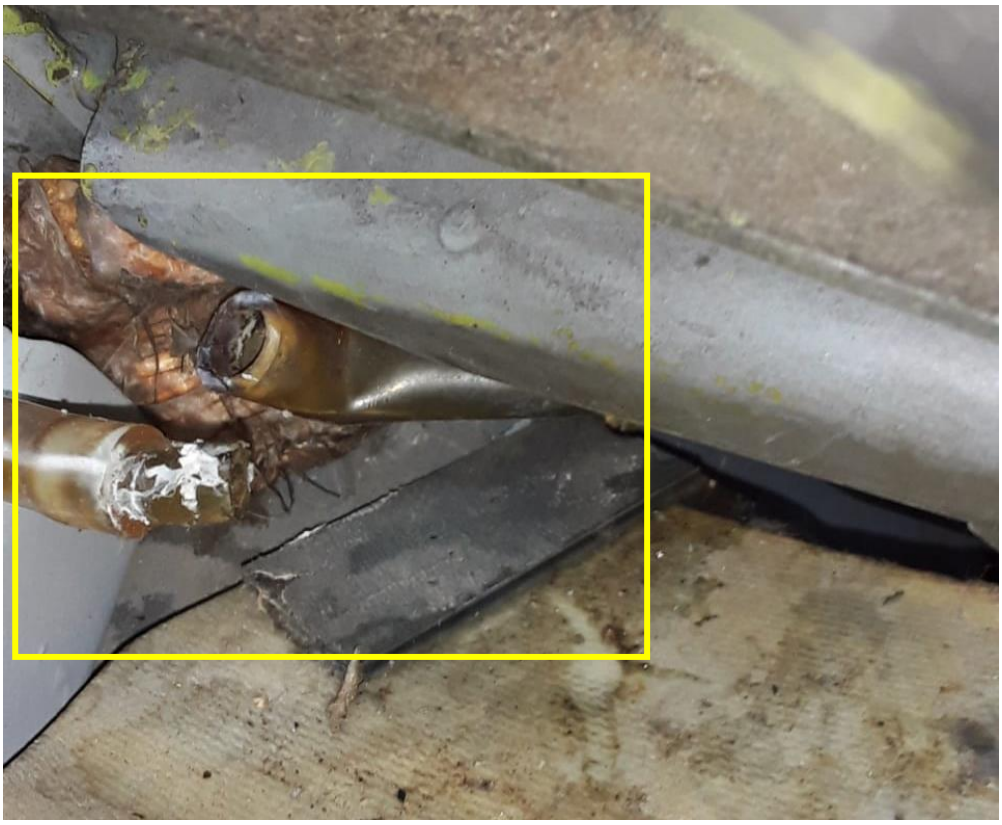


Figure 5: A dislodge water drain tube as found during an inspection by the AMO.
(Source: Safair Aviation Safety Division)

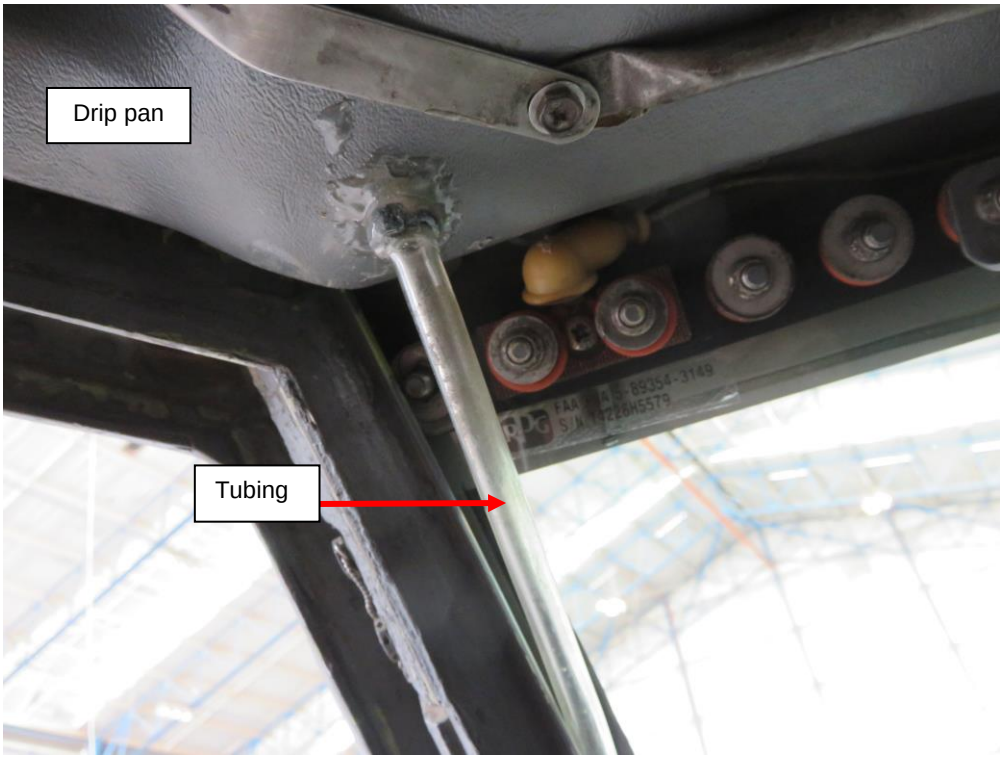


Figure 6: Tubing (drain pipe) viewed from inside the cockpit of another similar aircraft (left side).

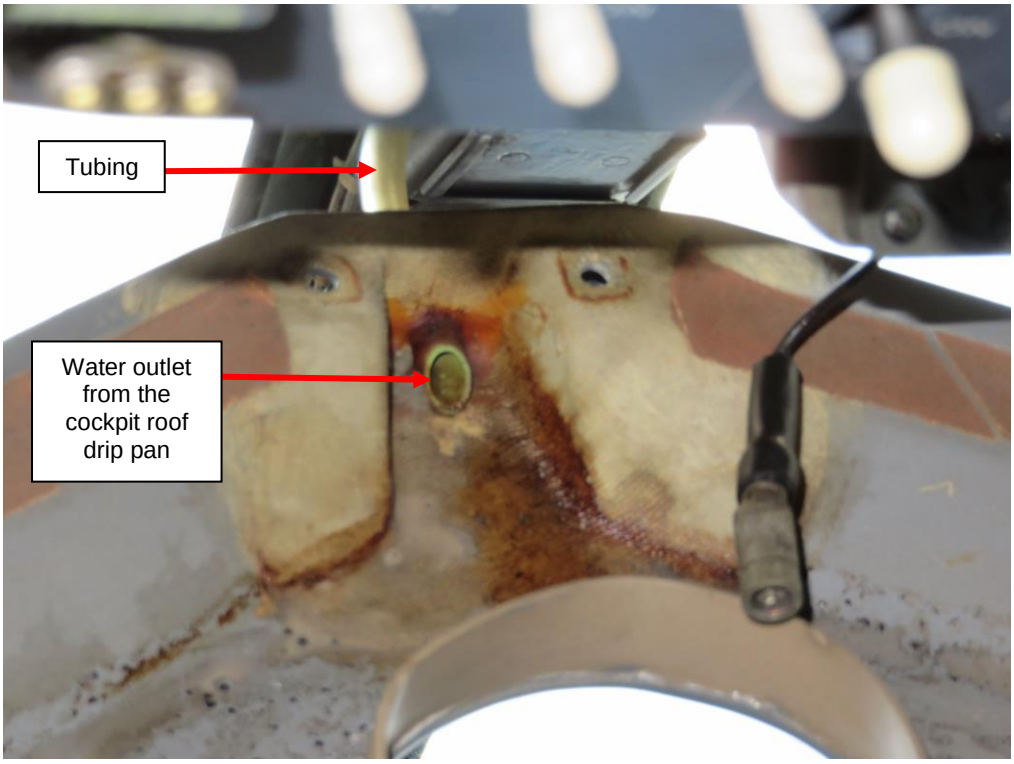


Figure 7: Overhead cockpit drip pan with visible water drain and tubing (centre console).

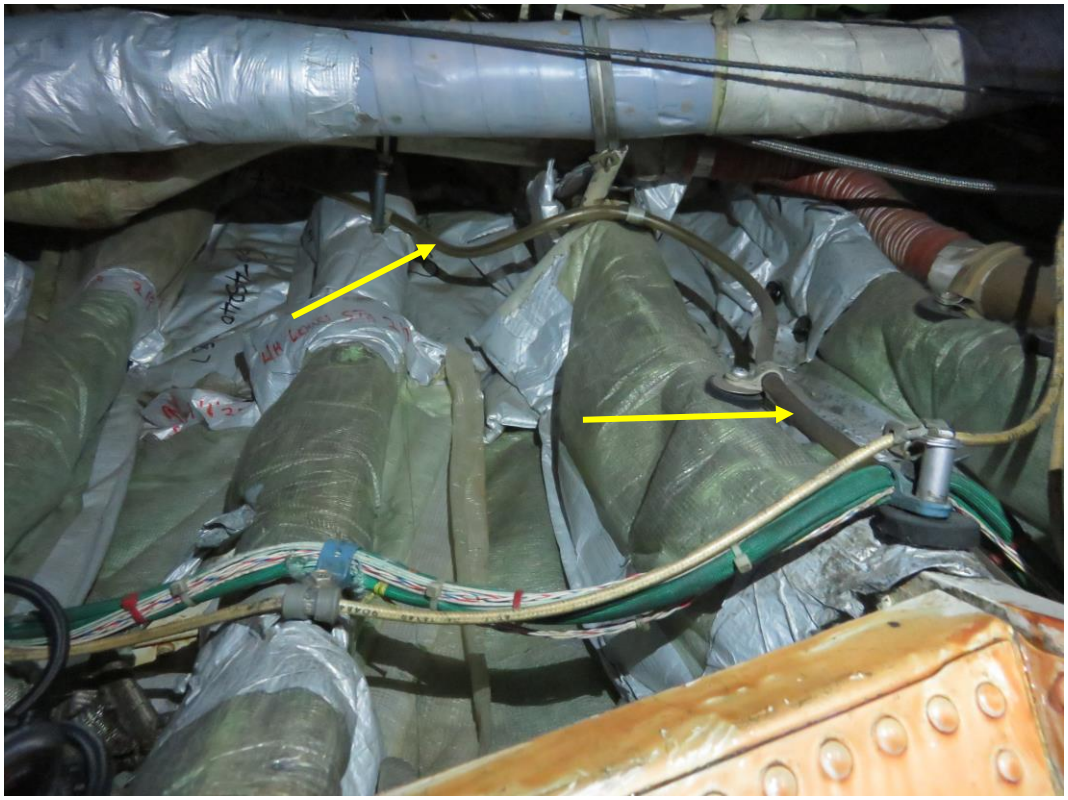


Figure 8: Tubing from the cockpit drain routing to the external drain valve on the lower fuselage.

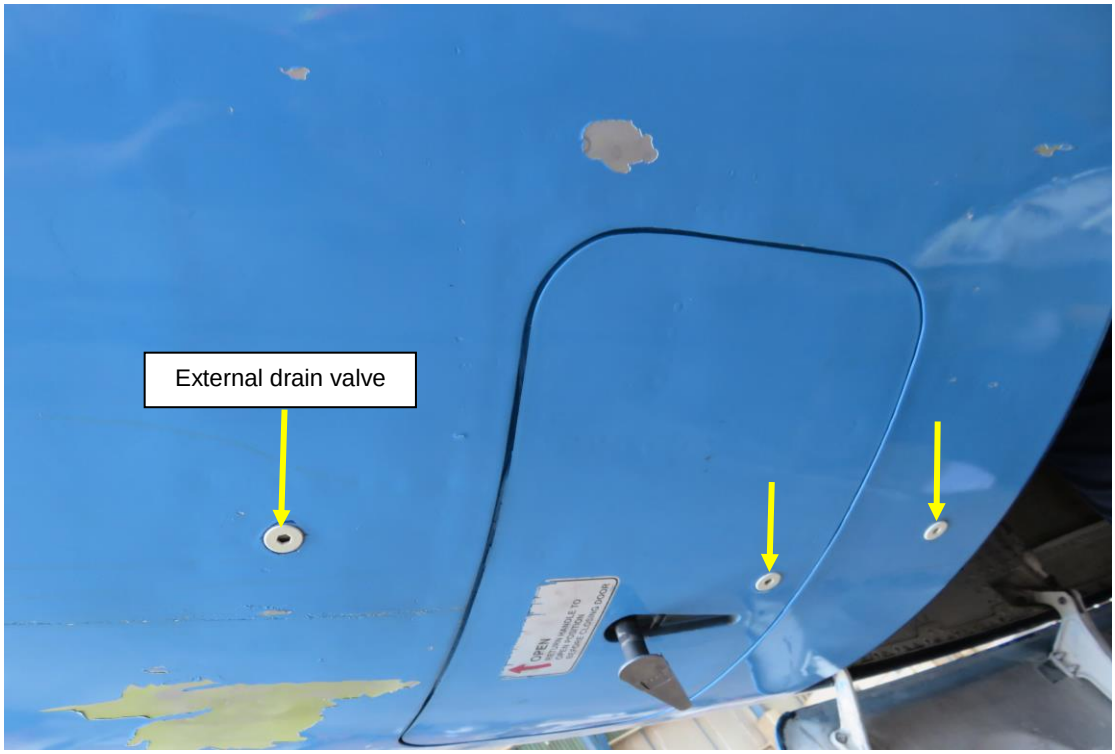


Figure 9: Three of the external drain valves visible on the lower forward fuselage of the aircraft.

1.17. Organisational and Management Information

1.17.1 The operator was issued a Class 1 Air Service Licence No. S941D on 26 March 2014 by the Department of Transport. The licence authorised the carrier to operate under categories: Type S1 – *Transport of passengers between two or more specified points*, and Type S2 – *Transport of cargo or mail between two or more specified points*. The aircraft utilised under this operation should meet category A1 provisions – *Any aircraft, excluding a helicopter, with a maximum certificated mass exceeding 20 000 kilograms.*

1.17.2 The operator was issued an Air Operating Certificate (AOC) No. CAA/N942D on 26 April 2019 by the SACAA with an expiry date of 30 April 2020. The aircraft was duly authorised to operate under the AOC.

1.17.3 The aircraft maintenance organisation (AMO) that carried out the last maintenance inspection (A-check) prior to the serious incident flight was in possession of an AMO-approval certificate number 1165 that was issued by the SACAA on 15 April 2019 with an expiry date of 31 March 2020.

1.18. Additional Information

1.18.1 Crew protection (in-flight fire, smoke and fumes)

At the first indication or suspicion of smoke and fumes, or a fire within the aircraft, the flight crew should don smoke goggles and oxygen masks. These goggles and masks need to fit tightly to minimise any ingress of smoke and fumes into the mask. It is important that the crew is familiar with operating both the oxygen and intercom functions of their protective equipment.

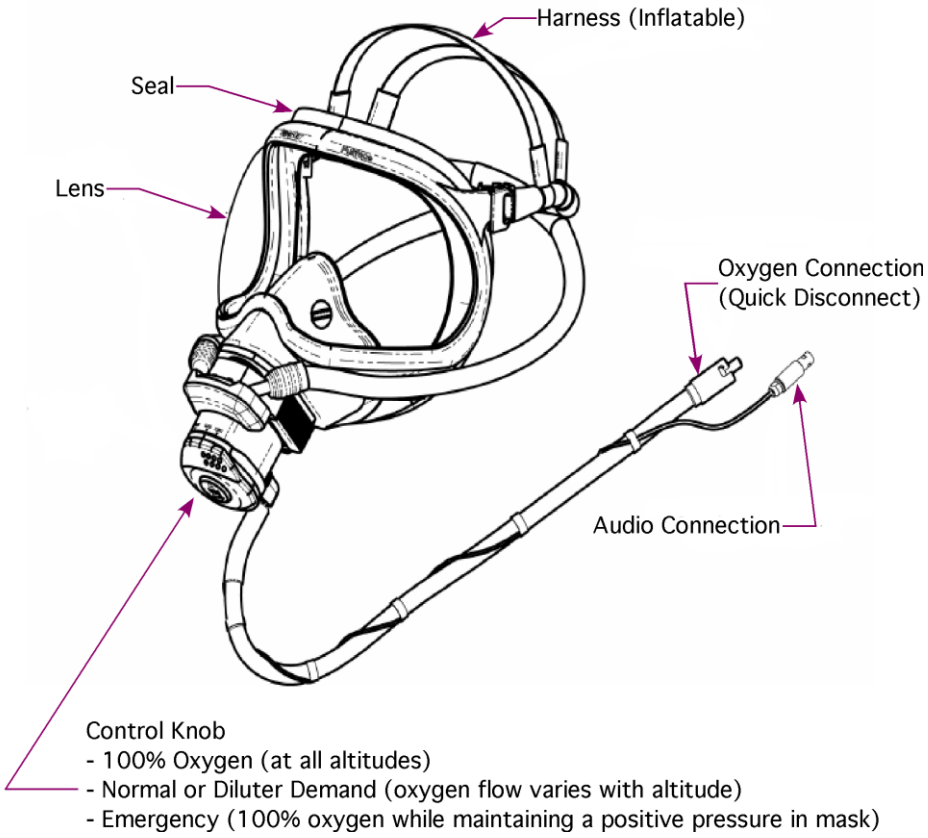


Figure 10: A smoke goggle for flight deck crew. (Source: daerospace.com/oxygen-systems/crew-masks/)

1.19. Useful or Effective Investigation Techniques

1.19.1 No new methods were used.

2. Analysis

2.1 Man (Crew)

The crew was properly rated and qualified to conduct the flight. At approximately 04:48:22Z, which was 12 minutes after take-off, the crew declared an emergency by broadcasting a Mayday, as well as requesting permission to return to FAOR while under radar control. The aircraft was instructed to turn right, descend to FL110 with no speed restrictions applicable. The crew then followed the emergency procedures for smoke, fire and fumes in the cockpit as contained in the QRH (see Annexure A).

The PIC first reported that there was fire in the cockpit; two seconds later, he said it was smoke in the cockpit, and not fire. By changing his observation from fire to smoke within seconds indicated that there might have been a flash or a spark visible when the water, which must have been a small amount, first made contact with the instrumentation/avionics. Following a flash, which was observed by the PIC, smoke then started to emanate from behind the instrument panel. There was no fire that required any radical intervention by the crew, i.e., making use of fire extinguishing units to contain the fire.

The crew fitted their smoke goggles, which incorporated oxygen masks. This observation was made when listening to the audio communication between the flight deck crew and the radar controller. The FO also confirmed that he was on oxygen, which was audible during communication with the radar controller. The oxygen masks in the cabin were not deployed as the smoke was limited to the cockpit. The smoke dissipated relatively quickly from the cockpit and it was possible for the crew to remove their smoke goggles before landing at 0506Z on Runway 03L. The decision by the crew to opt to return to FAOR was the correct one as the serious incident occurred shortly after take-off and the aircraft had to be inspected to determine the cause of flash/spark which was followed by smoke. FAOR was also the primary maintenance base for the operator. When the flight crew have to deal with any in-flight fire, smoke or bad odour/fumes, the crew needs to make a quick decision to either divert and (i) land at the nearest suitable aerodrome, or (ii) land immediately, which implies an immediate diversion to land on a runway, (iii) or landing could be imminent, this could include an off runway landing (i.e., forced landing).

2.2 Machine (Aircraft)

The aircraft flew for the first time on 8 May 1989 and was, therefore, in service for 30 years and 6 months when this serious incident occurred. From the aircraft history, which is tabled in sub-heading 1.6 of this report, it could be seen that the aircraft was registered with several airlines which operate from different geographical locations around the globe. Looking at the colour of the tubing that became dislodged from the fitting as illustrated in Figure 5 of the report, it differs substantially from the tubing which could be seen in Figure 6, which was taken from the cockpit of another aircraft of a similar type.

The tubing that was used in this application most probably became increasingly brittle as it was exposed to ultraviolet light for prolonged periods, as well as cold temperatures, which would have degraded the tubing by changing its properties, and which would have included its tensile strength and colour. Ageing of the tubing would also have had an effect as all polymers or plastics undergo some amount of degradation over time, which would cause the tubing to become less flexible and eventually split or crack.

At the time of this serious incident, the aircraft had been in service for 30 years and 6 months since new, of which 2 years were with the South African operator (C of R was issued on 14 November 2017). The tubing was an on-condition item and no record was available that the tubing on this aircraft was replaced since the aircraft was registered in South Africa. The possibility does exist that this tubing was never replaced since this aircraft entered service for the first time in 1989. It was evident from the appearance (discolouring) of the tubing that it had been subjected to prolonged environmental exposure/conditions, (i.e., ultraviolet light and cold weather conditions), as well as ageing.

2.3 Environment

On the day of the serious incident flight, it was raining at FAOR during start-up, taxi and take-off, as well as when the aircraft was en route to FAPE. The crew indicated in their statement that there was light rain with a cloud base of 200ft AGL at the time of take-off. These conditions were nothing out of the norm. With the aircraft being parked outside for some time prior to the flight, there might have been a possibility that a small amount of water could have accumulated on the upper cockpit drip pan.

This aircraft had been in service for more than 30 years when this serious incident occurred and, during its lifespan, had operated globally in different kinds of environmental conditions, which would have influenced the degradation of the tubing.

2.4 Mission

This was a scheduled domestic passenger flight from FAOR to FAPE, which was conducted under the provisions of Part 121 of the CAR 2011 as amended. Approximately 12 minutes after take-off, the PIC broadcasted a Mayday. He then

requested an air turn back to FAOR, which was granted. The crew complied with the emergency procedures as contained in the QRH and they fitted the smoke goggles and oxygen masks. With the smoke limited to the cockpit only, no oxygen masks were deployed in the cabin area. This flight, as well as the flight conditions, were nothing out of the norm.

2.5 Investigation reveal

This was the first flight of the day with this aircraft. While the aircraft was parked outside (at the aerodrome), and most probably during taxi and take-off roll, a small amount of water might have accumulated in the upper cockpit drip pan. Only once the aircraft levelled off at FL280 did the water start to drain via the tubing, which at that stage had most probably became dislodged from the fitting since it had been degrading over an undetermined period due to exposure to different environmental conditions.

The PIC who was seated on the left seat most probably did not notice this as it was slightly out of his peripheral vision. Furthermore, he was pre-occupied in monitoring the PF as they entered instrument meteorological conditions (IMC) shortly after rotation as the cloud base at FAOR at the time was reported to be at 200ft AGL.

Once the water made contact with some of the instrumentation, a flash/spark was seen, which the PIC first assessed as fire, however, shortly after, he changed his assessment of the situation to smoke in the cockpit. The crew then followed the emergency checklist for smoke, fire and fumes in the cockpit, and then broadcasted a Mayday, requesting the radar controller for an air turn back to FAOR.

3. Conclusion

3.1 Findings

3.1.1 The PIC was the holder of a valid Airline Transport Pilot Licence (ATPL). He had the aircraft type endorsed on his licence. He was issued a Class 1 aviation medical certificate on 12 April 2019 with an expiry date of 30 April 2020.

3.1.2 The FO was in possession of a valid Airline Transport Pilot Licence (ATPL). He had the aircraft type endorsed on his licence. He was issued a Class 1 aviation medical certificate on 29 January 2019 with an expiry date of 31 January 2020.

3.1.3 The crew declared an emergency by broadcasting a Mayday requesting permission to return to FAOR.

3.1.4 The radar controller granted permission for the aircraft to return to FAOR and provided the crew with vectors for a landing on Runway 03L.

3.1.5 The aircraft was issued a Certificate of Airworthiness (C of A) on 14 December 2017 with an expiry date of 31 December 2020.

3.1.6 The aircraft was issued a Certificate of Release to Service on 6 November 2019 at 80 762.00 airframe hours. The certificate was due to lapse at 81062 airframe hours.

3.1.7 The last maintenance inspection (A-check) that was carried out on the aircraft prior to the serious incident flight was certified on 11 November 2019 at 80 762.00 airframe hours. Following the inspection, a further 107.61 hours were flown with the aircraft.

3.1.8 No data from the FDR or CVR was downloaded as it was deemed not necessary for the purpose of this investigation.

3.1.9 According to available data, the first flight for this aircraft was on 8 May 1989. It was imported to South Africa from Russia (Transaero Airlines) and was registered on the SA Register on 14 November 2017 with the current operator.

3.1.10 The aircraft had been in service for 30 years and 6 months at the time of the serious incident, of which the last 2 years were in South Africa.

3.1.11 The flight was conducted under instrument flight rules (IFR) during daylight.

3.1.12 The prevailing weather conditions at the time were overcast with rain at FAOR, as well as en route to FAPE.

3.1.13 The operator was in possession of a valid Air Service Licence No. S941D that was issued by the Department of Transport on 26 March 2014.

3.1.14 The operator was issued an Air Operating Certificate (AOC) No. CAA/N942D on 26 April 2019 by the SACAA with an expiry date of 30 April 2020. The aircraft was duly authorised under the AOC.

3.1.15 The aircraft landed safely on Runway 03L at 0506Z, and no injuries were reported.

3.1.16 This was an off-site investigation by AIID, with information being source from the operator to compile this report.

3.1.17 The operator had taken immediate safety action following the serious incident which called for the inspection of the drip pan and tubing as per Boeing AMM 25-11-21 task.

3.1.18 The investigation revealed that during the climb, the tubing draining water from the overhead cockpit drip pan became dislodged and water made contact with some of the instrumentation, which caused smoke in the cockpit.

3.2 Probable cause

3.2.1 The tubing was found to have been exposed to prolonged environmental conditions as well as ageing, which caused it to become hard and brittle, and subsequently became dislodged from a connection fitting which allowed water from the overhead drip pan to leak onto the back of some of the instrumentation situated on the left side (pilot-in-command) of the cockpit. This caused arcing (flash was seen) followed by smoke in the cockpit.

4. Safety Recommendation

4.1 The aircraft operator advised that as a result of this serious incident, they had issued an immediate special inspection on all Boeing 737 series aircraft in their fleet.

The inspection calls for the proper security of the overhead drip pan, which is bolted to the structure above the overhead instrument panel with special emphasis on the security of the tubing (PIC and FO sides) that drains water from the drip pan into the aircraft drain system. This inspection was signed off in the Aircraft Technical Log Report for each of the respective aircraft by the aircraft maintenance engineer (AME) responsible for the task, which was conducted in accordance with AMM 25-11-21, Task 25-11-21-002-031, (see Annexure D).

4.2 Safety Message: This inspection should be conducted on a regular basis to prevent a recurrence of this serious incident. This inspection does not have to be limited to the operator in question but should be applicable to all aircraft owners/operators that are operating the Boeing 737 series of aircraft with this configuration installed as discussed in this report.

5. Appendices

5.1 Annexure A (Emergency checklist for: Smoke, Fire and Fumes)
5.2 Annexure B (Communication between radar controller and flight SFR369)
5.3 Annexure C (Aerodrome chart for FAOR)
5.4 Annexure D (Boeing AMM 25-11-21, Task 25-11-21-002-031)

This report is issued by:

Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa

Smoke, Fire or Fumes

Condition: Smoke, fire or fumes occur.

1 Diversion may be needed.

2 Don oxygen masks and set regulators to 100%, as needed.

3 Don smoke goggles, as needed.

4 Choose one:

◆Smoke or fumes **affect** vision:

Use the EMERGENCY position on the oxygen regulator to clear the goggles.

►►**Go to step 5**

◆Smoke or fumes do **not** affect vision:

►►**Go to step 5**

5 Establish crew and cabin communications.

6 BUS TRANSFER switch . . . . . OFF

24165, 25116 - 28891

7 GALLEY switch . . . . . OFF

25095, 25096

8 GALLEY/IFE switch . . . . . OFF

9 RECIRC FAN switches (both) . . . . . OFF

10 Instruct the cabin crew to turn off the IFE and PC power switches (as installed).

11 APU BLEED air switch . . . . . OFF

▼ Continued on next page ▼

▼Smoke, Fire or Fumes continued▼

12 **Anytime** the smoke or fumes become the greatest threat:

►►**Go to the Smoke or Fumes Removal checklist on page 8.20**

13 Choose one:

◆Source of the smoke, fire or fumes is **obvious and** can be **extinguished quickly**:

Isolate and extinguish the source.

If possible, remove power from the affected equipment by switch or circuit breaker in the flight deck or cabin.

►►**Go to step 14**

◆Source of the smoke, fire or fumes is **not** obvious **or cannot** be extinguished quickly:

►►**Go to step 15**

▼ Continued on next page ▼

▼Smoke, Fire or Fumes continued▼

14 Choose one:

◆Source is **visually confirmed** to be extinguished **and** the smoke or fumes are **decreasing**:

Continue the flight at the captain's discretion.

Restore unpowered items at the captain's discretion.

►►Go to the Smoke or Fumes Removal checklist on page 8.20, if needed

■ ■ ■ ■

◆Source is **not** visually confirmed to be extinguished **or** smoke or fumes are **not** decreasing:

►►Go to step 15

15 EQUIP COOLING SUPPLY and EXHAUST switches (both) . . . . . ALTERNATE

16 Instruct the cabin crew to:

Turn on cabin reading lights.

Turn on galley attendants work lights.

Turn off cabin fluorescent light switches.

17 Divert to the nearest suitable airport while continuing the checklist.

18 Consider an immediate landing if the smoke, fire or fumes situation becomes uncontrollable.

▼ Continued on next page ▼

▼Smoke, Fire or Fumes continued▼

19 Do **not** delay landing in an attempt to complete all of the following steps.

20 ISOLATION VALVE switch . . . . . CLOSE

21 R PACK switch . . . . . OFF

22 **Wait** 2 minutes unless the smoke or fumes are increasing. This allows time for the smoke or fumes to clear.

23 Choose one:

◆Smoke or fumes are **decreasing**:

►►Go to the Smoke or Fumes Removal checklist on page 8.20, if needed

■ ■ ■ ■

◆Smoke or fumes **continue or are increasing**:

R PACK switch . . . . . AUTO

L PACK switch . . . . . OFF

►►Go to step 24

24 **Wait** 2 minutes unless the smoke or fumes are increasing. This allows time for the smoke or fumes to clear.

▼ Continued on next page ▼

▼Smoke, Fire or Fumes continued▼

25 Choose one:

◆Smoke or fumes are **decreasing**:

►►**Go to the Smoke or Fumes Removal checklist on page 8.20, if needed**

■ ■ ■ ■

◆Smoke or fumes **continue or are increasing**:

L PACK switch . . . . . AUTO

Consider an immediate landing.

►►**Go to the Smoke or Fumes Removal checklist on page 8.20, if needed**

■ ■ ■ ■

APU DET INOP

APU DETECTION INOPERATIVE

Condition: APU fire detection is inoperative.

1 APU switch. . . . . OFF

Caution! Do not run the APU. An APU fire would not be detected and the APU would continue to run.

■ ■ ■ ■

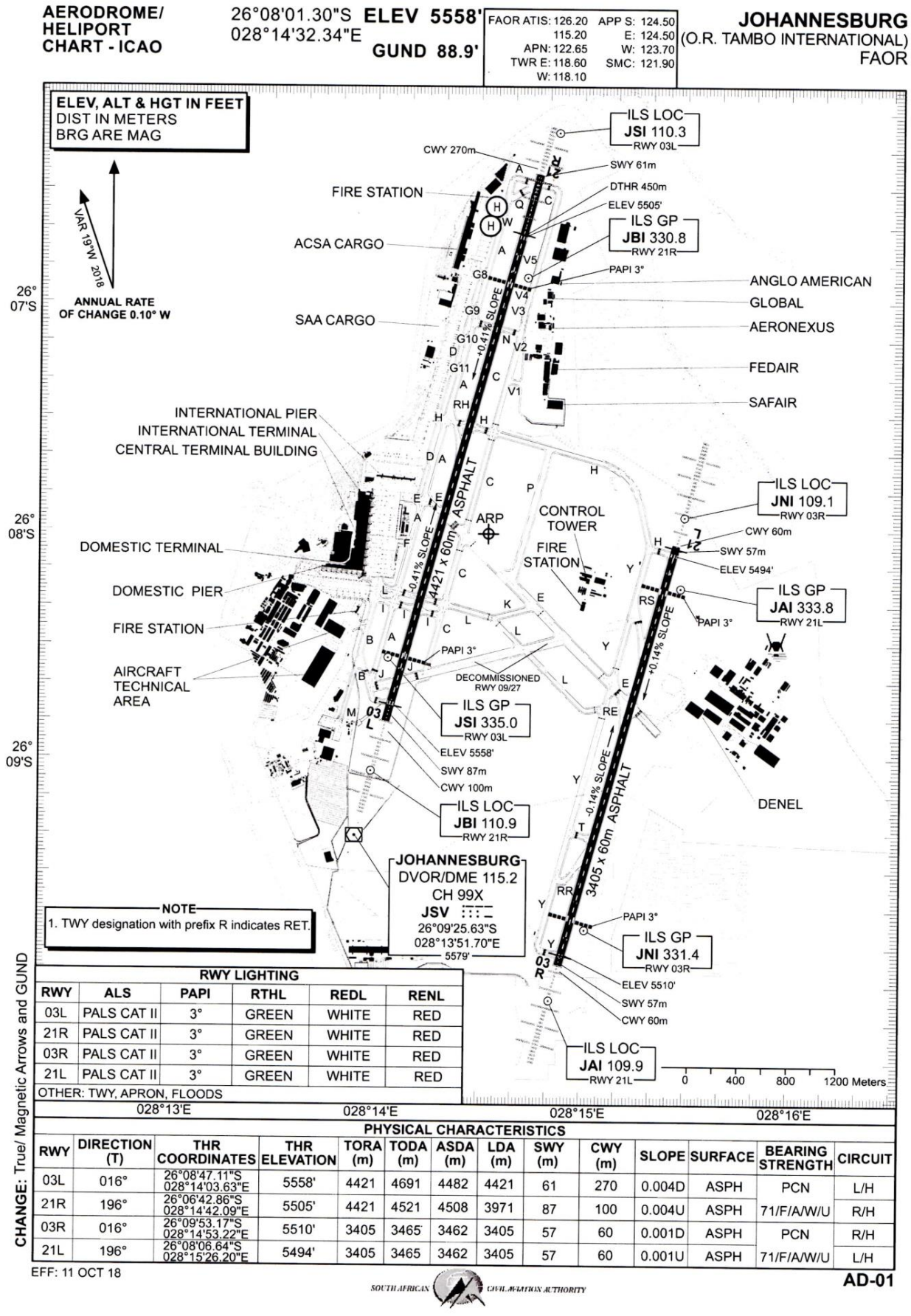
ANNEXURE B

This is a transcript of the communication between Johannesburg Area and Radar and the PIC who was doing most of the radio work as well as the FO of the aircraft ZS-DMI (Boeing 737-400). The frequency use for Area was 126.70 and for Radar was 124.50 MHz.

Time	From	To	Message
04:48:20	ZS-DMI	Area	Mayday Mayday Mayday (*Radio call not clearly audible*)
04:48:25	Area	ZS-DMI	Last call for the Mayday, say again?
04:48:28	ZS-DMI	Area	Safair 369 Mayday Mayday Mayday
04:48:36	Area	ZS-DMI	Safair 369 go ahead with the emergency?
04:48:41	ZS-DMI	Area	We would like to return to Johannesburg we have fire in the cockpit .....(*brief pause*) ……smoke in the cockpit
04:48:47	Area	ZS-JRM	Safair 369 turn right route direct for the course fix, no speed restrictions and when ready descent to flight level 160
04:48:56	ZS-DMI	Area	Say again please?
04:48:58	Area	ZS-DMI	Safair 369 turn right route direct for the course fix, no speed restrictions
04:49:02	ZS-DMI	Area	No speeds, level 160 to descent for the course fix Safair 369
04:50:06	Area	ZS-DMI	Safair 369 you can turn for runway 03 left
04:50:20	Area	ZS-DMI	Safair 369 I will broadcast blind you can plan for landing runway 03 left
04:50:39	ZS-DMI	Area	Control, Safair 369, please say again? (*Pilot on oxygen*)
04:50:43	Area	ZS-DMI	Safair 369 landing runway 03 left, route course fix, 03 left
04:50:48	ZS-DMI	Area	Routing course fix, 03 left, Safair 369 thank you
04:50:55	FO	PIC	Kan jy my hoor kaptein? Okay, first officer on oxygen
04:51:01	FO		Right level change, for 73 for descent right turn onto heading 080 standing by the course fix
04:51:23	FO	PIC	No problem I am descending at 300 knots in CP speed for the course fix
04:51:35	FO		Checked
04:51:41	Area	ZS-DMI	Safair 369 if you have a chance please report persons on board and fuel endurance?
04:51:47	ZS-DMI	Area	Wilco, Safair 369
04:53:30	ZS-DMI	Area	Safair 369 is approaching level 120, confirm further
04:53:37	Area	ZS-DMI	Safair 369 descent to flight level 110, contact radar 124.5
04:53:42	ZS-DMI	Area	124.5 confirm, …*not audible* …, Safair 369
04:53:06	Area	ZS-DMI	Safair 369, affirm
04:53:48	ZS-DMI	Area	124.5, Safair 369
			Intentionally left blank
04:54:09	ZS-DMI	Radar	Safair 369, good morning passing level 152 for 110
04:54:14	Radar	ZS-DMI	Safair 369, good day, runway 03 left
04:54:17	ZS-DMI	Radar	Copied runway 03 left, Safair 369

04:54:27	Radar	ZS-DMI	Safair 369 your persons on board and fuel endurance please?
04:54:31	ZS-DMI	Radar	Standby Sir I will get back to you.
04:56:26	ZS-DMI	Radar	Area, Safair 369 Mayday information as follows, ready to copy?
04:56:33	Radar	ZS-DMI	Affirm, Affirm
04:56:36	ZS-DMI	Radar	Okay, we are 4 …5 crew members and we got 166 passengers on board, no dangerous goods, with 4 hours endurance of fuel
04:56:46	Radar	ZS-DMI	Copied, 5, 166, 4 hours endurance
04:56:50	ZS-DMI	Radar	Affirm
04:56:53	Radar	ZS-DMI	Safair 369 descent to level 100
04:56:59	Radar	ZS-DMI	Safair 369 descent to level 100
04:57:02	ZS-DMI	Radar	Level 100, Safair 369
04:59:07	ZS-DMI	Radar	Area, correction radar, Safair 369 Mayday require heading of 360 for the next 10 miles or so then we will route back to the centre fix.
04:59:16	Radar	ZS-DMI	Safair 369 heading 360 is approved report ready for the approach
04:59:22	ZS-DMI	Radar	Wilco, Safair 369
04:59:26	Radar	ZS-DMI	Safair 369 decent to 90
04:59:30	ZS-DMI	Radar	Descent 90, Safair 369
05:00:58	ZS-DMI	Radar	Radar, Safair 369 Mayday turning onto a heading of 020
05:01:04	Radar	ZS-DMI	Safair 369 heading is approved
05:01:07	ZS-DMI	Radar	Thank you, Safair 369 Mayday
05:01:13	Radar	ZS-DMI	Safair 369 descent altitude 8000 feet, QNH 1020
05:01:18	ZS-DMI	Radar	That is 1020, 8000 feet, Safair 369
05:02:18	ZS-DMI	Radar	Radar, Safair 369 Mayday routing centre fix runway 03 left
05:02:24	Radar	ZS-DMI	Safair 369 routing core fix runway 03 left clear the ILS approach
05:02:30	ZS-DMI	Radar	Clear for the ILS approach, 03 left, Safair 369
05:02:33	Radar	ZS-DMI	Safair 369 descent altitude 7000
05:02:39	ZS-DMI	Radar	Say again, Safair 369?
05:02:42	Radar	ZS-DMI	Safair 369 descent 7000 till you're on the slope
05:02:45	ZS-DMI	Radar	7000 on the slope, Safair 369 Mayday
05:03:40	Radar	ZS-DMI	Safair 369 report establish on the localiser
05:03:44	ZS-DMI	Radar	Wilco, Safair 369
05:03:52	ZS-DMI	Radar	Safair 369 we are established on the localiser for runway 03 left
05:03:57	Radar	ZS-DMI	Safair 369 thanks, contact the tower on 118.1.
05:04:00	ZS-DMI	Radar	118.1, Safair 369 Mayday

ANNEXURE C



RWY LIGHTING

RWY	ALS	PAPI	RTHL	REDL	RENL
03L	PALS CAT II	3°	GREEN	WHITE	RED
21R	PALS CAT II	3°	GREEN	WHITE	RED
03R	PALS CAT II	3°	GREEN	WHITE	RED
21L	PALS CAT II	3°	GREEN	WHITE	RED

OTHER: TWY, APRON, FLOODS

PHYSICAL CHARACTERISTICS

RWY	DIRECTION (T)	THR COORDINATES	THR ELEVATION	TORA (m)	TODA (m)	ASDA (m)	LDA (m)	SWY (m)	CWY (m)	SLOPE	SURFACE	BEARING STRENGTH	CIRCUIT
03L	016°	26°08'47.11"S 028°14'03.63"E	5558'	4421	4691	4482	4421	61	270	0.004D	ASPH	PCN	L/H
21R	196°	26°06'42.86"S 028°14'42.09"E	5505'	4421	4521	4508	3971	87	100	0.004U	ASPH	71/F/A/W/U	R/H
03R	016°	26°09'53.17"S 028°14'53.22"E	5510'	3405	3465	3462	3405	57	60	0.001D	ASPH	PCN	R/H
21L	196°	26°08'06.64"S 028°15'26.20"E	5494'	3405	3465	3462	3405	57	60	0.001U	ASPH	71/F/A/W/U	L/H

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AD-01

D. Procedure

SUBTASK 25-11-21-342-070

(1) Refer to PAGEBLOCK 25-01-12/801, Equipment/Furnishings - Repairs, for these procedures:

(a) Repair of Insulation Blanket and Cover.

(b) Insulation Blanket Manufacturing.

——— END OF TASK ———

TASK 25-11-21-002-031

7. Flight Compartment Drip Pan Removal

(Figure 203)

A. Location Zones

Zone	Area
101	Control Cabin - Left
102	Control Cabin - Right

B. Procedure

SUBTASK 25-11-21-012-032

(1) Remove the overhead instrument panels.

SUBTASK 25-11-21-012-033

(2) Remove the adjacent lining panels.

SUBTASK 25-11-21-012-034

(3) Remove the structure which holds the panels.

SUBTASK 25-11-21-032-035

(4) Remove the wire supports and the clips.

SUBTASK 25-11-21-032-036

(5) Disconnect the wire where it is necessary.

SUBTASK 25-11-21-032-037

(6) Loosen the wire bundles where it is necessary.

SUBTASK 25-11-21-012-038

(7) Disconnect the drain line.

SUBTASK 25-11-21-022-039

(8) Remove the remaining fasteners.

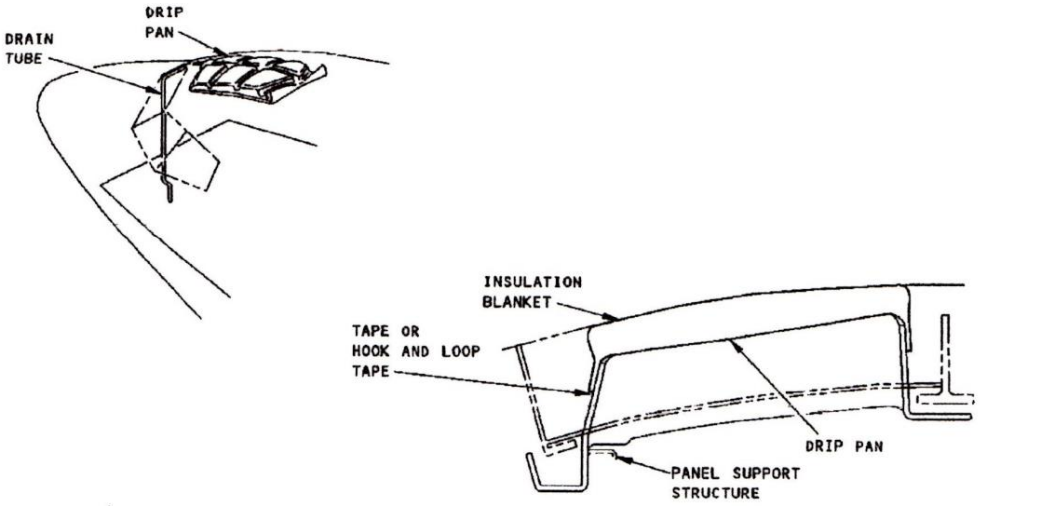
SUBTASK 25-11-21-022-040

(9) Push the wire bundles out of the holes to remove the drip pan.

SUBTASK 25-11-21-212-041

(10) Examine for loose insulation and for damaged insulation pads.

——— END OF TASK ———



Flight Compartment Drip Pan Installation
Figure 203/25-11-21-990-803

TASK 25-11-21-402-042

8. **Flight Compartment Drip Pan Installation**
(Figure 203)

A. Location Zones

Zone	Area
101	Control Cabin - Left
102	Control Cabin - Right

B. Procedure

SUBTASK 25-11-21-422-043

(1) Put the drip pan into its position and install it with the bolts.

SUBTASK 25-11-21-412-044

(2) Connect the cooling and drain lines.

SUBTASK 25-11-21-432-045

(3) Put the wire bundles into their correct positions and attach the bundles where it is necessary.

SUBTASK 25-11-21-432-046

(4) Connect the wire where it is necessary.

SUBTASK 25-11-21-412-047

(5) Install the wire supports and the clips.

SUBTASK 25-11-21-412-048

(6) Install the structure which holds the panels.

SUBTASK 25-11-21-412-049

(7) Install the lining panels.

SUBTASK 25-11-21-412-050

(8) Install the instrument panels.

——— END OF TASK ———

TASK 25-11-21-002-051

9. **Flight Compartment Crash Padding Removal**

(Figure 204)

A. **Location Zones**

Zone	Area
101	Control Cabin - Left
102	Control Cabin - Right

B. **Procedure**

SUBTASK 25-11-21-012-052

(1) Remove the equipment where it is necessary to get access to the crash pad.

SUBTASK 25-11-21-022-053

(2) Pull off the crash pad, if it is necessary.

——— END OF TASK ———