AIRCRAFT ACCIDENT

FINAL REPORT

A 05/23P

Air Accident Investigation Bureau (AAIB)

Ministry of Transport Malaysia

Accident Involving Fixed Wing Aircraft Hawker Beechcraft 390 Premier 1, Registration N28JV, at Elmina, Shah Alam, Selangor on 17 August 2023

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FINAL REPORT A 05/23P

AIR ACCIDENT INVESTIGATION BUREAU (AAIB)
MALAYSIA

ACCIDENT REPORT NO: A 05/23P

OPERATOR	**: JET VALET SDN BHD**[1] **(PRIVATE OPERATOR)**
AIRCRAFT TYPE	**: HAWKER BEECHCRAFT 390 PREMIER 1**
NATIONALITY	**: UNITED STATES OF AMERICA**
REGISTRATION	**: N28JV**
PLACE OF OCCURRENCE	**: ELMINA, SHAH ALAM, SELANGOR, MALAYSIA**
DATE AND TIME	**: 17 AUGUST 2023 AT 1449 LT (0649 UTC)**

The sole objective of the investigation is the prevention of accidents and incidents. In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of this investigation to apportion blame or liability.

All times in this report are Local Time (LT) unless stated otherwise. LT is Coordinated Universal Time (UTC) + 8 hours.

[1] Jet Valet Sdn Bhd is a private operator and does not hold any certificate or approval from the Civil Aviation Authority of Malaysia (CAAM) as an aircraft operator under Malaysian regulations. For the purposes of clarity and consistency in this report, Jet Valet Sdn Bhd is referred to as the operator of the aircraft.

INTRODUCTION

The Air Accident Investigation Bureau (AAIB) is the authority responsible for investigating air accidents and incidents in Malaysia, operating under the Ministry of Transport. The AAIB's mission is to promote aviation safety through independent and objective investigations into air accidents and serious incidents. Additionally, the AAIB investigates incidents that reveal potential safety issues.

All investigations by the AAIB are conducted in accordance with Annex 13 to the Convention on International Civil Aviation (ICAO Annex 13) and the Civil Aviation Regulations 2016. It is important to note that AAIB reports are not intended to apportion blame or determine liability, as neither the investigations nor the reporting processes are designed for those purposes. The sole objective of this investigation and the Final Report is the prevention of accidents and incidents.

In accordance with ICAO Annex 13, notification of the accident was sent to the National Transportation Safety Board (NTSB) of the United States, the State of Registry, Design, and Manufacture, on 19 August 2023. An Accident/Incident Data Reporting (ADREP) notification was sent to ICAO on 20 August 2023. The Preliminary Report was submitted on 15 September 2023 to the aforementioned organisations, the Civil Aviation Authority of Malaysia (CAAM), and the aircraft operator. The Draft Final Report was subsequently sent on 14 June 2024 to these same organisations and the Transport Safety Investigation Bureau (TSIB) of Singapore, which participated in the investigation, inviting their significant and substantiated comments.

The AAIB extends its deepest appreciation to the NTSB and TSIB for their extensive and valuable assistance in the investigation of this accident, provided through their respective Accredited Representatives and teams.

Unless otherwise indicated, recommendations in this report are addressed to the investigating or regulatory authorities of the State responsible for the matters concerning the recommendations. It is up to those authorities to decide what actions to take.

TABLE OF CONTENTS

LIST OF APPENDICES

GLOSSARY OF ABBREVIATIONS

A

AAIB	Air Accident Investigation Bureau
ADREP	Accident/Incident Data Reporting
ADS-B	Automatic Dependent Surveillance-Broadcast
AIK	Accident Investigator's Kit
AMEL	Airplane Multi Engine Land
AOC	Air Operator's Certificate
APHB	AP Holding Berhad
AR	Accredited Representative
ATC	Air Traffic Controller
ATCO	Air Traffic Controller Officer
ATP	Acceptance Test Procedure
ATPL	Air Transport Pilot License

C

CAAM	Civil Aviation Authority of Malaysia
CAD	Civil Aviation Directive
CAM	Cockpit Area Microphone
CB	Cumulonimbus Cloud
CE	Caledonian NDB
CFR	Code of Federal Regulation
CH	channel
CRM	Crew Resource Management
CSMU	Crash Survivable Memory Unit
CT	Computed Tomography
CVR	Cockpit Voice Recorder

D

DME	Designated Medical Examiner
DNA	Deoxyribonucleic acid

E

EXT	Extend
EGPWS	Enhanced Ground Proximity Warning System
ECU	Engine Control Unit

F

FAA	Federal Aviation Administration, United States of America
FAOC	Foreign Air Operator’s Certificate
FAR	Federal Aviation Regulation
FDR	Flight Data Recorder

H

hrs	hours
HMU	Hydromechanical Unit
HSCM	Hydraulic Spoiler Control Module
HPC	High-Pressure Compressor
HPT	High-Pressure Turbine
HQC	High-Quality Channel

I

IC	integrated circuit
ICAO	International Civil Aviation Organisation
ICU	Intercom Communication Unit
IP	Intermediate Pressure

K

KAPB	Koperasi Amanah Pelaburan Berhad
KB	kilobytes

L

LED	light-emitting diode
LH	left-hand
LLC	Limited Liability Company
LOC-I	Loss of Control – Inflight

LP	Low Pressure
LT	Local Time
LVDT	Linear Voltage Differential Transformer

M

m	metres
METAR	Meteorological Aerodrome Report
MOR	Mandatory Occurrence Report

N

N/A	not available
NDB	Non-Directional Beacon
nm	nautical miles
NVM	non-volatile memory
NTSB	National Transport Safety Board

O

OEM	original equipment manufacturer

P

PCB	printed circuit board
PIC	Pilot-In-Command
PF	Pilot Flying
PNF	Pilot Non-Flying

R

RET	Retract
RH	right-hand
ROSE	Readout Support Equipment
RPM	revolution per minute

S

SCU	Spoiler Control Unit
SIC	Second-in-Command

SOP	Standard Operating Procedures
STRIDE	Science and Technology Research Institute for Defence

T

TSIB	Transport Safety Investigation Bureau, Singapore

U

UFN	until further notice
UTC	Coordinated Universal Time

V

VRB	variable
VRMS	volts root mean square

W

WAV	Waveform Audio File Format
WMKL	Langkawi International Airport
WMSA	Subang (Sultan Abdul Aziz Shah Airport)

FINAL REPORT A 05/23P

SYNOPSIS

On 17 August 2023, at approximately 1408 LT, a Hawker Beechcraft Model 390 Premier 1, with the call sign N28JV, operated by Jet Valet Sdn Bhd, departed from Langkawi International Airport (WMKL), Langkawi, Kedah, enroute to Sultan Abdul Aziz Shah Airport (WMSA), Subang, Selangor. At around 1449 LT, N28JV impacted the ground while manoeuvring for landing at WMSA, Subang, Selangor. The airplane was destroyed following the ground impact and subsequent fire. All eight occupants and two ground bystanders were fatally injured.

A Mandatory Occurrence Report (MOR) was submitted by the Civil Aviation Authority of Malaysia (CAAM) Subang to the Air Accident Investigation Bureau of Malaysia (AAIB) as notification of the incident.

1.0 FACTUAL INFORMATION

1.1 History of the Flight

N28JV departed WMKL with eight persons on board at approximately 1408 LT, heading to WMSA. At around 1446 LT, N28JV contacted the WMSA air traffic tower controller to report it was established on the NBD Runway 15 approach and requested landing clearance. At 1448:36 LT, N28JV was cleared to land on Runway 15. The flight acknowledged the clearance at 1448:41 LT. No further radio transmissions were heard from the flight.

Automatic Dependent Surveillance–Broadcast (ADS-B) data indicated that at 1447:24 LT, at an altitude of 2,600 feet, the aircraft began a speed reduction and descent. At approximately 1449:06 LT, at an altitude of 1,025 feet, the aircraft initiated a right turn, continuing until about 1449:14 LT, when it was at an indicated height of 550 feet. This was the last recorded data transmission from the accident flight, which was near the accident location. The ground speed during the right turn ranged between 146 and 154 knots. The aircraft crashed at Persiaran Elmina, Elmina, Shah Alam.

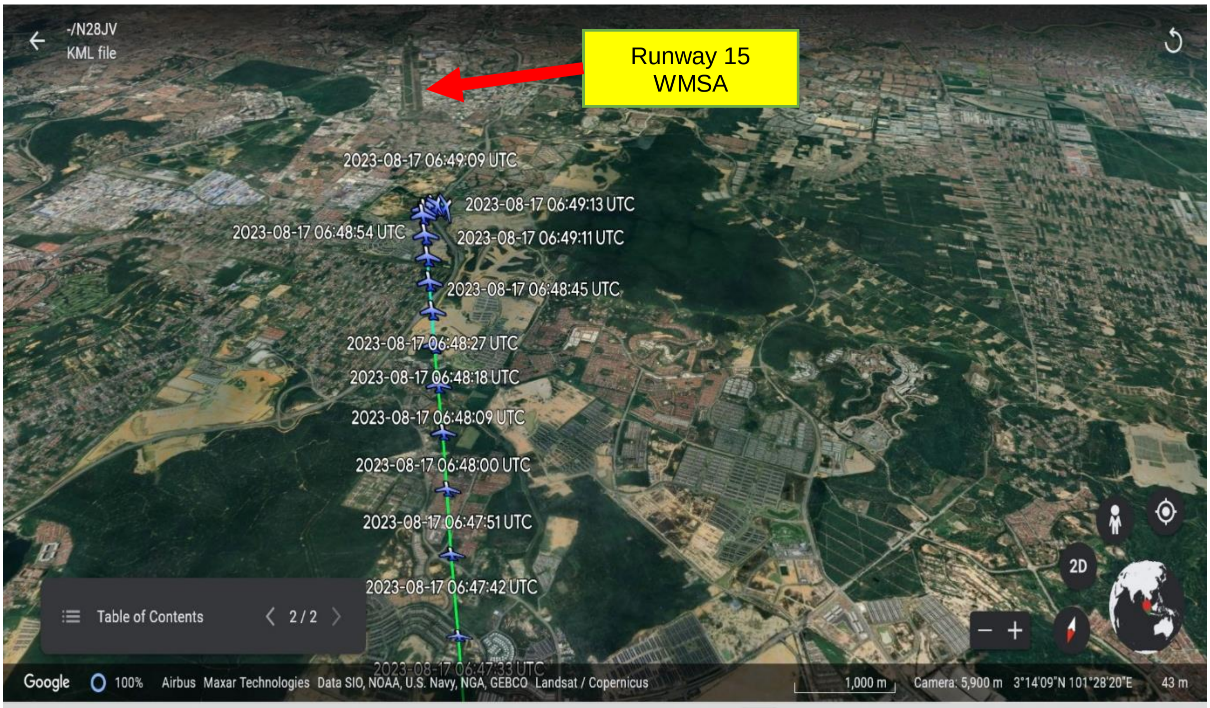

Figure 1. N28JV Flight Path on Final Runway 15.

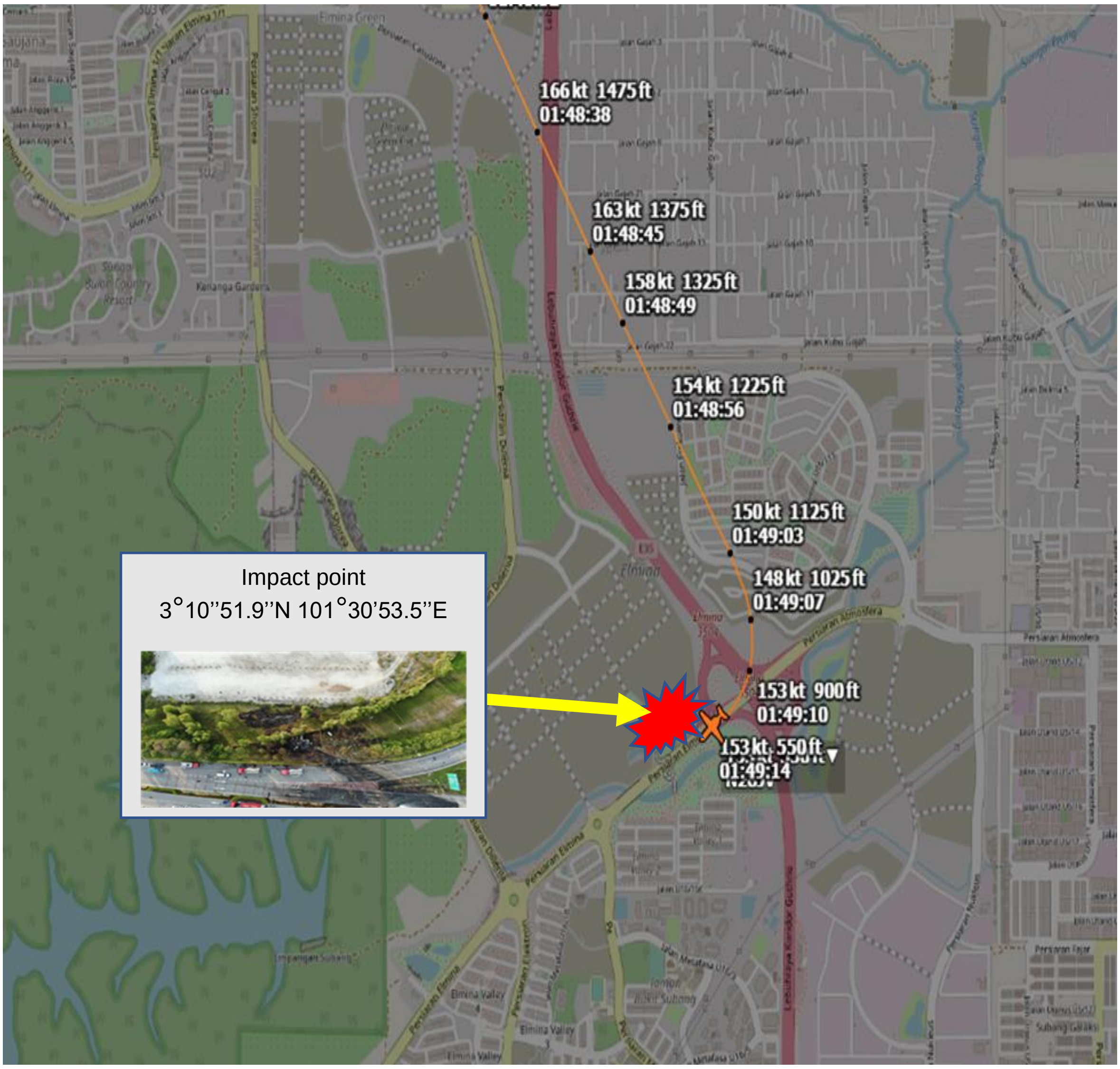

Figure 2. N28JV Impact Point[2].

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	Total
Fatal	2	6	2	**10**
Serious	Nil	Nil	Nil	**Nil**
Minor/None	Nil	Nil	Nil	**Nil**

Table 1. Injuries to Persons.

[2] Times in UTC – 5 (US EST).

1.3 Damage to Aircraft

The airplane was destroyed following the ground impact and subsequent fire.

1.4 Other Damage

One car, a Nissan Almera (registration number WC 1687 U), and one motorcycle, a Honda RS-X (registration number KFK 2150), were destroyed in this accident. There was also damage to the public road surface and infrastructure at and near the impact point.

1.5 Personnel Information

1.5.1 Pilot-in-Command (PIC)

<table>
<tr><td colspan="2">Nationality</td><td>Malaysian</td></tr>
<tr><td colspan="2">Age</td><td>41</td></tr>
<tr><td colspan="2">Gender</td><td>Male</td></tr>
<tr><td colspan="2">License Type</td><td>FAA[3] Airline Transport Pilot (ATP)</td></tr>
<tr><td colspan="2">License Issuance / Expiry Dates</td><td>Issued on 24 March 2023
Expiry on 29 February 2024</td></tr>
<tr><td colspan="2">Medical Certificate (CAAM)</td><td>Issued on 6 December 2022
Expiry on 31 December 2023</td></tr>
<tr><td colspan="2">Aircraft Rating</td><td>Airplane Multi Engine Land (AMEL), RA-390S</td></tr>
<tr><td colspan="2">Instructor Rating</td><td>N/A</td></tr>
<tr><td rowspan="2">Flying Hours</td><td>Total Hours</td><td>6275.39</td></tr>
<tr><td>Total on Type</td><td>36.72</td></tr>
</table>

Table 2. Personnel Information – Pilot-in-Command.

[3] Federal Aviation Administration, United States of America.

1.5.2 Second-in-Command (SIC)

Nationality		Malaysian
Age		44
Gender		Male
License Type		FAA ATP
License Issuance / Expiry Dates		Issued on 27 July 2023 Expiry on 30 November 2023
Medical Certificate (CAAM)		Issued on 15 September 2022 Expiry on 30 September 2023
Aircraft Rating		AMEL, Gulfstream IV (Nil rating on RA-390)
Instructor Rating		N/A
Flying Hours	Total Hours	9298.40
	Total on Type	3.15

Table 3. Personnel Information – Second-in-Command.

There is evidence indicating that the PIC, who had a RA-390S single-pilot rating, was seated in the right-hand seat, while the SIC, who was not rated on the 390 Premier 1 but rated as SIC on the Gulfstream IV, was seated in the left-hand seat. This scenario is supported by the testimony of two ground eyewitnesses, the Ground Marshaller and Ground Handler at WMKL, who saw the aircraft taxi to the holding point before departure.

Prior to the accident flight, the same crew had operated two other flights the day before, on 16 August 2023: from Subang (WMSA) to Kuantan (WMKD) and then from Kuantan to Langkawi (WMKL). Other than these flights, the SIC had not operated the 390 Premier 1 aircraft type before and had not received any formal training on operating this aircraft type.

1.6 Aircraft Information

The airplane was manufactured in 2004 and initially registered as N6197F. It was subsequently exported to the United Kingdom and registered as G-FRYL, then deregistered in the United States. In April 2023, the airplane was deregistered in the United Kingdom and re-registered in the United States as N28JV. It was issued a Standard Airworthiness Certificate by the Federal Aviation Administration (FAA) on 10 May 2023. Records revealed that the aircraft arrived in Malaysia on 16 May 2023 after departing Germany on 10 May 2023.

The aircraft was a Hawker Beechcraft Model 390 Premier 1. It was 46 feet (14.02 meters) long, had a wingspan of 44 feet 6 inches (13.56 meters), and a height of 15 feet 3.6 inches (4.66 meters). It was constructed of metal and carbon fibre composite and was a low-wing airplane powered by two Williams-Rolls FJ44-2A turbofan engines, each capable of producing 2,300 pounds of thrust. The aircraft was equipped with retractable tricycle landing gear. Dual mechanical controls with three-axis electrical trim operated the ailerons, rudder, and elevator. The spoilers were electronically controlled and hydraulically actuated.

Aircraft Type	Hawker Beechcraft 390 Premier 1
Manufacturer	Raytheon/Hawker Beechcraft
Year of Manufacture	2004
Owner	Koperasi Amanah Pelaburan Berhad (KAPB)[4]
Registration No.	N28JV
Aircraft Serial No.	RB-97
Certificate of Airworthiness[5]	Issued on 10 May 2023
Certificate of Aircraft Registration[5]	Issued on 3 May 2023 / Expiry on 31 May 2030
Total Flight Hours	3142.90

Table 4. Aircraft Data.

[4] The aircraft was registered with the FAA and the Certificate of Aircraft Registration was issued to Delaware Aircraft Trust LLC Trustee. According to the aircraft operator, the ownership of the aircraft was held in trust by a member of the Board of Directors of KAPB. For the purposes of clarity and consistency in this report, KAPB is referred to as the owner of the aircraft.

[5] Refer to Appendix A.

1.7 Meteorological Information

The incident happened in day time. The weather was fine, with visibility reported as more than 10 kilometres, and wind was variable (VRB) at 05 knots.

METAR WMSA 170500Z VRB04KT 9999 FEW018 30/24 Q1012=
METAR WMSA 170600Z VRB05KT 9999 FEW018 30/24 Q1011=
METAR WMSA 170700Z 24004KT 160V300 9999 FEW017CB 31/23 Q1010=
METAR WMSA 170800Z 25006KT 210V300 9999 FEW017CB 32/23 Q1009=

1.8 Aids to Navigation

The Instrument Landing System (ILS) for Runway 15 was declared unserviceable from 1 Jan 2023 UFN due to replacement works (AIP SUP 05/23 effective from 9 Feb 2023). The available instrument approach for inbound aircraft was NDB Runway 15. Other navigation aids were operating normally.

1.9 Communications

All ATC communications frequencies were operating normally.

1.10 Aerodrome Information

Airfield	Sultan Abdul Aziz Shah Airport, Subang
Runway	15 / 33
Length	3782 m
Width	45 m
ICAO Designator	WMSA
IATA Designator	SZB
Elevation	21.5 m

Table 5. Sultan Abdul Aziz Shah Airport (WMSA) Aerodrome Information.

1.11 Flight Recorders

1.11.1 Flight Recorder Installed

The aircraft was equipped with an L3Harris FA2100 Cockpit Voice Recorder (CVR), capable of recording 30 minutes of high-quality, 4-channel voice data. The aircraft did not have a Flight Data Recorder (FDR). No other flight recorders or types of non-volatile memory (NVM) storage media were recovered from the aircraft wreckage.

1.11.2 Search and Recovery of CVR

The CVR was recovered promptly during the search and recovery operation following the accident. The on-site search team was cleared by the police forensics team to begin searching for the CVR at about 2030 LT. The damaged CVR was found under the main aircraft wreckage at around 2150 LT on 17 August 2023.

The recovered CVR was secured and kept in the custody of the AAIB team until it was handed over to the AAIB Flight Recorder Laboratory at the Science and Technology Research Institute for Defence (STRIDE) in Kajang, Selangor, at approximately 0900 LT on 18 August 2023.

1.11.3 CVR Data Recovery

The CVR was cleaned upon receipt at the AAIB Flight Recorder Laboratory on 18 August 2023. Details of the recovered CVR are as follows:

- Manufacturer: L3Harris (formerly L3 Communications)
- Type: FA2100
- Part number: 2100-1010-51
- Serial number: 000229957

An initial damage assessment confirmed that the CVR was too damaged to be processed with the existing equipment at the AAIB laboratory[6].

The Transport Safety Investigation Bureau (TSIB) Singapore offered technical assistance for CVR data recovery. A TSIB Accredited Representative (AR) was appointed and dispatched to Malaysia on 18 August 2023 to provide technical assistance.

On 19 August 2023, the damaged CVR was disassembled for further assessment at the AAIB Flight Recorder Laboratory. Visual inspection (Figure 3) indicated that the CVR was exposed to high temperatures from the post-crash fire. Parts of the external paint coating had detached from the metal surface of the Crash Survivable Memory Unit (CSMU), and the front face connector had melted

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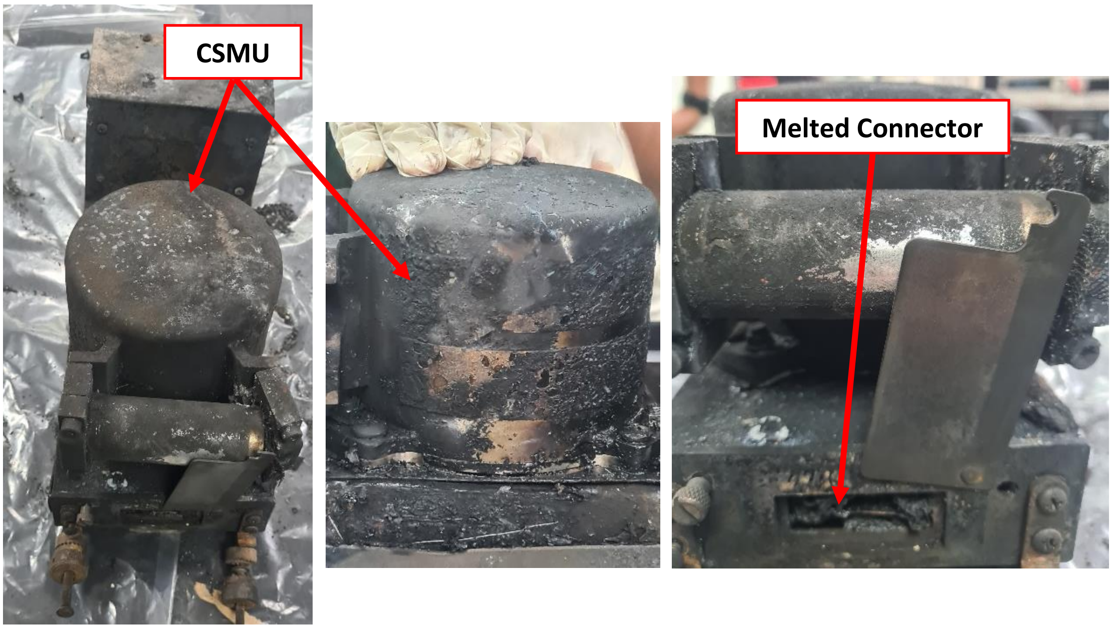

Figure 3. (Left): Overall view of CVR. (Centre): View of CMSU with bare metal surface visible, absent of paint coating. (Right): Front face connector melted.

[6] The AAIB Flight Recorder Laboratory lacks the equipment and capability to process damaged L3Harris flight recorders. In this case, the facility does not possess the L3Harris FA2100 Accident Investigator's Kit (AIK) required to process the damaged CVR (L3Harris FA2100). This kit includes an L3Harris Golden Chassis, cable spares, Readout Support Equipment (ROSE) software, and other repair kit stores.

The CSMU was then removed from the CVR chassis. The exposed portion of the ribbon cable connecting the memory storage module showed signs of thermal stress (Figure 4). Visual examination of the circuit board within the CVR chassis indicated exposure to high temperatures, sufficient to cause the solder joints to melt, with several integrated circuit (IC) chips not in their original positions.

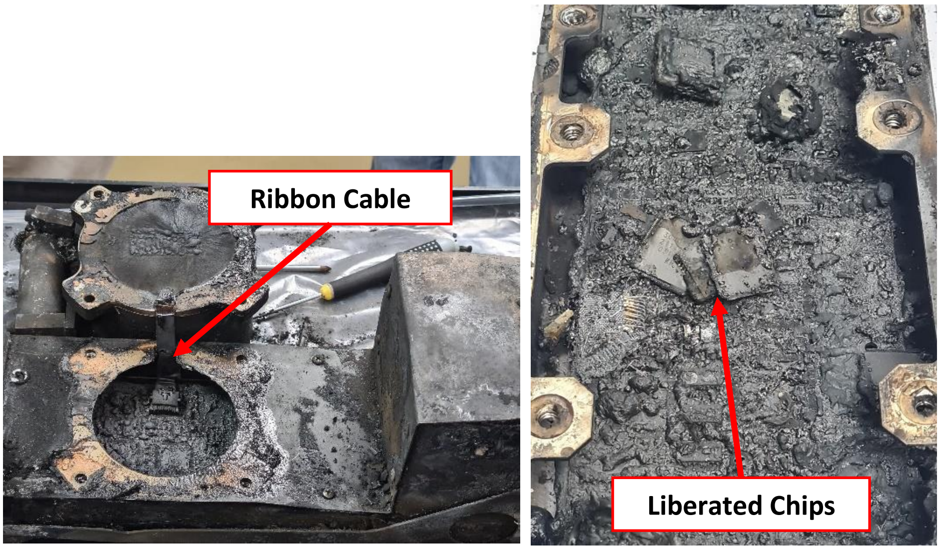

Figure 4. (Left) CSMU separated from CVR chassis.
(Right) Several IC chips liberated from their solder joints.

The CSMU base plate was removed, revealing that the internal area of the CSMU was in good condition, with the thermal absorption material still intact[7] (Figure 5). The portion of the ribbon cable within the CSMU appeared undamaged.

[7] If the internal of the CSMU had been exposed to elevated temperatures for a prolonged duration, the thermal absorption material would have melted into a semi-liquid state. This state would have enabled it to absorb the thermal energy, thereby reducing the amount of heat transferred to the memory puck.

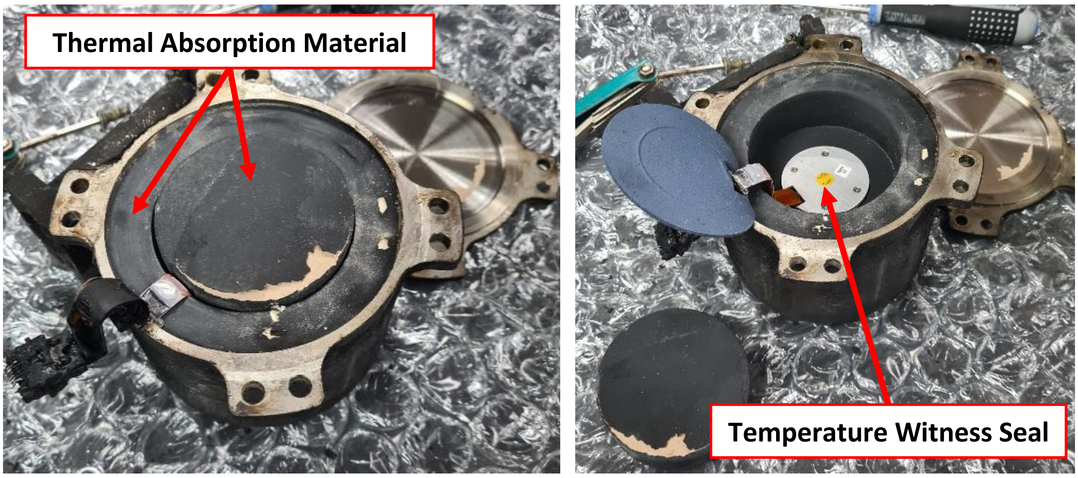

Figure 5. (Left): Thermal absorption material condition.
(Right): View of memory storage module exposed.

The CSMU's memory storage module (memory puck) was extracted, and the temperature witness seal was found in its original yellow colour[8]. According to the manufacturer's procedures, if the temperature witness seal had turned black, the manufacturer should be contacted for assistance to extract the stored data.

Since the temperature witness seal indicated that the memory storage unit was not exposed to high temperatures, it was possible to recover the data following the manufacturer's Accident Investigator's Kit (AIK) recovery procedures. As the TSIB's flight recorder laboratory in Singapore possesses the necessary AIK equipment and spare parts, it was decided to perform the memory storage module recovery in the TSIB's laboratory to maximise the chances of recovering the stored data quickly.

The CVR data recovery effort was conducted at the TSIB's flight recorder laboratory in Singapore from 20 to 22 August 2023. This data downloading effort was unsuccessful due to technical issues. Subsequently, on 28 August 2023, the data download from the accident CVR was successfully completed at the L3Harris Technologies facility in St. Petersburg, Florida, USA. The two CVR data download efforts are summarised in Appendix B.

[8] In the event that the memory storage module was exposed to elevated temperature for a sufficiently long duration, the temperature witness seal will change to black colour.

1.11.4 CVR Audio Files Download

The audio data from the accident CVR was fully downloaded by the L3Harris facility in St. Petersburg, Florida on 28 August 2023. There were no anomalies observed during the download process. The following data files were downloaded and converted to respective Waveform Audio File Format (WAV) files in the following order:

- CH1 (N28JV H1.wav): 29,119 kilobytes (KB); Length: 31 min, 3.576 sec.
  Left/Right Crew Chief and Rear Intercom Communication Unit (ICU).
- CH2 (N28JV H2.wav): 29,119 kilobytes (KB); Length: 31 min, 3.576 sec.
  Left Seat Audio Panel.
- CH3 (N28JV H3.wav): 29,119 kilobytes (KB); Length: 31 min, 3.576 sec.
  Right Seat Audio Panel.
- HQC (N28JV H4.wav): 58,237 kilobytes (KB); Length: 31 min, 3.576 sec.
  High Quality (HQC) Cockpit Area Microphone (CAM)

* Note: CH=Channel; HQC=High Quality Channel

1.11.5 CVR Recording Transcript and Analysis

The transcription and analysis of the CVR recording were conducted by investigators with technical assistance from the NTSB Vehicle Recorder Division. Excerpts of the transcript of the CVR recording essential to the analysis and understanding of the accident are provided in Appendix C.

1.12 Wreckage and Impact Information

The aerial photo of the crash site (impact point position – 3°10’’51.9’’N 101°30’53.5’’E) in Figure 6 provides a general illustration of the site, indicating the initial ground impact point, the location of the main wreckage, and the location of the right engine. Area 1 (the red line circle) denotes the initial ground impact point. Area 2 (the red line circle) highlights the main wreckage, while Area 3 (the red line circle) indicates the location of the right engine. The yellow line illustrates the distribution area of the aircraft debris.

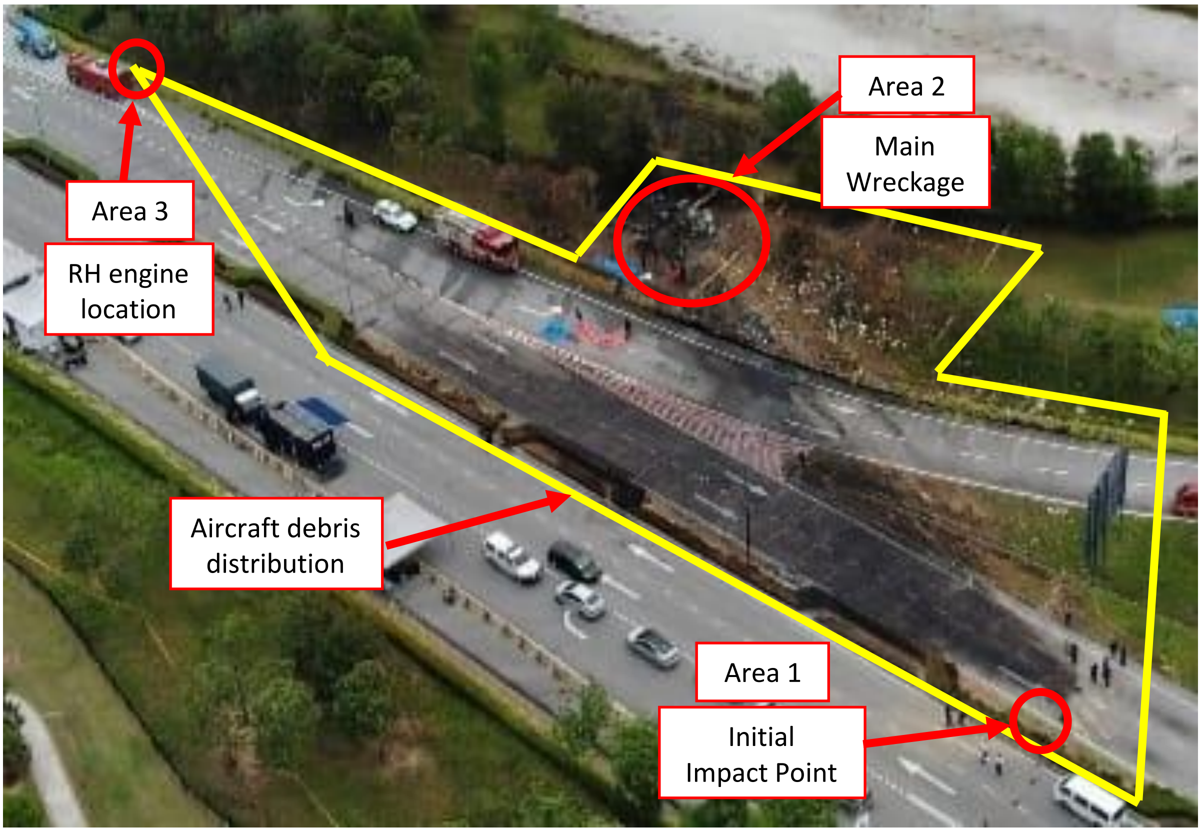

Figure 6. General Map of Wreckage and Impact Information.

Figure 7. Main Wreckage at the Accident Site.

The first identified point of impact was characterised by a 5-ft-long ground scar, on a heading of 260° (Figure 7), in the central median of the highway about 3 miles northwest of the approach end of WMSA airport Runway 15. Fragments of the green navigation light lens were located within the disruption.

A basic reconstruction method of the aircraft wreckage was used to identify the aircraft parts, components and power plants assembly for further investigation (Figure 8).

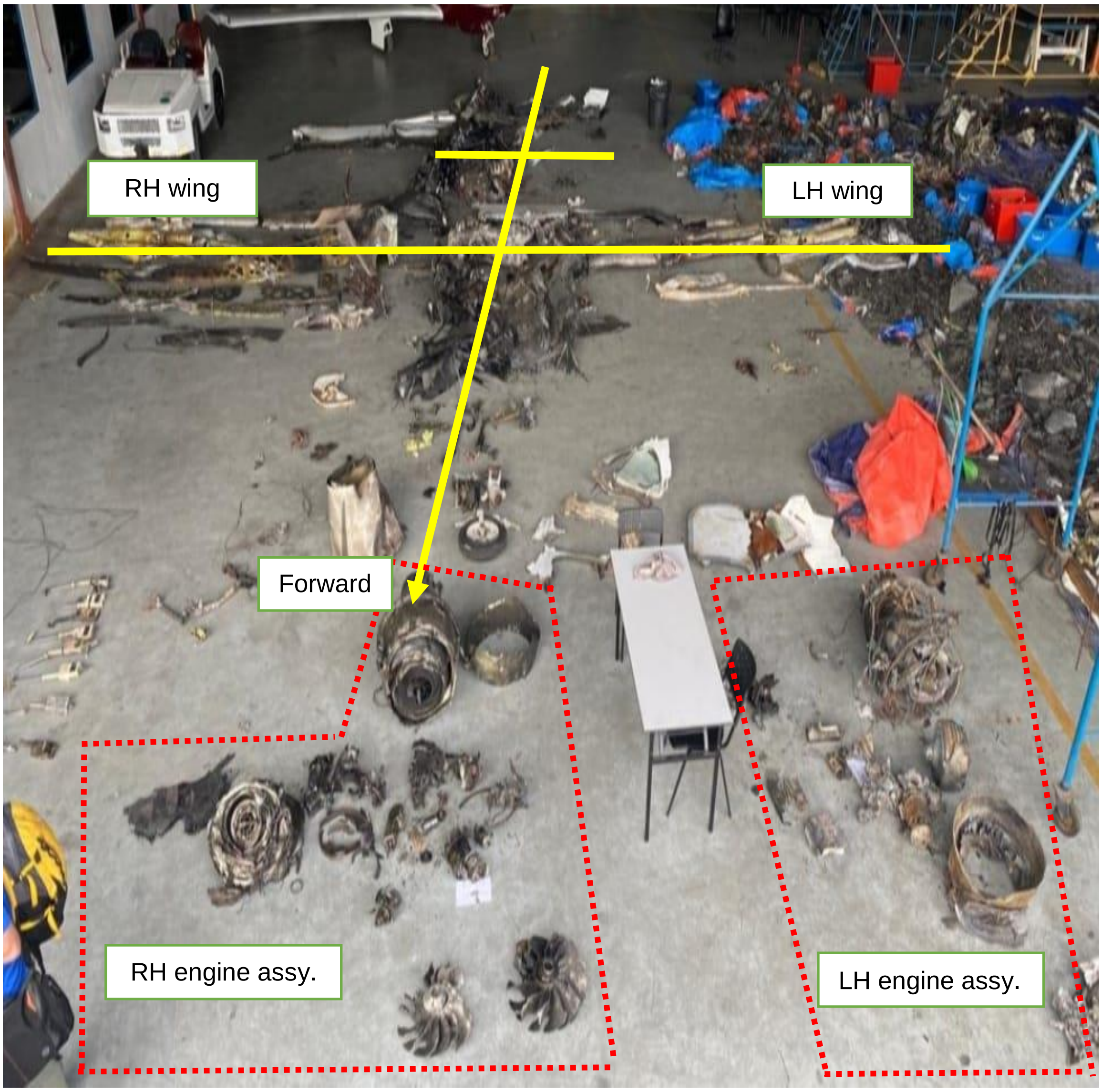

Figure 8. Layout of the Aircraft Wreckage.

The initial aircraft damage assessment report is provided in Appendix D, while the subsequent detailed test and examination reports are provided in Appendices E and F. The summary of the aircraft damage assessment is as follows:

1.12.1 Cockpit Section

The cockpit was highly fragmented. The landing gear handle was found in the down position but was damaged (Figure 9). The lift dump handle was also damaged and found in an intermediate position, whereas the normal range is either retracted or extended (Figure 10).

Figure 9. Damaged Landing Gear Handle.

Figure 10. Lift Dump Handle Found in Intermediate Position.

1.12.2 Cabin

Fragments of the windshield screens were located, along with a fractured single tempered pane. The main cabin door had broken into three segments, and the external latch was in the locked position. The entire cockpit was fragmented and consumed by fire, destroying all avionics equipment and electrical wiring. The escape hatch door was fragmented into several sections.

1.12.3 Engines

Visual inspection revealed that the right and left engines had broken into three and four distinct segments, respectively, including the fan, fan case assembly, Intermediate Pressure (IP) compressor section, and the High-Pressure Compressor/ Hot Section. The starter, Hydromechanical Unit (HMU), and gearbox had detached from both engines. Neither engine showed evidence of blade liberation, such as case dents or perforations at the compressor sections. The fan shroud also did not exhibit any evidence of blade liberation. There was no evidence of foreign object ingestion, bird feathers, or matter in any of the engine components.

1.12.4 Aileron System

The aileron system, from the control column to the left and right ailerons, was examined. Due to wreckage fragmentation, the aft sector and the left wing inboard sector could not be definitively identified. The breaks in the cables had ends with a splayed, broom straw appearance consistent with tension overload. Both the left and right aileron trim actuators were extended approximately 1.9 inches, corresponding to about 6 degrees aileron trim trailing edge tab up.

1.12.5 Rudder System

The rudder cables from the middle fuselage to the rudder were examined. Most cable breaks had ends with a splayed, broom straw appearance consistent with tension overload. One break in a right rudder cable was retained for further examination. However, the rudder cables from the middle fuselage to the rudder pedals could not be definitively identified due to wreckage fragmentation. Various lengths of flight control cables were found, exhibiting breaks consistent with tension overload, but these cables could not be positively identified as rudder or elevator cables.

1.12.6 Elevator System

The elevator cables from the cockpit to the elevator were examined. Most cable breaks had ends with a splayed, broom straw appearance consistent with tension overload. One break in an elevator cable was retained for further examination.

1.12.7 Spoilers

The right lift dump actuator was found in an extended position, while the left lift dump actuator was found in the retracted position. The down-lock striker on the right lift dump panel was bent from impact. Both the left and right middle and outboard spoilers were in the stowed position. The Hydraulic Spoiler Control Module (HSCM) and Spoiler Control Unit (SCU) were thermally damaged and retained for further examination. The lift dump actuators, roll control actuators, and pull (blow) down actuators were removed for further examination. The results of the detailed examination by the NTSB, original equipment manufacturer (OEM) and other relevant facilities on the spoiler components and parts are provided in Appendices E and F.

Examination of the piston and body of the lift dump actuators confirmed that the right actuator was in the fully extended position during the accident and remained there. The left actuator was in the fully retracted position when the component experienced heat damage. Notably, detailed examination, including computed tomography (CT) scans, conclusively determined that the lift dump handle was in the "EXT" position (Figure 11). The lock release was in the "unlocked" position, without indications of deformation at the end that engages the lift dump handle.

In summary, all spoilers were extended, and the accident sequence locked the right lift dump spoiler in the extended position upon initial impact. The other spoilers retracted immediately after the loss of hydraulic power. The position of the lift dump handle confirms that all spoilers were commanded to extend (lift dump mode). Inflight extension of the lift dump is strictly prohibited, as stated clearly on the lift dump panel: “WARNING – DO NOT EXTEND INFLIGHT.” Examination details for the components of the lift dump system are provided in Appendices E and F. For reference, systems description of the speed brake/lift dump spoilers is provided in Appendix G.

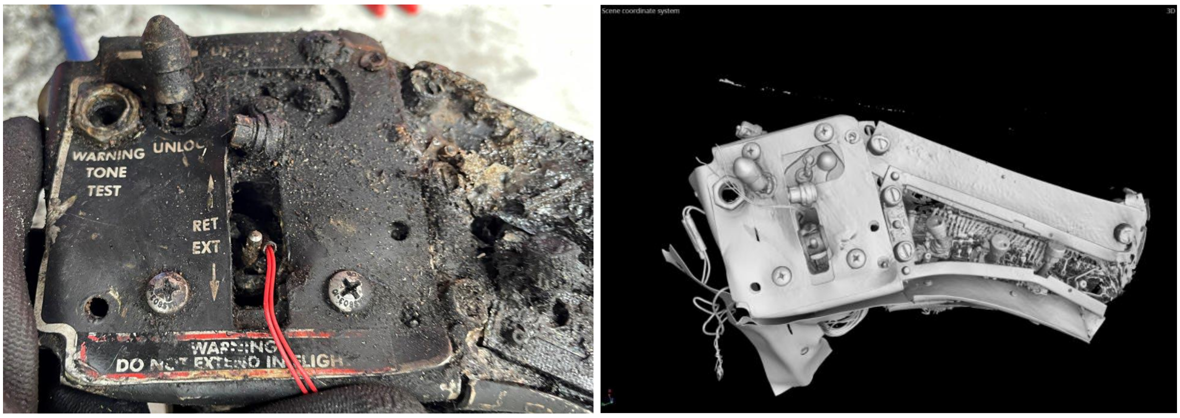

Figure 11. Lift Dump Panel (Left) and CT Image of the Panel (Right).

1.12.8 Flap System

All eight flap actuators were found at the wreckage site. Six of the eight actuators were easily measured, with two actuators separated from their control rods. The flap actuators were all in the 'DOWN' position (fully extended). The positions of the flaps were determined by examining their control rods and the end of the ball screw. However, the installation location of each actuator on the aircraft could not be definitively identified due to the fragmentation of the wreckage.

1.12.9 Landing Gear System

The left and right main landing gear assemblies remained intact and attached to their respective wing attachment points, exhibiting heat/thermal and impact damage. The left and right main landing gear actuators remained attached to their respective gear and wing, with the right main landing gear actuator piston impact-separated. Both actuators were found in the fully extended/down position. The nose gear was separated from its attachment point, with the lower strut separated from the upper trunnion. The nose gear assembly exhibited impact damage.

1.13 Medical and Pathological Information

In this accident, a total of ten (10) victims were fatally injured. These included the PIC, the SIC, six (6) passengers onboard, one (1) motorcyclist on the ground, and one (1) motorist on the ground.

1.13.1 On-Site Investigation

After the collision, the site was engulfed in fire. Once the area was declared safe, the medical forensic team conducted a pathological investigation. They marked and documented the position of bodies, body parts, and biological tissues before extraction. Due to poor illumination at night during the search and recovery operation, the retrieval of biological tissues continued for two days during daylight hours. All biological tissues were transported to the Medical Forensic Department, Hospital Tengku Ampuan Rahimah, Klang, for further identification and post-mortem investigation.

The distance between the first impact of the aircraft on the ground and the furthest body found was approximately 100 meters. The main wreckage came to rest about 73 meters from the initial impact point (Figure 12). A massive post-crash fire engulfed the aircraft immediately after the collision.

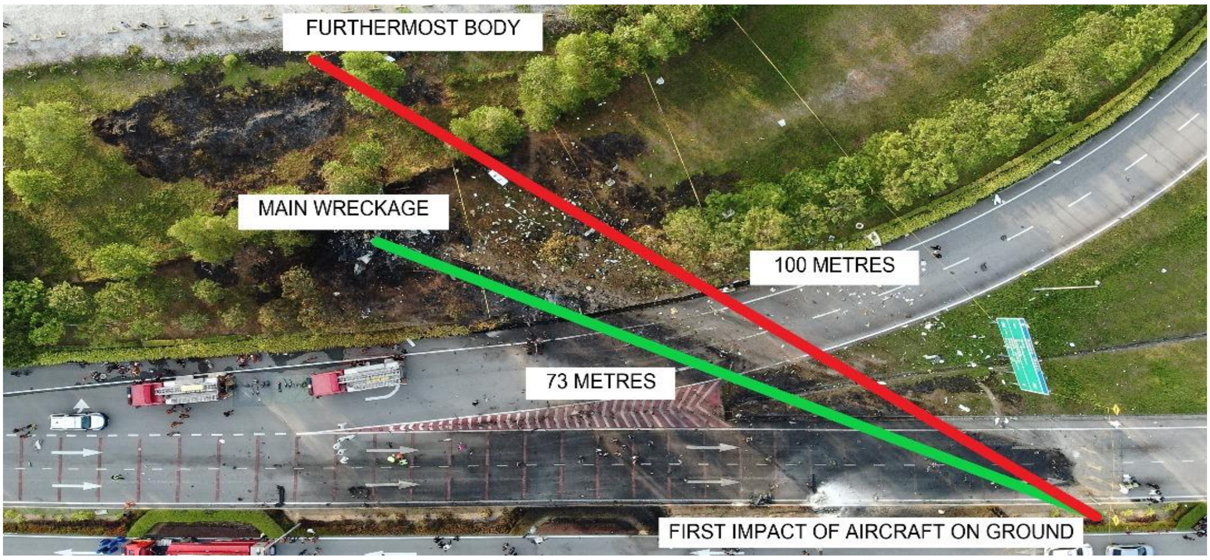

Figure 12. Distance between first impact and wreckage and furthermost body.

1.13.2 Off-site Investigation

All victims were successfully identified through primary criteria, such as DNA analysis, odontology comparison, and fingerprinting, as well as secondary criteria, including body features, clothing, and birthmarks recognisable by family members.

1.13.3 Cause of Death

Both the PIC and SIC succumbed to multiple injuries. Evidence indicate that neither of the pilots suffered from cockpit incapacitation, thus ruling out medical causal and contributing factors to the accident.

1.13.4 Toxicology Information

Post-mortem investigations found that neither the PIC nor the SIC were under the influence of alcohol or illicit drugs.

1.13.5 Medical Fitness Status of PIC

Witness accounts reported that the PIC was in good health the night before the accident and had adequate rest before the flight departing from Langkawi.

1.13.6 Licensing Medical Information from Aviation Authorities

Both the PIC and SIC possessed valid medical certificates from both the FAA and the CAAM.

The PIC acquired a First Class Medical Certificate from the FAA on 24 March 2023, with the limitation "Must use corrective lenses to meet vision standards at all required distances." Simultaneously, he held a CAAM Medical Certificate valid from 6 December 2022, to 31 December 2023, with the limitation "VDL – Valid only with correction for defective distant vision." A review of the Medical Certificate and supporting documentation shows no significant medical concerns reported by the PIC and the attending Designated Medical Examiner (DME) identified no significant conditions upon physical examination. Based on available history and physical examinations, this pilot had no known medical conditions that could pose significant hazards to flight safety.

Similarly, the SIC obtained a First Class Medical Certificate from the FAA on 24 July 2023, with the limitation "Must use corrective lenses to meet vision standards at all required distances." Concurrently, he held a CAAM Medical Certificate valid from 15 September 2022 to 30 September 2023, with the limitation "VDL – Valid only with correction for defective distant vision." A review of the Medical Certificate and supporting documentation indicates no significant medical concerns reported by the SIC and the attending DME identified no significant conditions upon physical examination. Based on available history and physical examinations, this pilot had no known medical conditions that could pose significant hazards to flight safety.

1.14 Fire

The high-energy collision of the aircraft on the ground ignited a catastrophic fire due o flammable fuel in the tank. The fire engulfed the entire fuselage, aircraft occupants, as well as the collateral motorist and motorcyclist on the ground. Several remains were severely charred.

1.15 Survival Aspects

There were no survivors in this catastrophic accident.

1.15.1 Crash Dynamic and Injuries

Visual and field analysis indicated that the aircraft's right wing tip first impacted the solid ground, followed immediately by the nose at high energy. The short-duration acceleration (0.1-0.5 seconds) typical in high-energy collisions led to fatal injuries of the aircraft occupants. The impact forces, collision pattern, and magnitude were beyond the limit of human tolerance, indicating that this was not a survivable accident.

1.15.2 Analysis of Aircraft Crashworthiness and Post-Crash Survivability

Crash survivability and human tolerance to impact were analysed using the reference tool C.R.E.E.P (Container, Restraint, Environment, Energy Absorption, Post-Crash factors). Assessment of these factors determined the causes of injuries and the survivability of the occupants.

1.15.3 Container

The container, encompassing both the cockpit and cabin spaces, should withstand deformation to prevent injury or death. However, the aircraft container shattered due to the high-energy impact and post-crash fire, leading to fatal injuries for occupants.

Figure 13. Container was shattered. Survivability was almost impossible.

1.15.4 Restraint

While the restraint system aims to keep the crew in place to maintain control of the aircraft and limit occupant movement during a crash, its analysis was not applicable here as occupants would not have survived the initial impact. Additionally, the fire consumed the restraint system, leaving no evidence of its function.

1.15.5 Environment

The environment, referring to the volume space of the container, could still cause injuries to occupants even if the container maintained its integrity. However, survivability regarding this element was not applicable due to the lethal energy environment involved.

1.15.6 Energy absorption

The aircraft's crumple zone should deform in a controlled manner during impact to reduce accelerations acting on occupants. However, in this accident, the impact forces far exceeded the aircraft structure's limits, causing disintegration and transmitting excessive energy to cabin occupants.

1.15.7 Post-crash factor

After the immediate impact event, various factors could affect occupants, with fire being a significant hazard. In this accident, survival beyond the initial impact was unlikely due to the fire consuming the entire remnant.

1.16 Tests and Research

1.16.1 Mechanical Functionality Test

The relevant mechanical parts and components of the recovered flight control surfaces were identified and sent to the NTSB laboratory and the relevant OEM facilities in the United States for further inspection and examination. The purpose was to determine the functionality and status/conditions of these parts and components. The list of items sent to the NTSB and OEM is as follows:

No.	Descriptions	P/No.	S/No.	Qty
1.	LH Aileron Trim Actuator	390-381009-0009	080	1

2.	RH Aileron Trim Actuator	390-381009-0008	67	1
3.	LH Pull Down Actuator	390-381010-0001	0202	1
4.	RH Pull Down Actuator	390-381010-0001	0197	1
5.	LH Lift Dump Actuator	390-381008-0001	0216	1
6.	RH Lift Dump Actuator	390-381008-0001	648	1
7.	LH Roll Control Actuator	390-381007-0003	0214R	1
8.	RH Roll Control Actuator	390-381007-0003	0252	1
9.	Lift Dump Switch/Panel	Unknown	Unknown	1
10.	RH Rudder Cable & Elevator Cable	Unknown	Unknown	1
11.	Spoiler Hydraulic Control Module	Unknown	Unknown	1
12.	Annunciator Panel	Unknown	Unknown	1

Table 6. List of Aircraft Parts and Components Sent to NTSB and OEM.

1.16.2 Results of Components Examination by NTSB and OEM

Examination of the aircraft components sent to the NTSB and other testing facilities revealed no pre-impact failures or malfunctions of the aircraft flight controls. For results of the examination, refer to Appendices E and F.

1.17 Organisational and Management Information

Aircraft Operator. The aircraft operator is Jet Valet Sdn Bhd. Established in 2021, Jet Valet operates as a subsidiary of Koperasi Amanah Pelaburan Berhad (KAPB), which has a membership base of approximately 12,000 individuals. Jet Valet was conceived to enhance travel convenience and offer supplementary perks to members enrolled in KAPB's membership programme. The company operates a fleet of three aircraft types: Premier 1 (N28JV), Hawker Beechcraft 4000 (N35JV), and Gulfstream IV (N729TY), all stationed at Sultan Abdul Aziz Shah Airport in Subang, Selangor. Notably, one of the passengers aboard the accident flight was a KAPB member.

KAPB facilitates access to Jet Valet's aircraft for all its members, with payments for flights apparently debited through members' accounts within KAPB. However, details regarding the booking arrangements for aircraft use, including records of the ill-fated flight on N28JV by passengers on 17 August 2023, remain undisclosed. Neither KAPB nor Jet Valet has provided payment records for the utilisation of Jet Valet’s aircraft.

1.18 Additional Information

1.18.1 Foreign Aircraft Registration

Jet Valet's Premier 1 (N28JV) aircraft is registered in the United States and operates under Federal Aviation Regulation (FAR) Title 14, specifically within the Code of Federal Regulations Part 91 (14 CFR Part 91), which governs general aviation operations. Among the three parts of the FAR pertaining to aircraft operations, Part 91 is the least restrictive, limiting compensation for air transportation to very specific circumstances and with capped payment amounts.

This restriction serves to uphold air travel safety standards by directing paying passengers primarily to operators governed by more stringent regulations, such as CFR Part 121 (scheduled air carriers) and CFR Part 135 (commuter and on-demand operations), which are authorised to accept payment for passenger carriage.

However, aircraft registered under CFR Part 91 Subpart K (Part 91K) allow for fractional ownership, typically at a minimum share of 1/16th of a multi-engine turbojet-powered or large aircraft, though with limited payment options.

Despite this regulatory framework, a search in the FAA database for the N28JV aircraft did not reveal any association with 14 CFR Part 91K, 135, or 121 certificates. The aircraft possesses a registered "Bill of Sale" dated 28 April 2023, listing the purchaser as "Delaware Aircraft Trust, LLC," located in Wilmington, Delaware, United States. There was also an Aircraft Registration Application to the FAA dated 20 April 2023.

The aircraft was registered with the FAA in the United States, and the Certificate of Aircraft Registration was issued to Delaware Aircraft Trust LLC Trustee. According to the aircraft operator, ownership of the aircraft was held in trust by a member of the Board of Directors of KAPB[9]. A trust agreement was provided by the operator to show an ownership linkage between Delaware Aircraft Trust LLC Trustee and the nominated KAPB Board member.

1.18.2 Aircraft Operation in Malaysia

The N28JV aircraft, registered in the United States, is owned and operated by KAPB/ Jet Valet Sdn Bhd, a Malaysian-based organisation. This organisation operates the N28JV, along with two other aircraft, from a base in Malaysia (WMSA), carrying KAPB members as passengers within Malaysia.

On 15 May 2023, the aircraft owner reportedly sent a letter to CAAM, informing them that a KAPB “investee” company, AP Holding Berhad (APHB), owns Jet Valet Sdn Bhd and the N28JV aircraft. The letter stated that the aircraft would arrive at WMSA on 17 May 2023 for use by KAPB directors and members. Although the N28JV aircraft was explicitly intended to be based in Malaysia long-term, there is no evidence that the aircraft operator has taken measures to apply to CAAM for Malaysian registration of the aircraft, as required under the Civil Aviation Regulations 2016 for any foreign-registered aircraft operating in Malaysia for more than six months[10].

Furthermore, there is no indication that the operator has applied or intends to apply for the necessary approval from CAAM for non-scheduled air services and the carriage of passengers for valuable consideration in a foreign-registered aircraft, as mandated by current civil aviation policies[11] and regulations[12].

[9] For clarity and consistency, KAPB is referred to as the owner of the aircraft in this report.

[10] Malaysian Civil Aviation Regulations 2016, Part XVII General Aviation, Regulation 147.

[11] Ministry of Transport Malaysia, Policy on Non-Scheduled Air Services (MOT.600-2/2/11 (2)) dated 1 July 2022, Sections 3.4, 4.0. and 5.2.

[12] Malaysian Civil Aviation Regulations 2016, Part X Air Operator, Regulation 110 and Part XVIII Foreign Aircraft Operations, Regulation 148.

(Note: The carriage of passengers or cargo for hire and reward on non-scheduled flights within Malaysia's borders is allowable for local air operators that have a valid Air Service Permit issued by the Malaysian Aviation Commission as well as a valid Air Operator Certificate issued by the CAAM.)

1.19 Useful or Effective Investigation Techniques

Not applicable.

2.0 ANALYSIS

2.1 Introduction

The analysis framework for the accident involving N28JV, a Hawker Beechcraft Model 390 Premier 1, aims to provide clear and actionable insights into the accident. The approach begins by eliminating various aspects that evidently did not contribute to the accident, followed by a closer examination of factors that likely did. Discussion on non-causal factors will include the consequences, outcomes, or impacts resulting from the accident.

Key areas of analysis include aircraft operation, extension of the lift dump spoilers, crew resource management, and human and organisational factors contributing to the accident. The prompt recovery of the CVR provided significant clues regarding the likely cause of the accident, guiding investigators to focus on the most probable causes. The detailed investigation of these aspects aims to uncover the root causes and contributing factors to prevent future occurrences.

2.2 Summary of Non-Causal Factual Information

2.2.1 Flight Details. The N28JV departed from WMKL at approximately 1408 LT, heading to WMSA with eight people on board. At 1446 LT, the aircraft contacted WMSA tower for landing clearance, which was granted at 1448:36 LT. The aircraft acknowledged the clearance, and no further transmissions were received. Analysis of the CVR recording revealed that the flight was operating normally without any issues until the final phase of flight after the crew received the landing clearance from ATC at 1448:36 LT and started to perform the Before Landing checklist.

2.2.2 Flight Path and Impact. ADS-B data indicated a speed reduction and descent beginning at 1447:24 LT from 2,600 feet. The last recorded data was at 1449:14 LT at an altitude of 550 feet, near the crash site at Persiaran Elmina, Elmina, Shah Alam. The ground speed during the right turn ranged between 146 and 154 knots.

2.2.3 Injuries and Fatalities. All eight people on board, including two crew members and six passengers, were fatally injured. Additionally, two ground fatalities were reported: one motorcyclist and one motorist.

2.2.4 Aircraft and Other Damage. The aircraft was completely destroyed by the ground impact and post-crash fire. One car (Nissan Almera) and one motorcycle (Honda RS-X) were also destroyed. Damage to the public road surface and infrastructure was noted at the impact site.

2.2.5 Pilot Information. The Pilot-in-Command (PIC) had an ATPL license and a total of approximately 6,275 flying hours of experience. The PIC had a single-pilot RA-390S type rating with 36.72 hours on type.

2.2.6 Aircraft Information. The aircraft was manufactured in 2004, initially registered as N6197F, later as G-FRYL, and re-registered as N28JV in the United States in May 2023. As far as can be determined, the aircraft was airworthy at the time of the accident. There were no apparent failures or significant issues with the aircraft flight controls or other systems encountered by the crew during the flight based on the analysis of the CVR recording and examination of the wreckage.

2.2.7 Meteorological Information. METAR data confirmed good weather conditions at the time of the accident. The weather was fine with visibility over 10 kilometres and variable winds at 5 knots. Weather was not a contributing factor to the cause of the accident.

2.2.8 Navigational Aids and Communication. The Instrument Landing System (ILS) for Runway 15 was unserviceable; the available approach was NDB Runway 15. Other navigation aids and ATC communications were operating normally. Navigational aids and communication were not a contributing factor to the cause of the accident.

2.2.9 Flight Recorders. The aircraft had an L3Harris FA2100 CVR, which was recovered and data was successfully downloaded after technical assistance. The CVR recording offered crucial insights into the probable cause of the accident, directing investigators to concentrate on the most likely cause of the accident.

2.2.10 Wreckage and Impact Information. The main wreckage and engines were located and identified, indicating high-energy impact and post-crash fire. The examination revealed extensive damage to the cockpit, engines, control systems, and landing gear. As far as can be ascertained, there was no indication of aircraft structural and systems failure apart from damage due to high-energy impact and post-crash fire.

2.2.11 Medical and Pathological Information. All victims were identified through DNA analysis, odontology comparison, and fingerprinting. Post-mortem investigations showed no incapacitating medical conditions for the pilots. Toxicology reports indicated no influence of alcohol or illicit drugs.

2.2.12 Fire. A catastrophic fire erupted post-impact due to flammable fuel in the tank, engulfing the aircraft and nearby vehicles.

2.2.13 Survival Aspects. The accident was deemed non-survivable due to the high-energy impact and post-crash fire. Analysis confirmed that the aircraft container shattered, and the magnitude of the impact forces was beyond human tolerance.

2.3 Aircraft Operation Analysis

2.3.1 Sequence of Flight Events Leading to Accident

N28JV departed WMKL at approximately 1408 LT, bound for WMSA with eight people on board. During taxi, the PIC was seen in the right-hand seat and the SIC in the left-hand seat, as confirmed by the CVR recording. The take-off and flight were uneventful until the final moments.

The PIC was the pilot flying (PF), while the SIC acted as the non-flying pilot monitoring (PNF). The crew managed the aircraft operation without apparent issues. Amid light conversation, the PIC instructed the SIC on various aircraft systems, including communication, navigation, and flight control. In addition to performing PNF duties, the SIC also operated certain aircraft systems as part of the checklist items, such as the weather radar, flaps, landing gear, and spoilers, based on analysis of the CVR recording.

As N28JV approached WMSA, the Lumpur Approach air traffic controller instructed it to descend to 2,500 ft and proceed directly to the CE beacon for an NDB Approach to Runway 15. The SIC read the Approach checklist: "V ref confirmed (checked and set), land and descent check crew briefing confirm complete, seat position set, fuel balance within limits, landing lights on, recog lights as desired, cabin sign no smoke, seatbelts, ignition on." The SIC continued with "engine sync off, flaps ten (unintelligible word) on you, TCAS as required", to which the PIC responded with "check", and then the SIC followed with "…before landing stand by, …which is the landing gear and fuel dump[13]."

N28JV was then handed over to Subang Tower after establishing at 2,500 ft on the NDB Approach Runway 15. Subang Tower instructed N28JV to continue the approach to accommodate a departing aircraft, which the SIC acknowledged. The PIC then asked the SIC to lower the landing gear and flaps, and the SIC complied. At 1448:36 LT, Subang Tower cleared N28JV to land, and the SIC acknowledged the clearance.

[13] The SIC stated "fuel dump" here, but the actual checklist item is "Lift Dump", refer to Figure 14.

PREMIER I/IA PILOT CHECKLIST — MODEL 390

BEFORE LANDING

1. Landing Gear ....DN
2. Lift Dump...................................UNLOCK, HANDLE ILLUMINATED, J-HOOK CLEAR

WARNING

Do not extend lift dump in flight. Extending lift dump in flight could result in loss of airplane control leading to airplane damage and injury to personnel.

3. Flaps ....DN
4. Autopilot ....DISENGAGE
5. Yaw Damp..OFF

Figure 14. Premier 1/1A Pilot Checklist – Model 390.

At 1,000 ft on final approach, the PIC requested the SIC to run the Before Landing checklist. The SIC proceeded: “check before landing, landing gear down, lift dump unlocked, handle illuminated.” About 0.9 seconds after the SIC said “…handle illuminated,” the PIC acknowledged “lift dump unlocked.” Approximately 1.7 seconds after that, the SIC exclaimed loudly, “woah, woah, woah…, what's going on?” Multiple alarm sounds followed, including the lift dump aural warning tone, autopilot disconnect alert, and Enhanced Ground Proximity Warning System (EGPWS) callouts such as “minimums, minimums” and “sink rate, pull up, pull up”.

2.3.2 Inadvertent Inflight Extension of Lift Dump Spoilers

The lift dump handle was confirmed to be in the “EXT” position at the time of the crash. Analysis of the CVR recording, crew voices, cockpit sounds, and operational circumstances indicates a high probability that the SIC inadvertently extended the lift dump while performing the Before Landing checklist. This action caused the aircraft to abruptly lose lift, leading to a catastrophic loss of control in flight and resulting in the crash at Persiaran Elmina, Elmina, Shah Alam, approximately 2.7 nm short of Runway 15 at WMSA.

2.3.3 Key Evidences

Several key pieces of evidence support the conclusion that the lift dump spoilers were inadvertently extended inflight, most likely by the SIC:

- **CVR Analysis**: The CVR recorded the SIC running through the Before Landing checklist and stating, “lift dump unlocked, handle illuminated.” The PIC acknowledged this with “lift dump unlocked.” Immediately after this exchange, multiple alarms sounded, including the lift dump aural warning tone and autopilot disconnect alert. The SIC's loud exclamation of “woah, woah, woah…, what's going on?” indicates an unexpected and severe deviation from normal flight.

- **Lift Dump Handle Position**: Post-crash examination, in particular CT scan of the lift dump handle, confirmed that the lift dump handle was in the "EXT" position. This position is only meant to be used on the ground to deploy spoilers and reduce lift after landing, not during flight.

- **Ground Spoilers**: The deployment of ground (lift dump) spoilers inflight leads to a rapid loss of lift. This sudden aerodynamic change can cause a severe and uncontrollable descent, which matches the observed flight behaviour of N28JV just before the crash. Witnesses and video recordings from the ground observed the aircraft's rapid descent, consistent with spoiler deployment.

- **System Design and Warnings**: The checklist and lift dump handle on the centre pedestal include a very clear warning about the risk of deploying ground spoilers in flight, but this warning comes after the instruction to unlock the system. This placement could lead to confusion, especially for a non-rated SIC unfamiliar with the specific risks associated with the 390 Premier 1's lift dump system.

- **Crew Communication and Training**: The absence of specific briefings or warnings about the critical nature of the lift dump system operation suggests a gap in crew communication and training. The PIC, while managing multiple tasks, might not have adequately briefed the SIC on this particular hazard.

- **Flight Manual and Regulations**: The Hawker Beechcraft Corporation Premier I/IA Model 390 Airplane Flight Manual, Section 2 – Limitations, emphasises the importance of proper seating and crew qualification. The SIC, lacking the necessary type rating, would have been less familiar with the aircraft's unique systems and their operation, increasing the risk of such errors.

In summary, the inadvertent extension of the lift dump spoilers, most likely by the SIC, while carrying out the Before Landing checklist triggered a sudden loss of lift, leading to an uncontrollable descent and the subsequent crash. This incident highlights the critical need for rigorous adherence to operational protocols, thorough crew training, and clear communication to prevent similar accidents in the future.

2.4 Analysis of Inflight Lift Dump Extension

2.4.1 Confirmation of the Lift Dump Handle Extension

The CVR data indicates that the flight proceeded normally until just after the Before Landing checklist item No. 2: "Lift Dump…UNLOCK, HANDLE ILLUMINATED, J-HOOK CLEAR." The following evidence supports the conclusion that the Lift Dump Handle was moved to the EXT (extend) position during flight:

- **Lift Dump Handle Position**: The lift dump handle was found in the extended position and its lock release was in the unlocked position, as per the CT factual report (refer to Figure 9 in Appendix F).

- **Right Lift Dump Actuator**: The right lift dump actuator was discovered in the extended position during on-site and spoiler examination reports (refer to Appendix D).

- **Down Lock Striker Condition**: The right lift dump panel down lock striker was bent from impact and was not held by the locking actuator (Appendix D).

- **Video Evidence**: A video recording of the aircraft's approach showed a glare a few seconds before the aircraft began turning right and descending rapidly. This glare was likely caused by the spoilers extending and reflecting light, indicating the extension of the lift dump spoilers.

The other spoilers were found in their retracted positions (refer to Appendix D). The impact sequence explains why the right lift dump actuator remained in the extended position. The right wing impacted the ground first, and with the right lift dump actuator deployed, the impact damaged and deformed the actuator, locking it in the extended position. As the right wing disintegrated, hydraulic pressure was lost, causing the other spoilers to retract. The right lift dump panel moved to the retracted position due to the hold-down spring, but the down lock striker impacted the locking actuator and bent.

2.4.2 Computed Tomography (CT) Scan of Lift Dump Handle

The details of the examination of the accident aircraft lift dump panel using CT is provided in Appendix F. The CT images confirmed that the lift dump handle was extended at the time of the accident. The photograph of the accident lift dump panel and CT image of the panel are provided in Figure 11. Photographs of the accident lift dump panel and an exemplar lift dump are shown in Figures 15 and 16 respectively:

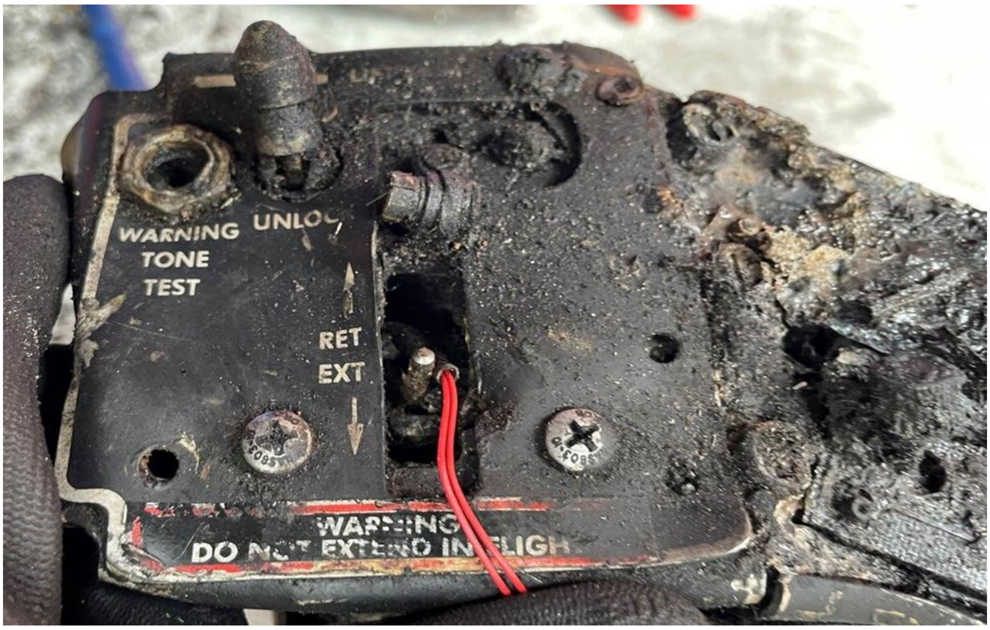

Figure 15. Lift Dump Panel

Figure 16. Photograph of an Exemplar Lift Dump Panel

The details of the examination of the N28JV aircraft's lift dump panel using CT imaging confirm that the lift dump handle was in the EXT (extend) at the time of the accident.

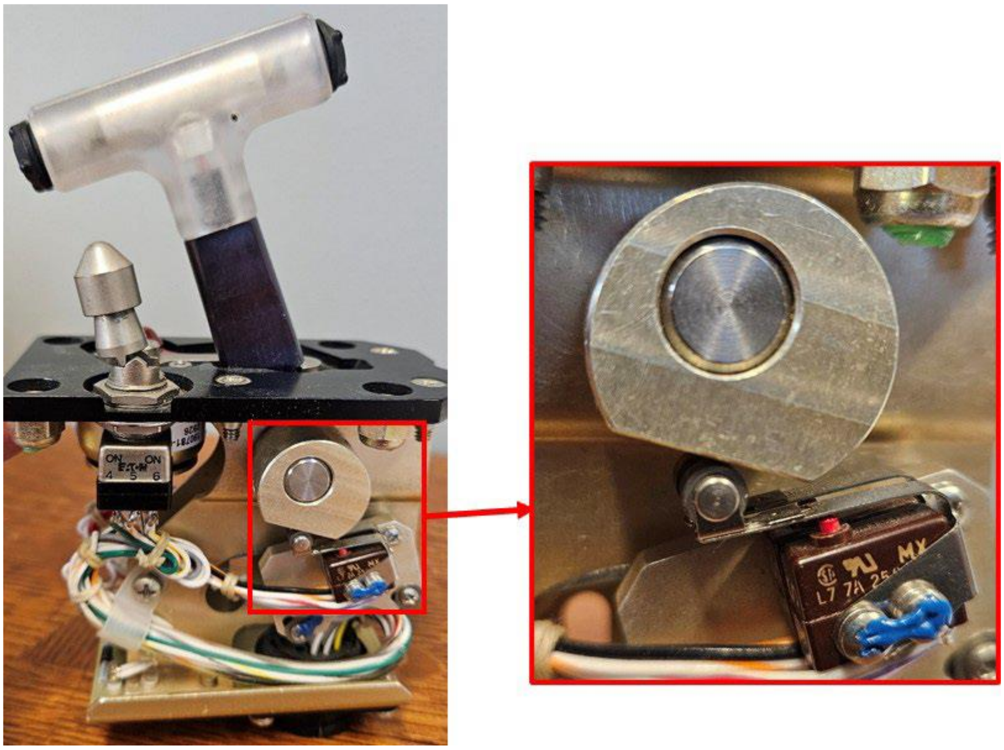

Figure 17: Photographs of exemplar lift dump handle – showing the left side in the RET (retract) position including a zoomed in view of the microswitch.

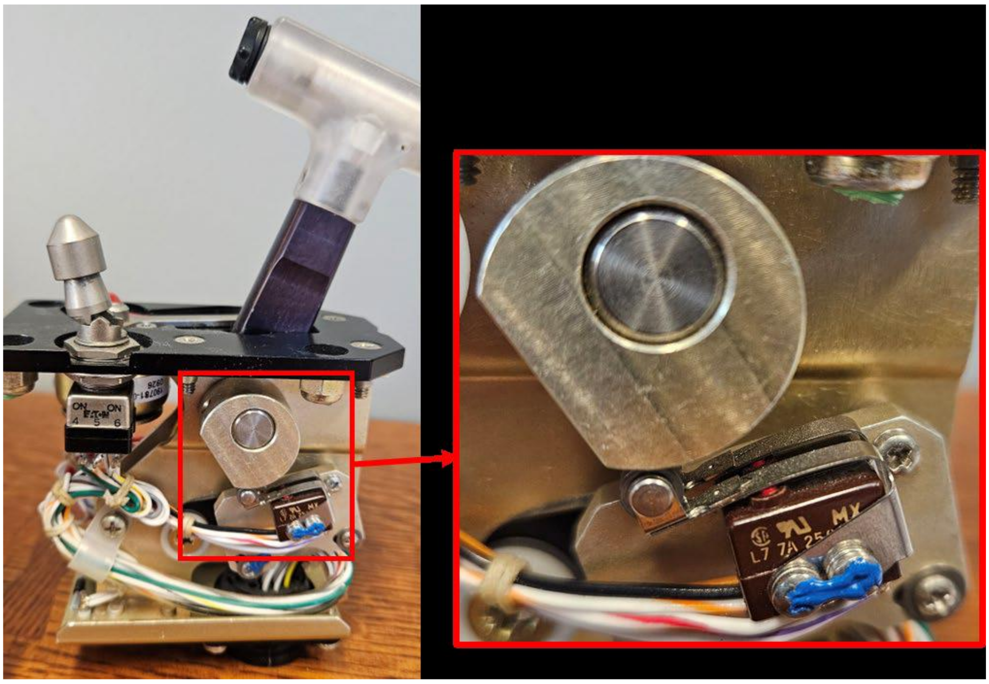

Figure 18: Photographs of exemplar lift dump handle – showing the left side in the EXT (extend) position including a zoomed in view of the microswitch.

Comparison of the exemplar lift dump handle photographs showing the RET (retract) and EXT (extend) positions in Figures 17 and 18 with the CT images in Figure 19 of the N28JV lift dump handle confirms that the lift dump handle was in the EXT (extend) position. Additional photographs, CT images, and detailed information from the CT examination are provided in Appendix F.

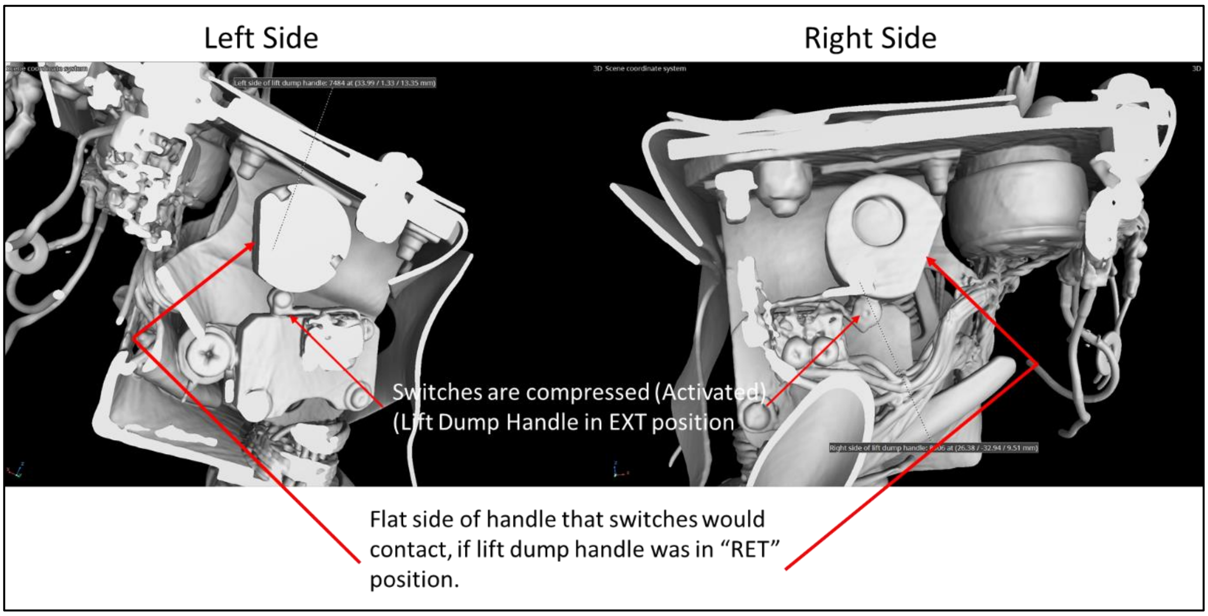

Figure 19. CT Image of N28JV Lift Dump Panel

2.5 Crew Resource Management (CRM) Analysis

2.5.1 Crew Seating Positions

Two ground eyewitnesses at WMKL, the Ground Marshaller and Ground Handler, confirmed that during the accident flight, the PIC, who held a single-pilot RA-390S rating, was seated in the right-hand seat. Meanwhile, the SIC, not rated on the 390 Premier 1 but rated as SIC on the Gulfstream IV, was seated in the left-hand seat. These witnesses observed the aircraft taxiing to the holding point, clearly noting the seating positions of the crew.

2.5.2 Limitation and Regulation on Crew Seating

This seating arrangement of the N28JV crew on the accident flight breached the Premier I/IA Model 390 Airplane Flight Manual, Section 2 – Limitations, which mandates that for single-pilot operations, the appropriately rated pilot must occupy the left seat (Figure 20). This requirement is crucial because the left seat is designed for optimal access to controls and instruments necessary for single-pilot operation. The SIC, lacking a rating on the 390 Premier 1, would not have been adequately prepared to manage these responsibilities, raising concerns about the decision to deviate from standard protocol.

Additionally, this non-compliance could have implications for the overall safety and decision-making process during the flight. The seating arrangement may have contributed to ineffective cockpit resource management, potentially impacting the crew's ability to handle critical situations. This deviation from prescribed procedures underscores the importance of adhering to established protocols to ensure safe and efficient aircraft operation.

OCCUPANCY LIMITS

Minimum Flight Crew

RA390S Type Rated . . . . 1 Pilot (must occupy left seat)

See the KINDS OF OPERATION EQUIPMENT LIST in this section for required equipment.

RA390 Type Rated . . . . 1 Pilot and 1 Copilot

Maximum Passenger Seating Configuration:

Single-Pilot Operations:

Pilot Compartment (Passenger must occupy right crew seat) 1

Cabin. 6

Two-Pilot Operations:

Cabin. 6

Figure 20: Hawker Beechcraft Corporation Premier I/IA Model 390 Airplane Flight Manual, Section 2 – Limitations

Moreover, the limitation on minimum flight crew was developed based on the United States 14 CFR Part 21.1523 (Minimum Flight Crew), which states that “The minimum flight crew must be established so that it is sufficient for safe operation, considering:

(a) The workload on individual crewmembers;

(b) The accessibility and ease of operation of necessary controls by the appropriate crewmember; and

(c) The kind of operation authorised under Part 25.1525.”

This regulation further emphasises the need for compliance with seating and operational protocols to ensure that each crew member can perform their duties effectively and safely.

2.5.3 Crew Operation and Safety

Operating with two crewmembers can significantly enhance flight safety by providing redundancy, sharing tasks, and increasing situational awareness. The FAA encourages using a Second-In-Command (SIC) on aircraft certified for single-pilot operations. Advisory Circular 135-43 (AC 135-43 – Part 135 Second in Command Professional Development Program) offers guidance on developing SIC professional development programmes. According to these guidelines, both the Pilot-In-Command

(PIC) and SIC should meet specific training requirements, including crew resource management and mentoring training for the PIC.

Running the Before Landing checklist usually poses no significant safety risk, as pilots with a commercial multi-engine land certificate should be able to safely lower flaps and landing gear. However, in this accident, the checklist included unlocking the ground spoilers—a step likely misunderstood by the SIC, leading to a catastrophic outcome. The checklist warns of the risk of deploying ground spoilers in flight, but this warning comes after the item to unlock the system. According to CVR recording, while running through the checklist items before landing, the SIC mistakenly stated one of the checklist items as "Fuel Dump" instead of "Lift Dump" according to the Premier 1/1A Pilot Checklist – Model 390.

Given the risk associated with unlocking the ground spoilers, it would have been prudent for the PIC to brief the SIC on this risk and for the warning to be presented before the checklist item specifying the unlocking of the ground spoilers. There was no indication during the period recorded on the CVR that the PIC had briefed and warned the SIC about the lift dump operation. Whether the PIC had done so on the two prior flights or at any other time cannot be determined. Ensuring that both pilots are aware of such critical steps and potential hazards is essential for maintaining safety and preventing accidents.

2.6 Human Factors Analysis

2.6.1 Summary of CRM Analysis

The crew's seating arrangement violated established protocol, likely affecting CRM. The PIC, who was single-pilot rated, sat in the right-hand seat, while the SIC, not rated on the 390 Premier 1, sat in the left-hand seat. This arrangement violated the Airplane Flight Manual's seating protocol and likely impacted safety and decision-making. While operating with two crewmembers enhances safety, adherence to protocols is crucial. The accident resulted from a misunderstood checklist item, leading to inadvertent ground spoiler deployment. Proper briefings on critical steps and potential hazards, such as ground spoilers, are essential for maintaining safety and preventing accidents.

2.6.2. Compliance with Standard Operating Procedures (SOPs)

The decision to deviate from the seating protocol outlined in the Airplane Flight Manual represents a significant lapse in adhering to SOPs. SOPs are designed to ensure the safety and efficiency of operations by providing clear guidelines and expectations. Non-compliance with these procedures undermines the safety framework and can lead to increased risks and errors, particularly in high-stress or emergency situations.

2.6.3 Training and Competency

The SIC was rated on the Gulfstream IV but not on the 390 Premier 1. This lack of rating suggests that the SIC might not have been fully trained or familiar with the systems and procedures of the 390 Premier 1. This is highlighted by the SIC's most likely inadvertent extension of the lift dump spoilers in flight. Proper training and familiarity with the aircraft type are crucial for effective performance and safety. Without appropriate training, the SIC's ability to perform essential tasks and respond to emergencies could have been compromised.

2.6.4 Decision-Making and Judgment

The PIC's decision to occupy the right-hand seat, contrary to the manual's requirements, raises questions about judgment and risk assessment. This decision may have been influenced by overconfidence in personal ability or underestimation of the potential risks associated with deviating from standard procedures. Effective decision-making requires a thorough understanding of the potential consequences and a commitment to safety protocols.

2.6.5 Workload Management

The improper seating arrangement likely disrupted the effective distribution of workload between the crew members. With the PIC performing flight duties as PF from the right-hand seat, he may have encountered increased workload and stress due to the less optimal position for controlling the aircraft. Additionally, having a non-rated SIC, who lacked specific training on the 390 Premier 1, may have further increased the PIC's workload, particularly if the PIC was relatively inexperienced with this aircraft type. Effective workload management is crucial for maintaining situational awareness and ensuring that all tasks are performed accurately and efficiently, which is essential for overall flight safety.

2.6.6. Situational Awareness

The deviation from standard seating protocols and the associated complications could have impaired the crew's situational awareness. Situational awareness involves understanding the current environment, anticipating future states, and recognising any changes that could impact safety. Any factors that disrupt normal operations, such as unfamiliar seating arrangements and lack of training, can significantly diminish situational awareness.

2.6.7 Communication

Effective communication is a cornerstone of safe flight operations. The unusual seating arrangement and the SIC's lack of rating on the aircraft could have led to misunderstandings or miscommunications during critical phases of the flight. Clear and effective communication is necessary for coordinating actions, sharing information, and making informed decisions.

2.6.8 Conclusion – Human Factors Analysis

The human factors analysis highlights several critical areas where deviations from standard procedures, inadequate training, and poor decision-making likely contributed to the accident. To prevent future incidents, it is essential to reinforce the importance of compliance with established protocols, ensure thorough training for all crew members, and promote a safety culture that prioritises adherence to SOPs and effective CRM practices.

2.7 Organisational Factors

2.7.1 Organisational Structure and Purpose

Jet Valet Sdn Bhd was established in 2021 as a subsidiary of Koperasi Amanah Pelaburan Berhad (KAPB), which serves a membership base of approximately 12,000 individuals. The company was created to enhance travel convenience and provide supplementary benefits to KAPB members. Jet Valet operates a fleet of three aircraft: Premier 1 (N28JV), Hawker Beechcraft 4000 (N35JV), and Gulfstream IV (N729TY), all based at Sultan Abdul Aziz Shah Airport in Subang, Selangor. With 12,000 KAPB members who can bring additional passengers, they form a large potential passenger base.

2.7.2 Regulatory Compliance and Grey Areas

The 390 Premier 1 (N28JV) is registered in the United States. It was not registered with any CFR Part 121 or 135 operators, and as such fell within the operational confines of Part 91, which governs general aviation operations and is the least restrictive in terms of stringent safety compliance requirements. CFR Part 91 limits compensation for air transportation to specific circumstances, primarily directing paying passengers to operators governed by stricter regulations such as CFR Part 121 (scheduled air carriers) and CFR Part 135 (commuter and on-demand operations).

Despite the U.S. registration, the operator being a Malaysian entity requires compliance with Malaysian regulations. Jet Valet, by virtue of its Malaysian operations, is mandated to follow local aviation laws and regulations. There is no indication that Jet Valet has applied for the necessary approval from the CAAM for non-scheduled air services and the carriage of passengers for compensation in a foreign-registered aircraft, as mandated by current civil aviation policies and regulations[14].

According to Malaysian policy on non-scheduled air services, local air operators must obtain an Air Operator's Certificate (AOC) from the CAAM, and foreign air operators must obtain a Foreign Air Operator's Certificate (FOAC) to provide commercial business flights. However, foreign air operators are not allowed to provide charter flight services and only considered on a case-by-case basis for other non-scheduled and on-demand flights[15]. The aircraft operator appears to be exploiting regulatory grey areas, thereby avoiding stringent oversight and necessary approvals.

Additionally, although the N28JV was intended for long-term operation in Malaysia, there is no evidence that the aircraft operator has applied for Malaysian registration of the aircraft as required under the Civil Aviation Regulations 2016 for foreign-registered aircraft operating in Malaysia for over six months[16].

2.7.3 Passenger Safety and Regulatory Gaps

The substantial membership base of KAPB, coupled with the ability of members to bring additional passengers, increases the potential safety risk. Under the less restrictive CFR Part 91 framework, these passengers may not receive the appropriate level of protection.

By not securing the necessary CAAM approvals for non-scheduled air services and using a foreign-registered aircraft for passenger carriage, the aircraft operator avoids stringent regulatory scrutiny. This practice potentially compromises the safety standards expected for commercial passenger operations.

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[14] Malaysian Civil Aviation Regulations 2016, Part XVIII Foreign Aircraft Operations, Regulation 148.

[15] Ministry of Transport Malaysia, Policy on Non-Scheduled Air Service (Ref. no MOT.600-2/2/11 (2)) dated 1 July 2022, Sections 4.1. and 5.2.

[16] Malaysian Civil Aviation Regulations 2016, Part XVII General Aviation, Regulation 147.

The avoidance of formal documentation and regulatory compliance reflect significant gaps in operational oversight. These gaps can lead to unaddressed safety issues, as evidenced by the accident involving the inadvertent extension of lift dump spoilers.

2.7.4 Crew Training and Communication

The regulatory grey areas and lack of strict oversight can lead to insufficient crew training and inadequate communication protocols, as highlighted by the accident's circumstances. The reliance on a non-rated SIC and deviations from standard procedures emphasise the need for rigorous training and clear operational guidelines.

2.7.5 Conclusion – Organisational Factors Analysis

The organisational and management practices of the aircraft owner and operator, including their exploitation of regulatory grey areas and failure to obtain necessary approvals, have significant implications for passenger safety. The large membership base and the associated high volume of passengers necessitate stringent adherence to regulatory standards to ensure safety. The incident underscores the critical need for comprehensive regulatory compliance, thorough crew training, and clear communication to prevent such accidents in the future.

3.0 CONCLUSION

3.1 Findings

The investigation into the accident involving N28JV, a Hawker Beechcraft Model 390 Premier 1, revealed several key findings:

3.1.1 **Inadvertent Extension of Lift Dump Spoilers**: The primary cause of the accident was the inadvertent extension of the lift dump spoilers, most likely by the Second-in-Command, during the Before Landing checks. This action led to a sudden loss of lift, resulting in catastrophic loss of control and the subsequent crash.

3.1.2 **Deviation from Seating Protocols**: The seating arrangement of the crew deviated from established protocols, with the Pilot-in-Command occupying the right-hand seat and the Second-in-Command in the left-hand seat, contrary to the Airplane Flight Manual. This deviation likely contributed to ineffective crew resource management and communication.

3.1.3 **Inadequate Crew Training and Awareness**: Insufficient crew training and awareness regarding the operation of the lift dump system were contributing factors to the accident. The Second-in-Command's unfamiliarity with the specific risks associated with the lift dump system led to the inadvertent extension of the spoilers.

3.1.4 **Regulatory Grey Areas and Oversight Gaps**: Regulatory grey areas and organisational practices compromised safety oversight and compliance. The aircraft operator's failure to obtain necessary approvals for non-scheduled air services and comply with Malaysian regulations highlighted gaps in operational oversight.

3.1.5 **Communication and Decision-Making**: Ineffective communication and decision-making processes were evident during critical phases of the flight. The absence of specific briefings or warnings about the lift dump system operation and the decision to deviate from standard seating protocols underscored deficiencies in communication and decision-making.

3.2 Cause/Contributing Factors

3.2.1 **Cause**. The accident was primarily caused by the inadvertent extension of the lift dump spoilers by the flight crew while performing the Before Landing checklist.

3.2.2 **Contributing Factors**. Contributing factors included deviations from standard operating procedures, inadequate crew training, regulatory grey areas, and deficiencies in communication and decision-making.

3.2.3 This aviation occurrence is coded as a **Loss of Control – Inflight (LOC-I)**.

4.0 SAFETY RECOMMENDATIONS

Based on the findings and contributing factors identified in the investigation, the following safety recommendations are proposed:

4.1 **Review and Reinforce Crew Training**: Jet Valet Sdn Bhd should enhance training programmes for all crew members, emphasising proper checklist procedures, crew resource management, and the criticality of adhering to established protocols. Special attention should be given to systems unfamiliarity and the operation of critical systems such as the lift dump system.

4.2 **Compliance with Regulatory Requirements**: Jet Valet Sdn Bhd must ensure full compliance with civil aviation regulations, including obtaining necessary approvals for non-scheduled air services and adhering to seating protocols outlined in aircraft manuals. Regular audits and oversight should be conducted to identify and rectify any regulatory compliance gaps.

4.3 **Enhance Organisational Oversight**: Koperasi Amanah Pelaburan Berhad and Jet Valet Sdn Bhd should implement a robust safety management system, promoting a culture of transparency, accountability, and continuous improvement. This includes establishing clear lines of responsibility, improving communication channels, and conducting regular safety audits and assessments.

4.4 **Enhance Operational Procedures**: Jet Valet Sdn Bhd should review and update operational procedures to include clear warnings and briefings on critical systems, such as the lift dump system, to ensure all crew members are fully aware of associated risks and procedures for safe operation.

4.5 **Review of Regulatory Framework**: The Civil Aviation Authority of Malaysia should review the current regulatory framework to provide an appropriate level of oversight of foreign aircraft operation in Malaysia by foreign licensed aircrew to ensure safe operation. This review should include an assessment of licensing requirements, training standards, and operational protocols to ensure compliance with international aviation safety standards and mitigate risks associated with foreign aircraft operation.

5.0 COMMENTS TO DRAFT FINAL REPORT

In accordance with ICAO Annex 13, paragraph 6.3, the Draft Final Report was sent to the State of Registry, Design and Manufacturer (NTSB), State that participated in the investigation (TSIB), CAAM, as well as the aircraft operator (Jet Valet Sdn Bhd) inviting their significant and substantiated comments on the report. The following (Table 7) is the status of the comments received:

Organisations	Status of Significant and Substantiated Comments
NTSB, United States of America	Accepted and report amended.
TSIB, Singapore	Accepted and report amended.
CAAM, Malaysia	Accepted and report amended.
Jet Valet Sdn Bhd	Partially accepted and report amended accordingly to include substance of the accepted comments.

Table 7: Status of significant and substantiated comments.

A total of 29 comments were received from the operator, Jet Valet Sdn Bhd. After a thorough review, one comment was accepted, and its substance was incorporated into the report. Two comments were partially accepted, and the report was amended to reflect the substance of the partially accepted points. The remaining comments were either deemed not significant or unsubstantiated. Comments that were not agreed upon are detailed in Appendix H. In accordance with ICAO Annex 13, paragraph 6.3, Note 2, the comments appended to this report are restricted to non-editorial-specific technical aspects of the Final Report on which no agreement could be reached.

CONCLUDING STATEMENT

This investigation has revealed instances of non-compliance and errors; however, it is crucial to emphasise that these findings are not intended for the purposes of apportioning blame or liability. Rather, they are solely for the purpose of preventing accidents in the future and improving aviation safety on the whole. Addressing the identified findings and implementing the recommended safety measures will enhance aviation safety and mitigate risks associated with operational lapses and regulatory gaps. It is imperative that all stakeholders prioritise safety and commit to implementing the necessary measures to prevent recurrence.

INVESTIGATOR IN-CHARGE

Air Accident Investigation Bureau
Ministry of Transport Malaysia

Appendix A

CERTIFICATE OF AIRWORTHINESS AND CERTIFICATE OF REGISTRATION

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION-FEDERAL AVIATION ADMINISTRATION
STANDARD AIRWORTHINESS CERTIFICATE

1 NATIONALITY AND REGISTRATION MARKS	2 MANUFACTURER AND MODEL	3 AIRCRAFT SERIAL NUMBER	4 CATEGORY
N28JV	RAYTHEON AIRCRAFT COMPANY 390	RB-97	Normal

5 AUTHORITY AND BASIS FOR ISSUANCE
This airworthiness certificate is issued pursuant to 49 U.S.C. § 44704 and certifies that, as of the date of issuance, this aircraft has been inspected and found to conform to its type certificate and be in a condition for safe operation. This aircraft meets the requirements of the applicable airworthiness standards in Annex 8 to the Convention on International Civil Aviation, except as follows:
None.

6 TERMS AND CONDITIONS
Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the FAA, this airworthiness certificate is effective as long as maintenance, preventative maintenance, and alterations are performed per the applicable Federal Aviation Regulations and the aircraft is registered in the United States.

DATE OF ISSUANCE	FAA REPRESENTATIVE	DESIGNATION NUMBER
10 May 2023	Kornelius Luling	900605884

Any alteration, misuse, or reproduction of this certificate for a fraudulent purpose may be punishable by certificate revocation, fine, and / or imprisonment.
THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT PER THE APPLICABLE FEDERAL AVIATION REGULATIONS.
FAA Form 8100-2 (11-2016) Previous Edition Dated 04-11 May be Used Until Depleted

REGISTRATION NOT TRANSFERABLE

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION – FEDERAL AVIATION ADMINISTRATION
CERTIFICATE OF AIRCRAFT REGISTRATION

This certificate must be in the aircraft when operated.

NATIONALITY AND REGISTRATION MARKS N 28JV

AIRCRAFT SERIAL NO. RB–97

MANUFACTURER AND MANUFACTURER'S DESIGNATION OF AIRCRAFT
RAYTHEON AIRCRAFT COMPANY 390

ICAO Aircraft Address Code: 50546176

ISSUED TO
DELAWARE AIRCRAFT TRUST LLC TRUSTEE
2000 BRETT RD STE 767
NEW CASTLE DE 19720-2428

LLC

This certificate is issued for registration purposes only and is not a certificate of title. The Federal Aviation Administration does not determine rights of ownership as between private persons.

It is certified that the above described aircraft has been entered on the register of the Federal Aviation Administration, United States of America, in accordance with the Convention on International Civil Aviation dated December 7, 1944, and with Title 49, United States Code, and regulations issued thereunder.

DATE OF ISSUE May 3, 2023
EXPIRATION DATE May 31, 2030

ACTING ADMINISTRATOR

U.S. Department of Transportation
Federal Aviation Administration

Appendix B

CVR DATA RECOVERY PROCESS

1.1 CVR Data Recovery at TSIB Flight Recorder Facility, Singapore

The recovery of data from the CVR memory storage module at the TSIB's flight recorder laboratory began on 20 August 2023. The process was performed based on L3Harris's FA2100 Accident Investigation Procedure FA2100 Rev. F and L3's Accident Investigators Training material 165E1436-22 (dated 18 June 2012).

During disassembly, the internal components and each layer of the memory puck appeared to be in good condition. The part number of the damaged ribbon cable was identified as 024-E1575-00, which is used for a memory storage module operating at 5V (Figure 1).

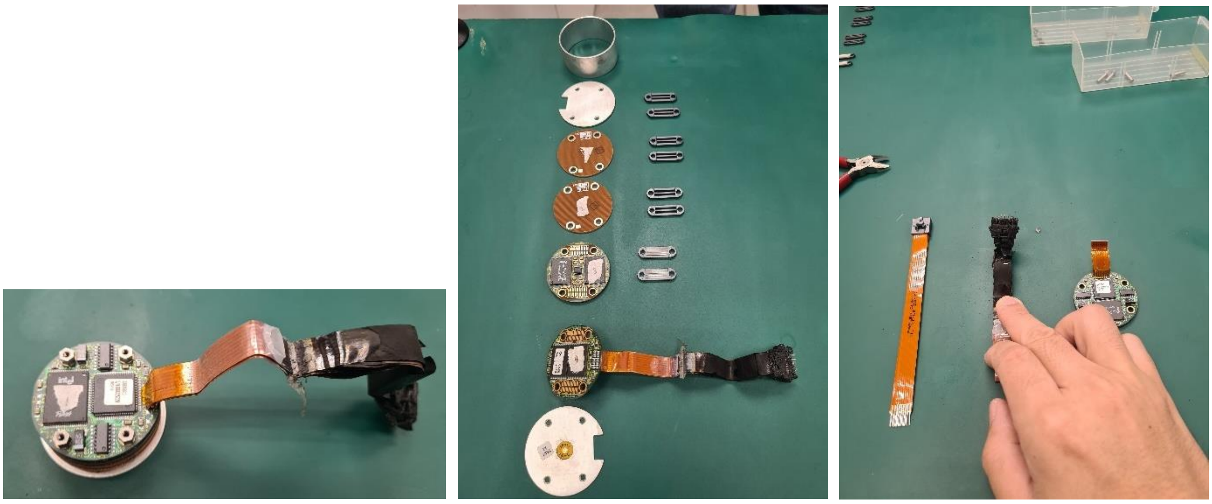

Figure 1: (Left). View of memory puck with base cover removed, showing the memory PCB. (Centre): Each layer of the memory puck is removed. (Right): Verification of the replacement cable to be used.

A new ribbon cable was successfully attached. The memory storage module was reassembled, and electrical checks were performed. Based on these checks, it was determined that it was safe to apply electrical power to the memory storage module to attempt downloading the stored data.

The Golden Chassis was successfully reprogrammed with the 2100-1010-XX AIK firmware, and the memory storage module was connected to it. Upon initial introduction of electrical power to the Golden Chassis with the accident memory storage module, the voltage and current readings were stable at 28V DC and 0.34A, indicating no electrical short circuit.

In L3Harris's Readout Support Equipment (ROSE) software, the "Test Flight Recorder" function was selected to determine if ROSE could communicate with the Golden Chassis and the memory storage module. An error was encountered indicating that ROSE could not establish communication with the memory storage module that was connected to the Golden Chassis (Figure 2).

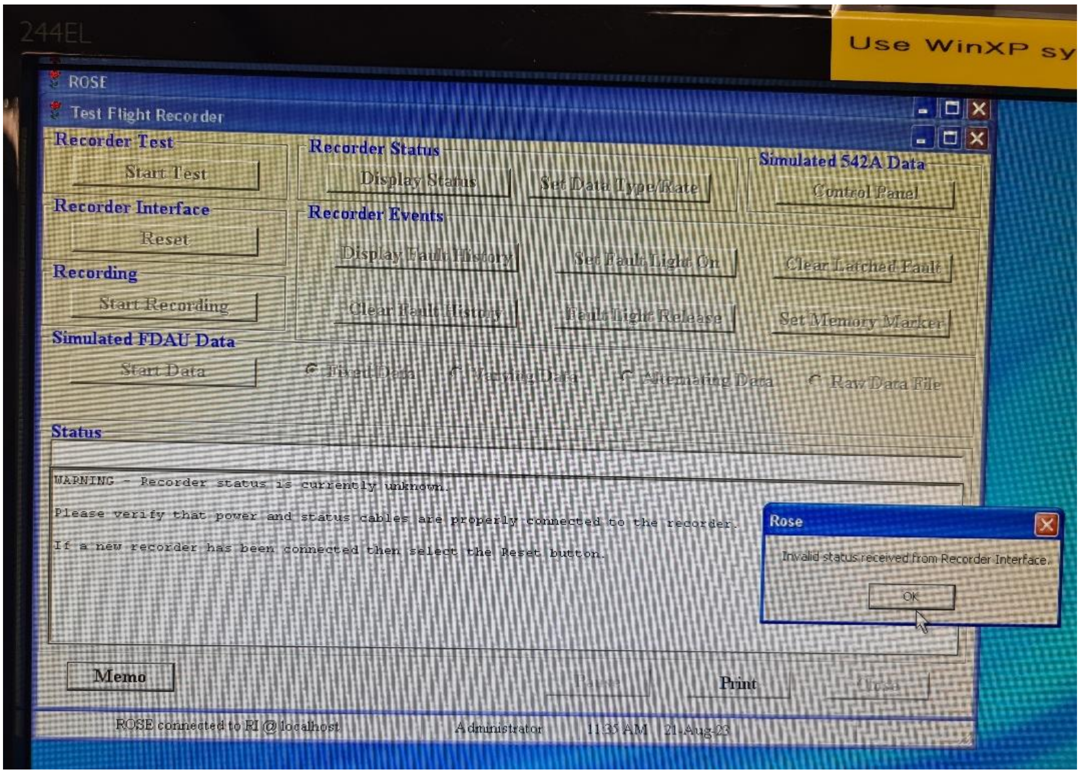

Figure 2. Error encountered in ROSE.

Further attempts were made to connect the Golden Chassis to ROSE, including restarting the download computer several times, disassembling and reassembling the memory storage module, and replacing the ribbon cable. However, these attempts repeatedly encountered the same error shown in Figure 2.

During subsequent troubleshooting, it was determined that the issue was likely related to the AIK firmware used to program the Golden Chassis. The team believed that the AIK firmware was not configuring the Golden Chassis to provide 5V to the memory storage module. The L3Harris representative for accident investigation was contacted regarding the issue. Over the rest of the day and the next day, further troubleshooting by TSIB and L3Harris, followed by reprogramming TSIB's Golden Chassis with updated AIK firmware, finally enabled successful communication with ROSE using the production CVR 5V CSMU.

Once the download process using the new AIK Firmware was successful, another attempt to recover data from the accident memory storage module was performed. After unpacking the memory storage module, a contact on the ribbon cable was observed to have detached from the solder attachment point, and some debris was observed on the PCB.

Rework on the loose contact point and cleaning of the PCB of the memory storage module were performed. The subsequent resistance checks did not return satisfactory results. The ribbon cable was then replaced with a fresh cable, but this measure also failed to achieve satisfactory resistance check values.

At this point, it was decided to perform the CVR data recovery at the L3Harris facility in the United States due to several considerations, including the depletion of spare ribbon cables at the TSIB facility, changes in resistance check values of the reassembled memory storage module, the risk of heat damage to the PCB with continuous soldering of the crimped contacts, and the availability of additional equipment and resources at the L3Harris facility should a more complex recovery process be required..

1.2 CVR Data Recovery at L3Harris, St. Petersburg, Florida, USA

The data recovery from the CVR memory storage module (Figure 3) at the L3Harris Technologies facility in St. Petersburg, Florida was conducted on 28 August 2023. The L3Harris team proposed a full replacement of the cable assembly which was a procedure that is not included FA2100 Accident Investigation Procedure. The investigation team agreed to adopt this method on the consideration that is it similar to the manufacturing process of the memory storage module.

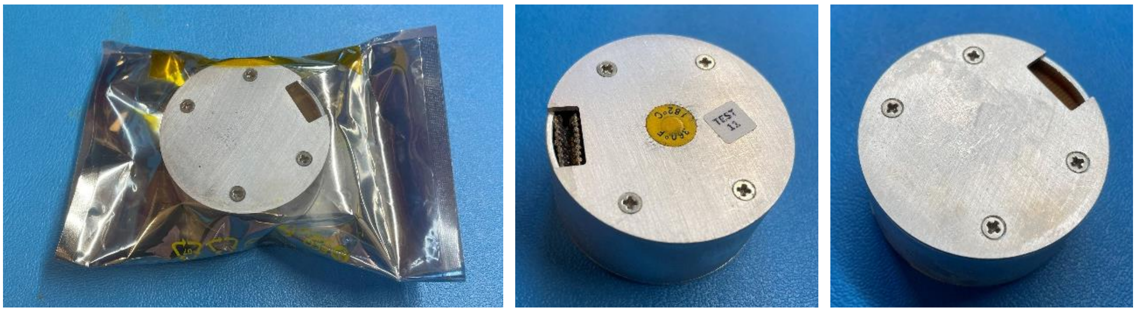

Figure 3: (Left). CVR memory module handed over to L3Harris.
(Centre): Front side. (Right): Back side.

Disassembly of the memory module, including the removal of the remaining cable assembly components, was uneventful (Figures 4 and 5). Safe-to-power measurements performed after the cable remnants removal were within specification.

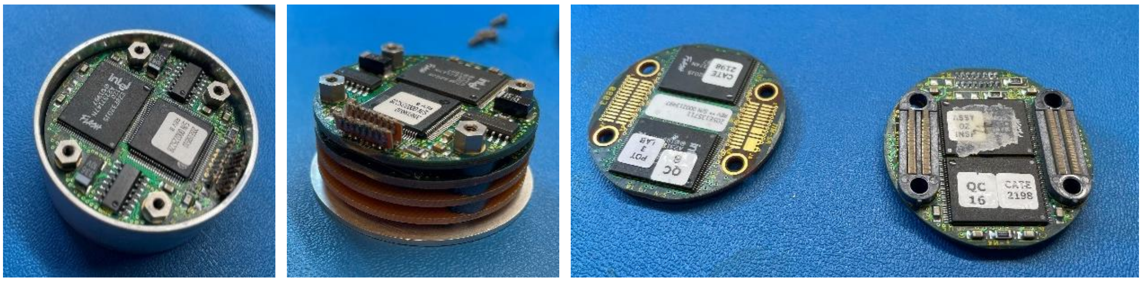

Figure 4: Dissemble of the memory module.

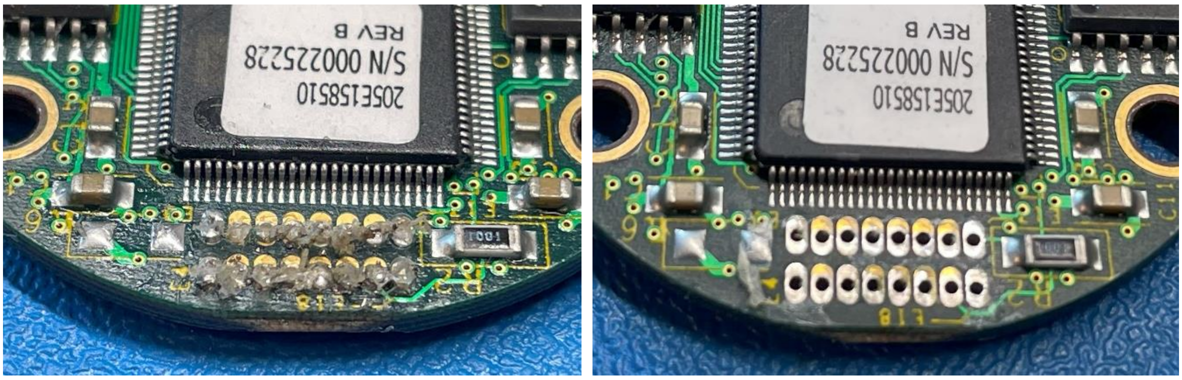

Figure 5. Removal of the remaining cable assembly. (Left): Before. (Right): After.

Reinstallation of a new cable assembly (Figure 6) was similarly uneventful. Post-installation and reassembly safe-to-power testing were successful (Table 1).

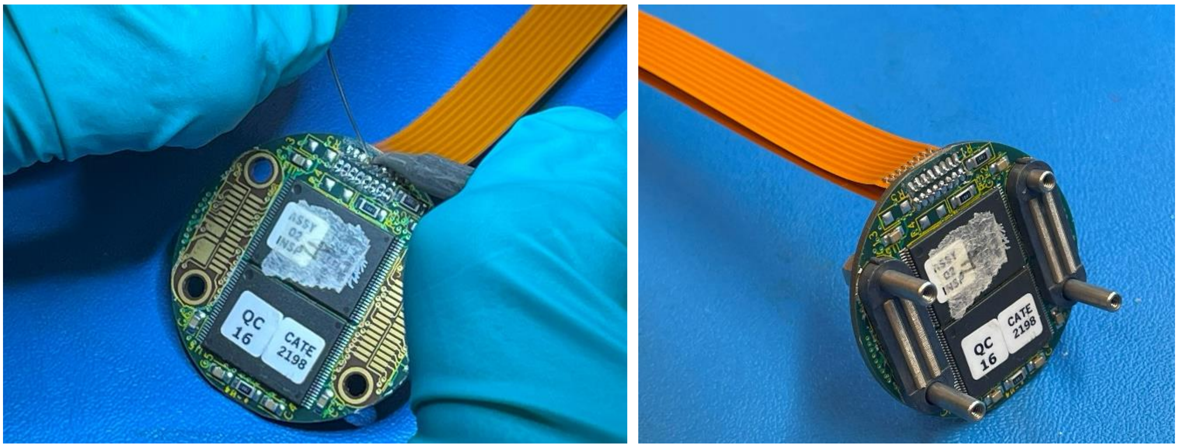

Figure 6. Reinstallation of a new cable assembly.

Between Pins			
From (Red Lead)	To (Black Lead)	Expected	Measured
E3	E5	open	open
E5	E7	3.686k	3.695k
E7	E9	2M	1.939M
E9	E11	open	open
E11	E13	open	open
E13	E15	6.06k	6.09k
E15	E17	6.06k	6.09k
E4	E6	0	0.5 Ω
E6	E8	0	0.6 Ω
E8	E10	2M	1.945M
E10	E12	open	open
E12	E14	open	open
E14	E16	6.06k	6.09k
E16	E18	6.06k	6.09k
E3	E4	open	open
E5	E6	600	608 Ω
E7	E8	3.09k	3.088k
E9	E10	open	open
E11	E12	open	open
E13	E14	935	936 Ω
E15	E16	884	883 Ω
E17	E18	936	942 Ω

Pinout	
Pin	Signal
E3	MIC_RESET_L
E4	GND
E5	VCC
E6	GND
E7	VPP
E8	GND
E9	HS_MSG_MI_LO
E10	HS_MSG_MI_HI
E11	HS_FS_MI_HI
E12	HS_FS_MI_LO
E13	HS_FS_AP_HI
E14	HS_FS_AP_LO
E15	HS_CLK_AP_HI
E16	HS_CLK_AP_LO
E17	HS_MSG_AP_HI
E18	HS_MSG_AP_LO

Table 1: Final safe-to-power measurements taken after new cable rebuild.

The FA2100 Accident Investigator's Kit (AIK) Golden Chassis was inspected, and a known good "golden" CSMU was used to demonstrate the functionality of the AIK. After successfully downloading the golden CSMU, the accident memory module (with replacement cable) was installed and downloaded (Figure 7). The download and subsequent data reconstruction/decompression were uneventful.

Figure 7. Accident memory module (with replacement cable) installed to (Left) and downloaded with the FA2100 AIK Golden Chassis (Right).

The downloaded audio files were then provided to the AAIB/TSIB/NTSB team for their analysis. The team reviewed the audio files retrieved, concluding that the files were complete and that the accident CVR data recovery was successful.

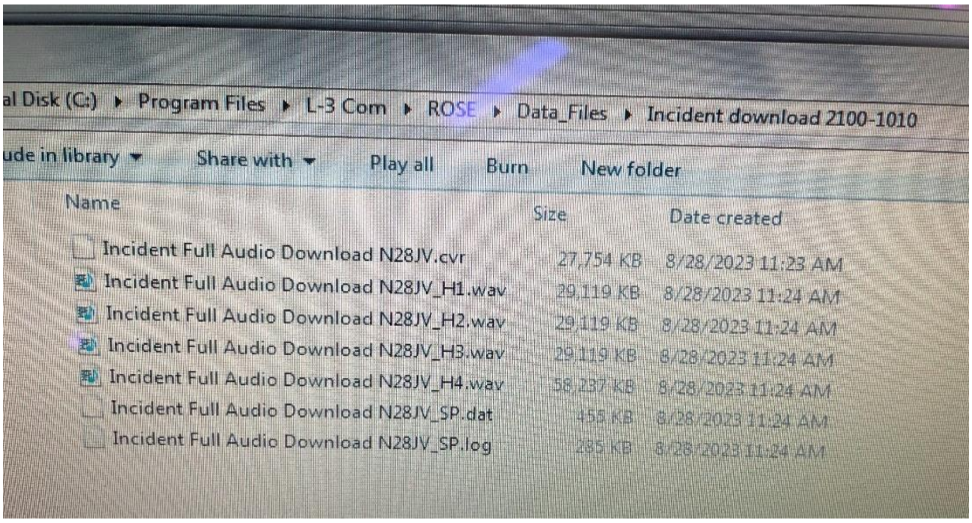

Figure 8. (Left): Complete and successful accident CVR data recovery.

Appendix C

CVR TRANSCRIPTION AND ANALYSIS[17]

1.0 Background

The CVR was damage by heat and impact during the accident sequence and was unable to be read out normally After unsuccessful data recovery attempts at the TSIB's flight recorder facility in Singapore, AAIB investigators transported the CVR's memory module to L3 Harris, the CVR manufacturer, for repair and readout on 28 August 2023, in St. Petersburg, Florida. The repair and readout process were witnessed by representatives from AAIB, TSIB, and NTSB. The NTSB Vehicle Recorder Division received files from the following CVR:

- Recorder Manufacturer/Model: L-3 Communications FA2100-1010
- Recorder Serial Number: 000229957

1.1 Recorder Description

This CVR model, the L-3 Communications FA2100-1010, records a minimum of 30 minutes of digital audio stored on solid-state memory modules. Four channels are recorded: one channel for each flight crew member, one channel for a cockpit observer, and one channel for the cockpit area microphone (CAM).

1.2 Audio Recording Description

The audio quality of each channel is indicated in Table 1[18]. Channel number one did not contain any audio information (nor was it required by regulations).

[17] The NTSB Vehicle Recorder Division provided technical support in the transcription and analysis of the CVR recording. This report is based on excerpts from NTSB's Accredited Representative CVR Group Chair's Report (DCA23WA416) dated 9 October 2023.

[18] Attachment 1 contains the CVR Quality Rating Scale.

Channel Number	Content/Source	Quality	Duration[19] (mm:ss)
1	N/A	N/A	30:48.4
2	Left Seat Audio Panel	Excellent	30:48.4
3	Right Seat Audio Panel	Excellent	30:48.4
4	Cockpit Area Microphone (CAM)	Good	30:48.4

Table 1. Audio Contents and Quality.

1.3 Timing and Correlation

Timing on the transcript is presented in elapsed UTC time based on correlation with a transcript of ATC communications.

1.4 Description of Audio Events

The transcript of the CVR recording that concerned flight events from the descent, approach, and accident sequence that is essential to the analysis and understanding of the accident is provided in Attachment 2. The transcript started at 06:44:30.9 UTC and ended at 06:49:11.5 UTC.

[19] The duration is based on the NTSB CVR Group report (DCA23WA416) dated 9 October 2023, which slightly differs from the recorded duration of the original WAV format file retrieved from the CVR. This variation may result from processing the recording in the laboratory, including the elimination of null data.

Attachment 1 to Appendix C

CVR QUALITY RATING SCALE

The levels of recording quality are characterised by the following traits of the cockpit voice recorder information:

Excellent Quality	Virtually all of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate only one or two words that were not intelligible. Any loss in the transcript is usually attributed to simultaneous cockpit/radio transmissions that obscure each other.
Good Quality	Most of the crew conversations could be accurately and easily understood. The transcript that was developed may indicate several words or phrases that were not intelligible. Any loss in the transcript can be attributed to minor technical deficiencies or momentary dropouts in the recording system or to a large number of simultaneous cockpit/radio transmissions that obscure each other.
Fair Quality	The majority of the crew conversations were intelligible. The transcript that was developed may indicate passages where conversations were unintelligible or fragmented. This type of recording is usually caused by cockpit noise that obscures portions of the voice signals or by a minor electrical or mechanical failure of the CVR system that distorts or obscures the audio information.
Poor Quality	Extraordinary means had to be used to make some of the crew conversations intelligible. The transcript that was developed may indicate fragmented phrases and conversations and may indicate extensive passages where conversations were missing or unintelligible. This type of recording is usually caused by a combination of a high cockpit noise level with a low voice signal (poor signal-to-noise ratio) or by a mechanical or electrical failure of the CVR system that severely distorts or obscures the audio information.
Unusable	Crew conversations may be discerned, but neither ordinary nor extraordinary means made it possible to develop a meaningful transcript of the conversations. This type of recording is usually caused by an almost total mechanical or electrical failure of the CVR system.

Attachment 2 to Appendix C

CVR TRANSCRIPT

The following is a transcript of the L-3 Communications FA2100-1010 solid state cockpit voice recorder, serial number 229957, installed on a Raytheon Aircraft Company 390 Premier 1, N28JV, which crashed during approach on 17 August 2023 at Elmina, Shah Alam, Selangor, Malaysia.

LEGEND	
CAM	Cockpit area microphone voice or sound source
HOT	Flight crew audio panel voice or sound source
RDO	Radio transmissions from N28JV
APR	Radio transmission from the Subang approach controller
TWR	Radio transmission from the Subang airport tower controller
EGPWS	Enhanced Ground Proximity Warning System sound source
SIC	Voice identified as the Second-In-Command (left seat)
PIC	Voice identified as the Pilot-In-Command (right seat)
?	Voice unidentified
*****	Unintelligible word
#	Expletive
@	Non-pertinent word
( )	Questionable insertion
[ ]	Editorial insertion
{ }	English translation of Malay language

Note 1: Times are expressed in UTC time.
Note 2: Generally, only radio transmissions to and from the accident aircraft were transcribed.
Note 3: Words shown with excess vowels, letters, or drawn-out syllables are a phonetic representation of the words as spoken.
Note 4: A non-pertinent word, where noted, refers to a word not directly related to the operation, control, or condition of the aircraft.

06:18:23.0
START OF RECORDING

06:44:30.9
START OF TRANSCRIPT

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:44:30.9 **SIC**	ok approach checklist *.		
06:44:32.1 **PIC**	yeah.		
06:44:32.4 **SIC**	V ref confirm and (checked or set).		
06:44:34.2 **SIC**	land and descent check crew briefing confirm complete. seat position set. fuel balance within limits. landing lights on. recog lights as desired. cabin sign. no smoke seatbelts. ignitions on.		
06:44:44.6 **PIC**	check.		
06:44:45.2 **SIC**	engine sync off.		
06:44:45.5 **PIC**	check.		
06:44:47.2 **SIC**	flaps ten ** on you. and TCAS as required.		
06:44:51.7 **PIC**	check.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:44:52.3 **SIC**	and uh before landing stand by.		
06:44:54.7 **PIC**	yes.		
06:44:55.4 **SIC**	which is landing gear and fuel dump. * [sound of chuckle]		
06:45:15.3 **PIC**	* …ni aku go below V ref. {* …I go below V ref.}		
06:45:16.7 **HOT**	[sound similar to altitude alert]		
06:45:17.9 **SIC**	owh okay okay. yup yup.		
06:45:27.2 **SIC**	owh ni dia punya glideslope ehh bulat tu. {oh this glideslope ehh is the circle one.}		
06:45:30.3 **PIC**	oh, tu kiranya kalau kan ikut punya ni ah. {oh, it will follow this ah.}		
06:45:31.6 **SIC**	reference glide slope.		
06:45:44.9 **PIC**	macam ni kan, nampak dekat kan, just arm approach jee. {like this one, seems close enough, just arm the approach.}		
06:45:48.9 **SIC**	ohhh.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:45:51.2 **SIC**	arm approach.		
06:45:52.2 **PIC**	yeah.		
06:45:52.8 **SIC**	owh okay.		
06:45:55.7 **SIC**	I-L-S pun arm approach, jugak? {I-L-S arm approach too?}		
06:45:57.0 **PIC**	yup… semua arm approach. {yup... for all arm the approach.}		
06:45:58.6 **SIC**	owh alahai.		
06:46:04.1 **SIC**	tak boleh pindah ni ke system ni ke G four aaa? {can we transfer this system to G four aaa?}		
06:46:06.5 **PIC**	Haha ok.		
06:46:06.8 **SIC**	[sound of laughter]		
06:46:07.6 **PIC**	okay.		
06:46:08.0 **SIC**	okay.		
06:46:08.5 **PIC**	alt capture there.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:46:09.5 **SIC**	alt checked.		
06:46:13.4 **PIC**	okay. flaps ten please.		
06:46:14.0 **EGPWS**	twenty five hundred [automated callout]		
06:46:15.5 **SIC**	flaps ten. speed check. flaps ten okay in transit. stand by.		
06:46:17.5 **PIC**	check.		
06:46:18.5 **CAM**	[sound of click]		
06:46:21.9 **CAM**	[sound similar to engine spool up]		
06:46:28.1 **SIC**	okay established. want to tell them?		
06:46:30.4 **PIC**	aaa belum lagi aaa, jap aaa. {aaa not yet aaa. standby aaa.}		
06:46:31.3 **SIC**	nanti dia beritau. {later it will tell.}		
06:46:32.6 **PIC**	aaa boleh la. {ah can now.}		
06:46:33.3 **SIC**	bagitau aaa… {tell ah...}		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
		06:46:34.1 **RDO-SIC**	november two eight juliet victor two thousand five hundred feet established on N-D-B runway one five.
		06:46:39.1 **APP**	roger november juliet victor tower one one eight two.
		06:46:42.3 **RDO-SIC**	one one eight two tower. november two eight juliet victor. bye bye.
06:46:46.3 **HOT**	[sound of tone]		
06:46:46.4 **PIC**	tengok ni aah, dah approach ni glidepath now glidepath armed. {look at this ah. already approaching glidepath now. glidepath arm.}		
06:46:46.7 **SIC**	okay.		
06:46:49.8 **SIC**	glide path armed. okay. yup.		
06:46:50.3 **PIC**	aah so glidepath akan datang. {ah so glidepath will come.}		
		06:46:53.4 **RDO-SIC**	tower. uh subang tower uh premier jet november two eight juliet victor established on the N-D-B runway one five. good afternoon.
		06:47:01.0 **TWR**	november two eight juliet victor subang tower. afternoon. continue approach.

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:47:03.4 **HOT**	[sound of double chime similar to top of descent alert]		
		06:47:05.7 **RDO-SIC**	continue approach november two eight juliet victor.
06:47:08.2 **PIC**	check. okay flaps aaa twenty.		
06:47:11.2 **SIC**	okay speed check. flaps twenty advancing.		
06:47:19.4 **SIC**	okay flaps twenty.		
06:47:21.0 **PIC**	check.		
06:47:23.3 **CAM**	[sound of clicks]		
06:47:29.0 **PIC**	so glide path capture so now we on the G path.		
06:47:32.4 **SIC**	okay.		
06:47:35.5 **SIC**	owh. ah.		
06:47:36.9 **PIC**	so vertical glide path.		
06:47:38.6 **SIC**	real live huh?		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:47:40.1 **PIC**	yup.		
06:47:40.4 **SIC**	okay. checked.		
06:47:41.6 **PIC**	yup… so aku delay kejap eehh. {yup... so I delay a little bit eehh.}		
06:47:43.4 **SIC**	okay.		
06:47:53.6 **PIC**	so terrain off. radar off. all off aaa alright.		
06:48:02.2 **SIC**	…boleh off, weather tadak. {...can switch off. no weather.}		
06:48:05.6 **CAM**	[sound similar to decrease in engine speed]		
06:48:06.4 **CAM**	[unintelligible passenger conversation]		
06:48:17.4 **PIC**	okay one five. okay and gear down. bang [Malay word for brother].		
06:48:20.5 **SIC**	okay gear's down.		
06:48:22.9 **CAM**	[sound similar to landing gear extension and increasing air noise]		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:48:33.4 **SIC**	okay flaps down.		
06:48:35.1 **PIC**	okay the last flaps. flaps down.		
		06:48:36.7 **TWR**	november juliet victor surface wind one eight zero seven knots. clear to land.
06:48:37.4 **CAM**	[sound of click]		
		06:48:41.3 **RDO-SIC**	clear to land runway one five november two eight juliet victor.
		06:48:45.2 **TWR**	november juliet victor.
06:48:46.8 **SIC**	okay cleared to land.		
06:48:47.9 **PIC**	check.		
06:48:51.8 **PIC**	okay one thousand. stabilised. and the check list. bang.		
06:48:53.7 **SIC**	check. before landing. landing gear down.		
06:48:56.3 **PIC**	landing gear.		
06:48:56.6 **SIC**	lift dump unlock. handle illuminated.		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:48:56.9 **CAM**	[sound of click]		
06:48:57.5 **PIC**	lift dump unlock.		
06:48:58.5 **EGPWS**	one thousand. [automated callout]		
06:48:59.2 **CAM**	[sound of several clicks]		
06:48:59.2 **SIC**	woah.		
06:48:59.6	[sound similar to lift dump warning aural tone lasting about 1.5 seconds]		
06:49:00.0 **SIC**	woah woah woah woah woah woah woah woah. what's going on?		
06:49:01.0 **PIC**	#.		
06:49:01.0	[sound similar to autopilot disconnect aural alert]		
06:49:03.7 **SIC**	woah. woah woah woah.		
06:49:03.9	[sound similar to lift dump warning aural tone lasting until end of recording]		

Time and Source	Intra-Aircraft Communication	Time and Source	Over-the-Air Communication
06:49:04.1 **EGPWS**	minimums. minimums [automated callout]		
06:49:04.6 **PIC**	# # # #. [repeats until end of recording]		
06:49:06.5 **EGPWS**	sink rate. pull up. [automated callout]		
06:49:07.6 **PIC**	# # #. [straining]		
06:49:08.8 **EGPWS**	pull up. [automated callout]		
06:49:09.5 **?**	[sound of straining and grunting]		
06:49:10.2 **SIC**	oihhh… oihhh oihh.		
06:49:11.2 **PIC**	Ya Allah. [screaming] {Almighty Allah.}		
06:49:11.2 **SIC**	Ya Allah. Ya Allah. Ya Allah. [screaming] {Almighty Allah. Almighty Allah. Almighty Allah.}		

06:49:11.5

END OF TRANSCRIPT

END OF RECORDING

Appendix D

AIRCRAFT DAMAGE ASSESSMENT[20]

1.0 Examination Details

1.1 Structures

The majority of the airplane was consumed by fire. Both wings and the vertical stabiliser structure had detached from the airframe. All four corners of the aircraft, along with remnants of all flight controls, flaps, and spoiler surfaces, were located. There was no evidence of feathers or bird debris on any of the airframe structure.

1.1.1 Accident Site

By the time of the investigation group's arrival, some of the wreckage had been removed from the initial impact point along the "Persiaran Elmina" highway junction and moved to a field adjacent to the main wreckage. The road surface with the impact scar marks was then repaved.

The first identified point of impact was characterised by a 5-ft-long ground scar, on a heading of 260°, in the centre median of the highway about 3 miles northwest of the approach end of WMKL airport Runway 15 (Figure 1). Fragments of the green navigation light lens were located within the disruption.

Debris, including the right engine, right wing fragments, cabin contents, and skins, continued across the paved highway and into a tree-lined grass area to the west. The main wreckage came to rest about 240 ft west of the initial impact, next to a stand of four felled trees. The grass and surrounding vegetation were burnt.

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[20] Damage assessment information is extracted from the field notes (DCA23WA416) compiled by the NTSB Accredited Representative Airworthiness Group during the investigation of the N28JV accident in Malaysia.

Within the main wreckage area, the cabin had come to rest on a reciprocal heading from the debris and was resting against the left engine and a crushed automobile. The left wing remained partially attached to the cabin and was pointing north. The vertical stabiliser assembly was about 10 ft west of the cabin, and the left and right main landing gear remained with the main wreckage and attached to their respective wing attachments. The trunnion/upper section of the nose landing gear was found in the main wreckage. The nose gear piston/wheel was found in the immediate vicinity of the main wreckage.

Figure 1. Accident Site.

1.1.2 Right Wing

The right wing had fragmented (Figure 2), and its skins were distributed throughout the debris field. One of the wing spars was located principally intact and bent slightly aft, while the remaining spars were fragmented with eight distinct sections identified.

Figure 2. Right Wing.

The aileron remained attached to the wingtip by all of its hinges. The trim tab and actuator remained attached to the aileron. The inboard flap sustained thermal damage to about 70% of its surface and remained attached to its tracks, which had detached from the aft spar. The outboard flap had broken in half about midspan. The outboard track had detached from the aft wing spar and remained attached to the flap.

The inboard lift dump surface was bent on the inboard side and remained attached by its actuators. The inboard spoiler remained attached to its intermediate spar by all hinges. The outboard spoiler had broken into two pieces and remained partially attached by the actuators.

The fuel filler cap was not located, but the filler neck exhibited jagged tearing deformation to its locking tab consistent with the cap being installed at impact.

1.1.3 Left Wing

The left wing exhibited leading-edge crush damage starting at the root and progressively moving aft and through the intermediate spars as it continued to the aft spar at the tip (Figure 3). The wing sustained thermal damage to most of its skin surface, bubbling and darkening the paint.

Figure 3. Left Wing.

The inboard section of the leading edge was crushed aft to the wing forward spar and upward to the wing top skin. It also exhibited diagonal scratches in an aft/upward direction.

The aileron had broken into three sections, with the centre section remaining attached to the wing by its push/pull rod. The trim tab remained attached to the inboard section of the aileron.

The outboard spoiler remained attached by its hinges and actuators. The inboard spoiler sustained thermal damage, consuming its inboard section, but it remained attached by its outboard hinges and actuators. The lift dump surface was burnt but remained attached by its hinges. The fuel cap was installed at the filler neck.

The inboard flap had completely detached but remained connected to its inboard track. The outboard flap had broken in half and remained attached to its outboard track, which had detached from the wing.

1.1.4 Vertical and Horizonal Stabiliser

The vertical stabiliser skins sustained thermal damage, consuming the resin and leaving only fabric remnants. The top rudder hinge and bell-crank rudder assembly remained attached to the vertical stabilizer aft spar, and remnants of burnt rudder skin were located.

Remnants of the horizontal stabiliser remained attached to the center box section. The bolts that attach the box to the vertical stabiliser were still in place, along with the fiber remnants of the vertical stabiliser.

The left horizontal stabiliser sustained thermal damage, consuming the resin and leaving only fabric remnants of the skin. The stainless steel leading edge sustained crush damage and remained attached to the skin remnants. The left elevator had detached and fragmented, with the centre and tip sections located. The outboard hinge remained attached to the control surface.

The right horizontal stabiliser had broken in half about midspan, and the stainless steel leading edge had detached and crushed aft. The inboard section of the elevator was located, along with its inboard hinge and trim tab, both of which remained attached.

1.1.5 Cabin

Fragments of the windshield screens were located, along with a fractured single tempered pane. The main cabin door had broken into three segments, and the external latch was in the locked position. The entire cockpit was fragmented and consumed by fire, destroying all avionics equipment and electrical wiring. The escape hatch door was fragmented into several sections.

1.2 Engines

1.2.1 Right Engine (SN: 105102)

The engine had broken into three distinct segments: the fan, fan case assembly with Intermediate Pressure (IP) blades, and the High-Pressure Compressor and Hot Section. The starter, Hydromechanical Unit (HMU), and gearbox had all detached.

The Low Pressure (LP) shaft remained partially attached to the fan, which had separated from the engine (Figure 4). Remnants of the spinner were still in place. The LP shaft had separated aft of the 1.5 bearing retainer and exhibited twisting in the opposite direction of rotation and deformation with 45° shear lips at the separation area.

Figure 4. Right Engine Fan.

Two adjacent fan blades had broken off about one inch from the root, and another blade had broken off about one inch from the root. All blades sustained significant leading-edge and tip gouges, nicks, and abrasions, with embedded asphalt material. The three separated blades exhibited similar separation features of even grainy dull striations. The fan shroud did not exhibit any evidence of blade liberation such as case dents or perforations.

The fan case and IPC rotor assembly had detached. The inter-stage assembly group, which had separated, was found fragmented. On the front side, the fan stator was retained within the engine inlet case, but most blades were crushed and torn away from the fan stator centre body. The urethane segment of the hub had partially melted.

The aft fan hub and LP shaft remained within the assembly, and the hub was continuous to the aft side.

The Intermediate Pressure Compressor (IPC) rotor hub was torn away from its hub. An approximate 180° radial segment of the first stage blades was separated at their roots. All blades appeared bent opposite the direction of rotation. The forward side of the number one bearing was exposed due to the IPC rotor hub separation, and a single ball bearing was observed.

The second stage blades remained attached to the hub and exhibited varying degrees of leading-edge tears and tip damage. The IP one and two stators appeared to be in place but were bent and crushed, with no blade loss to the observable sections. The third stage stator was largely intact, and the IP rotor could be seen through the rear of the assembly; all blades were observed to be detached at the root.

The 1.5 bearing housing was partially bent, and the bearing was not located, although the inner cage remained in place.

The number one bearing remained in place and did not show any evidence of discoloration or heat distress. About 3 inches of the LP shaft was protruding from the assembly; the shaft exhibited torsional damage with 45° shear lips at the separation area.

The engine control unit harnesses remained partially attached to the engine but were severed in multiple locations.

Within the aft assembly, the High-Pressure Compressor (HPC) was intact, but the outboard sections of the tips at the main, large, and small splitter stages were bent 90° up to 3/8 inch from the tips. The entire assembly was coated in a greasy dark film, and the inner case had evidence of rotational blade contact. None of the blades exhibited dents or dings that would have indicated an upstream blade liberation or FOD event. According to Williams, the dark oil was likely a result of the inter-stage oil tank rupturing during impact while the inner HPC stage was still spinning.

The LP shaft was protruding about 4 inches and had twisted and separated, such that the normally straight serial number was beginning to spiral (Figure 5).

Figure 5. Right Engine LP Shaft.

On the aft side of the inter-stage, remnants of the casing remained attached to the diffuser.

The exhaust mixer assembly was crushed and coated in dark oily coke-like deposits. There was no evidence of blade uncontainment such as dents in an outward direction. From the aft end of the engine, viewed through the mixer, the 2^{nd} stage LP turbine blades appeared intact and but appeared to have sustained crush damage.

The first stage LP blades could not be observed, and the case could not be removed due to the damage sustained, however there was no damage to the rear housing/mixer that would have indicated 1^{st} stage LP blade liberation. The diffuser outer case showed no outward dents or any other signs of High-Pressure Turbine (HPT) damage that would have indicated HPT blade or disk liberation (Figure 6).

Figure 6. Right Engine Diffuser Case.

The lubricant oil cooler had broken away, leaving its mounting pad attached, but the bolts were not found. The oil filter had burned, but the element was free of debris. The lubricant and scavenge pump remained attached to the remnants of the gearbox casing, and the scavenge chip collector was free of metallic debris. The starter gear shaft crown gear remained intact and undamaged; the airframe starter shaft had separated from the starter but remained attached to its drive gear, which appeared clean and undamaged. A section of the inter-stage assembly had detached from the gearbox mount. The hydraulic pump remained attached to sections of the gearbox assembly. The gearbox magnetic chip collector was documented as installed in the collector fitting at the accident site; however, it was not observed in the fitting after the wreckage had been relocated to the hangar.

Removal of the hydraulic pump revealed that the shear coupling was intact, and the input shaft could be rotated smoothly by hand.

The Hydromechanical Unit (HMU) had completely detached from the airframe. Fuel was observed flowing from the inlet fitting, which had broken away. The HMU fuel pump input drive shaft remained attached, the throttle control arm remained attached and could be moved by hand, and the cut-off detent was felt. The Engine Control Unit (ECU) harness had pulled away from its connector.

There was no evidence of foreign object ingestion, bird feathers, or other matter in any of the engine components.

1.2.2 Left Engine (SN: 105103)

The engine had broken into four distinct segments: the fan, fan case, Intermediate Pressure (IP) compressor section, and the high-pressure compressor/hot section. The starter, HMU, and gearbox had all detached.

The fan had detached, but the fan nut and locking plate were in place; none of the blades had separated, but all exhibited significant leading edge gouges and tip separation, along with embedment of mud material (Figure 7). The blades were covered in black soot.

Figure 7. Left Engine Fan.

The fan case and insert had detached and were crushed and distorted, with about a 20° arc of the melted shroud remaining. A crushed 30° arc of remnants of the fan stator remained attached.

The LP shaft had twisted away from the aft fan hub in the opposite direction of rotation and remained attached to the IP rotor. About 45% of the 1st stage IP rotor blades had detached at their roots. The IP stage 1 and 2 stators were largely intact, along with the 2nd stage rotor.

The third stage stator was largely intact, and the IP rotor could be seen through the rear of the assembly, with blades observed to be detached at the root.

The 1.5 bearing housing exhibited an indentation next to the bearing. The outer cage was not located, although the inner cage remained in place.

The number one bearing remained in place. About 2 inches of the Low Pressure (LP) shaft was protruding from the assembly, and its inner core was full of mud.

Number 2 bearing and the 1st reduction bevel gear assembly remained in position, and the LP shaft remained in position but had twisted and separated, causing the shaft to twist in the opposite direction of rotation (Figure 8).

Figure 8. Left Engine LP Shaft.

On the aft side of the inter-stage, remnants of the casing remained attached to the diffuser.

The exhaust mixer assembly was intact and had sustained thermal damage with rust-coloured deposits on its external surface. There was no evidence of blade uncontainment, such as outward-pointing dents. The LP trip pass-through had been torn and elongated.

From the aft end of the engine, viewed through the mixer, the 2nd stage LP turbine blades appeared intact and undamaged. The first stage LP blades could not be observed, and the case could not be removed due to the damage sustained. However, there was no damage to the rear housing mixer assembly that would indicate 1st stage LP blade liberation. The diffuser outer case showed no outward dents or any other signs of HPT damage that would indicate HPT blade or disk liberation (Figure 9).

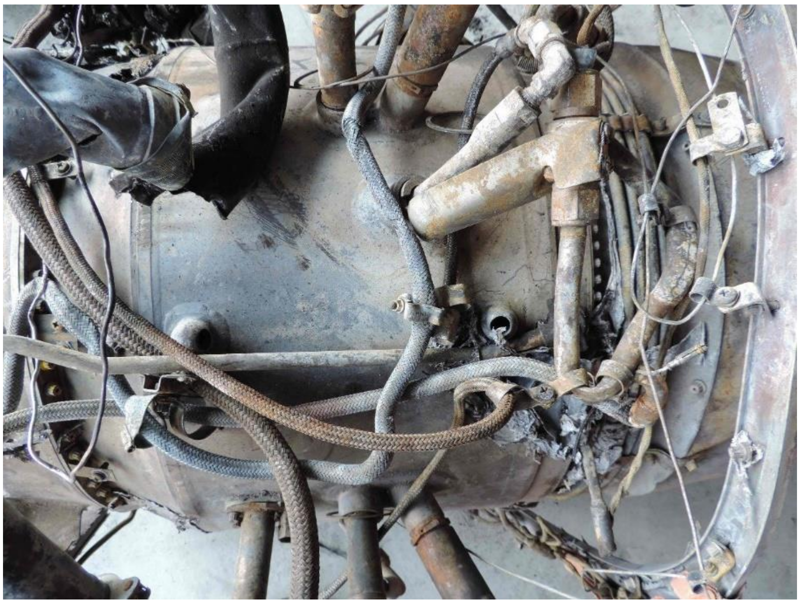


Figure 9. Left engine diffuser case.

The accessories were liberated and sustained thermal damage. The starter, lubricant pump, and hydraulic pump remained attached as an assembly to a remnant of the gearbox casing.

The magnetic chip collectors for the gearbox, lube, and scavenge assemblies were not observed at the accident site or the hangar.

The HMU and fuel pump remnants were partially consumed, the fuel pump input driveshaft remained intact, and the lubricant oil cooler had broken away from its fitting. The fuel and oil filters had sustained thermal damage but were free of debris.

The Engine Control Unit (ECU) sustained thermal damage, preventing recovery of any non-volatile memory.

There was no evidence of foreign object ingestion, bird feathers, or other matter in any of the engine components.

1.3 Cockpit

The cockpit was highly fragmented. The cockpit controls were examined. The landing gear handle was found in the down position, but the handle was damaged (Figure 10). The lift dump handle was damaged and found in an intermediate position (normal range is retracted or extended) (Figure 11).

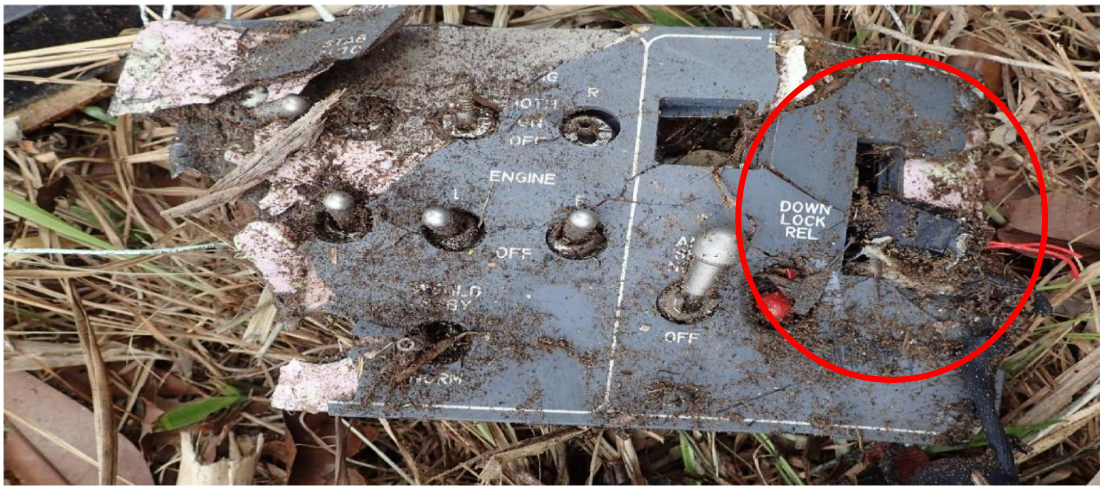


Figure 10. Landing Gear Handle.

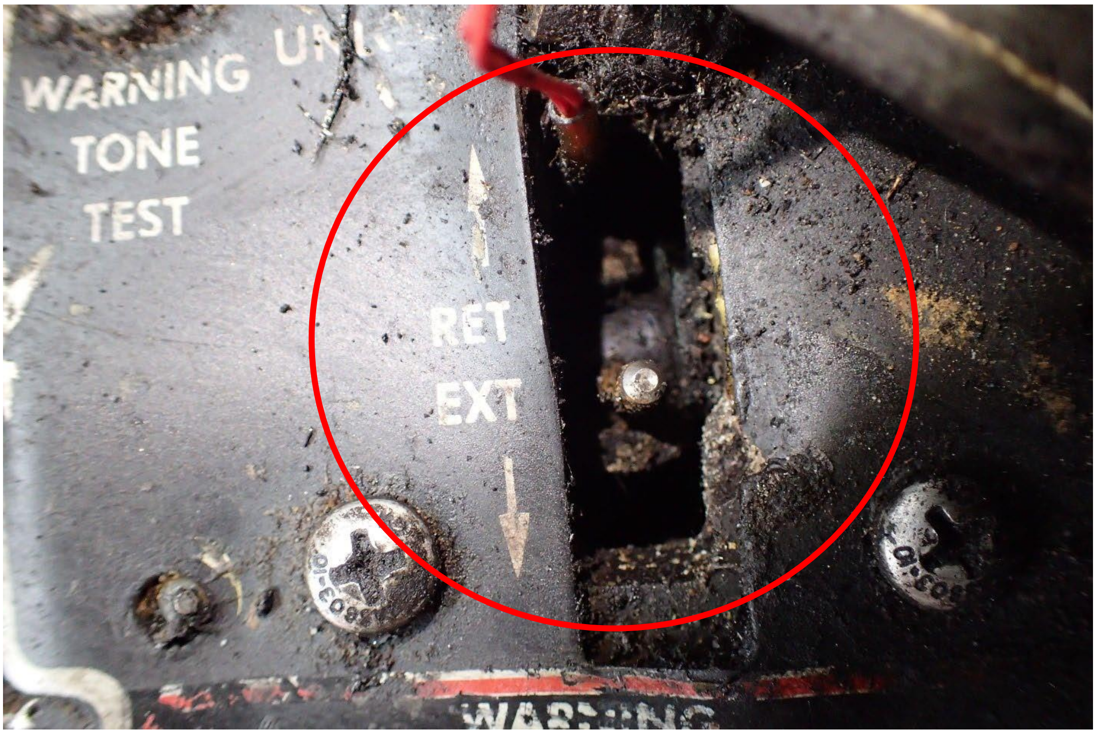


Figure 11. Lift Dump Handle.

1.4 Aileron System Examination

The aileron system was retrieved from the wreckage and examined. The aileron system from the control column to the left and right ailerons were recovered and examined except for the aft sector and the left wing inboard sector (Figure 12). These components could not be definitively identified due to wreckage fragmentation. The breaks in the cables had ends that had a splayed, broom straw appearance consistent with tension overload. All remaining control sectors and their associated fittings were either intact or exhibited damage consistent with overload.

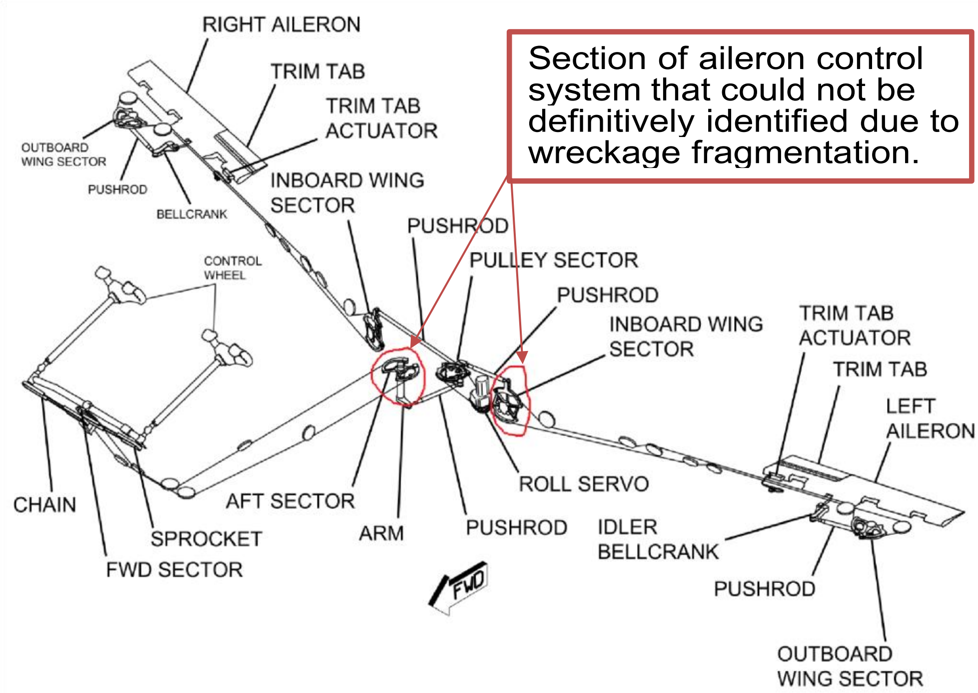


Figure 12. Aileron control system components examined during investigation.

The aileron trim actuators were examined. Both the left and right aileron trim actuators were extended approximately 1.9 inches. This corresponds to approximately 6 degrees aileron trim trailing edge tab up.

Aileron Trim Actuator	RAC Part Number	S/N	Extension Distance	Tab Position
Left Wing	390-381009-0009	080	~1.9 inches	6 deg trim tab up
Right Wing	390-381009-0008	67	~1.9 inches	6 deg trim tab up

1.5 Rudder System Examination

The rudder system was retrieved from the wreckage and examined. Portions of the rudder pedals and forward sector were found in the wreckage debris (Figure 13). The rudder cables from mid fuselage to the rudder were found and examined. Most breaks in the cable had ends that had a splayed, broom straw appearance consistent with tension overload. One break in a “right rudder” cable was retained for further examination. The rudder cables from mid fuselage to the rudder pedals could not be definitively identified due to wreckage fragmentation.

Flight control cables of various lengths were found that exhibited breaks consistent with tension overload but these cables could not be positively identified as rudder or elevator cables.

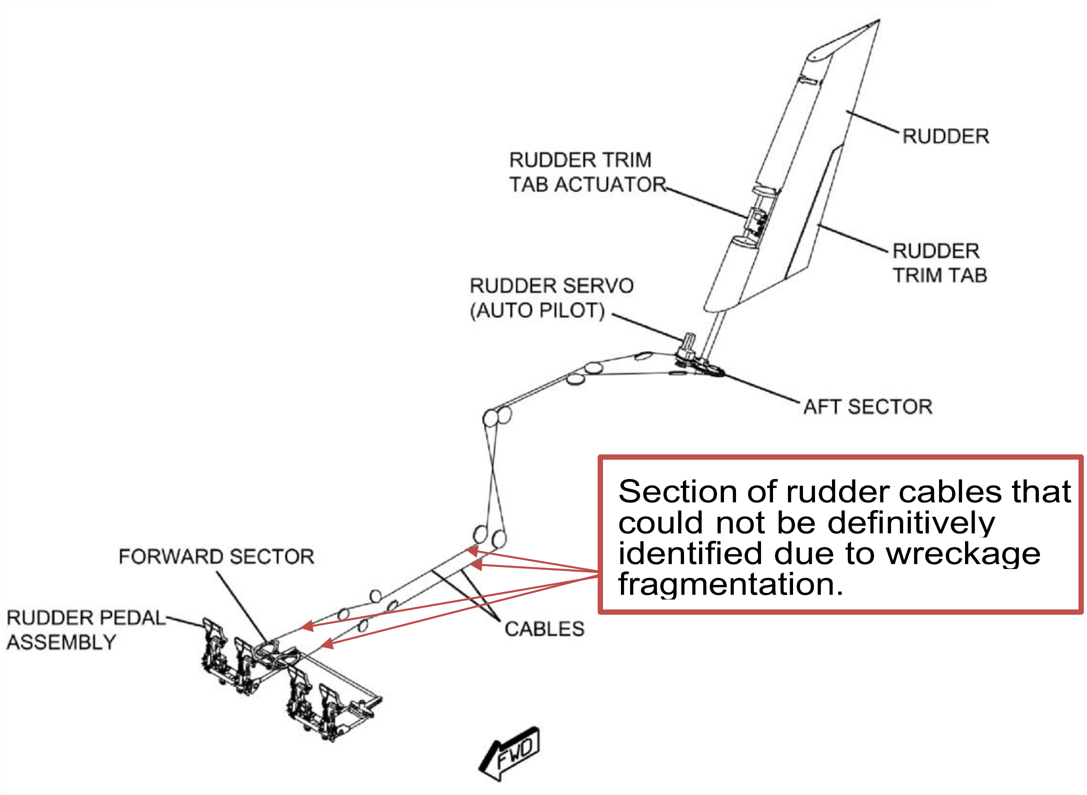


Figure 13. Rudder control system components examined during investigation.

The rudder trim actuator was examined. The trim actuator was close to the null position (0 degrees).

1.6 Elevator System Examination

The elevator system was retrieved from the wreckage and examined. Portions of the control columns and forward sector were found in the wreckage debris. The elevator cables from the cockpit to the elevator were found and examined. Most breaks in the cable had ends that had a splayed, broom straw appearance consistent with tension overload. One break in an elevator cable was retained for further examination.

1.7 Horizontal Stabiliser and Pitch Trim Examination

The pitch trim actuator was found broken with the severed links exhibiting indications of tensile overload. (Figure 14) The parts of the actuator were placed together and the extension distance was measured at approximately 16.5 inches. This corresponds to -3.6 degrees leading edge down. The take-off range is -3.2 degrees to -4.4 degrees. The pitch trim actuator range is -7.0 degrees to +1.4 degrees.

Figure 14. Pitch trim actuator.

1.8 Spoiler Examination

The right lift dump actuator was found in an extended position while the left lift dump actuator was found in the retracted position (Figure 15). The down-lock striker on the right lift dump panel was bent from impact (Figure 16). Both the left and right middle and outboard spoilers were in the stowed position.

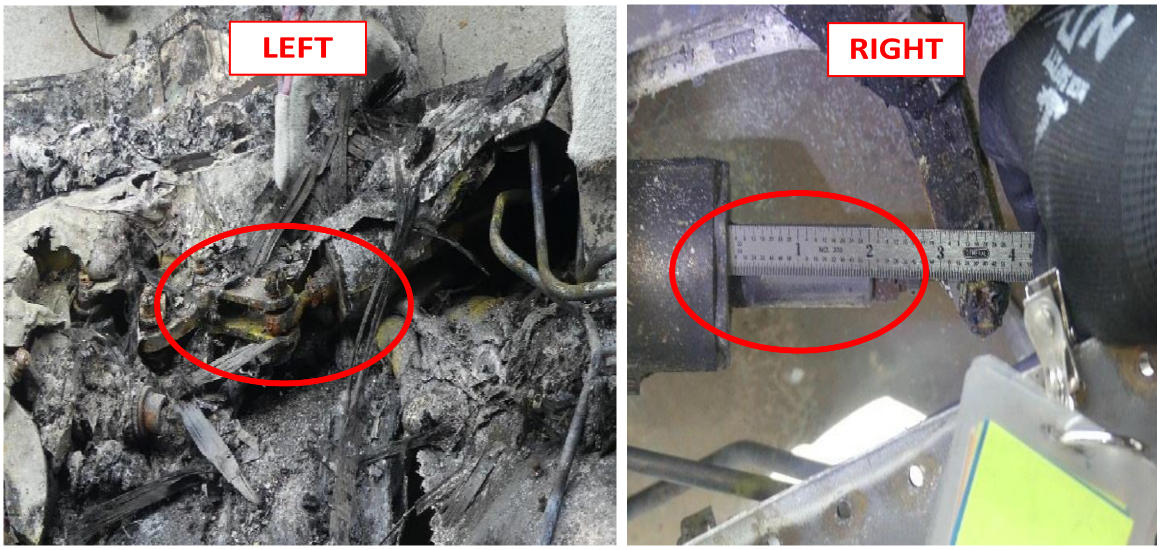


Figure 15. Left and Right Lift dump Actuators.

The Hydraulic Spoiler Control Module (HSCM) was impact and thermally damaged (Figure 17). It was retained for further examination. The Spoiler Control Unit (SCU) was thermally damaged (Figure 18).

The lift dump actuators, the roll control actuators and the pull (blow) down actuators were removed from the aircraft for further examination.

Figure 16. Right lift dump panel down-lock striker and locking actuator.

Figure 17. Hydraulic Spoiler Control Module (HSCM).

Figure 18. Spoiler Control Unit (SCU).

1.9 Flap System Examination

The eight (8) flap actuators were found at the wreckage site. Six (6) of the eight (8) actuators were easily measured. Two (2) actuators were separated from their control rods. By examining their control rods and the end of the ball screw, the position of the flaps was determined. The flap actuators were all in the “Down” position (fully extended). Where each actuator was installed on the aircraft could not be definitively identified due to the fragmentation of the wreckage.

Actuator	Description	RAC Part Number	S/N	Extension Distance	Flap Position
A	Long Actuator	390-381402-0018	00274	~8.125	DOWN
B	Short Actuator	390-381403-0011	unreadable	~4.75	DOWN
C	Short Actuator	390-381403-0011	HUxx	~4.5	DOWN
D	Long Actuator	390-381402-0019	G0165	~8.25	DOWN
E	Long Actuator	390-381402-0020	G0079	~8.00	DOWN
F	Long Actuator	390-381402-0017	G0305	~8.25	DOWN
G	Long Actuator	390-381402-00xx	unreadable	unmeasurable	DOWN based on visual inspection of ball screw and piston rod
H	Long Actuator	390-381402-00xx	unreadable	unmeasurable	DOWN based on visual inspection of ball screw and piston rod

1.10 Landing Gear System Examination

The left and right main landing gear assemblies remained intact, remained attached to their respective wing attachment and exhibited heat/thermal and impact damage. The left and right main landing gear actuators remained attached to their respective gear and wing, However, the right main landing gear actuator piston was impact separated. The left and right main landing gear actuators were found in the full extended/down position.

The nose gear was separated from its attachment point. The lower strut was separated from the upper trunnion. The nose gear assembly exhibited impact damage.

1.11 Components Retained for Further Examination

The following components were removed from the aircraft and sent to the NTSB and OEM for further examination. Results of the examination is provided in the following Appendices E and F.

Description	Part Number	Serial Number	Comment
Right Lift Dump Actuator	390-381008-0001	648	
Right Roll Control Actuator	390-381007-0003	0252	
Right Pull Down Actuator	390-381010-0001	0197	
Left Lift Dump Actuator	390-381008-0001	0216	
Left Roll Control Actuator	390-381007-0003	0214R	
Left Pull Down Actuator	390-381010-0001	0202	
Spoiler Hydraulic Control Module	N/A	N/A	The nameplate was not legible.
Right Aileron Trim Actuator	390-381009-0008	67	
Left Aileron Trim Actuator	390-381009-0009	080	
Rudder and Elevator Cables	N/A	N/A	
Annunciator panel	N/A	N/A	
Lift Dump Switch/Panel	N/A	N/A	

Appendix E

DETAILED EXAMINATION OF COMPONENTS[21]

1.0 Components Selected for Detailed Examination

Selected components and mechanical parts from the N28JV aircraft wreckage were sent to the NTSB and components' manufacturer (OEM) laboratories in the United States. Some of the components were partially tested and some cannot be tested due to physical damaged (impact forces and thermal exposure). The list of components sent for detailed examination is as follows:

Description	Part Number	Serial Number	Comment
Right Lift Dump Actuator	390-381008-0001	648	
Right Roll Control Actuator	390-381007-0003	0252	
Right Pull Down Actuator	390-381010-0001	0197	
Left Lift Dump Actuator	390-381008-0001	0216	
Left Roll Control Actuator	390-381007-0003	0214R	
Left Pull Down Actuator	390-381010-0001	0202	
Spoiler Hydraulic Control Module	N/A	N/A	The nameplate was not legible.
Right Aileron Trim Actuator	390-381009-0008	67	
Left Aileron Trim Actuator	390-381009-0009	080	
Rudder and Elevator Cables	N/A	N/A	
Annunciator panel	N/A	N/A	
Lift Dump Switch/Panel	N/A	N/A	

2.0 Spoiler Components Examination by Moog Inc.

The following aircraft spoiler components were sent by the NTSB to Moog Inc. for further examination:

[21] This report is based on the field notes (DCA23WA416) compiled by the NTSB Accredited Representative Airworthiness Group Chair.

Spoiler System Component Description	Textron Part Number	Moog Part Number	Serial Number	Comments
Left Roll Control Actuator	390-3810070003	233500101	0214R	1. Shipped 09/17/2002 (New). 2. RUR W11160504 SO# WRT0016803 Shipped 04/06/2005 (Overhaul)
Right Roll Control Actuator	390-3810070003	233500101	0252	1. SO# WFG0008174, Shipped 02/14/2003 (New)
Left Pull Down Actuator	390-3810100001	233400100	0202	1. SO# WFG0005997, Shipped 09/18/2002 (New). 2. RUR W11200690, SO# WRJ0018255, Shipped 04/28/2005 (Overhaul)
Right Pull Down Actuator	390-3810100001	233400100	0197	1. SO# WFG0005997, Shipped 08/21/2002 (New). 2. RUR W11015294, SO# WRJ0011914, Shipped 08/06/2003 (Repair).
Left Lift Dump Actuator	390-3810080001	233300100	0216	1. SO# WFG0002273, Shipped 08/23/2001 (New)
Right Lift Dump Actuator	390-3810080001	233300100	0648	1. Reported as found extended on the aircraft. 2. SO# WFJ0233874, Shipped 10/15/2010 (New).
Spoiler Hydraulic Control Module	390-3810060005	233100-102	Unknown	1. The nameplate is not legible.

3.0 Details of Examination of Spoiler Components

3.1 Right Lift Dump Actuator

The name plate was inspected and the following info was confirmed: part number was 390-381008-0001 and serial number was 648. There was an additional name plate wrapped with the actuator which belonged to the left lift dump actuator.

Several dimensions of the actuator were measured as detailed in the Table below (Figures 1 and 2).

Measurement Description	Dimension (in)
Full Stroke (Component Maintenance Manual (CMM))	2.04 +/- 0.02
As received extension dimension (Rod end to gland nut)	2.06
Pin to pin – fully retracted (CMM)	8.20
Pin to pin – fully extended (CMM)	10.24
Pin to pin (As received dimension of unit)	10.21

The actuator was disassembled. The threaded gland nut was removed. The back-up rings and the O-ring were thermally damaged (Figure 3). They were removed from the gland and placed in a zip-lock bag. The piston did not move in the actuator. The actuator was sectioned to evaluate the inside of the actuator.

The gland nut was re-installed. The actuator was placed on a band saw. The actuator was sliced in half (approximately) to show a cross section view (Figures 4 and 5). The piston and body components were compared and the marks on these parts confirmed that the actuator was in the fully extended position during the accident and remained there until the actuator was sectioned.

Figure 1. Right lift dump actuator.

Figure 2. Right lift dump actuator extension dimension.

Figure 3. Right lift dump actuator gland nut after removal.

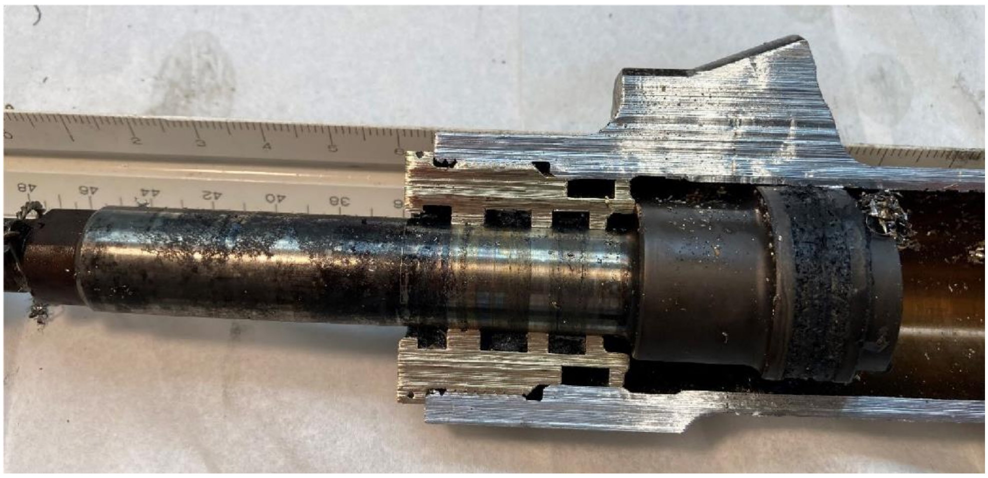


Figure 4. Right lift dump actuator after sectioning – half 1.

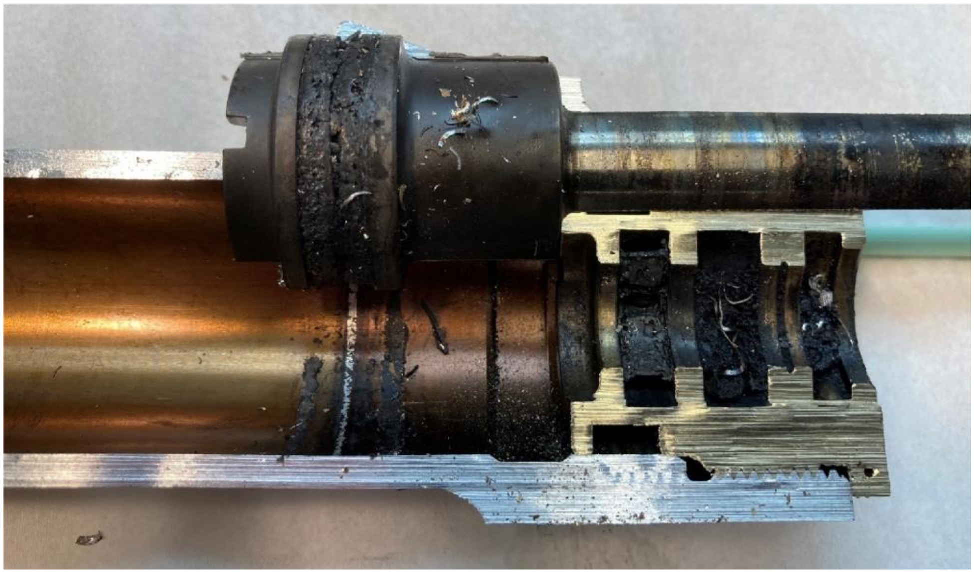


Figure 5. Right lift dump actuator after sectioning – half 2.

3.2 Right Roll Control Actuator

The name plate was inspected and the following info was confirmed: part number was 390-381007-0003 and serial number was 0252. The rod end jam nut had a safety cable. (It is shipped from Moog with safety wire/ lock wire.) The connector for the wire harness was not present. The wire harness retainer was not present. The cable retainer screws were sheared off (Figures 6 and 7). One of the retainers screwhead was retained by the lock wire. The lock wire at the threaded retainer for the slider and sleeve was observed to be broken. The bearing in the rod end was observed to be loose due to thermal damage to Teflon liner. There was an impact mark near the retainer.

Several dimensions of the actuator were measured as detailed in the Table below (Figure 8). (Note that for the roll control actuator, the actuator fully retracted position corresponds to fully deployed spoilers and the actuator fully extended position corresponds to fully stowed spoilers.)

Measurement Description	Dimension (in)
Full stroke (CMM)	1.53 +/- 0.02
As received extension dimension – exposed piston chrome (Rod end to gland nut)	1.102
Pin to pin – fully retracted (CMM) (spoilers extended)	8.652
Pin to pin – fully extended (CMM) (spoilers retracted)	10.20
Pin to pin (As received dimension of unit)	9.01
% extended (actual pin to pin distance – nominal fully retracted distance/ nominal stroke *100)	23.4%
Exposed piston chrome (Rod end to gland nut) after pushing the rod end to the fully retracted position	0.70

The unit was not tested per the Acceptance Test Procedure (ATP) because the connector was not present on the electrical harness.

The actuator was disassembled (Figures 9 and 10). The rod end jam not safety wire was removed. The rod end jam nut was removed using finger pressure. (Note that the CMM specifies a torque of 180-210 in-lbs for this jam nut.) The retaining nut for the rod end was removed. Fluid was drained from the unit into a sample bottle. The piston was extracted. The actuator piston was inspected for witness marks but no witness marks were observed. Normal radial wear marks were observed. Material transfer from a seal was observed on the piston.

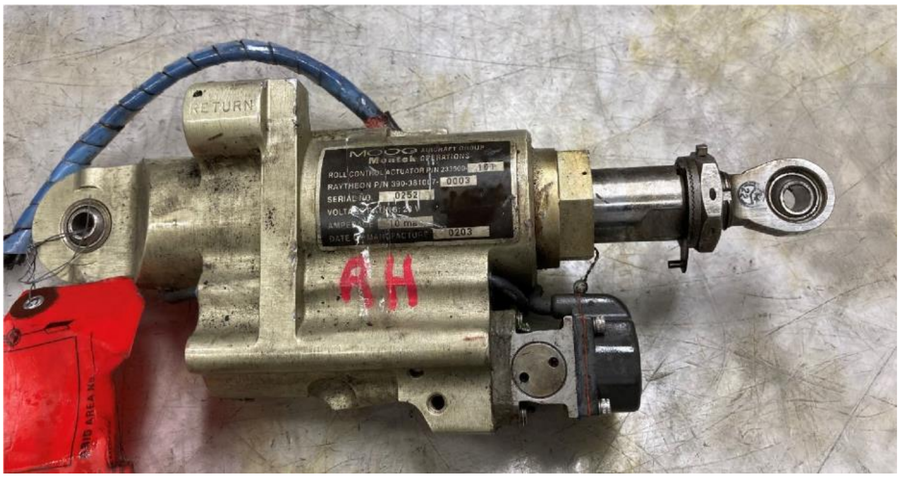


Figure 6. Right roll control actuator.

Figure 7. Right roll control actuator showing where the cable retainer screws for the wire harness retainer were sheared off.

Figure 8. Right roll control actuator as received extension dimension.

Figure 9. Right roll control actuator gland nut after removal.

Figure 10. Right roll control actuator piston.

3.3 Right Pull Down Actuator

The name plate was inspected and the following info was confirmed: part number was 390-381010-0001 and serial number was 0197. The wire harness was present including the mating connector from the aircraft and a small section of aircraft wiring (Figure 11). The slotted rod end was bent (Figure 12). There were some impact marks on the rod end of the actuator. The hydraulic fittings were sheared off the unit with portions remaining imbedded in the ports (Figure 13). The return port had an impact mark and was slightly deformed.

The unit was not tested per the Acceptance Test Procedure (ATP) because the hydraulic fittings were damaged.

The aircraft side of the electrical connector was removed. The wire harness was connected to the test stand to measure the nitrogen charge of the actuator. The pressure transducer output was recorded as 2.33 volts and was within limits. (CMM allows a value of 2.44 +/- 0.25 volts for a full nitrogen charge of 2100 psi.)

The actuator was disassembled. The nitrogen charge was released from the actuator. The actuator piston and cylinder were inspected for witness marks but no witness marks were observed. Normal radial wear marks were observed (Figures 14 and 15).

Figure 11. Right pull down actuator.

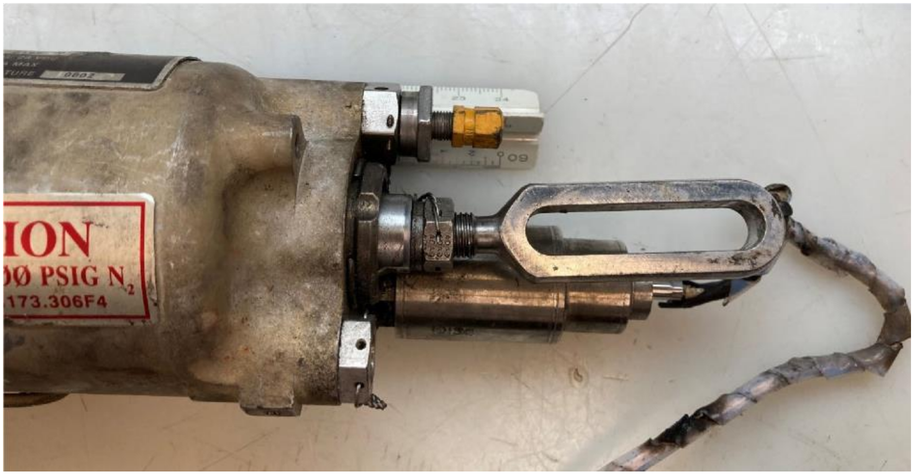


Figure 12. Right pull down actuator showing the bent slotted rod end.

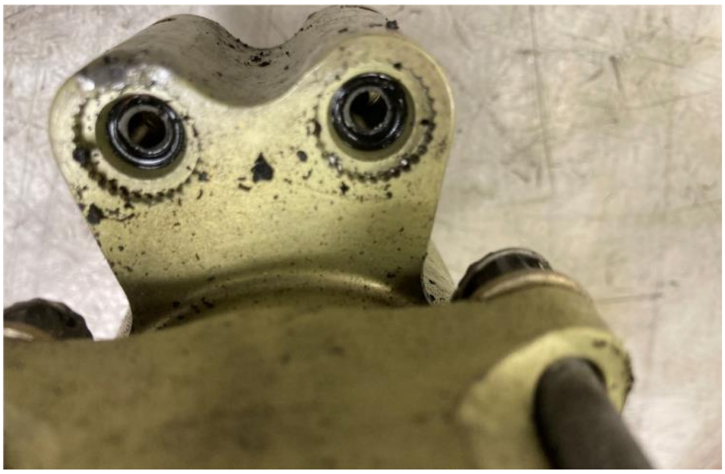


Figure 13. Right pull down actuator showing hydraulic ports.

Figure 14. Right pull down actuator showing the inside of the cylinder.

Figure 15. Right pull down actuator piston.

3.4 Left Lift Dump Actuator

The name plate was not in the bag with the actuator but was included with the right lift dump actuator. There was extensive heat damage to the actuator (Figures 16 and 17). The rod end bearing and the fixed end bearing exhibited signs of heat damage. A portion of hydraulic line was attached to the retract port. The hydraulic line fitting and the port fitting were removed using finger pressure. The extension port had a hydraulic fitting but no hydraulic line. The fitting was removed using finger pressure. The O-ring below the fitting was severely thermally damaged.

Several dimensions of the actuator were measured as detailed in the Table below (Figure 18).

Measurement Description	Dimension (in)
Pin to pin – fully retracted (CMM)	8.20
Pin to pin – fully extended (CMM)	10.24
Pin to pin (As received dimension of unit)	8.23

The actuator could not be disassembled. The threaded gland nut could not be removed. The actuator was placed on a band saw. The actuator was sliced in half (approximately) to show a cross section view (Figures 19 and 20). The piston and body components were compared and the marks on these parts confirmed that the actuator was in the fully retracted position when it experienced the heat damage.

Figure 16. Left lift dump actuator.

Figure 17. Left lift dump actuator tail side
and rod end bearings.

Figure 18. Left lift dump actuator inside pin to pin measurement
(must add 0.31 pin diameter to get actual pin to pin measurement).

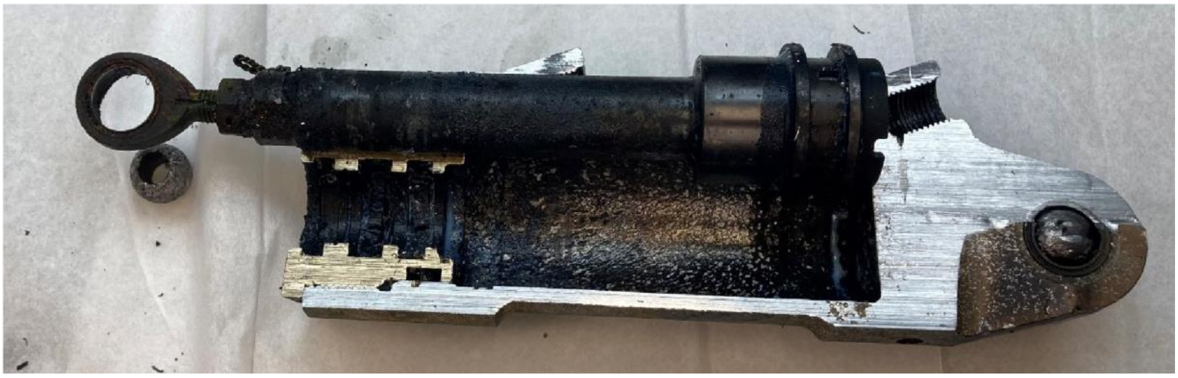


Figure 19. Left lift dump actuator after sectioning – half 1.

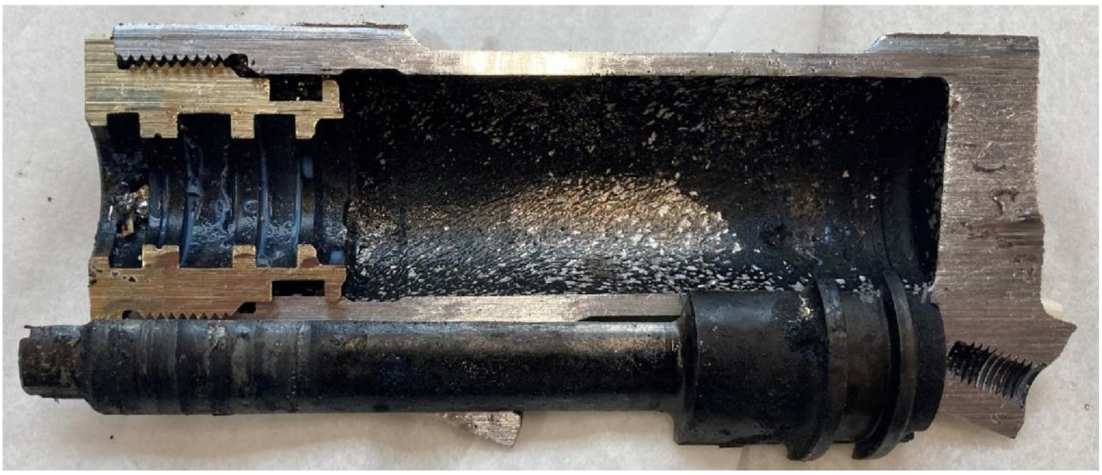


Figure 20. Left lift dump actuator after sectioning – half 2.

3.5 Left Roll Control Actuator

The name plate was inspected and the following info was confirmed: part number was 390-381007-0003 and serial number was 0214R. The rod end jam nut had a safety cable. (It is shipped from Moog with safety wire.) A portion of hydraulic line was attached to the retract and extend ports. The wire harness retainer was present. The wire harness was present including the mating connector from the aircraft and a small section of aircraft wiring (Figure 21). The tamperproof sealant was intact on the servo valve. The safety wire for the servo valve was sheared at the second hole (Figure 22).

Several dimensions of the actuator were measured as detailed in the Table below (Figure 23). (Note that for the roll control actuator, the actuator fully retracted position corresponds to fully deployed spoilers and the actuator fully extended position corresponds to fully stowed spoilers.)

Measurement Description	Dimension (in)
Pin to pin – fully retracted (CMM) (spoilers extended)	8.652
Pin to pin – fully extended (CMM) (spoilers retracted)	10.20
Pin to pin (As received dimension of unit)	9.836
% extended (actual pin to pin distance – nominal fully retracted distance/ nominal stroke *100)	77.4%

The portions of the hydraulic lines connected to the actuator were removed. The aircraft side of the electrical connector was removed. The ATP for the actuator was completed except proof pressure testing and rod end rigging were omitted. The proof pressure testing is a structural test and omitted because the unit was subjected to impact forces and thermal exposure. The main purpose of performing the ATP was to establish functionality of the unit. The ATP data sheets are attached in Appendix A. The unit passed the ATP except that the linear voltage differential transformer (LVDT) (position sensor) null rigging was slightly out of tolerance (actual was 0.0067 volts root mean square (VRMS) versus limit of <0.004 VRMS).

The actuator was disassembled. The piston was extracted. The actuator piston was inspected for witness marks but no witness marks were observed. An area of the shaft with seal material transfer was observed. In addition, there was an abrasion area approximately 180 degrees around the shaft that corresponds to the scrapper seal when the actuator is fully extended (Figures 24 – 26). (This is the actuator’s normal position for spoilers stowed.) There were also some unknown deposits on the piston that were easily rubbed away.

Figure 21. Left roll control actuator.

Figure 22. Left roll control actuator showing sheared safety wire near the servo valve.

Figure 23. Left roll control actuator as received inside pin to pin measurement (must add 0.31 pin diameter to get actual pin to pin measurement).

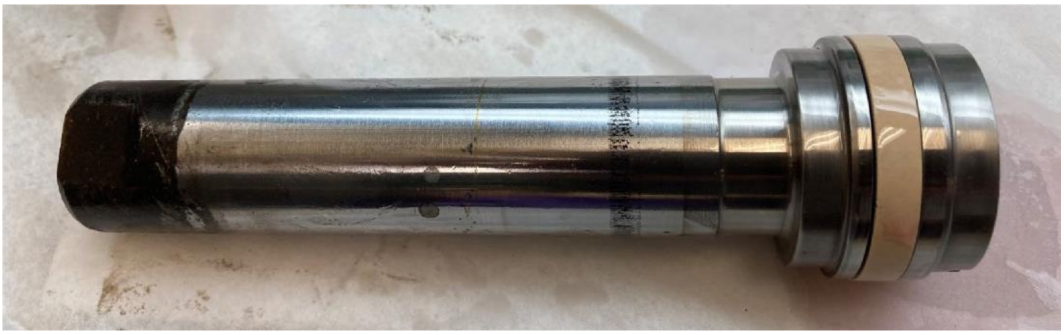


Figure 24. Left roll control actuator piston showing the seal material transfer area.

Figure 25. Left roll control actuator piston showing the abrasion area and material deposits.

Figure 26. Left roll control actuator piston showing the abrasion area under a microscope.

3.6 Left Pull Down Actuator

The name plate was inspected and the following info was confirmed: part number was 390-381010-0001 and serial number was 0202. The wire harness was present including the mating connector from the aircraft and a small section of aircraft wiring Figure 27). The electrical grommet was visibly protruding from the electrical connector Figure 28). The rod seal lubrication transfer tube was crushed (Figure 29). The slotted rod end was bent (Figure 30). There were some impact marks on the rod end of the actuator. The hydraulic fittings were intact with portions of the hydraulic lines. The rod end scraper seal of the actuator was protruding (Figure 31). The lock wire on the jam nut was damaged.

The aircraft side of the electrical connector was removed. The wire harness was connected to the test stand to measure the nitrogen charge of the actuator. The pressure transducer output was recorded as 0.003 volts. (CMM allows a value of 2.44 +/- 0.25 volts for a full nitrogen charge of 2100 psi.) It was noted that the nitrogen charge on this actuator was depleted on-site in Malaysia.

The actuator was prepared for ATP by removing the aircraft hydraulic lines connected to the actuator. The electrical connector of the actuator was connected to the test stand. The unit was serviced with nitrogen. The actuator was serviced to 2050 psi corresponding to 2.532 volts. Approximately 1 hour later, the reading was 2.505 volts. The ATP requires servicing the actuator and waiting 24 hours but the shorter dwell time was done to facilitate testing the unit on the same day. The actuator could not be placed in the test fixture due to the bend in the rod end. The rod end from the right actuator was installed on the left actuator to facilitate testing. This slotted rod end was still rubbing against the test stand fixture but there was no other rod end available. (This rubbing could have impacted the friction test of the ATP.)

The ATP for the actuator was completed except fluid reservoir filling, fluid reservoir leakage check and proof pressure testing were omitted. Reservoir filling and fluid reservoir leakage are completed during actuator assembly. The proof pressure testing is a structural test and omitted because the unit was subjected to impact forces and thermal exposure. The main purpose of performing the ATP was to establish functionality of the unit. The unit was ATP'd and the results are included in Appendix B. The unit passed the ATP except the retract friction checks were slightly out of limits. The retract pressures were 1913 psi initial and 1543 psi final (limits were 1920 psi min initial and 1550 psi min final).

The actuator was disassembled. The nitrogen charge was released from the actuator. Approximately 25% of the scrapper ring was missing. The actuator piston was inspected for witness marks but no witness marks were observed. Normal wear marks were observed (Figures 32 – 34).

Figure 27. Left pull down actuator.

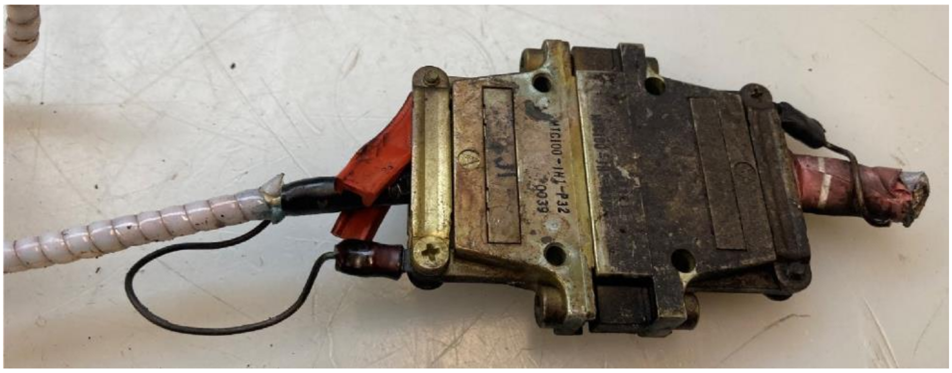


Figure 28. Left pull down actuator showing the electrical grommet of the connector.

Figure 29. Left pull down actuator showing the crushed transfer tube.

Figure 30. Left pull down actuator showing the bent slotted rod end.

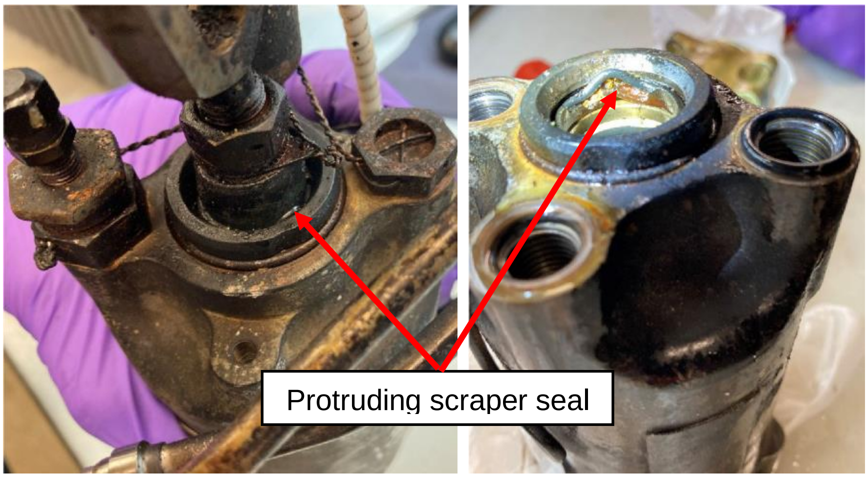


Figure 31. Left pull down actuator showing the protruding scraper seal on the rod end of the actuator.

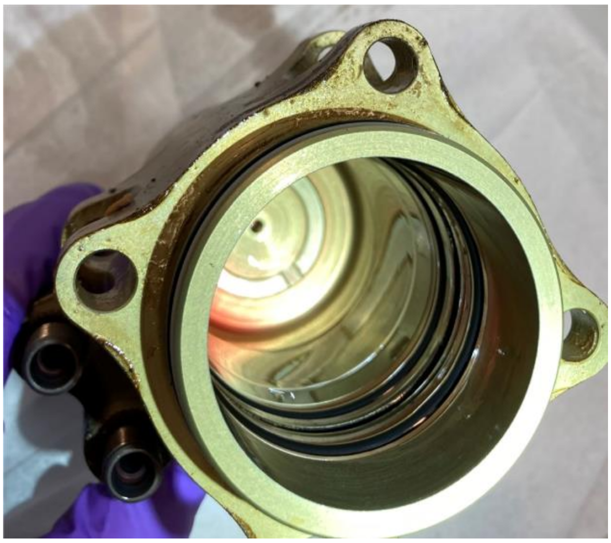


Figure 32. Left pull down actuator showing inside the lug end assembly.

Figure 33. Left pull down actuator piston.

Figure 34. Left pull down actuator piston – close-up.

3.7 Spoiler Hydraulic Control Module

The unit was inspected but the name plate was not present (Figure 35). The serial number of the manifold was located. The manifold was serial number 013 (Figure 36). The build paperwork for the manifold was no longer available due to Moog's document retention policy. The unit was too thermally damaged to be tested.

Figure 35. Spoiler Hydraulic Control Module.

Figure 36. Spoiler Hydraulic Control Module
showing the manifold serial number.

4.0 Other Components Examined

4.1 Aileron Trim System Examination

The aileron trim actuators were removed and examined (Figures 37 and 38). The acceptance test was completed on each unit. S/N 080 (left wing) operated and passed the ATP except for 1) time to extend was 29.03 seconds and retract was 27.78 seconds which exceeded the limit of 20-27 seconds; 2) maximum force for extend did not achieve the 100 lbs. minimum; 3) midpoint potentiometer check was 7.18 volt versus a requirement of 7.4-7.6 volts; and 4) end play was 0.011 versus a requirement of below 0.010. S/N 67 (right wing) operated and passed the ATP except for mid-point potentiometer checks were 6.97 volts for potentiometer 1 and 6.9 volts for potentiometer 2 versus a requirement of 7.4-7.6 volts.

Figure 37. Right Aileron Trim Actuator.

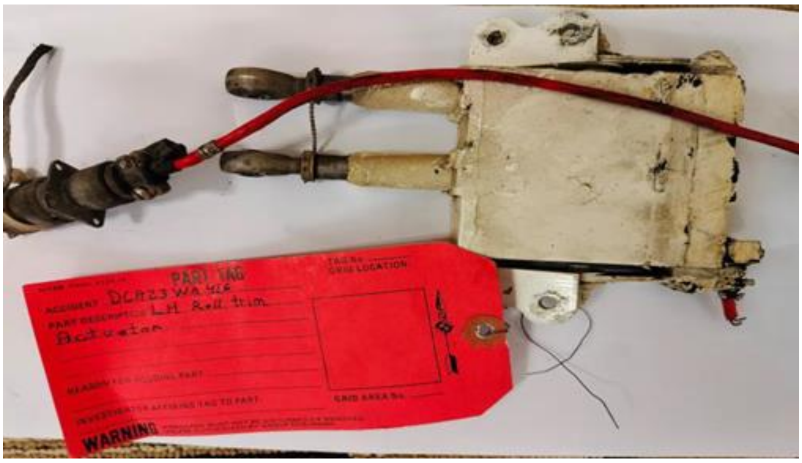


Figure 38. Left Aileron Trim Actuator.

4.2 Right-Hand Side Rudder Cable and Elevator Cable

The cables consisted of multiple twisted wires. Both cables were separated into two pieces. The ends of the separation were visually examined to determine the mode of separation. The ends of the individual wires exhibited "cup and cone" morphology with associated areas of thinning and necking. These morphologies are consistent with overstress. These surface features are shown in the photographs below (Figure 39).

Figure 39. Rudder Cable (Left) and Elevator Cable (Right).

4.3 Annunciator Panel

The front cover of the annunciator panel (Figure 40) was removed to facilitate examination during the field investigation. It was determined that the panel contained LED light bulbs. The illumination status of the LED light bulbs at the time of the accident cannot be determined. No further examination of this component was possible due to thermal damage.

Figure 40. Annunciator Panel.

4.4 Lift Dump Switch/Panel

The lift dump switch/panel (Figure 41) was examined in detail using computed tomography. The examination report is provided in Appendix F.

Figure 41. Lift Dump Panel recovered from the wreckage.

Appendix F

COMPUTED TOMOGRAPHY ON LIFT DUMP PANEL[22]

1.0 Lift Dump Handle

The spoiler system cockpit components are shown in Figure 1. A photo of an exemplar lift dump panel (also referred to as lift dump control assembly) is shown in Figure 2.

The lift dump function is readied for activation by placing the lift dump unlock/lock safety switch on the centre cockpit pedestal extension to the unlock position which automatically moves the lift dump lock release away from the lift dump handle, unlocking and illuminating (white) the handle. The lift dump lock release safety hook can also be manually moved to unlock the lift dump handle. Lifting the lift dump handle and moving it to EXT (extend) position signals the spoiler control unit (SCU) to extend all six spoiler panels.

Photos of the exemplar lift dump handle was shown in Figures 3 to 6. They show the left and right sides of the handle in the extended (EXT) and retracted (RET) positions. The microswitches that signal the SCU are also shown.

[22] The computed tomography factual report (DCA23WA416), dated 14 February, is provided by the NTSB, Office of Aviation Safety.

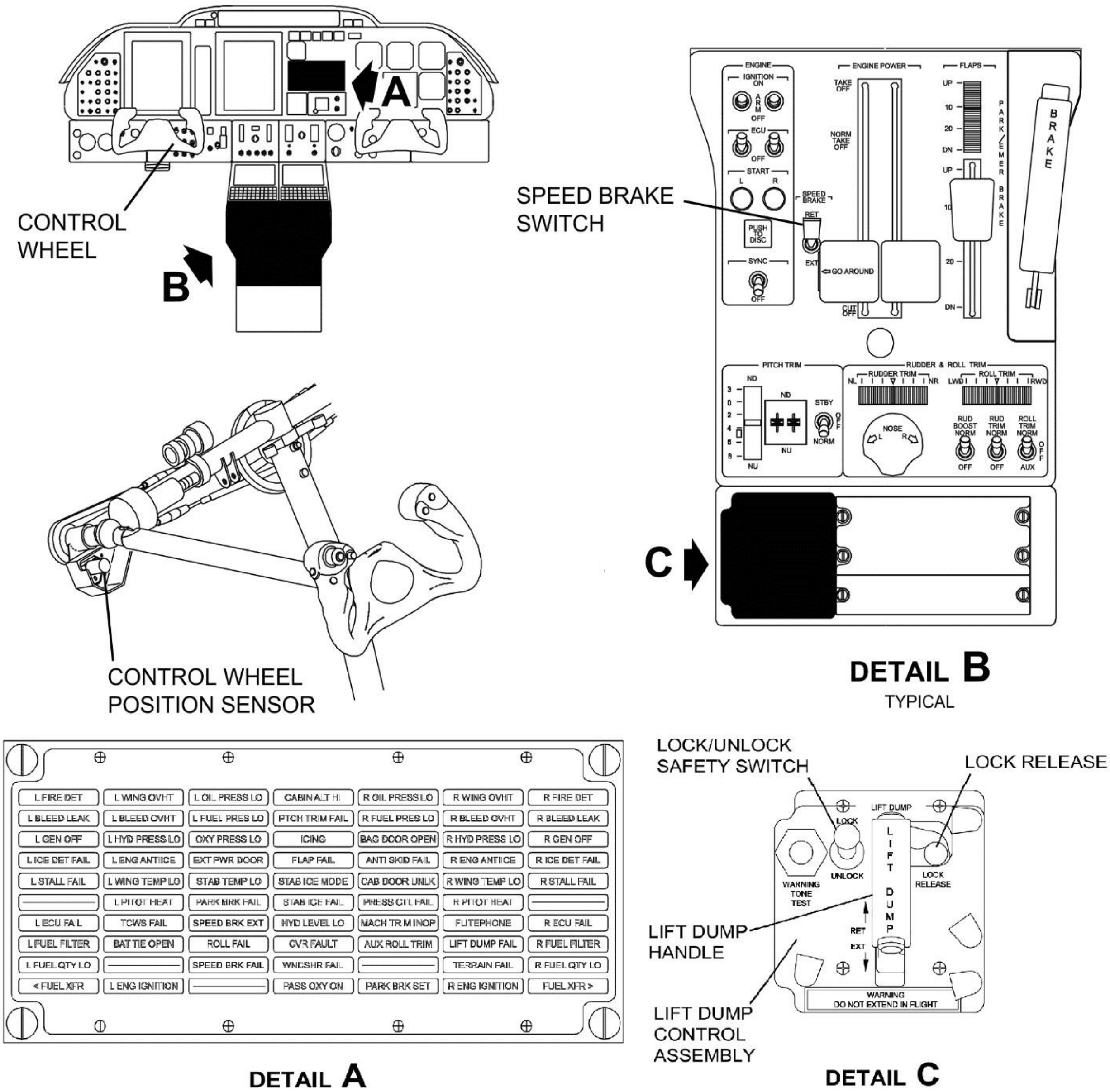


Figure 1. Spoiler System – Cockpit Components. (Courtesy of Textron Aviation).

Figure 2. Exemplar lift dump panel. (Courtesy of Textron Aviation).

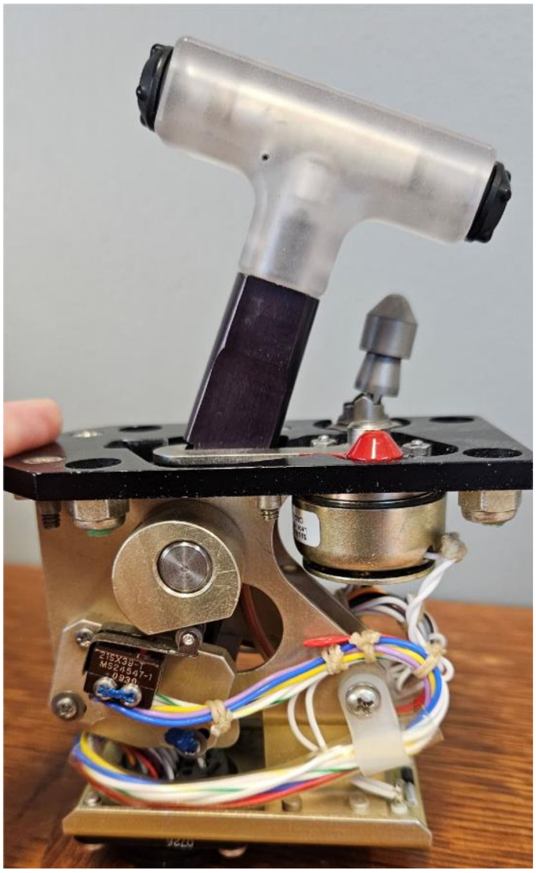


Figure 3. Exemplar lift dump handle – showing the right side in the RET (retract) position. (Courtesy of Textron Aviation).

Figure 4. Exemplar lift dump handle – showing the right side in the EXT (extend) position. (Courtesy of Textron Aviation).

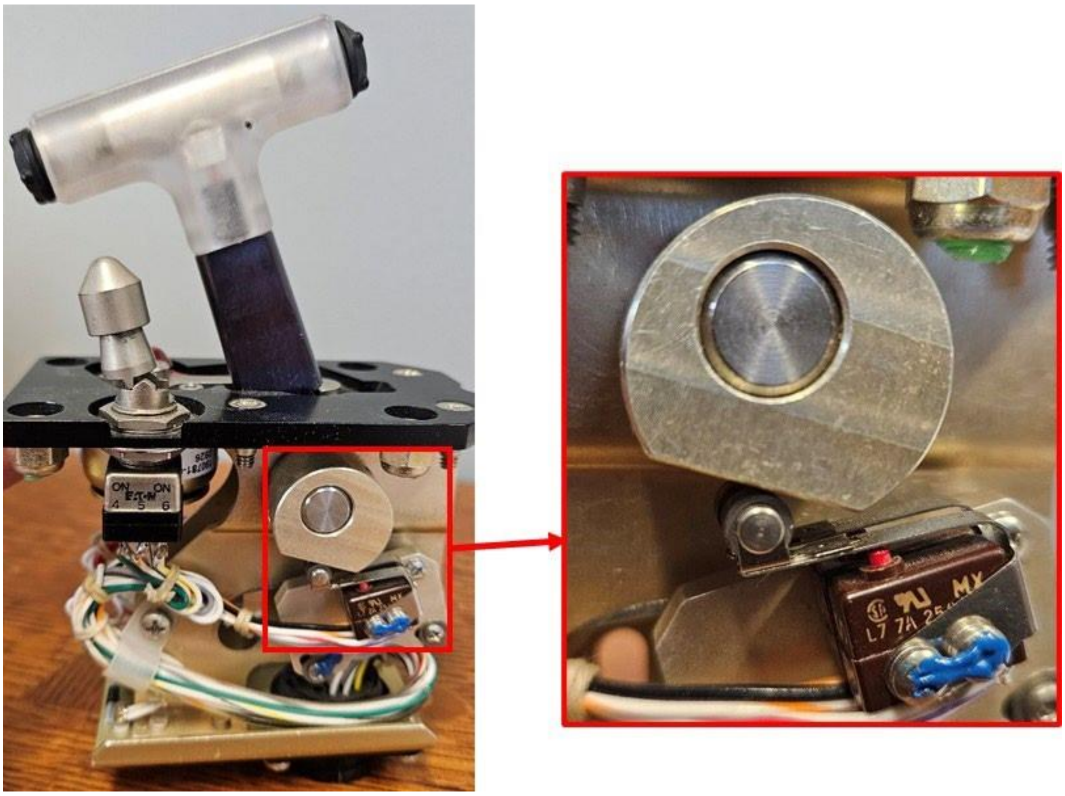


Figure 5. Exemplar lift dump handle – showing the left side in the RET (retract) position including a zoomed in view of the microswitch. (Courtesy of Textron Aviation).

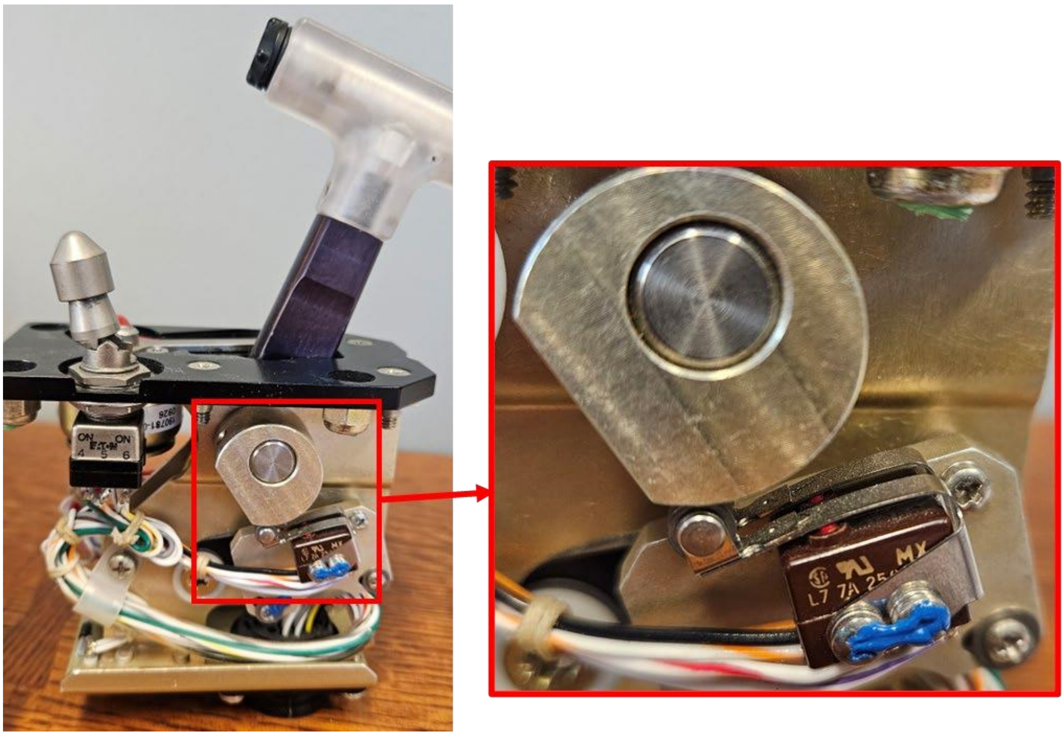


Figure 6. Exemplar lift dump handle – showing the left side in the EXT (extend) position including a zoomed in view of the microswitch. (Courtesy of Textron Aviation).

2.0 Details of The Examination

2.1 General

The lift dump panel from the accident aircraft was subjected to x-ray radiograph and computed tomography (CT) scanning to document the position of the handle. (Figure 7.) The scanning was conducted from 7 December 2023, to 14 December 2023, in Chicago, Illinois by Varex Imaging, Inc under the direction of the NTSB using the Actis 225/500 microfocus CT system.

For the CT scans, the component was loaded into the imaging unit and placed on a turntable. The component was then rotated in front of the x-ray source, and the x-rays were captured by a detector after they went through the part. The x-ray source produced a cone shaped beam of x-rays, and the portion of the part imaged was adjusted slightly after each scan was completed until the entire assembly (or region of interest of the part) was scanned. The x-ray energy levels measured by the detector were recorded at several thousand different points during each rotation, and this information was converted into slice images using reconstruction algorithms.

The component was scanned using a total of 2,400 slices, and the total size of the combined data sets was approximately 40.2 GB. The complete scan protocols are given in Table 1. The digital radiograph and CT axial slice images were provided by Varex Imaging to the NTSB where they were examined, processed, and analysed to evaluate the component.

CT System	450 kV (microfocus)
Area scanned	Area of lift dump handle
Number of Slices	2400
Voxel[23] Size - X Direction (millimetre (mm))	0.125
Voxel Size - Y Direction (mm)	0.125
Voxel Size - Z Direction (mm)	0.125
Image Projections per Revolution	3600
Exposure Time (milliseconds)	1
Frames to Avg (frames per projection)	1
X-ray Source Voltage (kilovolts)	450
X-ray Source Current (mA) (microfocus system)	0.89
Source Filter Thickness (mm)	5
Source Filter Material	copper
CT Matrix Size (voxels, x, y, z)	3000x3000

Table 1. Scan Protocol.

The data sets of slice images were examined, processed, and analysed by the NTSB using the VGStudioMax software package to convert the axial slice data into orthogonal slice images and a three-dimensional reconstructed image of the component. As part of the evaluation, some sections of the components were digitally removed or rendered transparent to allow closer observation of interior parts. In all the

[23] A voxel is a three-dimensional picture element (pixel).

images, the higher density areas were shown as brighter shades of gray and lower density areas were shown as darker shades of grey. Each 2-D quadrant within the images shows a scale at the bottom of that quadrant – note that the scales in each quadrant may be different. The pointers shown in some of the images denote specific areas of interest within that image. The numbers associated with the pointer are the grey value at the pointer location and the three positional coordinates of the pointer. The images of the handle were examined to determine the handle position. Specific results (including example images) are presented in subsequent sections of this report.

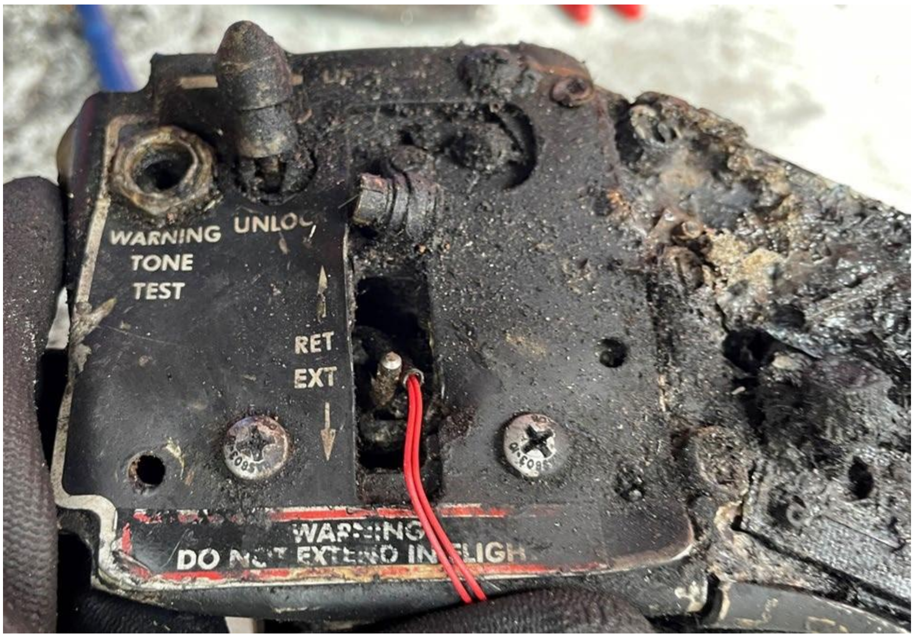


Figure 7. Lift dump panel.

2.0 Computed Tomography Results

The CT results for the lift dump panel are shown in Figures 8 through 16. Review of the images determined that the handle was in the “EXT” position when the scan was completed. The lock release was in the “unlocked” position. The lock release did not exhibit indications of deformation at the end that engages the lift dump handle. (Figure 10.) The inner microswitch on the right side and both microswitches on the left side of the lift dump handle were depressed which corresponds to the EXT (extend) position. (Figures 11 to 14.) The outer microswitch on the right side was in contact with the side of the lift dump handle cam versus along the running surface. (Figure 11 and 12.) The inner microswitch lever on the right side appears to have a sharp bend. (Figure 11 and 12.) The structure of the lift dump panel was deformed. Figure 15 and 16.)

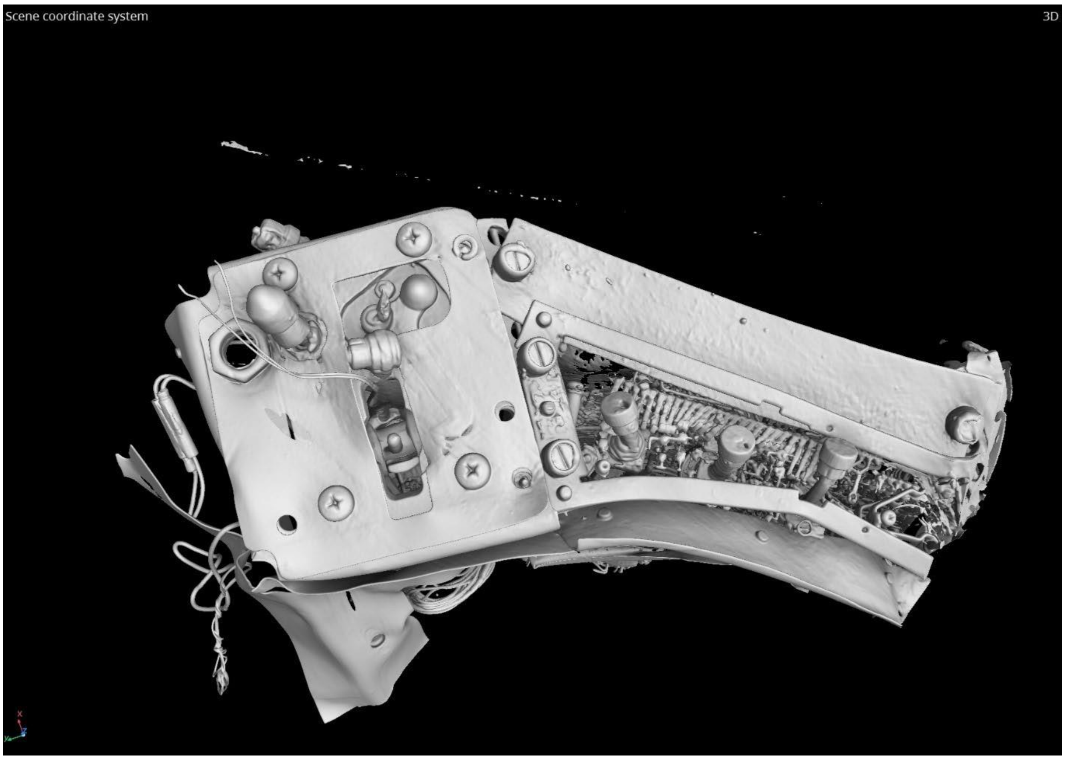


Figure 8. Image of lift dump panel.

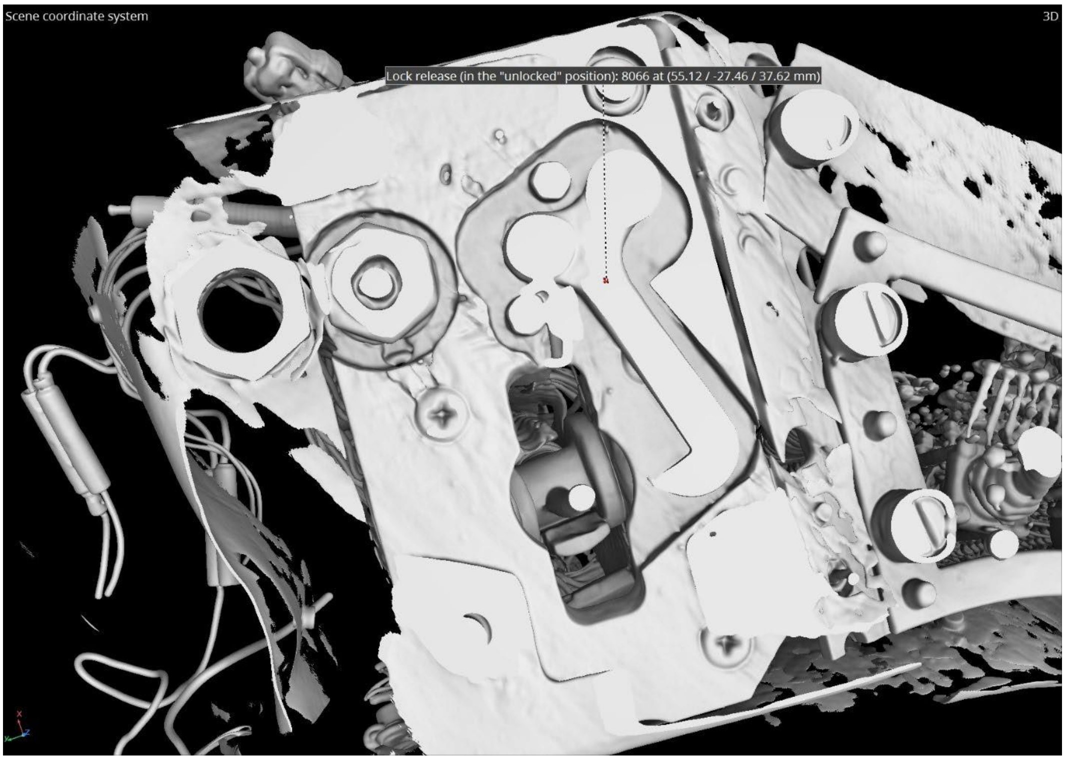


Figure 9. Image of lift dump panel – showing the lock release.

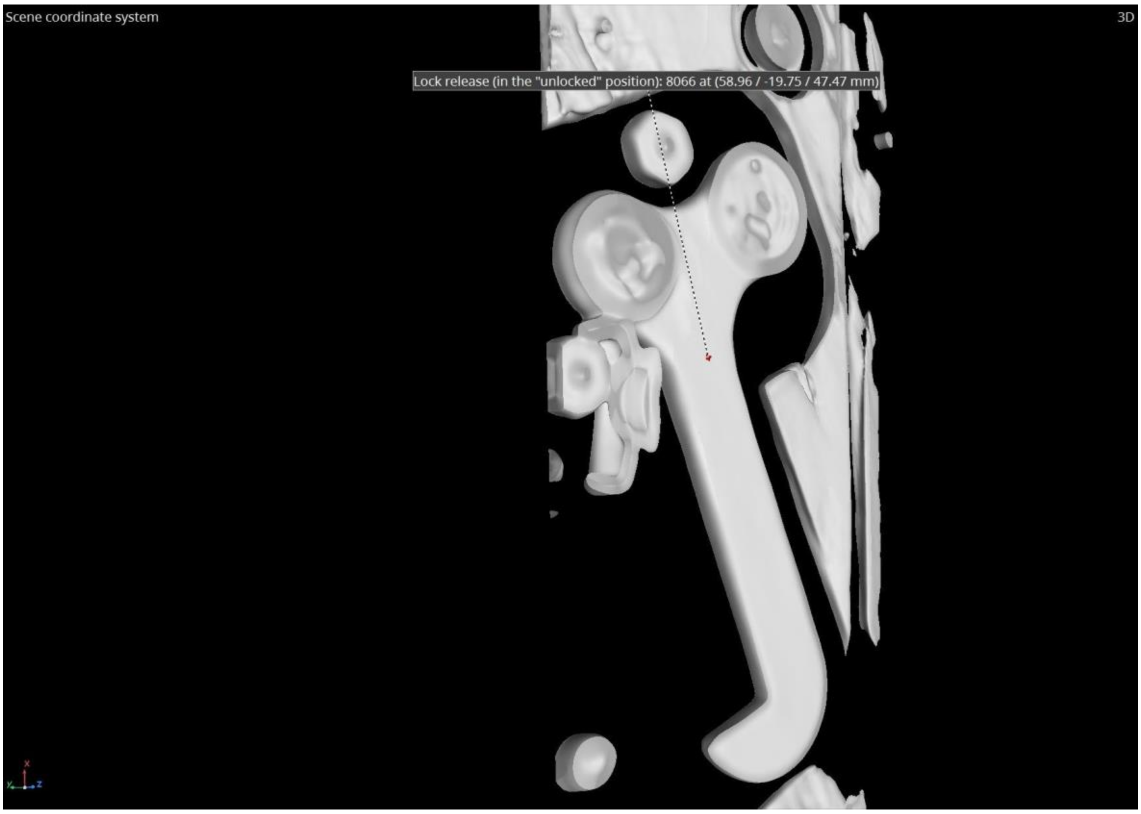


Figure 10. Image of lift dump panel – showing a close-up of the lock release.

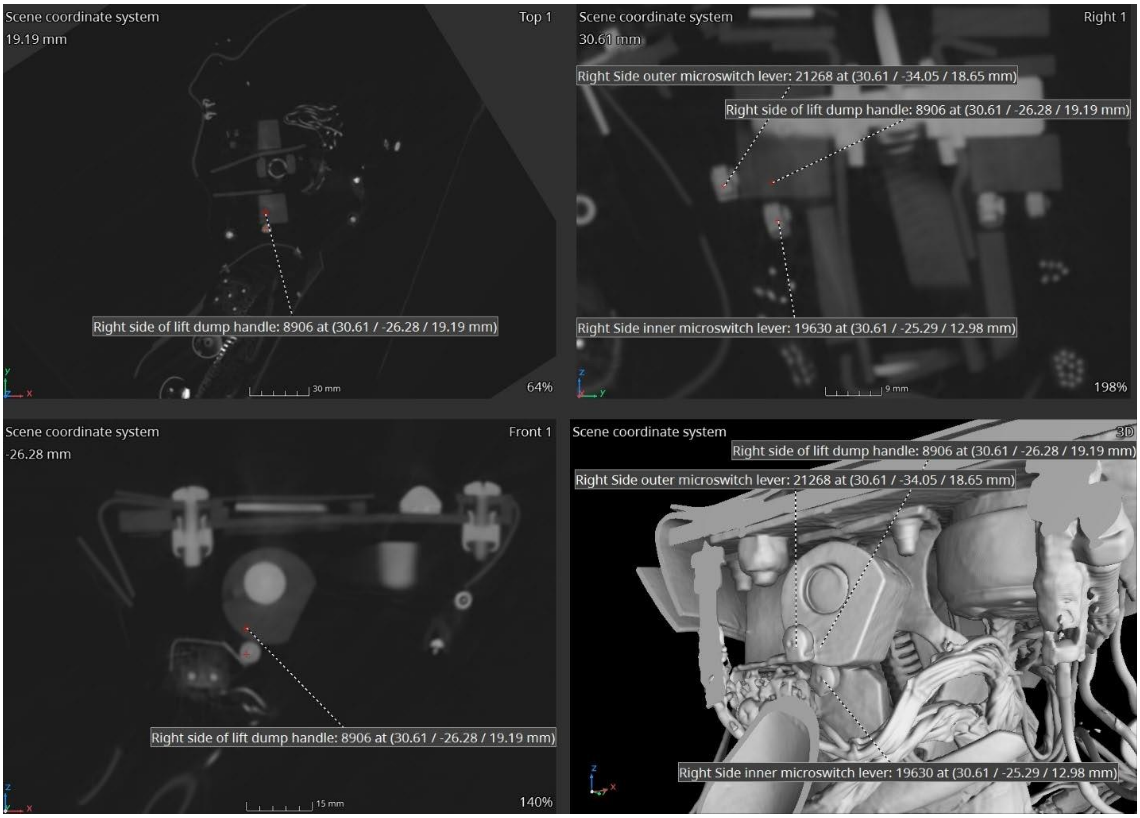


Figure 11. Image of lift dump panel – showing the right side.

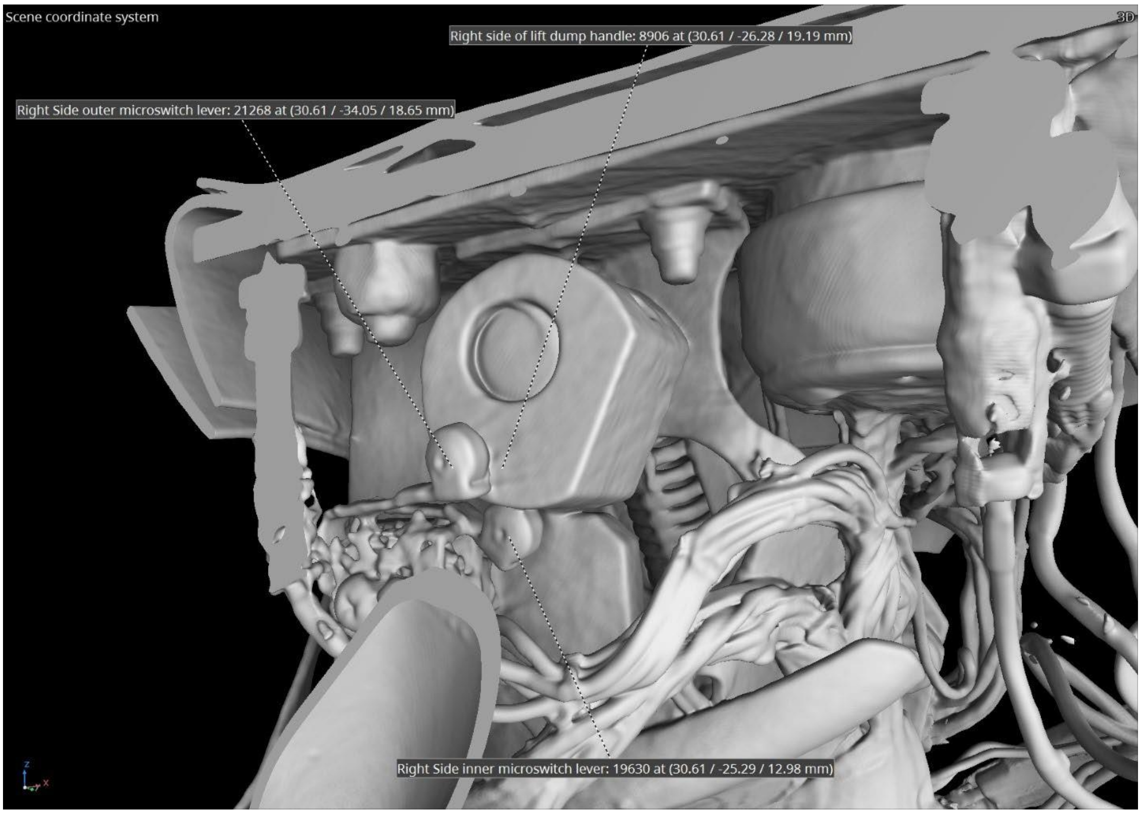


Figure 12. Image of lift dump panel – showing the right side of 3D image.

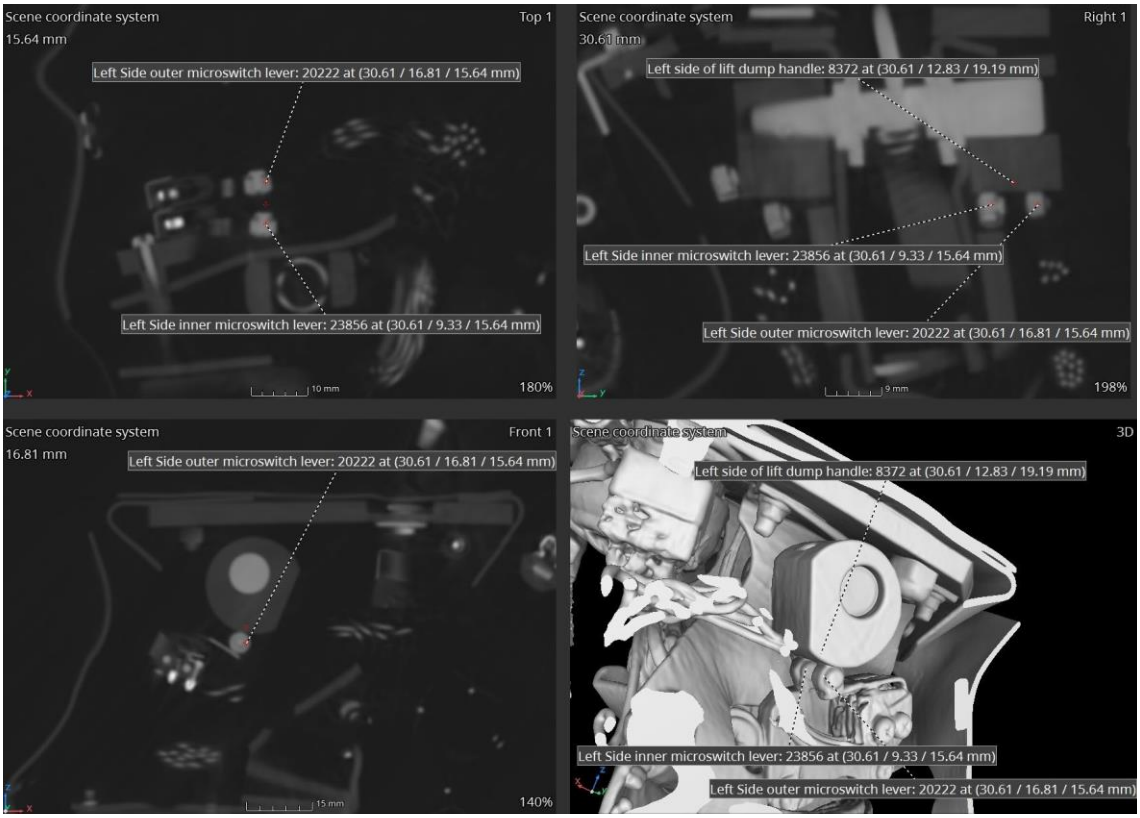


Figure 13. Image of lift dump panel - showing the left side.

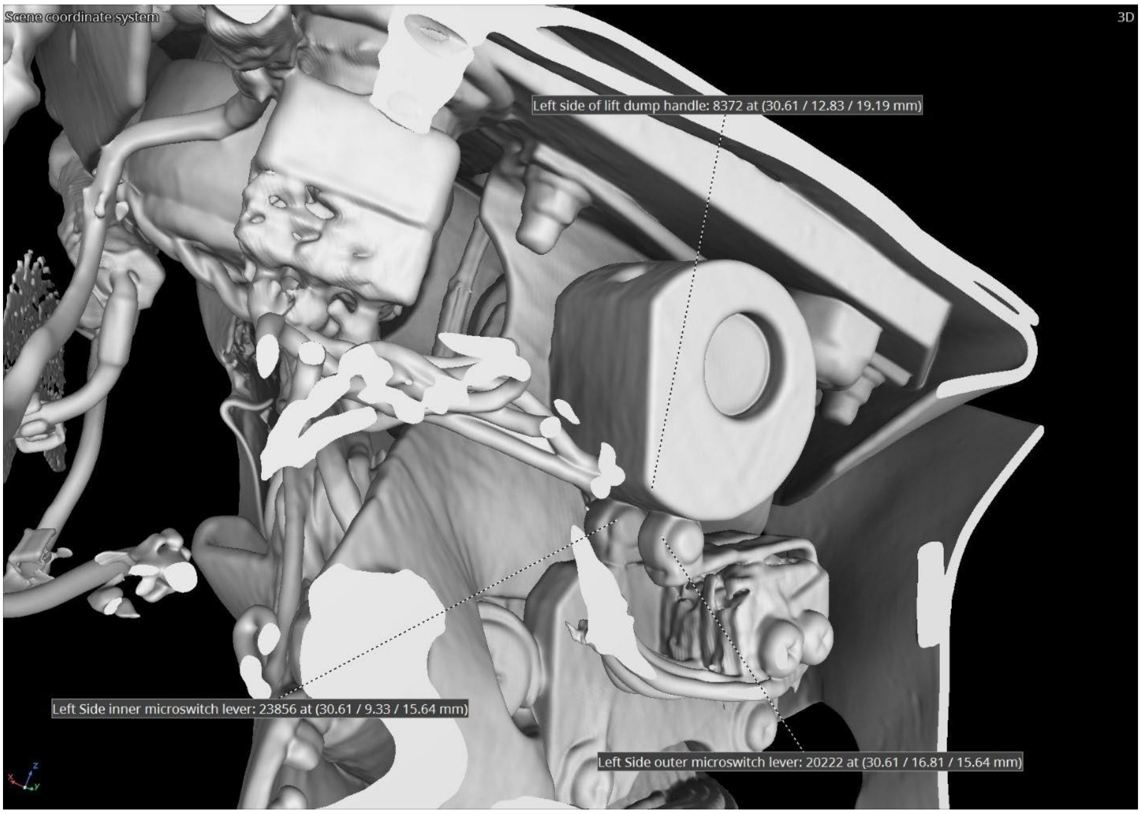


Figure 14. Image of lift dump panel - showing the left side of 3D image.

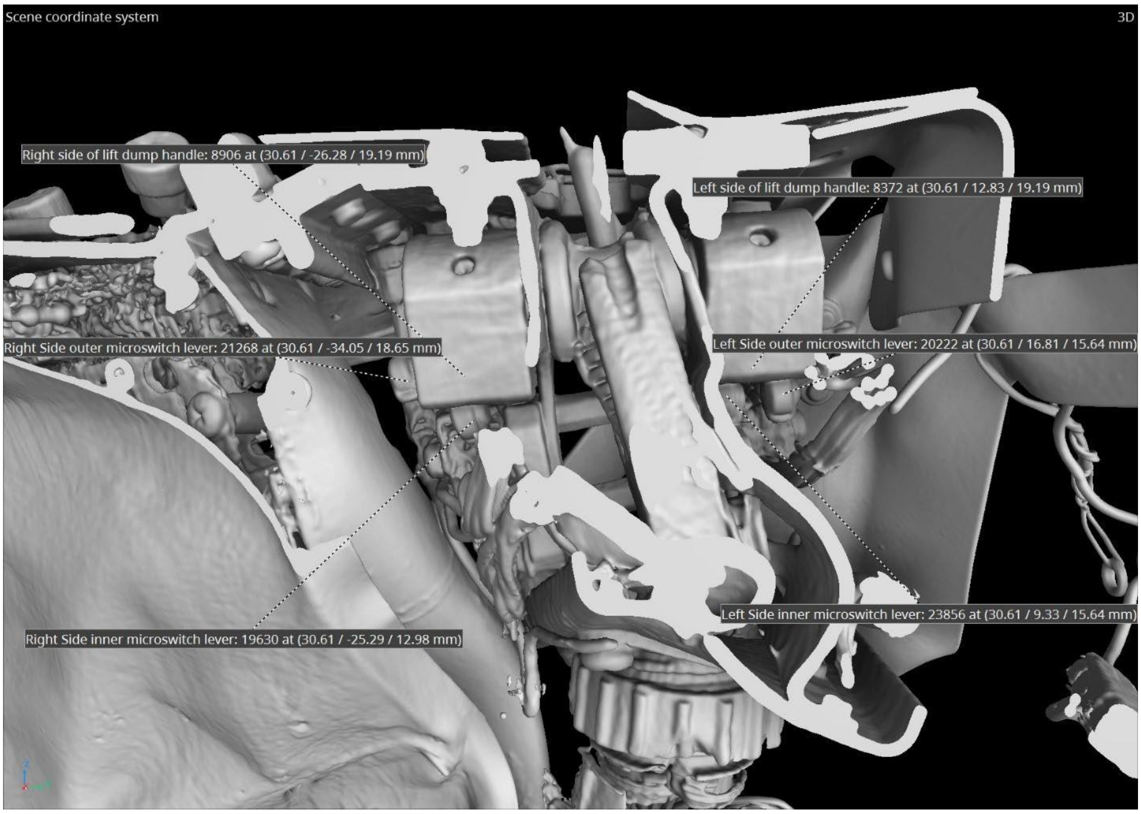


Figure 15. Image of lift dump panel – view looking aft.

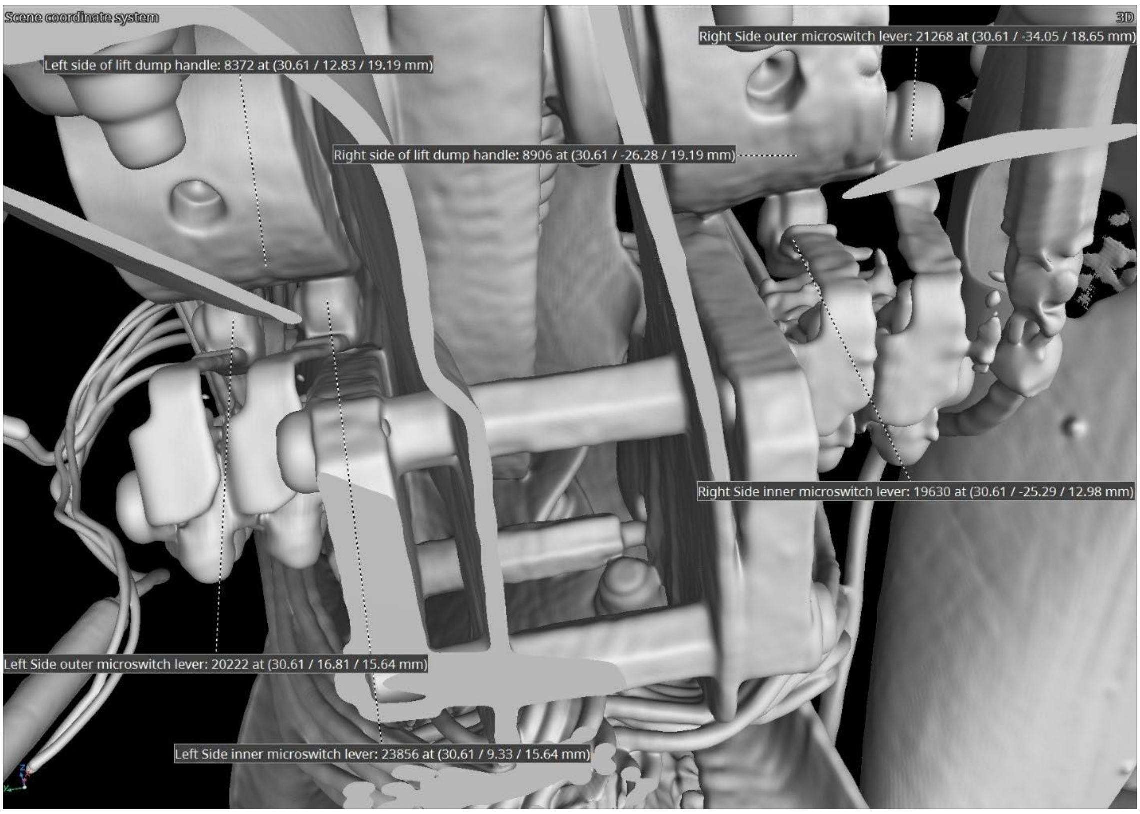


Figure 16. Image of lift dump panel – view looking forward.

Appendix G

SYSTEMS DESCRIPTION – SPEED BRAKE/LIFT DUMP

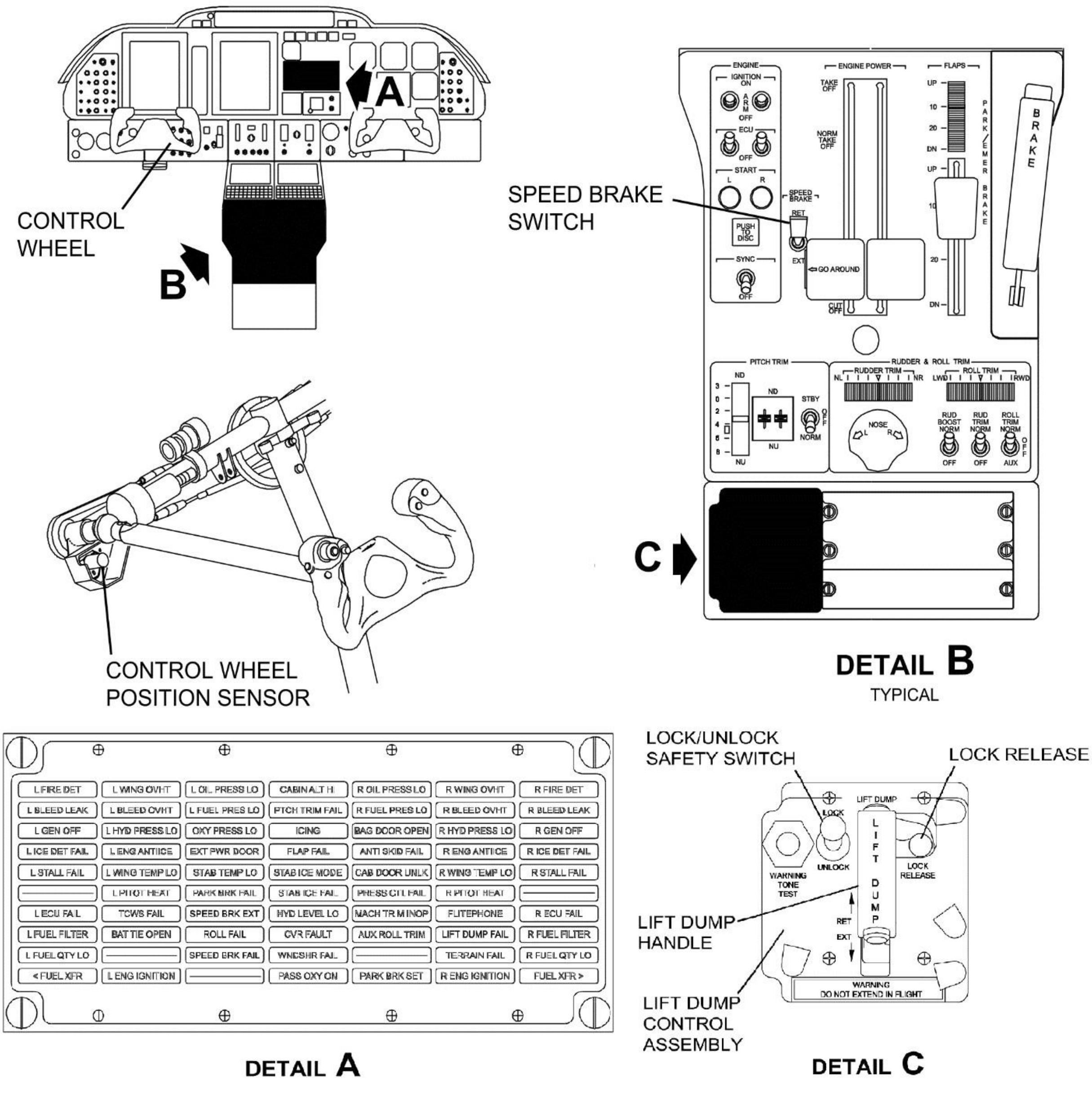
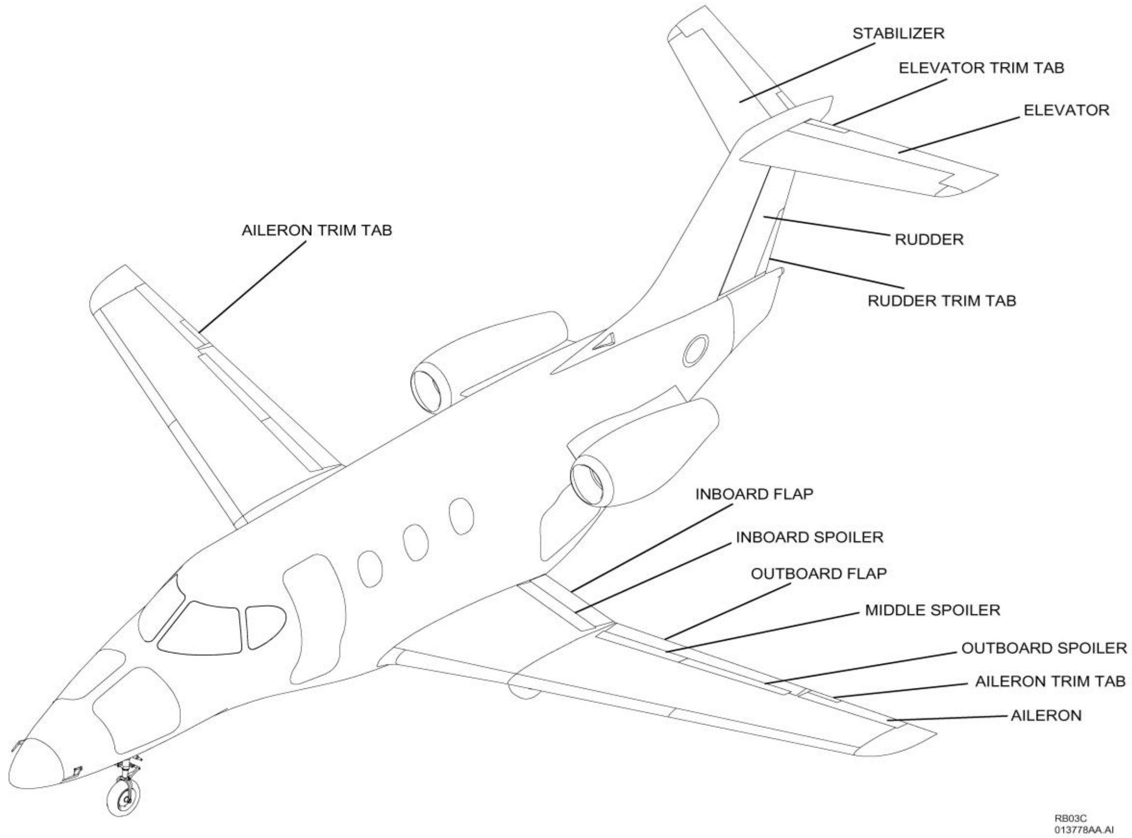


Figure 1. Spoiler System – Cockpit Components. (Courtesy of Textron Aviation).

Raytheon Aircraft Company
Premier I/IA Model 390

POM
Section III - Systems Description



FLIGHT CONTROL SURFACES

July 15, 2006 **3-53**

Figure 2. Flight Control Surfaces.[24]

[24] Reference: Premier I/IA Model 390 Pilot's Operating Manual, Page 3-53.

Raytheon Aircraft Company POM

Premier I/IA Model 390 **Section III - Systems Description**

SPEED BRAKE/LIFT DUMP

The outboard and middle spoilers are used as a speed brake as well as for roll control when airborne and, along with the inboard spoilers, for lift dump on the ground. The speed brake function is electrically controlled by the SPEED BRAKE switch located on the center pedestal. The Lift Dump function is electrically controlled by the Lift Dump Handle located in the center pedestal extension. The spoilers are hydraulically operated.

NORMAL OPERATION - SPEED BRAKE

The speed brake function is controlled by the SPEED BRAKE switch located on the center pedestal. When the switch is placed in the EXT position, the Spoiler Control Unit (SCU) activates the speed brake function and extends the outboard and middle spoilers accordingly.

A failure of the speed brake spoilers is identified by an amber caution annunciator labeled SPEED BRK FAIL together with an associated flashing of the amber MASTER CAUTION switches.

NORMAL OPERATION - LIFT DUMP

The Lift Dump function is controlled by the LIFT DUMP handle located on the center pedestal extension. The LIFT DUMP handle is mechanically protected from an inadvertent selection by means of a lever locked safety switch, placarded LOCK/UNLOCK, located adjacent to the LIFT DUMP handle on the center pedestal extension. The process of selecting the LOCK/UNLOCK safety switch to UNLOCK illuminates the LIFT DUMP handle and energizes a solenoid which removes a gate from the LIFT DUMP handle allowing the LIFT DUMP handle to be raised out of its detent and transitioned aft to the deploy position.

In the event that the solenoid fails a mechanical LOCK RELEASE button is provided which manually performs the function of the LOCK/UNLOCK safety switch.

When the LIFT DUMP handle is placed in the EXT position, the Spoiler Control Unit (SCU) activates the LIFT DUMP function and extends the outboard, middle and inboard spoilers accordingly. Command of LIFT DUMP will override mixed roll spoiler and speed brake commands.

A failure of the Lift Dump spoilers following an extension of the LIFT DUMP handle is identified by an amber caution annunciator labeled LIFT DUMP FAIL together with an associated flashing of the amber MASTER CAUTION switch and a unique aural tone. A failure of the lift dump spoilers with no Lift Dump extension commanded is identified by an amber caution annunciator labeled LIFT DUMP FAIL, together with an associated flashing of the amber MASTER CAUTION switch.

July 15, 2006 **3-57**

Figure 3. Systems Description – Speed Brake/Lift Dump[25]

[25] Reference: Premier I/IA Model 390 Pilot's Operating Manual, Page 3-57.

Raytheon Aircraft Company — POM

Premier I/IA Model 390 — **Section I - General**

INBOARD SPOILER

Area. . . . . .3.71 sq. ft. x 2 (0.34 sq. m x 2)

Span . . . . 4 ft. 10 in. (1.47 m)

DEFLECTION

SPEED BRAKE RETRACTED AND CONTROL WHEEL FULLY ROTATED ~ FLAPS UP, 10 AND 20

Spoiler Surface		Full Left	Full Right
Left	Outboard	9.1°	0°
	Mid	9.1°	0°
	Inboard	0°	0°
Right	Outboard	0°	9.1°
	Mid	0°	9.1°
	Inboard	0°	0°

SPEED BRAKE RETRACTED AND CONTROL WHEEL FULLY ROTATED ~ FLAPS DN

Spoiler Surface		Full Left	Full Right
Left	Outboard	4.3°	0°
	Mid	4.3°	0°
	Inboard	0°	0°
Right	Outboard	0°	4.3°
	Mid	0°	4.3°
	Inboard	0°	0°

November 4, 2005 **1-23**

Figure 4. Spoilers Deflection Range[26] (1)

[26] Reference: Premier I/IA Model 390 Pilot's Operating Manual, Page 1-23.

POM — Raytheon Aircraft Company
Section I - General — Premier I/IA Model 390

SPEED BRAKE EXTENDED AND CONTROL WHEEL FULLY ROTATED ~ FLAPS UP, 10, 20 AND DN

Spoiler Surface		Full Left	Full Right
Left	Outboard	23°	18.7°
	Mid	23°	18.7°
	Inboard	0°	0°
Right	Outboard	18.7°	23°
	Mid	18.7°	23°
	Inboard	0°	0°

SPEED BRAKE EXTENDED AND CONTROL WHEEL NEUTRAL

Spoiler Surface		
Left	Outboard	23°
	Mid	23°
	Inboard	0°
Right	Outboard	23°
	Mid	23°
	Inboard	0°

LIFT DUMP MODE

Spoiler Surface		
Left	Outboard	45°
	Mid	45°
	Inboard	60°
Right	Outboard	45°
	Mid	45°
	Inboard	60°

1-24 — November 4, 2005

Figure 5. Spoilers Deflection Range[27] (2)

[27] Reference: Premier I/IA Model 390 Pilot's Operating Manual, Page 1-24.

Appendix H

JET VALET SDN BHD COMMENTS TO DRAFT FINAL REPORT

Draft Final Report Section/Paragraph	Operator's Comments	AAIB Feedback
1.5 Personnel Information		
1.5.2 Prior to the accident flight, the same crew had operated two other flights the day before, on 16 August 2023 – from Subang (WMSA) to Kuantan (WMKD) and then from Kuantan to Langkawi (WMKL). Other than these flights, the SIC had not operated the 390 Premier 1 aircraft type before and had not received any formal training on operating this aircraft type.	Recommend deletion of "Other than these flights, the SIC had not operated the 390 Premier 1 aircraft type before and had not received any formal training on operating this aircraft type". Purpose of above sentence is unclear, noting that the SIC had operated the aircraft twice in the preceding days without incident and obviously received training in-flight as part of these flights.	Purpose of sentence is to establish the absence of formal training received by the SIC to operate the 390 Premier 1 aircraft.
1.17 Organisational and Management Information		
1.17 KAPB facilitates access to Jet Valet's aircraft for all its members, with payments for flights apparently debited through members accounts in KAPB. However, details regarding the booking arrangements for aircraft use, including records of the ill-fated flight on N28JV by passengers on 17 August 2023, remain undisclosed. Neither KAPB nor Jet Valet has provided payment records for the utilisation of Jet Valet's aircraft.	Recommend deletion entirely – report does not provide any basis for the relevance of this statement.	The sentence highlights that the operator did not provide the necessary evidence and documentation for payment records. This is because the operator stated that flight payments were made through deductions from members' KAPB accounts.

1.18 Additional Information		
1.18.1 ...no formal documentation was provided to show ownership linkage between the FAA registered owner, Delaware Aircraft Trust LLC, and the nominated KAPB board member.	Recommend deletion of: "no formal documentation was provided to show ownership linkage between the FAA registered owner, Delaware Aircraft trust LLC, and the nominated KAPB board member".	The first part of the comment, regarding the ownership linkage between Delaware Aircraft Trust and the KAPB board member, is accepted and incorporated in the Final Report.
Although the N28JV aircraft was explicitly intended to be based in Malaysia long-term, there is no evidence that the aircraft operator has taken measures to apply to CAAM for Malaysian registration of the aircraft, as required under the Civil Aviation Regulations 2016 for any foreign registered aircraft operating in Malaysia for more than six months. Furthermore, there is no indication that the operator has applied or intends to apply for the necessary approval from CAAM for non-scheduled air services and the carriage of passengers for valuable consideration in a foreign registered aircraft, as mandated by current civil aviation policies and regulations.	AAIB does not provide any basis for the relevance of this statement. Notwithstanding, please also see attached our BOD resolution and trust documents that were previously provided to the AAIB. Recommend deletion of: Although the N28JV aircraft was explicitly intended to be based in Malaysia long-term, there is no evidence that the aircraft operator has taken measures to apply to CAAM for Malaysian registration of the aircraft, as required under the Civil Aviation Regulations 2016 for any foreign registered aircraft operating in Malaysia for more than six months. Note that aircraft was not in operation for 6 months at time of the incident, therefore CAAM application comments irrelevant?	The trust agreement was only provided to investigators on 12 August 2024, at the end of the consultation period for the draft final report. The N28JV aircraft had not operated in Malaysia for six months at the time of the accident. However, the investigators noted that the operator had not provided evidence of applying for or intending to apply for CAAM approval for non-scheduled air services and passenger carriage in a foreign-registered aircraft. Since the N28JV was planned for long-term operation in Malaysia, it needed to be registered here. Additionally, the operator did not apply for the required CAAM approval for such services. Other aircraft in the fleet, including the Hawker Beechcraft 4000 (N35JV) and Gulfstream IV (N729TY), are foreign-registered and had been based in Malaysia for over six months.

1.18.2 On 15 May 2023, the operator reportedly sent a letter to CAAM, informing them that a KAPB "investee" company, AP Holdings Berhad (APHB), owns Jet Valet Sdn Bhd and the N28JV aircraft. The letter stated that the aircraft would arrive at WMSA on 17 May 2023 for use by KAPB directors and members. Although the N28JV aircraft was explicitly intended to be based in Malaysia long-term, there is no evidence that the aircraft operator has taken measures to apply to CAAM for Malaysian registration of the aircraft, as required under the Civil Aviation Regulations 2016 for any foreign registered aircraft operating in Malaysia for than six months.	In reference to 15 May 2023 letter, as stated therein, CAAM were informed the aircraft was intended for use in Malaysia. Notwithstanding, the aircraft had not been in use in Malaysia at the time of the incident for 6 months, so applications for registration are irrelevant in the circumstances. Furthermore, the AAIB report does not note that CAAM never responded to that letter and did not make any further enquiries regarding oversight of registration application for Malaysian operations. We were transparent in notifying the CAAM and should not be criticised for the lack of engagement from the CAAM on this matter. Recommend deletion of: Although the N28JV aircraft was explicitly intended to be based in Malaysia long-term, there is no evidence that the aircraft operator has taken measures to apply to CAAM for Malaysian registration of the aircraft, as required under the Civil Aviation Regulations 2016 for any foreign-registered aircraft operating in Malaysia for more than six months N28JV has only been in Malaysia since May 2023, less than six months. The current statement is speculative.	The letter sent to CAAM on 15 May 2023 only informed them of the aircraft's intended use by KAPB directors and members. Given its large membership base and potential passenger volume, the operator needs CAAM approval for non-scheduled air services and for carrying passengers for valuable consideration in a foreign-registered aircraft. Additionally, because the aircraft was intended for long-term operation in Malaysia, it must be registered with CAAM.

2.3 Aircraft Operation Analysis		
2.3.1 "In addition to performing PNF duties, the SIC also operated certain aircraft systems as part of the checklist items, such as the weather radar, flaps, landing gear, and spoilers, based on analysis of the CVR recording."	Recommend deletion – sentence is speculative as CVR recordings do not confirm which (either SIC or PIC) operated controls.	Analysis of the CVR recording revealed that the SIC had operated the aircraft systems and was instructed by the PIC to do so in several instances.
2.3.2 "a high probability that the SIC inadvertently extended the lift dump while performing the Before Landing checklist."	Recommend deletion – sentence is speculative as CVR recordings do not confirm which (either SIC or PIC) operated controls for specific action. In the alternative, recommend amendment to: 'a high probability that the lift dump was inadvertently extended during the Before Landing Checklist."	The lift dump could only have been inadvertently extended by one of the two individuals in the cockpit: either the PIC or the SIC. The assessment that the SIC was most likely responsible is based on several factors. Analysis of the CVR recording, including crew voices, cockpit sounds, and the operational context, suggests a high probability that the SIC accidentally extended the lift dump. This conclusion is supported by the fact that the PIC, being a type-rated pilot, would have been aware of the serious risks associated with accidentally extending the lift dump, whereas the SIC was less familiar with the system.
2.3.3 …In summary, the inadvertent extension of the lift dump spoilers by the SIC while carrying out the Before Landing Checklist triggered a sudden loss of lift, leading to an uncontrollable descent and the subsequent crash	Refer to comments above re lack of clarity as to individuals who operated controls. Also note that reference in preceding paragraph was for "high probability" of lift dump extension, whereas here it is referred to with certainty (e.g. "the inadvertent extension").	Refer to AAIB feedback on the comment for paragraph 2.3.2 above. Refer to AAIB feedback to the comment in paragraph 3.2.1 below about the phrasing of the inadvertent extension of the lift dump spoilers

The absence of specific briefings or warnings about the critical nature of the lift dump system operation suggest a gap in crew communication and training. The PIC, while managing multiple tasks, might not have adequately briefed the SIC on this particular hazard.	Recommend amendment to : In summary, the likely inadvertent extension of the lift dump spoilers while carrying out the Before Landing Checklist triggered a sudden loss of lift, leading to an uncontrollable descent and the subsequent crash Recommend deletion of: The absence of specific briefings or warning about the critical nature of the lift dump system operation suggests a gap in crew communication and training. The PIC, while managing multiple tasks, might not have adequately briefed the SIC on this particular hazard. The above statement does not factor for any briefings provided by the PIC on the previous two flights. It also assumes the SIC was responsible for the lift dump extension, which cannot be determined by CVR recordings. This statement also appears to contradict AAIB comments in Para 2.5.3. Therefore, entirely speculative.	while performing the Before Landing checklist is partially accepted. The Final Report has been amended to reflect the substance of this partially accepted comment. For the last part of the comment concerning briefings provided by the PIC on the previous two flights, refer to AAIB feedback on the comment for paragraph 2.5.3 below.
2.5 Crew Resource Management (CRM) Analysis		
2.5.2 “Additionally, this non-compliance could have implications for the overall safety and decision-making process during the flight.”	Recommend deletion. No evidence provided by the AAIB that seating position effects decision making and is therefore speculative.	The Premier I/IA Model 390 Airplane Flight Manual, Section 2 – Limitations, requires that for single-pilot operations, the pilot with the appropriate rating must occupy the left seat. This seat is designed for optimal access to the controls

		and instruments needed for single-pilot operation. Failure to comply with this requirement could affect the safety of aircraft operations and the effectiveness of decision-making by the flight crew in CRM.
2.5.3 "However, in this accident, the checklist included unlocking the ground spoilers – a step likely misunderstood by the SIC, leading to a catastrophic outcome".	Recommend deletion of: - a step likely misunderstood by the SIC, leading to a catastrophic outcome" Speculative, as based on assumption that SIC was responsible for spoiler extension.	Refer to AAIB feedback on the comment for paragraph 2.3.2 above.
2.5.3 "According to the CVR recording, while running through the checklist items before landing, the SIC mistakenly stated one of the checklist items as "fuel dump" instead of " Lift Dump" according to Premier 1/1A pilot checklist – Model 390".	Recommend deletion – failure by AAIB to establish relevance of this statement.	This statement indicates that the SIC was unfamiliar with the Premier I/IA Model 390 systems, including the lift dump system, due to a lack of training and competency in operating this aircraft. This issue is discussed in the Human Factors Analysis section of the Final Report.
2.5.3 "There was no indication during the period recorded on the CVR that the PIC had briefed and warned the SIC about the lift dump operation. Whether the PIC had done so on the two prior flights or at any other time cannot be determined."	Recommend deletion – the AAIB will agree that the second sentence can act to completely invalidate the first sentence – as the AAIB cannot determine what was discussed on previous flight, a logical inference is that the PIC had already briefed the SIC and didn't consider it necessary to cover the same ground in-flight on the day of the incident. It also assumes the SIC was responsible for the lift dump extension, which cannot be determined by CVR recordings.	Reviewing the entire period of the CVR recording did not reveal any evidence that the PIC briefed the lift dump operation. There is also no evidence to confirm that the briefing occurred on the two previous flights. The first and second sentences are consistent with each other.

2.6 Human Factor Analysis		
2.6.3 “This disparity in ratings suggests that the SIC may not have been fully trained or familiar with the specific systems and procedures…”	“may not have been” – speculative wording. Entire sentence therefore speculative. Recommend deletion.	Editorial-specific or non-technical aspect. The actual sentence is “This lack of rating suggests that the SIC might not have been fully trained or familiar with the systems and procedures of the 390 Premier 1” and is consistent with the discussion in the CRM Analysis and Human Factor Analysis sections.
2.7 Organisational Factors		
2.7.2 Regulatory Compliance and Grey Areas Although the N28JV was intended for long-term operation in Malaysia, there is no evidence that the aircraft operator had applied for Malaysian registration of the aircraft as required …	Recommend deletion of “Grey Areas” – negative connotations and unnecessary descriptive terminology. Recommend deletion of : Although the N28JV was intended for long-term operation in Malaysia, there is no evidence that the aircraft operator had applied for Malaysian registration of the aircraft as required . Previous comments refer – aircraft hadn’t been in operation for 6 months in Malaysia therefore application is irrelevant as not required.	The first sentence of the comment is editorial-specific and a non-technical aspect. For the remaining part of comment, refer to AAIB feedback on the comments for paragraphs 1.18.1 and 1.18.2 above.

2.7.3 Passenger Safely and Regulatory Gaps The substantial membership base of KABP, coupled with the ability of its members to bring additional passengers, increases the potential safety risk … By not securing the necessary CAAM approvals for non-scheduled air services and using a foreign registered aircraft for passenger carriage, the aircraft operator avoids stringent regulatory scrutiny. this practice potentially compromises the safety standards expected for commercial passenger operations.. …These gaps can lead to unaddressed safety issues..	Recommend deletion entirely – report does not provide any basis for the relevance of this statement. Note comments above.	Refer to AAIB feedback on the comments for paragraphs 1.18.1 and 1.18.2 above.
3.1 Findings		
3.2 Cause/Contributing Factors		
3.2.1 "The accident was primarily caused by the inadvertent extension of the lift dump spoilers by the Second-in-Command while performing the before landing checklist."	Recommend amendment: The accident was most probably caused by the inadvertent extension to the lift dump spoilers while performing the before landing checklist."	The comment about the phrasing of the inadvertent extension of the lift dump spoilers while performing the Before Landing checklist is partially accepted. The Final Report has been

	At 2.3.2 the term “high probability” was used to indicate lift dump extension. Need to reflect this uncertainty throughout entirety of report. Also, no clarity that it was the SIC who extended the lift dump based on CVR.	amended to reflect the substance of this partially accepted comment. For details on the use of the term “high probability” in paragraph 2.3.2 to indicate the likelihood of lift dump extension, refer to the AAIB feedback on the comment for the paragraph 2.3.2.