AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/3/2/9811		
Aircraft Registration	ZS-CBI	**Date of Accident**	22 Nov 2017		**Time of Accident**	1423Z	
Type of Aircraft	Hawker Beechcraft Premier 1		**Type of Operation**		Private (Part 91)		
Pilot-in-command Licence Type	Commercial		**Age**	61	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		3048		Hours on Type	641	
Last Point of Departure	Cape Town International Aerodrome (FACT) Western Cape Province						
Next Point of Intended landing	Rand Aerodrome (FAGM) Gauteng Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
FAGM Runway 11 beyond the threshold of Runway 29 at GPS S26°14'31.12" E028°09'04.88" at an elevation of 5 483ft							
Meteorological Information	Surface wind 230° at 11kts, temperature 18°, and visibility CAVOK.						
Number of People On Board	2+0	**No. of People Injured**	0	**No. of People Killed**	0		
Synopsis							

On 22 November 2017, the pilot-in-command (PIC) accompanied by the first officer (FO) took off from the Cape Town International Airport (FACT) on a private flight to the Rand Airport (FAGM). The flight was conducted under instrument flight rules (IFR) by day and the approach was conducted under visual flight rules (VFR). The PIC was the pilot flying (PF) and was seated on the left seat and the FO was occupying the right seat.

The air traffic controller (ATC) on duty at FAGM tower stated that the FO reported in-bound for a full-stop landing at FAGM. The last wind direction data for Runway 29 was transmitted to the FO as 230°/11 knots (kts) and Query Nautical Height (QNH): 1021. The FO acknowledged the transmission and the crew elected to land on Runway 11. The PIC stated that the approach for landing was stable and that the touchdown was near the first taxiway exit point. According to the FO, the aircraft floated for a while before touchdown. This was confirmed during the investigation. During the landing rollout, the PIC applied the brakes and the brakes responded for a short while, however, the aircraft continued to roll without slowing down. At approximately 300 metres (m) beyond the intersection of Runway 35 and Runway 11, the PIC requested the FO to apply emergency brakes. The FO applied the emergency brakes gradually and the aircraft continued to roll before the brakes locked and the tyres burst. The aircraft skidded on the main wheels and continued for approximately 180m until it overshot the runway. The undercarriage went over a ditch of approximately 200 millimetres in depth at the end of the runway into the soft ground and the aircraft came to a stop approximately 10m from the threshold facing slightly left off the extended centre line Runway 11. The aircraft was substantially damaged during the impact sequence and none of the occupants sustained injuries. The crash alarm was activated by the tower and the fire services responded to the scene.

The investigation revealed that the aircraft was unstable on approach (hot and high), resulting in deep landing, probably near the second exit point, leading to a runway excursion. Contributing factors were attributed to the lift dumps not being deployed and the incorrect application of the emergency brakes.

SRP Date	13 August 2019	Publication Date	28 August 2019

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ABBREVIATION	DESCRIPTION
ACU	Anti-skid Control Unit
AFM	Aircraft Flight Manual
AMO	Aircraft Maintenance Organisation
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
ATS	Air Traffic Services
CAVOK	Ceiling and Visibility OK
CFRE	Carbon fibre reinforced epoxy
C of A	Certificate of Airworthiness
CPL	Commercial Pilot Licence
CVR	Cockpit Voice Recorder
GPS	Global Positioning System
FAA	Federal Aviation Administration
FACT	Cape Town International Aerodrome
FAGM	Rand Aerodrome
ft	Feet
FDR	Flight Data Recorder
FL	Flight Level
FO	First Officer
IFR	Instrument Flight Rules
kg	Kilogram
kts	Knots
PF	Pilot Flying
MHz	Megahertz
MEA	Multi Engine Aircraft
mm	Millimetres
MOR	Mandatory Occurrence Report
MPI	Major Period Inspection
nm	Nautical Mile
PIC	Pilot-in-Command
POH	Pilots Operating Handbook
PSI	Per Square Metre
QNH	Query Nautical Height
QRH	Quick Reference Handbook
Rwy	Runway
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
SCU	Spoiler Control Unit
SEA	Single Engine Aircraft
SOPs	Standard operating procedures
VFR	Visual Flight Rules
VHF	Very High Frequency
VREF	Reference landing speed
WOW	Weight on Wheels

Reference Number	**:** CA18/3/2/9811
Name of Owner/Operator	**:** I Branco
Manufacturer	**:** Hawker Beechcraft
Model	**:** Premier 1
Nationality	**:** South African
Registration Marks	**:** ZS-CBI
Place	**:** Extended centre line for Runway 11 at FAGM
Date	**:** 22 November 2017
Time	**:** 1423Z

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

Purpose of the Investigation:

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

Investigations process:

The accident was reported to the Accident and Incident Investigation Division (AIID) on 22 November 2017 at about 1500Z. The investigator went to the Rand Aerodrome (FAGM) on 23 November 2017. The investigator coordinated with all authorities on-site by initiating the accident investigation process according to CAR Part 12 and the investigation procedures. The AIID is leading the investigation as the Republic of South Africa is the State of Occurrence.

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

- *Accident — this investigated accident;*
- *Aircraft — the Premier 1 involved in this accident;*
- *Investigation — the investigation into the circumstances of this accident;*
- *Pilot — the pilot involved in this accident;*
- *Report — this Accident report.*

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

Disclaimer:

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On 22 November 2017, the aircraft was operated on a private flight from the Cape Town International Aerodrome (FACT) to the Rand Aerodrome (FAGM). The aircraft was operated under instrument flight rules (IFR) by day and the landing was conducted under visual flight rules (VFR) by day. The first officer (FO) was the pilot monitoring and the pilot-in-command (PIC) was the pilot flying (PF).

1.1.2 No snags were reported or experienced during the flight. The take-off and cruise at flight level (FL) 410 until top of descent to hand over to FAGM were uneventful. The flight plan filed with the Air Traffic Services (ATS) was instrument flight rules (IFR). According to the air traffic control (ATC) recordings and the Mandatory Occurrence Report (MOR) filed by the ATC after the accident, the FO called Rand tower at 1413Z on frequency 118.7, reporting the aircraft's estimate for the field and requesting surface wind data. The ATC reported the runway in use as Runway 29; surface wind direction as 200° and the wind strength as 11 knots (kts) with Query Nautical Height (QNH) 1021 during initial contact.

1.1.3 The FO advised the tower that they would route for 5 nautical miles (nm) centre fix of Runway 11 and position for left downwind Runway 29 and that he would call the tower on handover. At 1420Z, the FO called the tower from 5nm in-bound for FAGM, positioned for final approach on Runway 11 and asked for a wind check, which the ATC gave as 220°/10 knots (kts). At this stage, the flight transitioned from IFR to VFR. He then advised the tower that they would use Runway 11. At 1421Z, the FO requested the ATC to keep them updated of the surface wind conditions and to advise the crew of any gusts above 12kts and the ATC gave the FO a wind check of 230°/11kts. The FO copied the wind check and confirmed that they would still land on Runway 11. The aircraft was cleared to land on Runway 11 at 1422Z.

1.1.4 The PIC stated that he configured the aircraft for landing and that the approach was stable as he touched down at the first exit taxiway. He applied the brakes, however, the aircraft continued rolling without slowing down. There was no malfunction with the hydraulic system reported by the crew. The PIC waited three seconds for the anti-skid to reset and applied the brakes again. The brakes only held for a short while, and the aircraft did not slow down. He waited for another three seconds and, during this time, the aircraft was 300 metres (m) beyond the intersection of Runways 11 and 35. The PIC requested the FO to apply the emergency brake. The FO stated that he applied the emergency brake by gradually pulling on the emergency brake handle, however, the main tyres burst. The right tyre burst first, followed by the left tyre in accordance to the tyre-trail markings on the runway surface. According to the FO, the aircraft approached very fast, resulting in float and deep touchdown on the runway. The FO stated that he had advised the PIC that with the tailwind component, the aircraft might float before touchdown.

1.1.5 The aircraft skidded with its main-wheels assembly on the runway surface until it overshot the runway into the soft ground. There was a ditch of approximately 200 millimetres (mm) in depth at the end of the runway. The nose gear went into the ditch and broke off, followed by the main undercarriage. The aircraft continued to skid on its belly and collided with the runway light on the left of the centre line before coming to rest with its nose pointing slightly to the left of the runway centre line. The damage was on the left and right main wheel-and-tyre assembly, the nose gear, the wing spar, the underside of the aircraft and the flaps, while damage was also caused to the runway light. The crew members sustained no injuries.

1.1.6 The tower activated the crash alarm and the aerodrome fire services responded to the site and arrived at the scene 5 minutes after the accident. The crew disembarked the aircraft unassisted. The fire services stated that there was fuel leaking from the main tanks and, hence, applied foam on the leakages to prevent a possible fire from erupting. They cut open the in-board flap (left-hand side) to gain access to the battery compartment.

1.1.7 The accident occurred at FAGM Aerodrome during daylight conditions at Global Positioning System determined to be S26°14´31.12" E028°09´04.88" at an elevation of 5 485 feet (ft).

1.2 Injuries to Persons

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

1.3 Damage to Aircraft

1.3.1 The aircraft was substantially damaged.

Figure 1: The aircraft as it came to rest.

1.4 Other Damage

1.4.1 Damage was caused to the runway light on the left side of the extended centre line.

Figure 2: The damaged runway light.

1.5 Personnel Information

Pilot-in-command (PIC)

Nationality	South African	Gender	Male	Age	61
Licence Number	xxxxxxxxxxxxx	Licence Type	CPL		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument ratings				
Medical Expiry Date	31 March 2018				
Restrictions	Corrective lenses				
Previous Accidents	None				

Flying Experience:

Total Hours	3048
Total Past 90 Days	38
Total on Type Past 90 Days	38
Total on Type	649

First Officer (FO)

Nationality	South African	Gender	Male	Age	59
Licence Number	xxxxxxxxxx	Licence Type	ATPL		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument ratings, night ratings, SEA and MEA,				
Medical Expiry Date	31 December 2018				
Restrictions	Corrective lenses				
Previous Accidents	None				

FO Flying Experience:

Total Hours	4718.5
Total Past 90 Days	Unknown
Total on Type Past 90 Days	Unknown
Total on Type	305

Note: The FO flying hours could not be confirmed during the finalisation of the report after numerous attempts.

Air Traffic Control Information

Nationality	South African	Gender	Female	Age	30
Licence Number	xxxxxxxxxxx	Licence Type	ATS		
Licence Valid	Yes	Endorsements	Yes		
Ratings	AD, ATSA/CLD, ATSA COORD and Instructor Grade 2				
Medical Expiry Date	31 January 2019				
Restrictions	None				

Note: The ATC signed on for duty at FAGM on 22 November 2017 at 0945Z. According to available information, the day of the accident was the second day of the shift after a three-day rest period. The controller was in contact with the aircraft crew since the handover from Radar. The frequency used was 118.7 MHz. According to the transcripts, the controller gave the aircraft permission to continue approach and land on Runway 11 although the runway in use was 29. The surface wind data provided to the PM before touchdown was 220°at 12kts. After the runway overrun, the controller requested the fire services to go and check on the aircraft at the end of Runway 11. No communication problems were reported between the flight crew and the controller from initial contact until the time of the accident. From the ATC audio transcript and the CVR, it was apparent that the crew had no difficulty contacting the ATC during the flight.

1.6 Aircraft Information

1.6.1 The Premier 1 Model 390 ZS-CBI serial number RB214 was manufactured by Hawker Beechcraft Aircraft Company. The model 390 is a metal and carbon fibre composite low-wing airplane powered by two FJ 44-2A turbofan engines, each having a minimum of 2000 pounds of take-off thrust, manufactured by Williams International. One engine is located on each side of the upper aft fuselage. The engines have a medium bypass ratio and mixed exhaust. There is no thrust reversal mechanism on the engines. The fuselage is of carbon fibre/reinforced epoxy (CFRE) honeycomb mono-coque construction. Aluminium alloy is used for the wing and other selected structures. The composite structure consisting of graphite plies and honeycomb core is used for the vertical stabiliser skin and horizontal stabiliser structure. (The horizontal stabiliser is located on top of the vertical stabiliser.)

1.6.2 A circular pressurised cabin section is utilised with a dropped aisle in the passage cabin to provide additional headroom. The airplane is equipped with retractable tricycle landing gear with air/oil shock struts. The nose landing gear retracts forward into the fuselage. Each main wheel has anti-skid equipped brakes with independent systems and hydraulic back up. Dual mechanical controls with three-axis electrical trim operate the ailerons, rudder and elevator. The spoilers are electronically controlled and hydraulically operated, providing a speed brake/lift dump/roll control capability. Single slotted fowler flaps are electronically controlled and driven. The flap panels are electrically controlled (by the flap control unit and one actuator for each flap), monitored and actuated in a closed loop positioning system.

1.6.3 Anti-skid system: The airplane is equipped with an electrically controlled anti-skid system incorporated in the power brake system, operated by toe action on the rudder pedals. The power brake/anti-skid control valve applies pressure to the brakes relative to the pressure applied by the brake pedals.

1.6.4 Emergency braking: Emergency braking is accomplished through the parking brake system (with hydraulic accumulator) by means of the parking brake lever. The anti-skid system detects the start of a skid condition at the wheels and automatically releases the brake pressure for both wheels in proportion to the severity of the skid. The system also provides touchdown and locked-wheel protection. Touchdown protection inhibits braking until 0.3 seconds after detection of weight on any one of the main landing wheels (by means of squat switches). Locked-wheel protection initiates a full brake release if either wheel slows to 30% or less of the other wheel's velocity at any speed above 25kts. A wheel-speed transducer is mounted inside each main landing gear axle, which detects any change in wheel rotation speed. The anti-skid control unit (ACU) monitors inputs from the wheel transducers for evidence of wheel skidding. The system is activated by placing the anti-skid switch in the "Norm" position (Not "Off"). However, there is a caution for the pilot: Do not land with the brake pedals depressed. "Touchdown protection inhibits braking until wheel spin-up occurs or until 0.3 seconds after detection of weight on the main landing gear wheels."

1.6.5 Speed Brake Lift Dump System: The outboard and middle spoilers are used as Speed Brake, as well as for Roll Control when airborne and, along with in-board spoilers, for lift dump on ground. The operation is controlled by means of Speed Brake Switch located on the central pedestal. The Spoiler Control Unit (SCU) determines the function depending on Weight on Wheels (WOW) input.

Figure 3: A picture of the Premier 1.

Airframe:

Type	Premier Jet 390	
Serial Number	RB 214	
Manufacturer	Hawker Beechcraft	
Date of Manufacture	2007	
Total Airframe Hours (At time of Accident)	963.5	
Last MPI (Date & Hours)	17 Feb 2017	871.7
Hours Since Last MPI	91.3	
C of A (Issue Date)	30 November 2016	
C of R (Issue Date) (Present Owner)	2 Dec 2011	
Operating Categories	Standard Part 135	

NOTE: Although the South Africa Civil Aviation Authority (SACAA) certified the aircraft for Part 135, at the time of the accident it was operating under Part 91.

Engine: 1

Type	Williams International FJ44-2A
Serial Number	105343
Hours Since New	963.5
Cycles	811
Hours Since Overhaul	TBO not reached

Note: The information depicted above was computed from the last entry of the flight folio. The accident flight hours were incorporated.

Engine: 2

Type	Williams International FJ44-2A
Serial Number	105336
Hours Since New	963.5
Cycles	811
Hours Since Overhaul	TBO not reached

Left- and Right-hand Brakes Assembly

Part Number	390-3888103-007	
Type	BF Goodrich Aerospace	
Serial Numbers	0153	0682
Date Installed	2 November 2015	
Hours Since New	203.1	
Cycles	151	
Hours Since Overhaul	TBO not reached	

According to available information, the brakes assembly were last changed on 2 November 2015 at airframe hours 760.4 and 700 cycles by an approved AMO during the Major Period Inspection (MPI). Since the last fitment, the brakes only accrued a total of 203.1 airframe hours and 151 landing cycles.

Weight and Balance

According to available information, the aircraft landed with approximately 786.4 kilograms (kg) of fuel on-board. There was a considerable amount of fuel leakage after impact. The weight of crew combined at 160kg was considered as standard weight in accordance with the weight and balance standard weight. The aircraft's computed empty weight at renewal of the mass and balance was 3 846kg and the maximum take-off mass was 5 700kg. Taking the above figures into consideration, the centre of gravity was within limits. The aircraft landing weight was well within the allowable landing weight for this type.

1.7 Meteorological Information

1.7.1 The following weather report is the one given to the crew by ATC FAGM on final approach.

Wind direction	230°	Wind speed	11kt	Visibility	CAVOK
Temperature	18°	Cloud cover	Nil	Cloud base	Nil
Dew point	Nil	QNH	1021		

1.8. Aids to Navigation

1.8.1 The aircraft was equipped with the standard factory-fitted navigational equipment approved by the manufacturer. No defects to this equipment were recorded prior to the flight.

1.9 Communication

1.9.1 The aircraft was equipped with standard communication equipment as approved by the manufacturer for this aircraft type and there were no reported defects when the FO last communicated with ATC. No communication problems were reported between the flight crew and the controller from its initial contact until the time of the accident.

1.10 Aerodrome Information

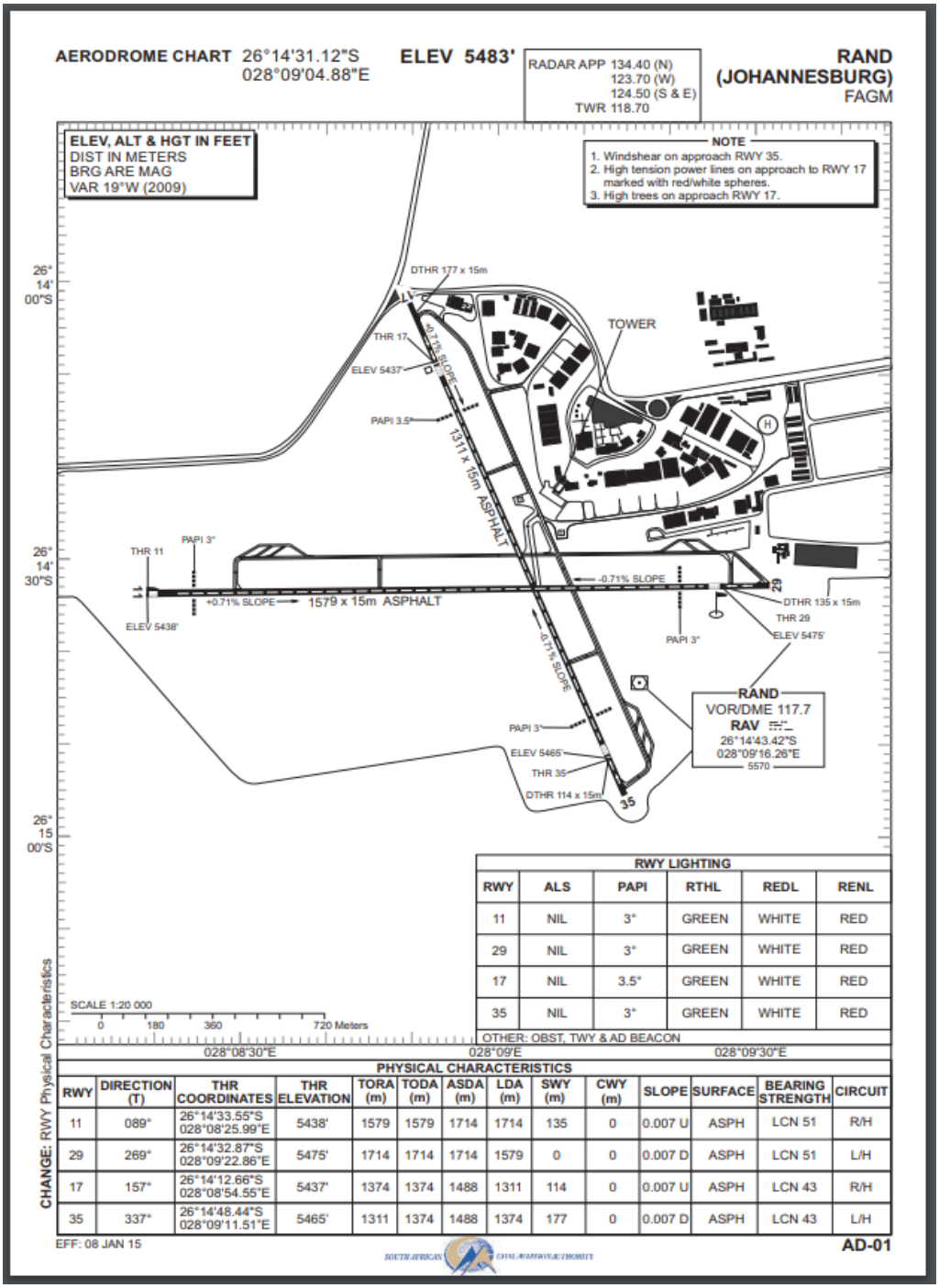


Figure 4: FAGM Aerodrome chart.

Aerodrome Location	Germiston, Gauteng	
Aerodrome Coordinates	S26°14'31" E028°09'05" East	
Aerodrome Elevation	5438ft Rwy 11 and 5475 Rwy 29	
Runway Designations	11/29	17/35
Runway Dimensions	1714X15	1376X15
Runway Used	Runway 11	
Runway Surface	Asphalt	
Approach Facilities	NDB, VOR and DME	
Slope	+0.71%	

1.11 Flight Recorders

1.11.1 The aircraft was not equipped with a flight data recorder (FDR), but was fitted with a cockpit voice recorder (CVR). It was not a regulatory requirement to be fitted to this type of aircraft. The CVR (Fairchild 2100-1010-51 SN: 000464382) was retrieved from the aircraft and downloaded and the downloaded information had no bearing on this accident.

1.12 Wreckage and Impact Information

1.12.1 The approach to land on Runway 11 was unstable. During the rollout after touchdown, the PIC applied the brakes, but the aircraft did not stop. He waited 3 seconds for the anti-skid to reset and then applied the brakes again, however, the aircraft did not stop. The PIC requested the FO to apply the emergency brakes. The application of the emergency brakes caused the brakes to lock and the aircraft skidded on the runway until the tyres burst.

1.12.2 Heavy rubber deposits were observed for a length of 180m, indicative of heavy braking on both main wheels on the left of the centre line as seen in Figure 5. The main wheel span was approximately 3m, while the rubber deposits were continuous and steady (indicative of decreasing gradually from the first point of application of emergency brakes), with periodic high and low intensity of rubber deposits and widening and narrowing of the width of tyre brake marks of each wheel. At approximately 80m, the braking marks on the right-hand side were wider with aluminium shinning marks observed on the surface, indicative of the right main wheel hub scratching along the surface, followed by the left hub assembly. It could be seen that the right main wheel burst first. Subsequent light wobbling marks were observed on the surface. These wobbling marks indicate a possibility of the PIC correcting the veering off to the left.

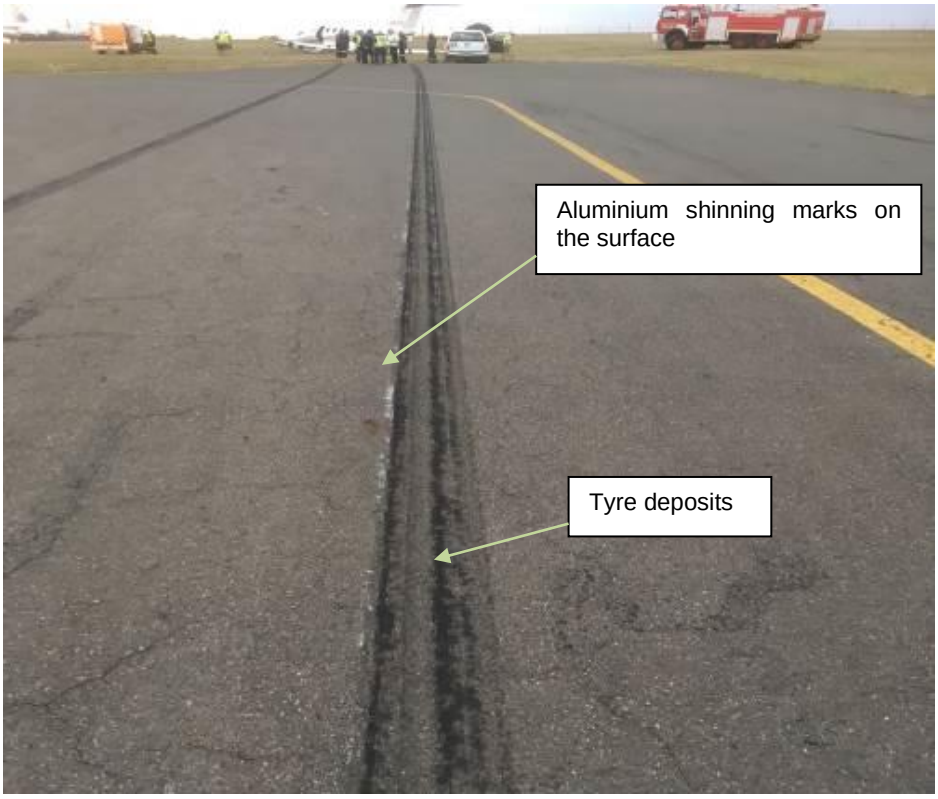


Figure 5: Heavy tyre braking marks, tyre deposits and aluminium shinning marks on the tarmac.

Figure 6: Damage due to erosion on the wheel hub assembly.

1.12.3 The aircraft, in this condition, continued to roll on the left of the centre line for the remaining length until it came to rest at the edge of Runway 29. At end of the runway, there is a ditch of approximately 200mm in depth. The nose gear dug into the ditch and collapsed, followed by the main undercarriage. The aircraft skidded on its belly, damaging a runway light, until it came to rest with the nose facing slightly to the left of the centre line. The aircraft was substantially damaged on the undercarriage. The flaps were observed to be fully extended in Figure 9. Although the main landing gear struts were disrupted, they were still attached and hanging loose under the belly. The landing gear struts had broken off from the attachment points as seen in Figure 7. Both main tyres were found to have burst at the tread surface having an oval hole which eroded off completely, indicative of erosion due to braking action as seen in Figure 8. Some burning signs were also observed on the plies. A few pieces of tyre plies were also recovered from the runway.

Figure 7: The damaged undercarriage.

Figure 8: An eroded spot caused by erosion due to heavy breaking.

1.12.4 The right-hand flaps were damaged when the fire services gained access to the battery compartment. The belly was observed to have sustained minor scratches and damage caused on the fairings as a result of the undercarriage collapsing. The flaps were observed to be in the fully down position as shown in Figure 9. The cockpit of the aircraft indicated that the flap lever setting was at the fully down position. The lift dump lever was at the down position. The anti-skid switch was in the normal position. The engines were cut off. The emergency brake lever was in the down position.

Figure 9: Flaps in fully down position (picture taken during recovery).

1.12.5 There was a considerable amount of fuel leakage on the main tanks after impact with the ditch.

1.12.6 The empennage was still intact and the CVR was recovered by the technicians in the presence of the investigator.

1.13 Medical and Pathological Information

1.13.1 None.

1.14 Fire

1.14.1 There was no evidence of pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was considered survivable because the cockpit structure was still intact, and both occupants made use of the aircraft safety harness inside the aircraft.

1.16 Tests and Research

1.16.1 **Left- and Right-Hand Brakes Assembly and Shuttle Valves**

The left- and right-hand brakes were recovered from the aircraft and subjected to bench testing by an approved AMO. The brakes were in good condition in accordance with the manufacturer's specification. The wear indication of the brakes according to the teller pin was at 50% lifespan. The bench test revealed normal operation of the brakes when subjected to a pressure test of approximately 200 pounds per square inch (psi). The pressure was increased to 500psi and the brakes assembly were checked for leaks, but none were evident. The test was carried out from both

the normal and emergency ports. The shuttle valves were subjected to the same pressure of 200psi on the normal port, with the piston inside the valve moving across to blank off the emergency port. The same pressure was applied on the emergency ports and the piston moved to block the normal ports. The operational test of the brakes assembly revealed no signs of malfunctions or leaks as indicated in the Appendices at the end of this report.

1.16.2 **Brake Master Cylinder Examination (X4)**

The master cylinders for both PIC and FO were retrieved and subjected to testing. The summary of the finding for each brake master cylinder was consistent with in-service units for all three tests. A copy of the test results is referenced in the Appendices of this report.

1.16.3 **Power Brake/Anti-skid Valve and Control Box Examination**

The power brake/anti-skid assembly was retrieved and subjected to bench testing. The summary of the examination yielded consistent results with in-service unit. The anti-skid control unit (ACU) part number 42-989-1 serial number 362 was also subjected to a bench test whereby it was connected to a test apparatus by an electronics technician. The unit successfully passed all the tests outlined in the test procedure. A copy of the examination results is referenced in the Appendices of this report.

1.17 Organisational and Management Information

1.17.1 The aircraft was owned and operated by the PIC.

1.17.2 The AMO that carried out the last maintenance inspection on the aircraft prior to the accident flight was in possession of an AMO approval certificate.

1.17.3 According to available records, the last MPI was carried out on 17 February 2017 at 871.7 airframe hours and landing cycles 785. According to available information, the aircraft's left- and right-hand brakes were changed in 2015 during the MPI at 760.4 airframe hours with 700 landing cycles. Since the last fitment, the brakes only accrued a total of 203.1 airframe hours and 151 landing cycles.

1.17.4 The flight folio was made available to the investigation team and there were no recorded defects prior and during the accident flight.

1.18 Additional Information

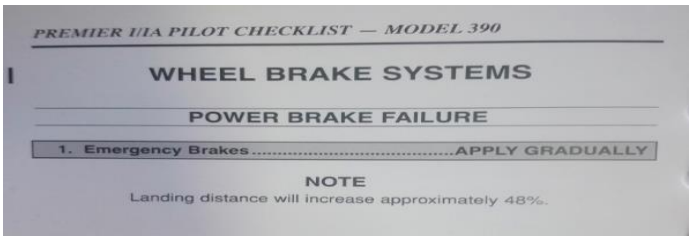
1.18.1 As per the South African Civil Aviation Authority (SACAA) approved Flight Manual of Hawker Beechcraft Corporation for aircraft Premier 1 Model 390:

The corresponding Average Landing Distance at pressure altitude of 5000ft and temperature of 20°C is approximately 3 604ft (1099m), while the reference speed (VREF) is 114kts. The associated conditions are: as required to maintain three degrees approach angle to 50ft and retard to idle at 50ft; approach angle: VREF, flaps down; anti-skid: normal; brake: maximum; lift dump: extended after touchdown. There is an increase in landing distance of 48% for power brake failure, as well as 53% for lift dumb failure as per checklist Section 3 of the emergency procedures. The wind component information that the FO received from the tower was 12kts. The slope gradient was obtained as 0.71%, which gave a distance of -142ft (43m). Therefore, the landing distance was corrected as 3 604ft (1098m) – 142ft (43m) = 3.462ft (1055m).

According to the aircraft flight manual (AFM), landing with lift dump failure, either full or partial lift dump effectiveness is lost, and the landing distance increases by 53% of the calculated landing distance required.

Emergency Procedure Checklist

The emergency procedure checklist for power brake failure primarily states: emergency brakes – apply gradually – anti-skid may not operate. Gradually pull emergency handle until desired braking action is observed. Avoid cycling the brake handle to conserve hydraulic pressure. Approximately twenty-five (25) applications are available with the fully charged system. The landing distance will increase by approximately 48%. The pictures depicting additional information can be found in the Appendices of this report.


PREMIER I/IA PILOT CHECKLIST — MODEL 390

WHEEL BRAKE SYSTEMS

POWER BRAKE FAILURE

1. Emergency Brakes.....APPLY GRADUALLY

NOTE

Landing distance will increase approximately 48%.

Effects of floating (Federal Aviation Administration [FAA] Advisory Circular 91-79A)

Floating of aircraft

"Floating during landing when applying normal landing techniques, pilots who land their aircraft with a higher than normal approach speed tend to bleed off the speed by floating the aircraft. Floating the aircraft just off the runway surface before touchdown should be avoided because this will use a significant part of the available runway…

A study of FAA and National Transport Safety Board (NTSB) data indicates that the following hazards increase the risk of a runway overrun: Page 2 Par 4 9/17/14 AC 91-79A • Unstabilised approach; • High airport elevation or high-density altitude, resulting in increased groundspeed; • Effect of excess airspeed over the runway threshold; • Airplane landing weight; • Landing beyond the touchdown point; • Downhill runway slope; • Excessive height over the runway threshold; • Delayed use of deceleration devices; • Landing with a tailwind; and • A wet or contaminated runway.

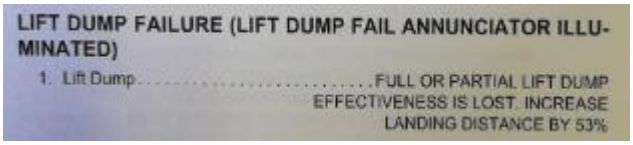
1.18.2 Take-off and Landing operations (Hawker Beechcraft AFM)

Runway Surface	*Smooth, Hard, Paved runway only*
Maximum weight	*See section 5, Performance*
Maximum airfield elevation (Pressure Altitude)	*9 400ft*
Ambient temperature	*-40°C to ISA +30°C*
Maximum tail wind component for take-off and landing	*10kts*
Maximum fuel imbalance for take-off	*200lbs*
Maximum fuel imbalance for landing	*200lbs*
Jet pumps and booster pumps	*Operable for take off*
Engine synchroniser	*Off for take-off, approach, landing and engine out operation*
Cabin pressure	*Landing altitude verified and set*
Yaw dump	*Off for take-off and landing*

1.18.3 Landing (Premier Pilot check list QRH)

Thrust	*Idle*
Brakes	*Apply*
Pitch attitude	*Nose wheel on ground*
Lift dump	*Extend*

1.18.4 Lift dump failure (AFM)


LIFT DUMP FAILURE (LIFT DUMP FAIL ANNUNCIATOR ILLUMINATED)

1. Lift Dump ..... FULL OR PARTIAL LIFT DUMP EFFECTIVENESS IS LOST. INCREASE LANDING DISTANCE BY 53%

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 General

From the available evidence, the following analysis was made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

2.2 Man

The PIC was the holder of a valid commercial pilot licence (CPL) on fixed wing aircraft which was issued on 3 April 2017 with an expiry date of 30 April 2018. He had an aviation medical certificate, with a restriction to wear corrective lenses, with an expiry date of 31 March 2018. The aircraft type was endorsed on the pilot licence.

The descent towards Runway 11 was unstable due to the aircraft approaching with high speed and height which led to the aircraft floating over the runway, resulting in a deep landing. This was further exacerbated by the PIC not deploying the lift dumps once positive weight on wheels was established. When the PIC realised that the aircraft was not stopping, he requested the FO to apply the park brakes. The application of the park brakes was not standard with the QRH which is by gradually pulling the emergency handle until desired braking action is observed and avoiding cycling the brake handle. Based on the analysis above, it is evident that the crew did not utilise the resources available to them optimally in terms of executing a go-around or landing at an alternative aerodrome.

2.3 Machine

The aircraft was maintained in accordance with the approved maintenance schedule and no defects were recorded on the flight folio. The aircraft was issued a valid Certificate of Airworthiness (C of A) on 30 November 2016 with an expiry date of 13 December 2017. The aircraft had a valid certificate of registration. The last MPI was carried out on 17 February 2017 at 871.7 airframe hours. The brakes assembly were last changed on 2 November 2015 at airframe hours 760.4 and 700 landing cycles by an approved AMO during the MPI. Since the last fitment, the brakes only accumulated a

total of 203.1 airframe hours and 151 landing cycles. The brake callipers were recovered after the accident and were subjected to pressure test, both operated normally without any leaks. The main fuel tanks had fuel of approximately 786 litres. According to the available information, there was a considerable amount of fuel leakage from the main tanks after the crash. The brakes assembly were examined and found to have operated as publicised in accordance with manufacturer's specification.

2.4 Medium

The available runway landing distance was 1 714m, which should have been enough for the aircraft to perform normal landing. The aircraft would have required a total landing distance of 1 055m, however, due to the floating of the aircraft above the runway, the pilot lost approximately 250m of available runway and, coupled with non-activation of the lift dumb after landing, it would have increased his landing distance by 53%, thus, giving him an additional 559m of landing distance required. This means that the aircraft would require a total distance of 1614m to stop. The non-use of the lift dumb would have given the PIC the feeling that the aircraft is not decelerating as expected, resulting in him requesting the FO to use the emergency brakes. The effect of the combination of these factors resulted in the runway excursion and the substantial damage to the aircraft.

3. CONCLUSION

3.1 General

From the evidence available, the following findings, causes and contributing factors were made with respect to this accident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this Investigation, the following sections are included in the conclusions heading:

- **Findings —** are statements of all significant conditions, events or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **Contributing factors —** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.2.1 The PIC was licensed and qualified in accordance with existing regulations and his licence was issued on 3 April 2017, with an expiry date of 30 April 2018.

3.2.2 The PIC was in possession of a valid aviation medical certificate with a medical waiver, with an expiry date of 31 April 2018.

3.2.3 The aircraft had a certificate of airworthiness (C of A) which was issued on 30 November 2016, with an expiry date of 13 December 2017.

3.2.4 The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and procedures. The last MPI was carried out at 871.7 flying hours on 17 February 2017 and landing cycles 785 by an approved AMO, which issued a certificate of release to service that would lapse either at 1071.7 flying hours or on 16 February 2018. The aircraft's left- and right-hand brakes were changed in 2015 during the MPI at 760.4 airframe hours with 700 landings cycles. The brakes only accumulated 111.3 hours and 85 landings cycles.

3.2.5 The mass and centre of gravity for the aircraft were within the prescribed limits as stipulated by the manufacturer.

3.2.6 There was no evidence to indicate any pre-existing failures of the engine, airframe or any other aircraft systems.

3.2.7 Both brakes assembly and associated subcomponents were recovered and subjected to bench test and analysis. No anomalies were found during the bench test; the brakes and subcomponents tested normal and were serviceable. The outside conditions of both brakes assembly were in good condition, and wear and tear indications were at 50% lifespan.

3.2.8 The runway did not have a smooth overrun that can be used by aircraft in case of emergencies.

3.2.9 The ATC was well rested, and traffic at the time before the accident was not overloaded.

3.2.10 The investigation revealed that the aircraft was unstable on approach (hot and high) resulting in deep landing, probably near the second exit point, leading to a runway excursion. Contributing factors were attributed to the lift dump not being deployed and the incorrect application of the emergency brakes.

3.2.11 There was an option to abort the landing during approach because of instability of the aircraft, this option was not considered.

3.3 Probable Cause/s

3.3.1 The aircraft was unstable on approach (hot and high) resulting in deep landing, probably near the second exit point, leading to a runway excursion.

3.4 Contributory Factors

3.4.1 None deployment of the lift dumps.

3.4.2 Unstable approach.

3.4.3 The incorrect application of the emergency brakes.

4. SAFETY RECOMMENDATIONS

4.1 General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report; the AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2 Safety Recommendation/s

4.2.1 None.

4.2.2 Safety message: NTSB safety alert 077 (https://www.ntsb.gov/safety/safety-alerts/Documents/SA-077.pdf)

5. APPENDICES

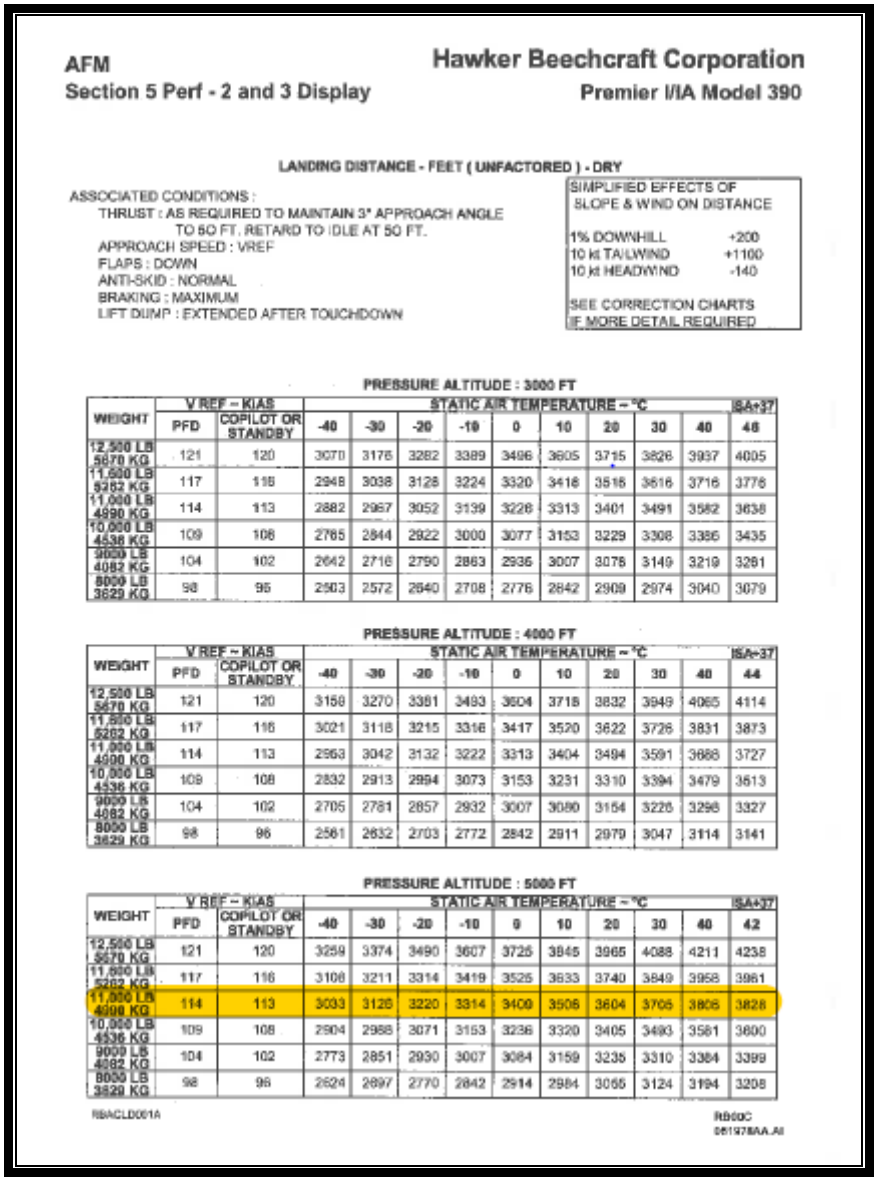
5.1 Annexure A: Landing distance

5.2 Annexure B: Wheel brake systems and power brake failure

5.3 Annexure C: Examination brakes master cylinders report

5.4 Annexure D: Anti-skid and power brake components examination

Annexure A: Landing distance



AFM
Section 5 Perf - 2 and 3 Display

Hawker Beechcraft Corporation
Premier I/IA Model 390

LANDING DISTANCE - FEET (UNFACTORED) - DRY

ASSOCIATED CONDITIONS :
THRUST : AS REQUIRED TO MAINTAIN 3° APPROACH ANGLE TO 50 FT, RETARD TO IDLE AT 50 FT.
APPROACH SPEED : VREF
FLAPS : DOWN
ANTI-SKID : NORMAL
BRAKING : MAXIMUM
LIFT DUMP : EXTENDED AFTER TOUCHDOWN

SIMPLIFIED EFFECTS OF SLOPE & WIND ON DISTANCE

1% DOWNHILL	+200
10 kt TAILWIND	+1100
10 kt HEADWIND	-140

SEE CORRECTION CHARTS IF MORE DETAIL REQUIRED

PRESSURE ALTITUDE : 3000 FT

WEIGHT	V REF – KIAS		STATIC AIR TEMPERATURE – °C									ISA+37
	PFD	COPILOT OR STANDBY	-40	-30	-20	-10	0	10	20	30	40	46
12,500 LB 5670 KG	121	120	3070	3176	3282	3389	3496	3605	3715	3826	3937	4005
11,500 LB 5262 KG	117	116	2948	3038	3128	3224	3320	3418	3518	3616	3716	3776
11,000 LB 4990 KG	114	113	2882	2967	3052	3139	3226	3313	3401	3491	3582	3638
10,000 LB 4536 KG	109	108	2765	2844	2922	3000	3077	3153	3229	3308	3386	3435
9000 LB 4082 KG	104	102	2642	2716	2790	2863	2936	3007	3078	3149	3219	3261
8000 LB 3629 KG	98	96	2503	2572	2640	2708	2776	2842	2909	2974	3040	3079

PRESSURE ALTITUDE : 4000 FT

WEIGHT	V REF – KIAS		STATIC AIR TEMPERATURE – °C									ISA+37
	PFD	COPILOT OR STANDBY	-40	-30	-20	-10	0	10	20	30	40	44
12,500 LB 5670 KG	121	120	3158	3270	3381	3493	3604	3718	3832	3949	4065	4114
11,500 LB 5262 KG	117	116	3021	3118	3215	3316	3417	3520	3622	3726	3831	3873
11,000 LB 4990 KG	114	113	2953	3042	3132	3222	3313	3404	3494	3591	3688	3727
10,000 LB 4536 KG	109	108	2832	2913	2994	3073	3153	3231	3310	3394	3479	3513
9000 LB 4082 KG	104	102	2705	2781	2857	2932	3007	3080	3154	3226	3298	3327
8000 LB 3629 KG	98	96	2561	2632	2703	2772	2842	2911	2979	3047	3114	3141

PRESSURE ALTITUDE : 5000 FT

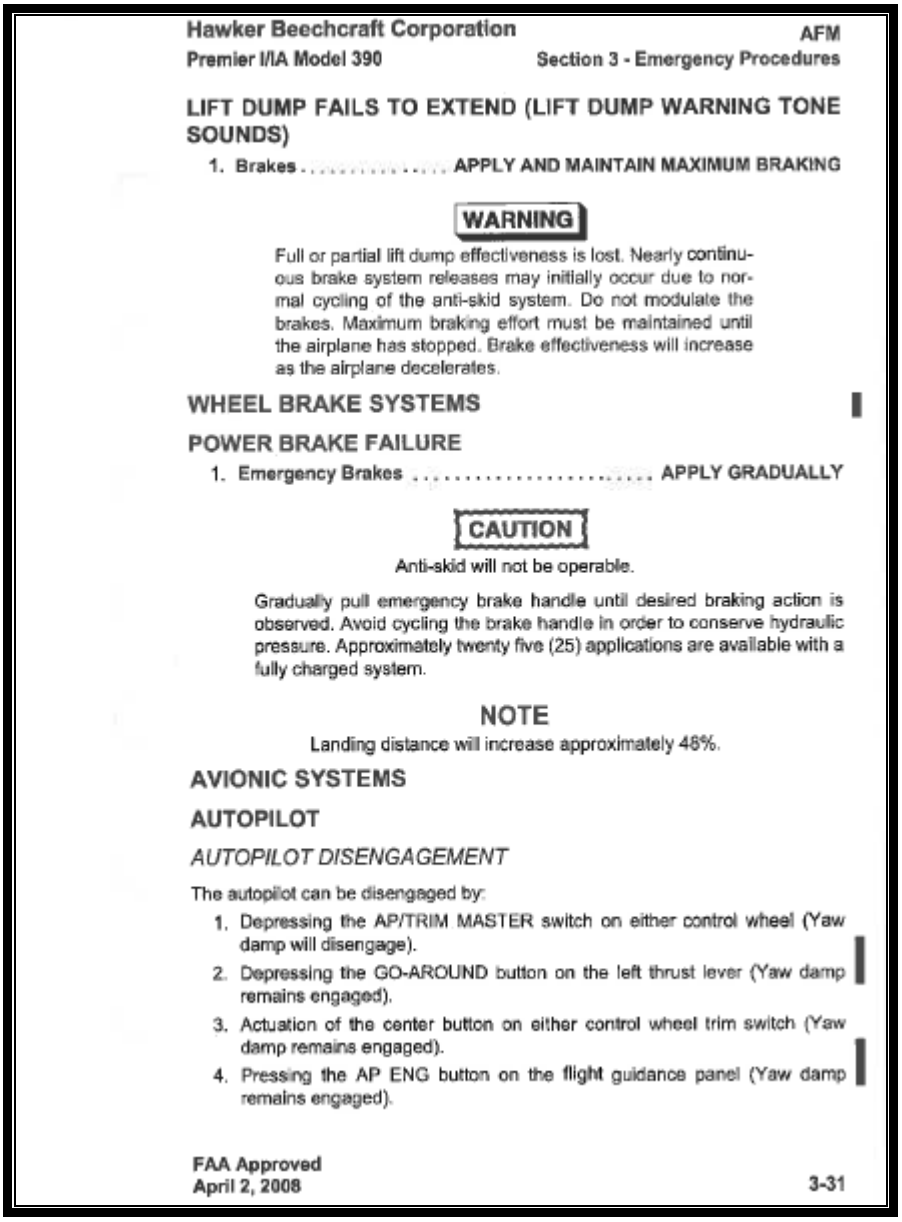
WEIGHT	V REF – KIAS		STATIC AIR TEMPERATURE – °C									ISA+37
	PFD	COPILOT OR STANDBY	-40	-30	-20	-10	0	10	20	30	40	42
12,500 LB 5670 KG	121	120	3259	3374	3490	3607	3725	3845	3965	4088	4211	4238
11,500 LB 5262 KG	117	116	3108	3211	3314	3419	3525	3633	3740	3849	3958	3981
11,000 LB 4990 KG	114	113	3033	3128	3220	3314	3409	3506	3604	3706	3808	3828
10,000 LB 4536 KG	109	108	2904	2988	3071	3153	3236	3320	3405	3493	3581	3600
9000 LB 4082 KG	104	102	2773	2851	2930	3007	3084	3159	3235	3310	3384	3399
8000 LB 3629 KG	98	96	2624	2697	2770	2842	2914	2984	3055	3124	3194	3208

RBACLD001A

RB60C
051278AA.AI

Figure 10: Landing distance correction.

Annexure B: Wheel brake systems and power brake failure



LIFT DUMP FAILS TO EXTEND (LIFT DUMP WARNING TONE SOUNDS)

1. Brakes ..... APPLY AND MAINTAIN MAXIMUM BRAKING

WARNING

Full or partial lift dump effectiveness is lost. Nearly continuous brake system releases may initially occur due to normal cycling of the anti-skid system. Do not modulate the brakes. Maximum braking effort must be maintained until the airplane has stopped. Brake effectiveness will increase as the airplane decelerates.

WHEEL BRAKE SYSTEMS

POWER BRAKE FAILURE

1. Emergency Brakes ..... APPLY GRADUALLY

CAUTION

Anti-skid will not be operable.

Gradually pull emergency brake handle until desired braking action is observed. Avoid cycling the brake handle in order to conserve hydraulic pressure. Approximately twenty five (25) applications are available with a fully charged system.

NOTE

Landing distance will increase approximately 46%.

AVIONIC SYSTEMS

AUTOPILOT

AUTOPILOT DISENGAGEMENT

The autopilot can be disengaged by:

1. Depressing the AP/TRIM MASTER switch on either control wheel (Yaw damp will disengage).
2. Depressing the GO-AROUND button on the left thrust lever (Yaw damp remains engaged).
3. Actuation of the center button on either control wheel trim switch (Yaw damp remains engaged).
4. Pressing the AP ENG button on the flight guidance panel (Yaw damp remains engaged).

Figure 11: Extract from aircraft flight manual.

C.1.1 Test Description and Results

Proof Pressure Test

The first unit was mounted to the hydraulic test table and the hydraulic fluid line was connected to the unit's input port to facilitate the Proof Pressure Test. After the air was expelled from the unit, a nut was affixed to the outlet port. The constant pressure prescribed by the test procedure was applied to the unit for the prescribed duration. This format was repeated for the remaining three cylinders.

Reverse Flow Test

The hydraulic fluid line was then connected to the unit's outlet port for the Reverse Flow Test. A horseshoe pin was used to actuate the cam while hydraulic fluid pressure was applied to the cylinder and fluid was observed flowing from the outlet port when the piston was at full extension and ceased when the piston was depressed. This format was repeated for the remaining three cylinders.

Internal Leakage Test

The unit was then mounted to the internal leakage test apparatus, with the outflow port capped and a hydraulic fluid line installed on the inlet port. A weight was used to apply pressure to the unit's piston and the amount of travel was measured. The test was repeated for the remaining units.

Summary of Findings

The findings for each brake master cylinder were consistent with in-service units for all three tests. A copy of the test results is referenced in Appendix C of this report.

Figure 12: Brake master cylinders wrapped together.

Figure 13: Brake master cylinders.

Figure 14: Brake master cylinder as installed in hydraulic tester.

Figure 15: Brake master cylinder as installed in internal leakage test apparatus.

Annexure D: Anti-skid and power brake components examination

Anti-skid control unit

The ACU, part no. 42-989-1, serial no. 362, did not display any external damage and was connected to the test apparatus by an R&O electronics technician, shown in Figure 19 below and in accordance with Crane Aerospace Test Procedure TP42-989-1, which involved the following tests:

- DC Voltage Tests
- Skid Response Test
- Locked Wheel Crossover Tests
- Spin-up Override Test
- Squat Delay Test
- Fault Detection Tests
- Dynamic Built-in Test
- Gear Retract Braking Test

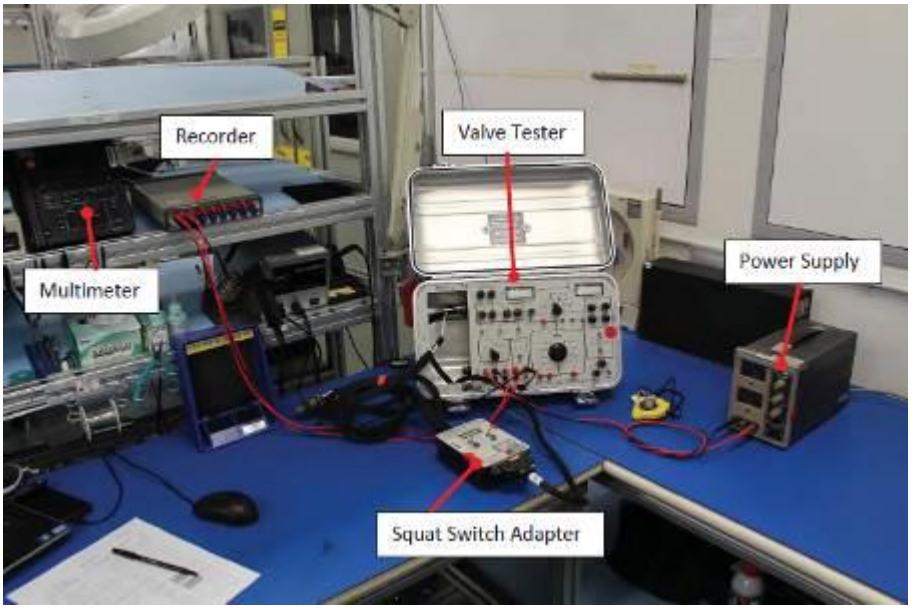


Figure 16: Control unit test setup (Note: the photograph depicts set up without control box).

Antiskid Control Unit Test	Test Function
DC Voltage Test	Observe the valve output in both air and ground modes to ensure the valve voltage is controlled by the squat switches
Skid Response Test	Test of the valve response to an induced skid through the transducer input
Locked Wheel Crossover Tests	To verify brake pressure is dumped to a locked wheel as detected by a difference between left and right wheel speeds
Spinup Override Test	Ground determination independent of the squat switches
Squat Delay Test	A test of the system's touchdown protection to ensure the brake pressure is available 3 seconds after touchdown
Fault Detection Tests	Fault detection for open and short conditions of valve and transducer wiring
Dynamic Built-In Test	System self test
Control Unit Fault Detection	Fault detection when unit is under low power
Gear Retract Braking System	Brake application when the gear is retracted to stop the wheels prior to entering the gear well

Table 1 – Anti Skid Control Unit Test Functions

Power Brake and Anti-Skid Valve

The power brake and anti-skid valve, part no. 84-015-1, serial no. 195, did not display any external damage or visual indications of leakage. The unit was connected to the test bench by an R&O team lead, shown in Figure 2 below and in accordance with Crane Aerospace Test Procedure TP84-015-1. The unit was photographed (see Appendix A) and the following tests were performed:

- Insulation Resistance
- Dielectric Test
- Resistance
- Polarity Test
- Proof Pressure Tests
- Right and Left Master Cylinder Lap Leakage Tests
- Valve Leakage Test
- Power Brake Valve Test (Right and Left Sides)
- Valve Flow Test (Right Side and Left Sides)
- Servo Modulation Test (Right and Left Sides)
- Step Response
- De-Spin Operation

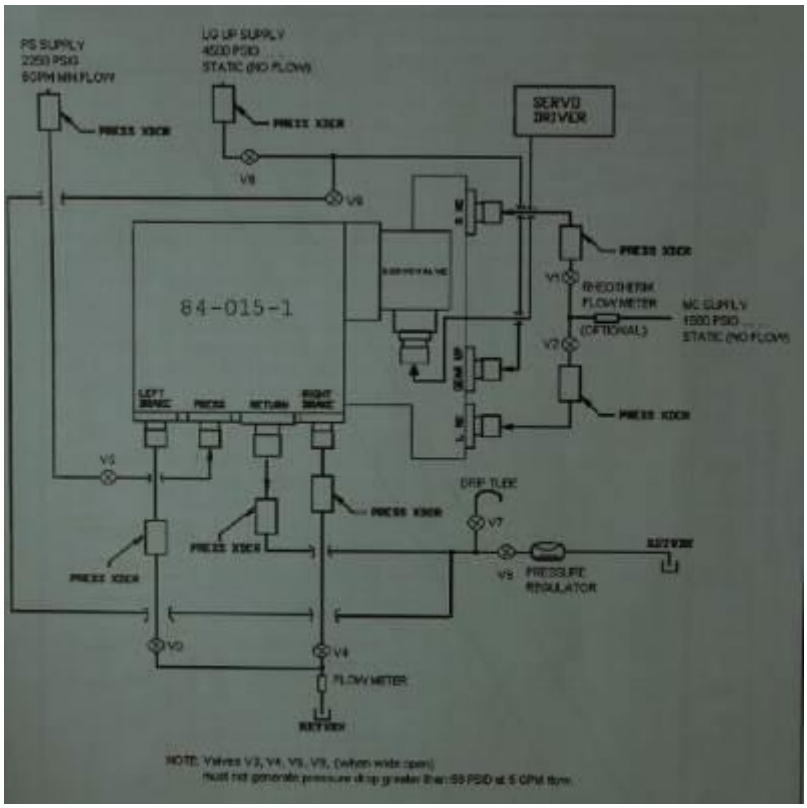


Figure 17: Power brake and anti-skid valve test setup.

Power Brake and Anti-Skid Valve Test	Test Function
Insulation Resistance	Integrity of internal wiring and grounding of pins
Dielectric Test	Test for flashover and leakage in excess of 1 mA
Resistance Test	Continuity and coil wire length
Polarity Test	To ensure valve reduces pressure when leads are connected; pressure reduces with an increase in current
Proof Pressure Test	Application of pressure to brake ports, master cylinder ports, and landing gear up ports for external leakage
Right and Left Master Cylinder Lap Leakage	Measurement of unit internal leakage
Valve Leakage Tests	Measure return port pressure at lowest valve current and then repeat test with increased valve current to show and measure external leakage
Power Brake Test	Master Cylinder and brake port pressure rise and fall within envelope – test results plotted
Valve Flow Test	Measure outflow with full brake applied through master cylinder ports
Servo Modulation Test	At 0 mA, valve should provide full command to apply brake pressure, and full release at 50 mA – test results plotted
Step Response	Captures response speed following full dump and recovery of brake pressure
De-Spin Operation	The valve applies pressure to stop wheels from spinning when entering the gear well

Table 2 – Power Brake and Anti-Skid Valve Test Function

Figure 18: Power brake and anti-skid valve as received in original packaging.

Figure 19: Anti-skid control unit instrument panel as received.

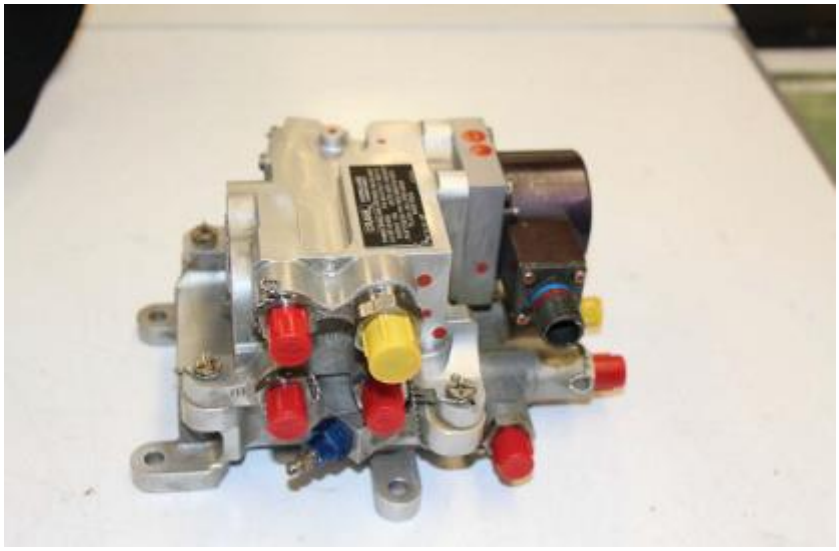


Figure 20: Power brake and anti-skid valve as received.

Figure 21: Power Brake and Anti-skid Valve in Test Stand (Note: photograph depicts unit setup on the right side).

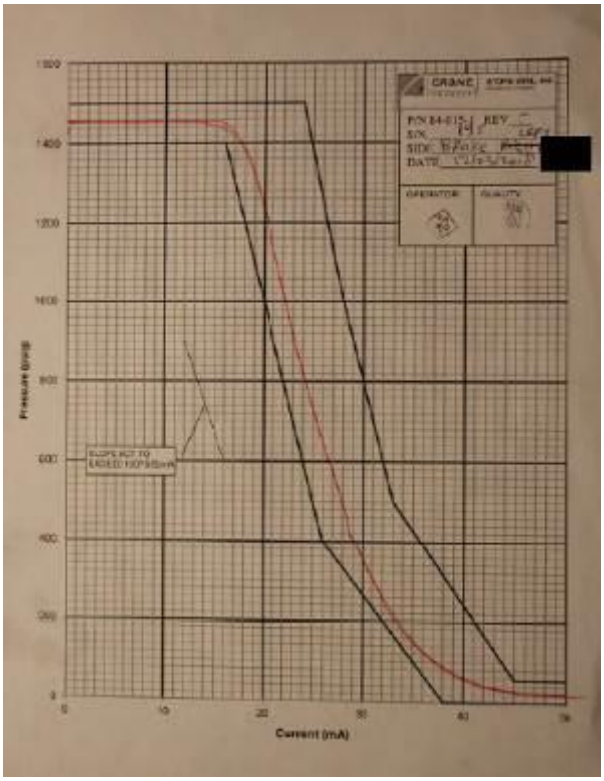


Figure 22: Graph depicts brake pressure examination (left-hand side).

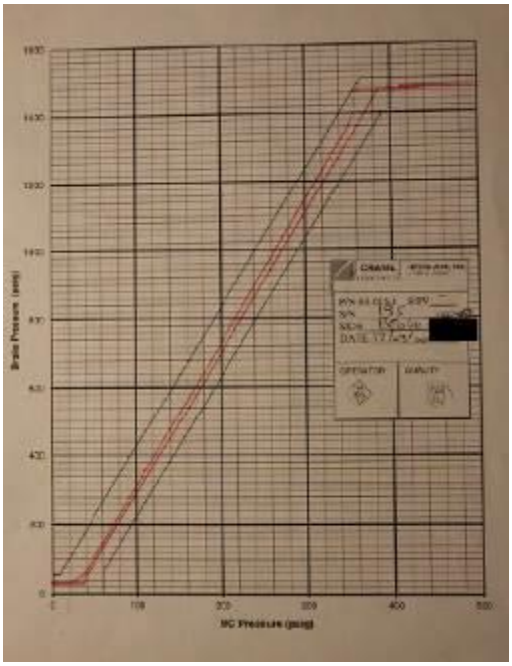


Figure 23: Graph depicts master cylinder and brake port pressure examination (left-hand side).

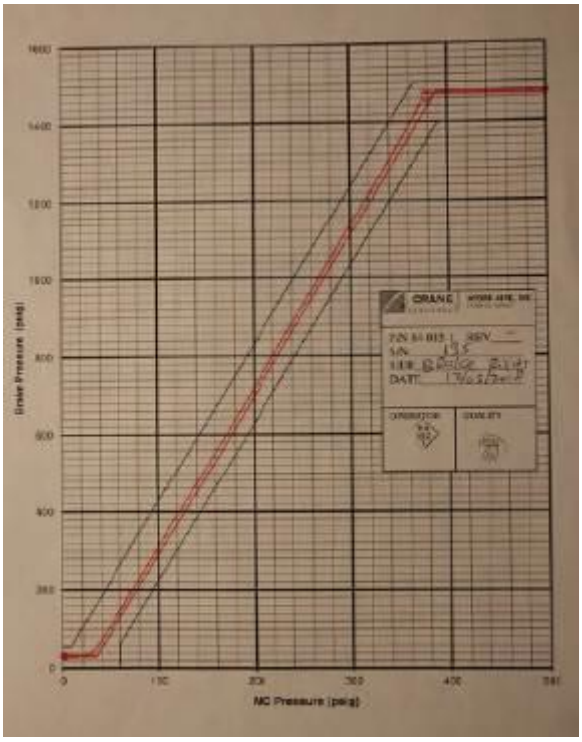


Figure 24: Graph depicts brake pressure and master cylinder pressure examination (right-hand side).

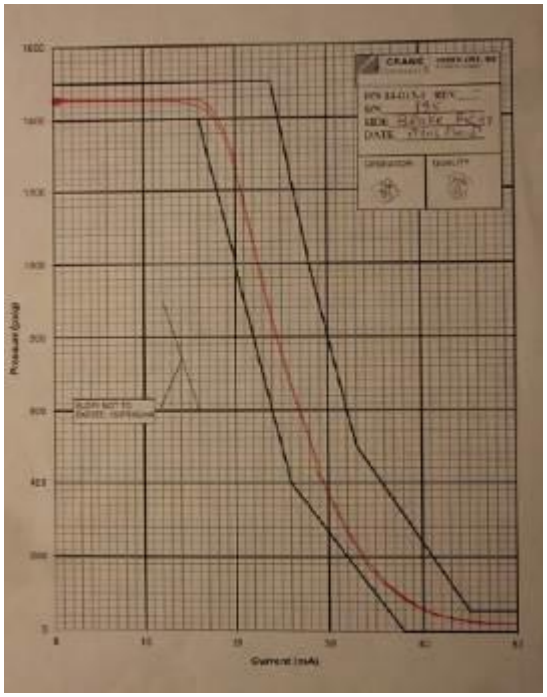


Figure 25: Graph depicts brakes pressure examination (right-hand side).

GRAINE | HYDRO-AIRE Division

Particle Count Data Sheet

Part Number	Serial Number	W/O Number	PAA Number
84-015-1	195	5226450	

Fluid	Source	Volume (100ml)	Date	Collected by	Counted by
MIL-H-83282	Brake Right		12/05/2018	[illegible] R	[illegible] R.

MAG. X	Area Per Field (A)	Particle Size Range	Fields Counted (R)	Total Particles Counted (C)	Particles in Sample (BxC)	Particles per ——Liter ——100ml ——cu ft.	Remarks
55		> 250 M	All	2	2		
55		100 -250	All	3	3		
55		50 -100	All	18	18		
100		25 - 50	10	10	100		
100		15 - 25	10	31	310		
100		5 - 15	10	120	1250		

Comments:

Class: 5

☒ As Received ☐ After Test ☐ Saved ☐ Other: _____

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Page: ____ of ____

GRAINE | HYDRO-AIRE Division

Particle Count Data Sheet

Part Number	Serial Number	W/O Number	PAA Number
84-015-1	195	5226450	

Fluid	Source	Volume (100ml)	Date	Collected by	Counted by
MIL-H-83282	Brake Left		12/05/2018	[illegible] R	[illegible] R

MAG. X	Area Per Field (A)	Particle Size Range	Fields Counted (R)	Total Particles Counted (C)	Particles in Sample (BxC)	Particles per ——Liter ——100ml ——cu ft.	Remarks
55		> 250 M	All	1	1		
55		100 -250	All	3	3		
55		50 -100	All	27	27		
100		25 - 50	10	5	50		
100		15 - 25	10	27	270		
100		5 - 15	10	140	1400		

Comments:

Class: 4

☒ As Received ☐ After Test ☐ Saved ☐ Other: _____

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Page: ____ of ____

CRANE | HYDRO-AIRE Division | **Particle Count Data Sheet**

Part Number	Serial Number	W/O Number	RMA Number
94-015-1	195	52264450	

Fluid	Source	Volume	Date	Collected by	Counted by
MIL-H-83282	Return	100ml	12/03/20	Rudi F	Rudi F

MAG. X	Area Per Field (A)	Particle Size Range	Fields Counted (B)	Total Particles Counted (C)	Particles in Sample (BxC)	Particles per —Liter —100ml —cu.ft.	Remarks
35		> 250 M	All	1	1		
35		100 -250	All	2	2		
35		50 -100	All	5	5		
100		25 - 50	10	10	100		
100		15 - 25	10	20	200		
100		5 - 15	10	75	750		

Comments: | Class: 4

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QA-10.3.11_a | Page: _____ of _____