AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9182		
Aircraft Registration	**V5-SMA**	**Date of Accident**	04 June 2013		**Time of Accident**	1335Z	
Type of Aircraft	Beechcraft King Air E90		**Type of Operation**		Training		
Pilot-in-command Licence Type	Airline Transport		**Age**	70	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		21107		Hours on Type	51	
Student pilot Licence Type	Commercial		**Age**	33	**Licence Valid**	Yes	
Student Pilot Flying Experience	Total Flying Hours		585		Hours on Type	6.1	
Last point of departure	Lanseria international airport (FALA): Gauteng province.						
Next point of intended landing	Rustenburg aerodrome (FARG):North West province.						

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

On Runway 34 at Rustenburg aerodrome GPS coordinates determined to be S25°38′40.67 E027°16′24.82 at an elevation of 3 671 feet above mean sea level (AMSL).

Meteorological Information	Wind direction, Variable: Wind Speed, 3 knots: Temperature, 20°C: Visibility, 10 kilometres: Cloud base, Nil.				
Number of people on board	3 + 0	**No. of people injured**	0	**No. of people killed**	0

Synopsis

A certified flight instructor accompanied by two pilots under instruction departed Lanseria (FALA) International Airport bound for Rustenburg Aerodrome (FARG) on a type conversion training flight. The flight from the departure point (FALA international airport) was uneventful with the first pilot being the pilot flying (PF). The mishap occurred during the second phase of flight “conversion training flight” with the second student pilot as a (PF). During the landing sequence the nose landing gear collapsed. The aircraft was substantially damaged and no injuries were reported. Post inspection of the aircraft revealed that the nose gear drag brace bracket had failed. The nose gear drag brace bracket pieces found on the runway surface were collected and sent for Metallurgical analysis where it was revealed that there was an overload caused by a heavy or hard landing.

Probable Cause

The nose gear failed due to hard landing.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator : Wings Over Africa CC
Manufacturer : Beech Aircraft Corporation
Model : Beechcraft King Air E90
Nationality : Namibian
Registration Marks : V5-SMA
Place : Rustenburg Aerodrome
Date : 04 June 2013
Time : 1335Z

All times given in this report is 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 (1997) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

Disclaimer:

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

1. FACTUAL INFORMATION:

1.1 History of Flight:

1.1.1 On 4 June 2013, an Instructor accompanied by two pilots flew the Beechcraft King Air E90 aircraft from Lanseria International Airport (FALA) to the general flying (GF) area with the intention to fly to Rustenburg Airport (FARG) thereafter.

1.1.2 According to the Instructor, before departure at FALA a thorough pre-flight inspection was carried out followed by a short briefing session. The three pilots then boarded the aircraft, started the engines and taxied to Runway 06L. The aircraft then took off from Runway 06L and maintained heading toward the GF area. The first pilot was flying the aircraft under the supervision of the Instructor.

1.1.3 While in the GF area, the pilot received flying training instructions which was part of the conversion on the type. After the GF training exercises were completed, the pilot flew the aircraft to FARG. On arrival at FARG, the pilot carried out a total of six (6) “touch and go” landings on Runway 34 and followed by a full stop landing at 1115Z. The aircraft was left parked on FARG apron while the pilots proceeded to have lunch at a local restaurant.

1.1.4 At 1215Z, the pilots returned to the aircraft and prepared the aircraft for the second training flight. It was the opportunity of the second pilot to receive flying training. According to the Instructor, they carried out another pre-flight inspection on the aircraft and no anomaly was identified. The second pilot then flew the aircraft, under the supervision of the Instructor, heading to the GF area again.

1.1.5 While in the GF area, the second pilot also received flying training instructions for his conversion on the type. After the training in the GF was completed, the second pilot flew the aircraft back to FARG at about 1313Z. The intention of flying to FARG was so that the second pilot could carry out “touch and go” training also.

1.1.6 According to the Instructor, when arriving at FARG they joined overhead the aerodrome to inspect Runway 34. Thereafter a standard approach was flown toward Runway 34. During the approach the second pilot selected the landing gear control lever to gear down position. Immediately after the student made the selection, three green lights came on which indicated that the landing gear was down and locked.

1.1.7 The Instructor reported that after they landed on the runway and during the landing roll they heard a “cluck” sound coming from the right hand side of the aircraft. A few seconds thereafter a second louder “cluck” sound was heard but this time coming from the nose section of the aircraft. Then suddenly the aircraft nose pitched down allowing the aircraft to rest on its propellers and skidding on the runway. The aircraft skidded in that attitude for approximately 350 metres when it eventually it veered off to the left toward the left side edge of the runway. The aircraft came to a complete stop on the grass next to the runway.

1.1.8 According to the Instructor, when the aircraft stopped he realised that they were involved in an accident and immediately shutdown the engines (left and right hand side). The aircraft was then secured by switching off all electrical power supply before all three pilots evacuated the aircraft. The aircraft sustained substantial damage in the accident and the pilots did not sustain any injuries.

1.1.9 The geographical position of the wreckage was at S25° 38′ 40.67 E027°16′24.82 at an elevation of 3 671 feet above mean sea level (AMSL).

Figure 1, shows aerial view of FARG, Runway 34 and wreckage.

1.2 Injuries to Persons:

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	3	-	-	-

1.3 Damage to Aircraft:

1.3.1 The aircraft was substantially damaged in the accident.

Figure 2, shows damage caused to propellers of the aircraft.

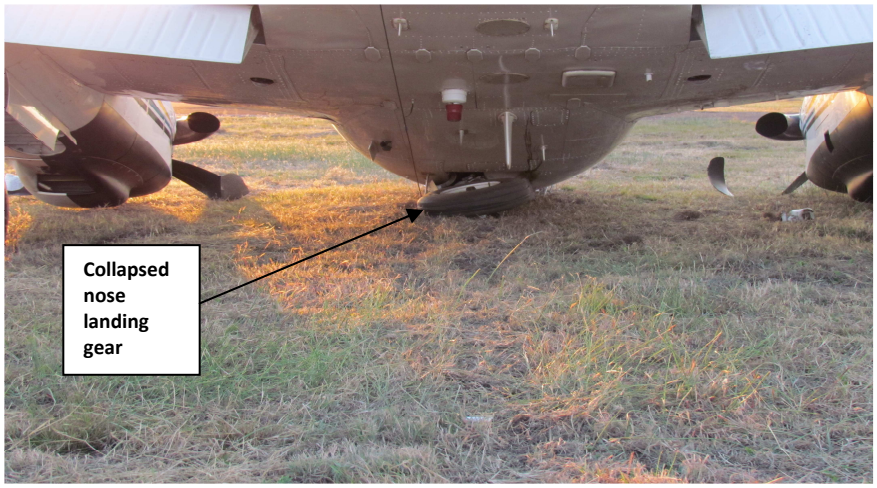


Figure 3, shows damage to nose landing gear of the aircraft.

1.4 Other Damage:

1.4.1 Other damage was limited to the runway surface and to a runway light.

Figure 4 and 5, shows damage caused to the runway surface and light.

1.5 Personnel Information:

1.5.1 Instructor

Nationality	South African	Gender	Male	Age	70
Licence Number	0270000086	Licence Type	Airline Transport		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instructor Grade 1, Instrument (A) and Test Pilot Ratings				
Medical Expiry Date	31 July 2013				
Restrictions	Corrective lenses				
Previous Accidents	None				

Flying Experience:

Total Hours	21107.0
Total Past 90 Days	51.0
Total on Type Past 90 Days	51.0
Total on Type	51.0

1.5.1.1 The Instructor held a valid foreign pilot license validation certificate issued by the State of Registry and Operator. The validation was issued on the 12 August 2012 and expires on 12 August 2014.

1.5.2 **Pilot**

Nationality	South African	Gender	Male	Age	33
South African Licence Number	0271061954	Licence Type	Commercial		
Namibian Licence Number	PA 3019	Licence Type	Commercial		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instrument and Night Ratings				
Medical Expiry Date	30 October 2013				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	585.0
Total Past 90 Days	6.1
Total on Type Past 90 Days	6.1
Total on Type	1.0

1.6 Aircraft Information:

1.6.1 Airframe

Type	Beechcraft King Air E90	
Serial Number	LW-110	
Manufacturer	Beech Aircraft Corporation	
Date of Manufacture	Unknown	
Total Airframe Hours (At time of Accident)	6 411.11	
Last Phase Inspection (Date & Hours)	5 April 2013	6 405.90
Hours since Last Phase Inspection	5.21	
C of A (Issue Date)	24 November 2009	
C of A (Expiry Date)	28 April 2014	
C of R (Issue Date)	31 January 2013	
Operating Categories	Part 135	

1.6.1.1 The aircraft documentation (e.g. certificate of registration, certificate of airworthiness, radio station licence, mass and balance certificate etc.) that was found carried on board the aircraft was valid. There was no anomaly identified with the aircraft documentation and found to have complied with applicable regulation of the State of Registry and Operator.

1.6.1.2 The aircraft maintenance documentation was inspected during the investigation process. It was established that all maintenance related entries made in the aircraft maintenance logbooks (airframe, engines and propellers) were found appropriately certified in terms of applicable regulations of the State of Registry and Operator.

1.6.1.3 The aircraft was examined during the investigation process. The evidence found shows that the aircraft suffered a landing gear failure during landing. The landing gear failure was caused as a result of the nose landing gear drag brace bracket that failed.

1.6.1.4 In order to clarify the reason for the nose landing gear drag brace bracket failing. It was necessary to review the history of maintenance carried out on the landing gear but specific emphasis on the nose landing gear. The following relevant information was found:

(i) Landing Gear Overhaul Inspection Work Pack:

(a) The work pack shows that an overhaul inspection was carried out on the nose landing gear on 12 February 2013. The inspection was carried out in accordance with HBC King Air Series component maintenance manual (CMM 32-20-00). As part of the inspection procedure, the nose landing gear was subjected to a non-destructive testing (NDT). After the inspection was completed, the nose landing gear was certified serviceable and installed on the aircraft. The aircraft was then released to service on 03 March 2013.

(b) According to another work pack dated 5 April 2013, there was an inspection carried out on the nose landing gear of the aircraft when it had reached a total of 6405.90 hour. The following checks had to be carried out:

- Inspection was carried out on nose landing shock absorber (Due every 6 years or 8 000 cycle requirement LW-118-NMG-1);
- Inspection on the nose landing gear drag brace assembly, axil assembly and torque knees (Due every 6 years or 800 cycle);
- Inspection on the nose gear actuator clevis hole (Due at 1000 cycle);
- The nose gear actuator overhauled (Due every 6 years or 8000 cycle, covers the 1 000 cycle and play requirement);

(c) After the inspection was complete, the nose landing gear was installed. After the landing gear was installed, the necessary checks were carried out including system rigging and retraction tests. The landing gear system operation was as per requirements.

Left engine:

Type	Pratt & Whitney-PT6A-28
Serial Number	P 50696
Hours since New	6 311.98
Hours since Overhaul	3 168.98

Right engine:

Type	Pratt & Whitney-PT6A-28
Serial Number	P50682
Hours since New	6 408.08
Hours since Overhaul	3 165.08

Left propeller:

Type	Hartzell HC-B3TN-3B
Serial Number	BUA 24731
Hours since New	6 749.18
Hours since Overhaul	142.10

Right propeller:

Type	Hartzell HC-B3TN-3B
Serial Number	BUA 25356
Hours since New	5 888.58
Hours since Overhaul	5.18

1.7 Meteorological Information:

1.7.1 The meteorological information in the table below was submitted by the Instructor:

Wind direction	Variable	Wind speed	3 Knots	Visibility	10 km
Temperature	20˚C	Cloud cover	Nil	Cloud base	Nil
Dew point	Unknown				

1.8 Aids to Navigation:

1.8.1 The aircraft was operated and landed at a licensed aerodrome. The aids to navigation available to the aerodrome were consisted only a distance measuring equipment (DME), runway lights and runway identification marks. All the identified aerodrome aids to navigation were serviceable.

1.8.2 According to the aircraft equipment list, the aircraft had standard navigation equipment installed as well as other additional navigation equipment as approved by the State of Registry and Operator. There were no report or entries of any anomalies experienced with the aircraft navigation equipment prior and during the flight or at time of the accident. The aircraft navigation equipment was serviceable.

1.9 Communications:

1.9.1 The aircraft was operated at an uncontrolled aerodrome. Due to the situation of the aerodrome being uncontrolled, communication from the aircraft was required on general area frequency.

1.9.2 The aircraft had VHF/UHF radio communication equipment installed. Whenever required, the pilots could use the aircraft radio communication equipment to communicate with any air traffic control services (ATS) in the area. There was no proof of an anomaly that was experienced with the aircraft communication equipment prior and during the flight. The aircraft communication equipment was serviceable.

1.9.3 There was no evidence found of any communication from the aircraft at the time of the accident.

1.10 Aerodrome Information:

1.10.1 The aerodrome information included in the table below was taken from the State of Occurrence issued aeronautical information publication (AIP).

Aerodrome Location	Republic of South Africa - Rustenburg
Aerodrome Co-ordinates	S25°39´00´ E027°17´48.00´
Aerodrome Elevation	3 700 feet (AMSL)
Runway Designations	16/34
Runway Dimensions	1 225 x 15.4
Runway Used	34
Runway Surface	Asphalt
Approach Facilities	Runway Lighting and Non Directional Beacon

Note: The aerodrome was issued with a valid license certificate.

1.11 Flight Recorders:

1.11.1 The aircraft was not fitted with a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR), nor was either required by applicable regulations of the State of Registry and Operator.

1.12 Wreckage and Impact Information:

1.12.1 The aircraft was approaching Runway 34 at FARG for landing. After the aircraft landed, but during the landing roll the crew experienced a landing gear failure. Following the landing gear failure, the aircraft nose suddenly pitched down and rested on both propellers on the runway. The aircraft maintained the described nose down attitude, but supported on the propellers, skidded for approximately 350 metres on the runway. The aircraft eventually veered off the runway onto the grass on the left side.

1.12.2 During the wreckage examination, the evidence found show that the aircraft nose landing gear trunnion detached from the keel during the accident. The damage was caused to the following items:

(i) The propellers, radar dome, nose gear doors and the pitot tubes.

(ii) The landing light bracket detached from its mounting point and was destroyed.

(iii) The nose landing gear shimmy damper and the nose gear steering collar detached from the nose gear.

Figure 6, shows the broken nose landing gear trunnion

Figure 7 and 8, shows the nose landing gear debris (steering collar and the shimmy damper).

1.13 Medical and Pathological Information:

1.13.1 None.

1.14 Fire:

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

1.15 Survival Aspects:

1.15.1 The accident was considered to be survivable. The aircraft was intact because damage was limited to the nose section and propellers only. The aircraft was exposed to the landing impact force only while skidding on the runway surface. The pilots were properly restrained with the aircraft safety belts. The pilots survived the accident without sustaining any injuries.

1.16 Tests and Research:

1.16.1 The on-site investigation process revealed that the nose landing gear drag brace bracket failed during landing roll on Runway 34 at FARG. The identified failure of the drag brace bracket resulted in the nose landing gear becoming loose and collapsed from the landing overload.

Figure 9, shows the nose landing gear drag brace bracket which was found approximately 55 metres from Runway 34 threshold.

Figure 10 and 11, shows broken nose landing gear drag brace bracket attachment.

1.16.2 Three parts from the Beechcraft King Air E90 were submitted for Metallurgical analysis. The material of construction was determined as a magnesium alloy, AZ91, in either F or T6 condition. Failure was attributed to overload caused by a hard landing.

1.16.3 Landing gear –description and operation: Source (King Air 90 Series Maintenance Manual)

Mechanical landing gear (LJ1 THRU LJ-1062; LW-1 and AFTER)

An electrically operated mechanical landing gear retraction and extension system is installed on these airplanes. The landing gear system retraction and extension system is operated by a split-field series-wound 28-volt motor locate forward of the front spar of the wing centre section. One field is used to drive the motor in each direction. To prevent over travel of the gear, a relay simultaneously breaks the power circuit to the motor and makes a complete circuit through the armature and the unused field winding. The motor then acts as a generator and the resulting electrical load on the armature stops the gear almost instantly

The landing gear motor is controlled by the gear control switch handle located to the right of the centre on the co-pilot's inboard subpanel. The main gear actuators are driven by torque shafts from the motor gearbox and the nose gear is driven by a chain from a sprocket on the main gear on the main gear torque shaft. A friction clutch between the gearbox and the torque shaft protects the system in the event of mechanical malfunction, and a 50 ampere, push-to-rest circuit breaker protects the system from electrical overloads.

Slotted down lock hook attachments fitted to each main gear upper drag brace leg and the over centre action of the nose gear drag brace acts as positive mechanical down locks, while the jackscrew in each actuator holds the gear in retracted position.

The King Air's landing gear incorporates Beech air-oil type shock struts that are filled with both compressed air and hydraulic fluid. Make sure they are correctly inflated before each flight.

Refer to the appendix "A" for further detail on landing gear operation

1.17 Organizational and Management Information:

1.17.1 The aircraft was maintained by an approved aircraft maintenance organisation (AMO). The AMO approval certificate was issued by the regulating authority of the State of Occurrence. The AMO approval certificate was valid. There were no anomalies identified with the organisation and management of the AMO relevant to the accident.

1.18 Additional Information:

1.18.1 None.

1.18 Useful or Effective Investigation Techniques:

1.19.1 None.

2. ANALYSIS:

2.1 Fine weather conditions prevailed during the flight as well as at the time of landing. The weather did not play any role in the sequence of events leading to the accident.

2.2 The review of the aircraft maintenance documentation shows that the aircraft was properly maintained in accordance with the manufacturer requirements. There was no evidence of any pre-existing maintenance related defect or malfunction that could have contributed or have caused the accident.

2.3 Both pilots (Instructor – ATPL and - CPL) had valid licences. The Instructor was issued with a validation licence issued by the State of Registry and Operator. The pilot had a license from the State of Registry and Operator. The Instructor had a valid Instructor Rating which authorised him to provide pilot training. He also held the required rating for the aircraft type. However, the student pilot was in the

process of receiving training on the type. The intention was that after the training process, the student may be issued with the aircraft type rating on his licence.

2.4 The training flight that was flown first from FALA to GF to FARG by the first student was uneventful. The aircraft was still serviceable after the identified training flight was completed.

2.5 The training flight that was flown second from FARG to GF to FARG by the second pilot was uneventful until the first touch and go landing when involved in the accident. This is the time when the aircraft experienced a landing gear failure. It appears as though the nose landing gear failed during the landing sequence. The failure of the nose landing gear resulted in gear collapsed scenario.

2.6 The wreckage was examined to determine the cause of the nose landing gear failure. The evidence found showed that the nose gear drag brace bracket failed during the last landing, debris of the drag brace bracket was recovered from the accident scene and sent for metallurgical testing and analysis. Refer to the Appendix “B”

2.7 The metallurgical testing and analysis revealed that neither fracture surfaces found on the drag brace bracket debris showed any sign of pre-existing defects. The drag brace bracket showed surface characteristics of the part failing quite rapidly. The fracture surfaces indicated that the failure occurred as a result of a severe, transient overload. There was no evidence of fatigue or material imperfection that was visually apparent on any of the fractures examined. However the conclusion was that the aircraft could have been exposed to a hard landing or subsequent bouncing which caused the drag brace bracket to fail.

2.8 The time when the drag brace bracket failed, the nose landing gear suddenly folded back “collapsed” with the result of the nose section impacting the runway. Due to the impact of the landing speed still very high at the time, the aircraft skidded for 350 metres down the runway supported by the propellers.

3. CONCLUSION:

3.1 Findings:

3.1.1 The Instructor was a holder of a valid Airline Transport Pilot licence (ATPL) and the aircraft type rating was endorsed on it.

3.1.2 The Instructor was having a valid Flight Instructors Rating Grade 1, thus authorised to provide the flight training which was done on the day.

3.1.3 The Instructor flew the aircraft, carrying two pilots on a training flight. The pilot flying was a holder of a valid Commercial Pilot licence (CPL) and was undergoing conversion on aircraft type.

3.1.4 The training flights were flown between FARG and GF area. The flights were flown by the two pilots under supervision of the Instructor.

3.1.5 The second pilot training was uneventful until they arrived back at FARG during first touch and go landing training exercise, the aircraft was involved in a landing gear failure.

3.1.6 The evidence found showed that the landing gear failure was as a result of the nose gear drag brace bracket that failed/broke while landing.

3.1.7 The nose drag brace bracket that failed was taken for metallurgical testing and analysis to determine its cause. The metallurgical analysis revealed that the part failed due to metal fatigue from overload.

3.1.8 The Instructor assisted by the pilots carried out pre-flight inspections before and between the training flights. The aircraft was serviceable. There were also no anomalies identified with the performance of the aircraft during the training flights.

3.2 Probable Cause/s:

3.2.1 Hard landing

3. SAFETY RECOMMENDATIONS:

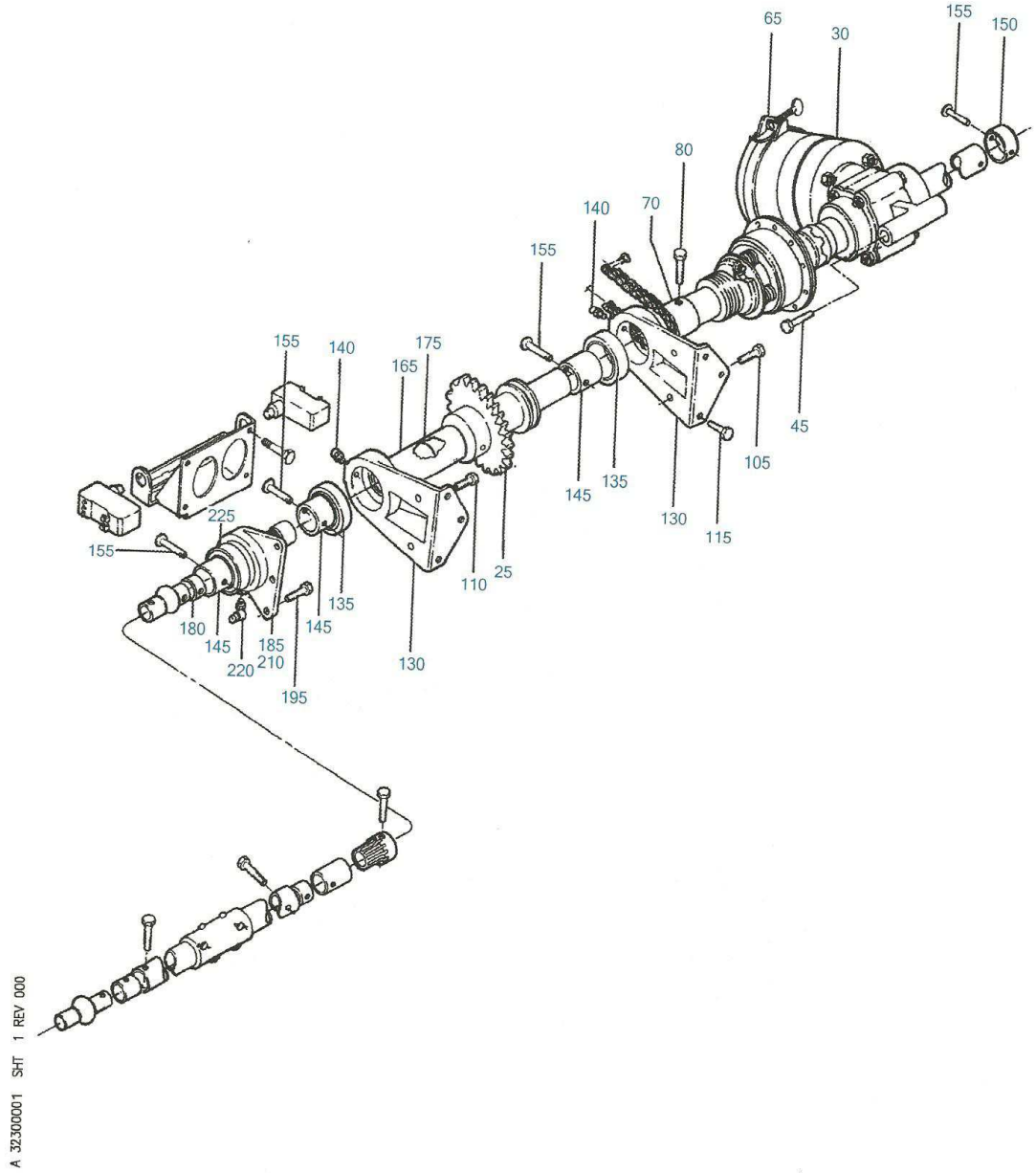
3.1 None

4. APPENDICES:

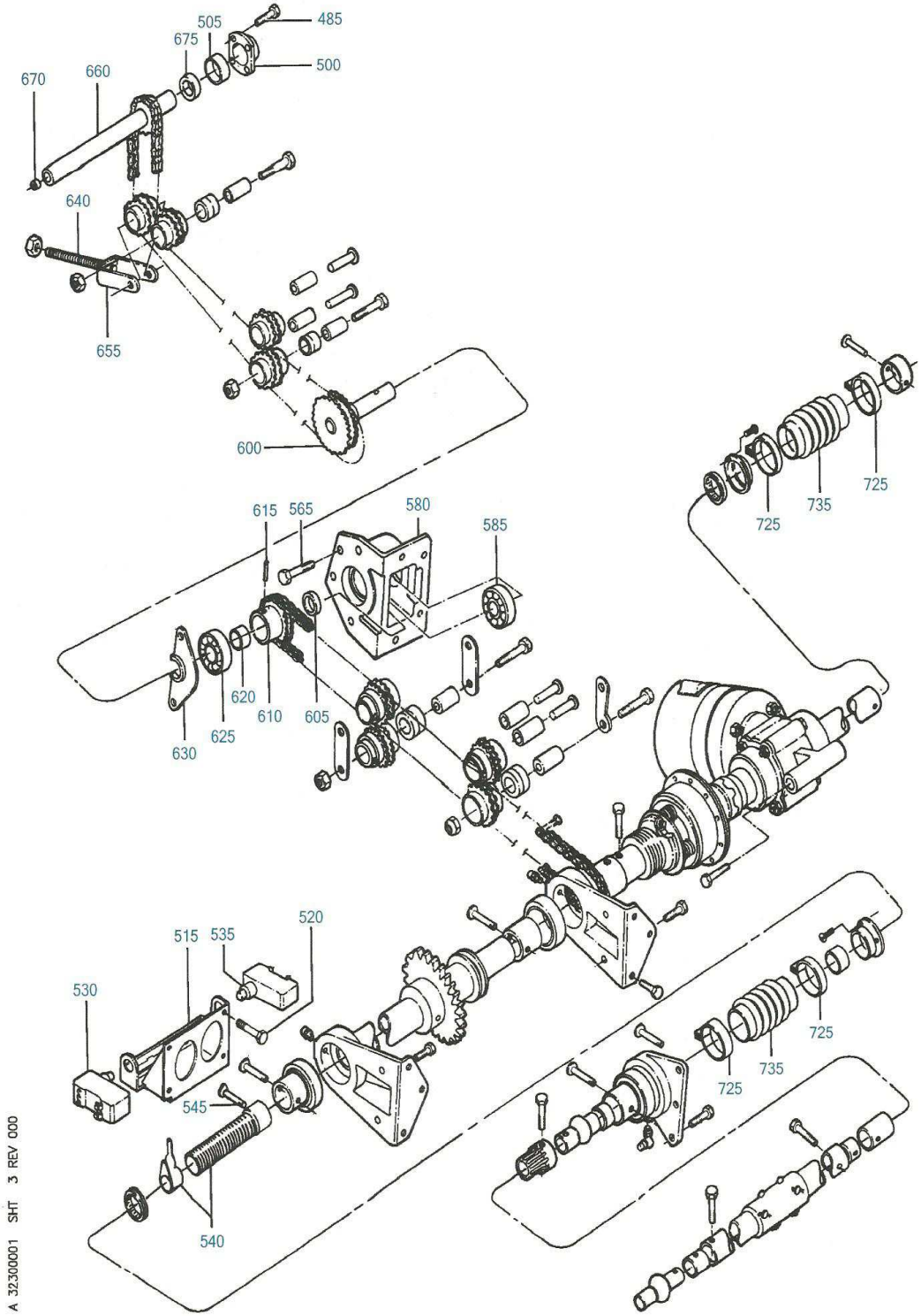
4.1 Appendix "A**"** Aircraft nose landing gear schematic.

4.2 Appendix "B" Metallurgical Analysis report.

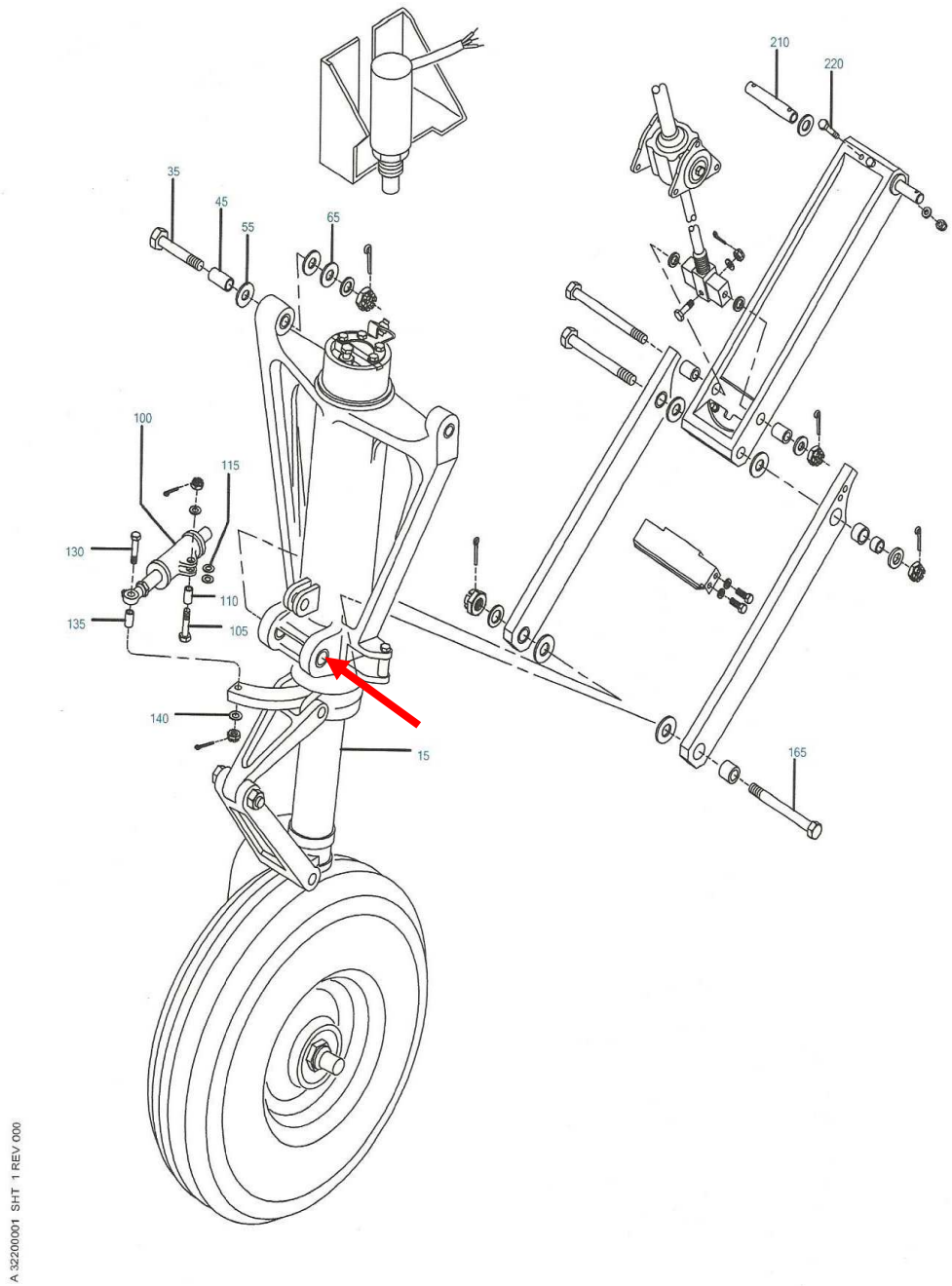
LANDING GEAR RETRACT MECHANISM



LANDING GEAR RETRACT MECHANISM



NOSE LANDING GEAR INSTALLATION



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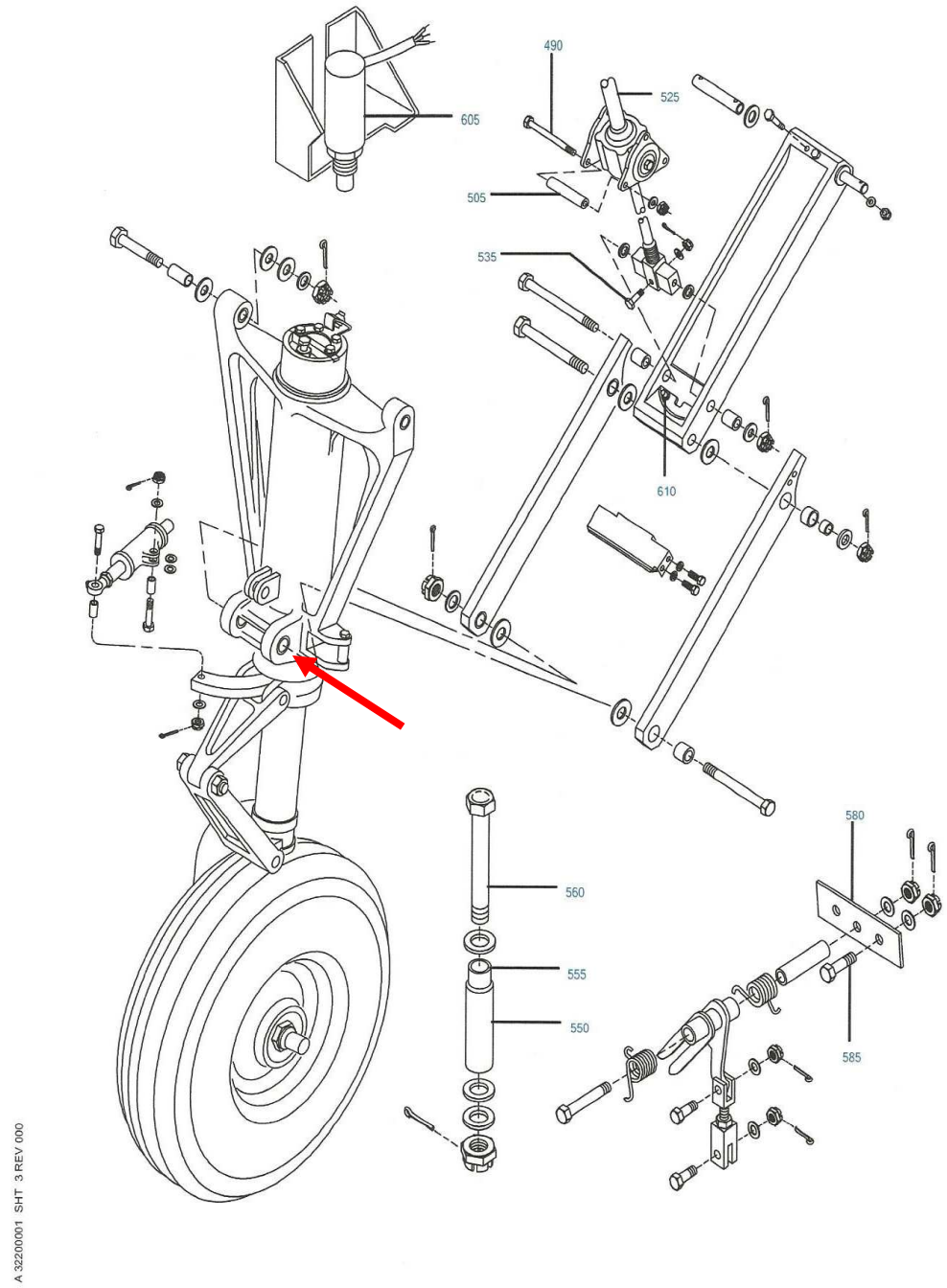
NOSE LANDING GEAR INSTALLATION



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P/N: 90-590012-17 Reissue Q - May 1, 2012

NOSE LANDING GEAR INSTALLATION

ITEM	PART NUMBER	DESCRIPTION	USABLE ON CODE	UNITS PER ASSY
100	50-820004-3	·· DAMPER ASSY-NOSE GEAR SHIMMY FOR DETAILS SEE: 32-50-00-03	FE	1
		ATTACHING PARTS		
105	130909B68	·· BOLT	FE	1
110	105739X-YN1280	·· BUSHING	FE	1
115	100951X031XJ	·· WASHER	FE	2
- 120	AN960-616L	·· WASHER	FE	2
- 125	130909N9	·· NUT	FE	1
130	130909B67	·· BOLT	FE	1
135	105739X-YR0520	·· BUSHING	FE	1
140	100951X063YN	·· WASHER	FE	1
- 145	130909N9	·· NUT	FE	2
- 150	MS24665-283	·· PIN-COTTER	FE	2
		-------★-------		
- 155	50-820205-19	· BRACE ASSY-NOSE GEAR, WITHOUT LUBRICATION PROVISIONS FOR SPARES ORDER: 50-820205-25	FE	1
- 155	50-820205-25	· BRACE ASSY-NOSE GEAR,WITH LUBRICATION PROVISIONS SPARES REPLACEMENT FOR: 50-820205-19	FE	1
		ATTACHING PARTS		
165	AN10-66M	· BOLT-WITHOUT LUBRICATION PROVISIONS	FE	1
- 170	90-820011-5	· BOLT-WITH LUBRICATION PROVISIONS	FE	1
- 175	AN960-1016	· WASHER	FE	1
- 180	AN960-1016L	· WASHER	FE	2
- 185	130909N12	· NUT-WITHOUT LUBRICATION PROVISIONS	FE	1
- 190	130909N20	· NUT-WITH LUBRICATION PROVISIONS	FE	1
- 195	MS24665-285	· PIN-COTTER,WITHOUT LUBRICATION PROVISIONS	FE	1
- 200	MS24665-355	· PIN-COTTER,WITH LUBRICATION PROVISIONS	FE	1
- 205	MS15001-1	· FITTING-WITH LUBRICATION PROVISIONS ALTERNATE SPARE: AS15001-1-P AS15001-1-C	FE	1
- 205	AS15001-1-P	· FITTING-WITH LUBRICATION PROVISIONS ALTERNATE SPARE: MS15001-1	FE	1
- 205	AS15001-1-C	· FITTING-WITH LUBRICATION PROVISIONS ALTERNATE SPARE: MS15001-1	FE	1
210	50-820233	· PIN-WITHOUT LUBRICATION PROVISIONS	FE	2
- 215	99-820110-3	· PIN-WITH LUBRICATION PROVISIONS	FE	2
220	AN4-16A /M/	· BOLT	FE	2
- 225	AN960-416	· WASHER	FE	1
- 230	AN960-1016L	· WASHER	FE	2
- 235	MS20365-428	· NUT- ALTERNATE SPARE: MS21044N4 MS21042-4 FOR SPARES ORDER: 130909N30	FE	2

NOSE LANDING GEAR INSTALLATION

ITEM	PART NUMBER	DESCRIPTION	USABLE ON CODE	UNITS PER ASSY
		ATTACHING PARTS		
360	130909B65	· BOLT	FE	1
365	105739X-YL3025	· BUSHING	FE	1
- 370	AN960-516	· WASHER	FE	1
- 375	130909N8	· NUT	FE	1
- 380	AN380-2-3	· PIN-COTTER	FE	1
		--------★--------		
- 385	50-820241-5	· LINK ASSY-NOSE GEAR DOOR	FE	2
		ATTACHING PARTS		
390	130909B39	· BOLT	FE	1
- 395	AN960-416	· WASHER	FE	1
- 400	130909N7	· NUT	FE	1
- 405	MS24665-132	· PIN-COTTER	FE	1
410	AN5-11/M/	· BOLT	FE	1
- 415	AN960-516	· WASHER	FE	1
- 420	130909N8	· NUT	FE	1
- 425	MS24665-134	· PIN-COTTER	FE	1
		--------★--------		
- 430	AN316-6R	· · NUT-LOCK	FE	1
435	50-820241-1	· · LINK-CLEVIS BOLT UPPER END	FE	1
440	50-820241-7	· · LINK-CLEVIS BARREL LOWER END	FE	1
445	50-820207-1	· YOKE-DRAG BRACE STOP PIN, WITHOUT LUBRICATION PROVISIONS FOR SPARES ORDER: 50-820201-29	FE	1
445	50-820201-29	· YOKE-DRAG BRACE STOP PIN, WITHOUT LUBRICATION PROVISIONS SPARES REPLACEMENT FOR: 50-820207-1	FE	1
- 450	50-820207-5	· YOKE-DRAG BRACE STOP PIN, WITHB LUBRICATION PROVISIONS	FE	1
		ATTACHING PARTS		
455	130909B133	· BOLT	FE	1
460	105739X-YR0875	· BUSHING	FE	2
- 465	AN960-616	· WASHER	FE	3
- 470	AN960-616L	· WASHER	FE	2
- 475	130909N9	· NUT	FE	1
- 480	AN380-3-3	· PIN-COTTER	FE	1
		--------★--------		
- 485	50-820276-1	· SUPPORT-LANDING GEAR ACTUATOR FOR SPARES ORDER: 50-820201-45	FE	RF
- 485	50-820201-45	· SUPPORT-LANDING GEAR ACTUATOR SPARES REPLACEMENT FOR: 50-820276-1	FE	RF
		ATTACHING PARTS		
490	AN3-42A	· BOLT	FE	1
- 495	130909B17	· BOLT	FE	2
- 500	AN960-10L	· WASHER	FE	AR
505	100696D-ZG302	· SPACER	FE	1
- 510	130909N29	· NUT	FE	1
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515	B543	· · BEARING- FOR SPARES ORDER: MS27646-43	FE	1
515	B543DD	· · BEARING- FOR SPARES ORDER: MS27646-43	FE	1

Report No: MR(13)345

Examination of Nose Gear Torque Link from Beechcraft King Air E90 V5-SMA for Santam Insurance Ltd.

by

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Abstract

Three parts from a Beechcraft King Air E90 were submitted after failure on landing. The material of construction was determined as a magnesium alloy, AZ91, in either F or T6 condition. Failure is attributed to overload caused by a heavy landing.

1. Introduction.

Following an incident in which the nose gear of King Air E90 registration V5-SMA collapsed on landing at Rustenberg Airfield on 4th June 2013, sections of the nose gear torque strut were submitted to Tim J Carter for examination and determination of the cause of failure.

2. Examination.

2.1 Background.

The aircraft was operated by Messrs Wings Over Africa. Failure occurred on landing at Rustenberg, it is unknown where the flight originated. The submitted samples were recovered from the runway some 300m from the aircraft.

2.2 Visual Examination.

The samples were arbitrarily identified as "A" and "B", figures 1 & 2. A third sample was not so identified, since it had been severely battered during the incident, figure 3.

Examination of the fracture surfaces of the two supplied showed that they were not matching surfaces and had originated in different areas of the torque link, figures 4 & 5.

Neither fracture surface showed any sign of any pre-existing defect. Both showed surface characteristics indicating a very rapid failure, although one did show marking which could be interpreted as very coarse beach marks, figure 6, indicating that, whilst the loading may have been cyclic, very few cycles were encountered.

Both showed damage which may be attributed to post-failure impacts, figure 7.

2.3 Metallurgical Examination.

2.3.1 Chemical Analysis.

Material from the two samples "A" and "B" were submitted for chemical analysis to determine the material of construction and the results obtained are given in appendix 1.

It will be seen that the material is similar to alloy AZ91.

2.3.2 Mechanical Properties.

Since the samples were too small for conventional mechanical testing and the relationship between hardness and mechanical properties is not well established for light alloys, electrical conductivity measurements were made using a Magnaflux FM-150 conductivity meter, S/n 0000306. The instrument was calibrated using the fitted standard test blocks immediately prior to testing. Results of 14.2 (A) and 13.8 (B) %IACS were obtained, indicating that the "F" (as cast) or "T6" (solution treated and artificially aged condition.

3. Discussion.

The appearance of the fracture surfaces submitted indicates that failure occurred as a result of a severe, transient overload and cannot be attributed to a previously existing defect.

The material of construction was determined to be AZ91 by analysis using ICP, and the mechanical condition was found to be either F , as cast, or T6 condition, solution treated and artificially aged, by electrical conductivity measurements. Both are considered normal for a component such as this.

The fracture surface features indicate that failure has occurred by a transient overload or small sequence of overload conditions, such as would occur if the aircraft had been subjected to an abnormally heavy landing of the nose gear.

4. Conclusions.

The material of construction of the linkage was AZ91, a Mg-9Al-1Zn casting alloy, which is both strong and light and widely used for undercarriage components.

It is considered that the link failed as a result of a transient overload, most likely during a heavier than normal landing.

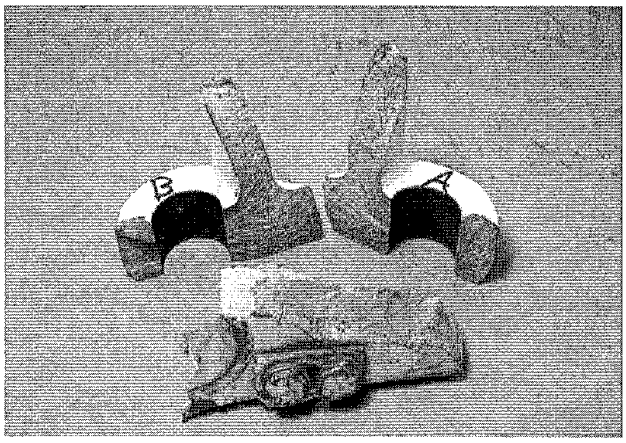

Figure 1. The three parts as received.

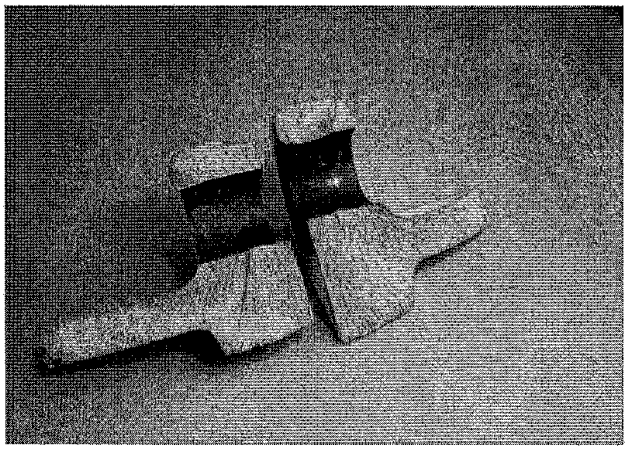

Figure 2. Fracture surfaces "A" and "B" as received. Note that they are not from the same fracture.

Figure 3. The third part received, showing severe battering.

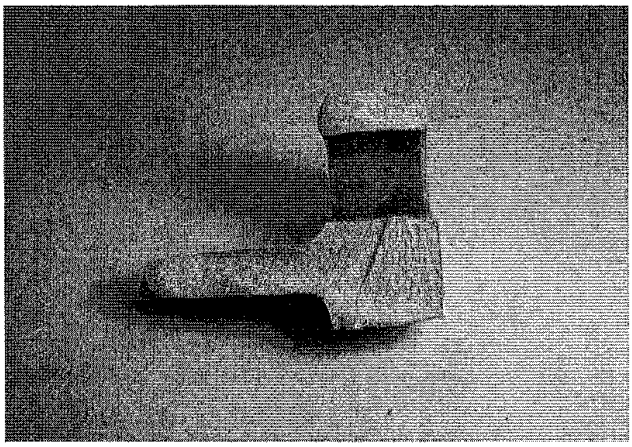

Figure 4. Fracture surface "A" as received.

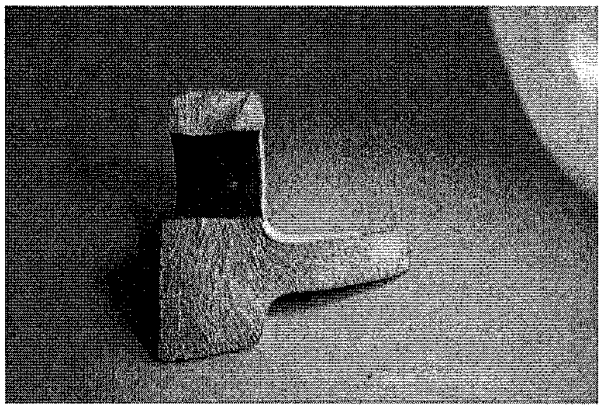

Figure 5. Fracture surface "B" as received.

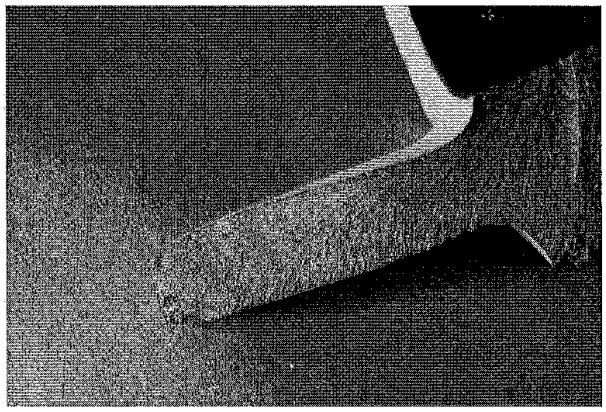

Figure 6. Possible very coarse beach marks on fracture surface "A".

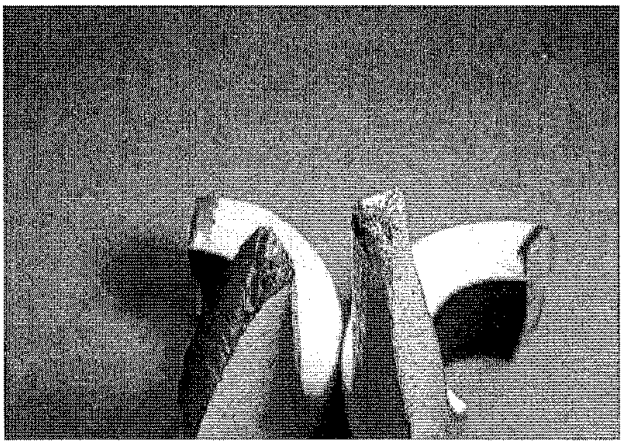

Figure 7. Impact damage attributed to contact with the runway surface after failure.

Appendix 1.

Chemical Analysis Results.

	Link	AZ91
Aluminium %	10.0	8.3 - 9.7
Manganese %	0.221	<0.13
Silicon %	0.161	<0.50
Zinc %	0.934	0.35 - 1.0
Calcium %	0.011	<0.30
Lead %	0.022	<0.30
Iron %	0.031	<0.30
Nickel %	<0.002	<0.030
Copper %	0.072	<0.10
Total Impurities	0.138	<0.30
Magnesium	Balance	Balance