FINAL INVESTIGATION REPORT

SERIOUS INCIDENT OF SHAHEEN AIR INTERNATIONAL FLIGHT NL-724 (SECTOR RIYADH – PESHAWAR), A-330-300 AIRCRAFT REG. NO. AP-BKN AT BACHA KHAN INTERNATIONAL AIRPORT (BKIAP) PESHAWAR ON 16TH OCTOBER, 2015

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Synopsis

The serious incident was reported to Safety Investigation Board (SIB) by the operator through Mandatory Occurrence Report (MOR) **(Appendix 'A')** and was notified **(Appendix 'B')** in accordance with ICAO Aannex-13 by SIB. Director General of Pakistan Civil Aviation Authority (CAA), issued Memorandum vide Letter No. HQCAA/1901/372/SIB/638 dated 02nd November, 2015 authorizing SIB, Pakistan to investigate the serious incident **(Appendix 'C')**. The investigation was conducted by SIB Pakistan (the state of registry / operator / occurrence) to recommend suitable measures to prevent a recurrence.

While coming for landing at BKIAP, Peshawar, when landing gears were selected down, a loud jolt was felt by crew. Right main gear indication did not show on the landing gear panel. Green hydraulic system leak, followed by green hydraulic low pressure ECAM came ON. On post flight inspection Retraction Bracket Assembly of Right Main landing gear was found broken.

1. FACTUAL INFORMATION

1.1. **History of the flight**. The Shaheen Air International Flight NL-724 was on a routine passenger flight from Riyadh to Peshawar on 16th October, 2015. The flight remained uneventful till landing gears were lowered prior to landing. The crew reported a loud jolt when landing gears were lowered for landing at approximately 1148 UTC. The Right Main Landing Gear (RMLG) down indication did not show up on the landing gear panel, Green hydraulic system leak ECAM came ON, followed by green hydraulic low pressure ECAM. Required actions were taken and a safe landing was made and aircraft was switched off on the runway. Post flight inspection revealed RMLG Retraction Bracket was broken, down lock actuator was over extended with internal seal protruding out and hydraulic fluid was leaking.

1.2. **Injuries to persons**. No injury reported to any person.

1.3. **Damage to aircraft**. Retraction Bracket Assembly of Right Main landing gear was found broken.

1.4. **Other damage.** None.

1.5. **Personnel Information.** Not applicable.

1.6. **Aircraft information**. The mishap aircraft was maintained by the operator in accordance with the regulations of Pakistan Civil Aviation Authority. Pertinent aircraft and major parts maintenance and life information is as follows:

1.6.1. **Aircraft**

Aircraft Make & Model	A330-300
Registration Marking	AP-BKN
Manufacturer Serial No	086
Year of Manufacture	July, 1995
Certificate of Airworthiness (C of A)	Valid till 12th Feb, 2016
Type of C of A	Regular Public Transport
Last Maintenance Review	Performed on 18th September, 2015 (70748 hrs/ 15746 cycles), valid till 17th March, 2016

Aircraft Hours Since New (HSN) / Cycles Since New (CSN)	70924 hrs / 15790 cycles
Daily Inspection	Performed at Peshawar on 15th November, 2015
Last Check-A	Check A6 performed on 30th May, 2015 (70163 hrs / cycles) by SEAMS Karachi
Last Check C	Performed on 21 March, 2015 (70163, hrs / 15579 cycles) at Turkey

1.6.2. **Left Main Landing Gear**

Time Since New (TSN)	54239 hrs
Time Since Overhaul (TSO)	1474 hrs
Next overhaul due	6815 hrs

1.6.3. **Right Main Landing Gear**

Time Since New (TSN)	55378 hrs
Time Since Overhaul (TSO)	14560 hrs, Overhauled in September, 2012
Next overhaul due	Main Landing Gear TBO defined by 10 years calendar time or 17000 flight cycles which ever falls earlier. No flight hours limit is provided.
Failed Part Identification	RMLG Retraction Bracket Part No. 201478286 S No HSM/DAM/0127/93
RMLG Retraction Bracket Life	72637 TSN / 13216 CSN completed 6584 Cycles Remaining

1.6.4. The records of life limited parts of RMLG **(Appendix 'D')** were reviewed. All life limited parts had sufficient remaining life. During the process of investigation the accredited representative requested certain life and defect history since last overhaul of the RMLG accomplished in September, 2012. The operator response on pertinent requested information is summarized below:

1.6.4.1. One event of Green Hydraulic system failure was reported in April, 2013 due to a ruptured fluid line. The same was repaired and later on no abnormality was reported.

1.6.4.2. No flight reported defect or inspection defects were observed on Retraction Actuator.

1.6.4.3. The Maintenance Planning Document (MPD) interval for greasing of W1 Pin is 400 Flight cycles / 4 months. The operator is performing the greasing at every Check-A, as a scheduled activity.

1.6.4.4. There was no scheduled or unscheduled replacement of Retraction Train Components since last overhaul in September, 2012.

1.6.4.5. There was no maintenance activity on Retraction Train Components since last overhaul in September, 2012. There was no intervention with the components of MLG retraction system in the past.

1.6.4.6. There was no hard landing reported during last three years. However, the airplane made three over weight landings on 3rd March 2013, 14th July, 2013 and 19th May, 2015. Inspection as per Aircraft Maintenance Manual (AMM) Task 05-051-11 was performed after every overweight landing and no abnormality was discovered.

1.6.5. The mass and center of gravity of the aircraft were within prescribed limits.

1.6.6. The aircraft used Jet-A1 fuel.

1.7. **Meteorological Information**. On 16th October, 2015 the weather prevailing at BKIAP, Peshawar is appended below:

Visibility	Outlook	Clouds	Wind	Temp	QNH
4 Km	Fair	3SC 040 2AC 100	Calm	21° C / 26° C	1010

1.8. **Aids to Navigation**. The mishap aircraft was equipped with serviceable ADF, VOR / DME, ILS and GPS for the conduct of flight operations. All ground equipment related to ADF, VOR / DME and ILS was serviceable at the time of occurrence.

1.9. **Communications**. The mishap aircraft was equipped with serviceable UHF / VHF sets for radio contact with all concerned agencies during flight / on ground.

1.10. **Aerodrome Information**. The BKIAP, Peshawar detailed aerodrome data is appended below:

01 JUL 15 **Pakistan**

OPPS AD 2.12 RUNWAY PHYSICAL CHARACTERISTICS

Designations RWY NR	True bearing	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY
1	2	3	4	5	6
17	176°	2743 x 46	68/F/C/X/U With Reduced Take Off load upto 223 Tons Bitumen	340021.62N 0713048.76E	THR 357M / 1171FT
35	356°			335853.16N 0713056.35E	THR 369M / 1211FT

Designations RWY NR	Slope of RWY/SWY	SWY dimension (M)	CWY dimension (M)	Strip dimension (M)	Obstacle Free Zone
7	8	9	10	11	12
17	-	122	274	3107 X 92	-
35	-	122	274		

RESA: RWY 17/35 90X 92M

OPPS AD 2.13 DECLARED DISTANCES (M)

Designations RWY NR	TORA	ASDA	TODA	LDA	Remarks
1	2	3	4	5	6
17	2743	2865	3017	2743	-
35	2743	2865	3017	2743	-

OPPS AD 2.14 APPROACH AND RUNWAY LIGHTS

RWY Designator	APCH LGT type LEN INTST	THR LGT colour WBAR	VASIS (MEH) PAPI	TDZM LGT LEN	RWY Centre line LGT Length, spacing, colour, INTST	RWY EDGE line LGT Length, spacing, colour, INTST	RWY End LGT spacing colour WBAR	SWY LGT LEN (M) colour	Remarks
1	2	3	4	5	6	7	8	9	10
17	-	GREEN	PAPI / Left 3°	-	-	2743 M 60 M WHITE LIL	RED	-	-
35	(CAT-1) HIL	GREEN	PAPI / Left 3°	-	-	2743 M 60 M WHITE LIL	RED	-	Strobe lights

Remarks: Airfield Lighting System CAT-1.

OPPS AD 2.19 RADIO NAVIGATION AND LANDING AIDS

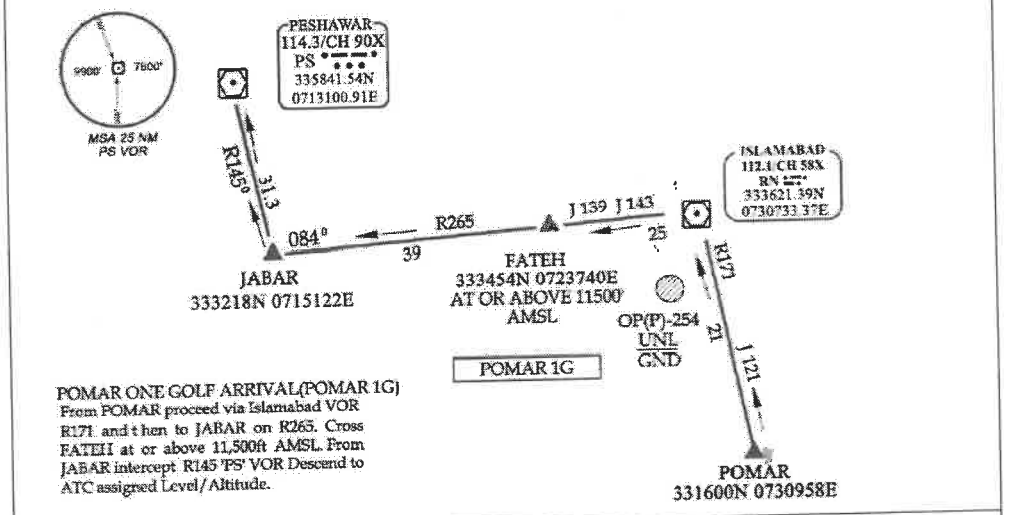
Type of aid. CAT of ILS (VAR VOR/ILS)	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
NDB	PS	308 KHZ	H24	3359.45N 07130.16.E		Coverage 150NM.
DVOR/DME (2°E/1995)	PS	114.3 MHZ CH90X	H24	335841.54N 0713100.91E	368 M	-
BS	Radio of Pakistan	540 KHZ 729 KHZ	HX	-	-	PBC Hours 0045-0405 0500-1800

STANDARD ARRIVAL CHART INSTRUMENT STAR

TRANSITION LEVEL FL 140
TRANSITION ALT 12000 ft

TWR 122.9
118.3
CHERAT 125.6
APP

PESHAWAR / Bacha Khan Int'l
BALKA 1C, HANGU 1C, PARTA 1C, POMAR 1G

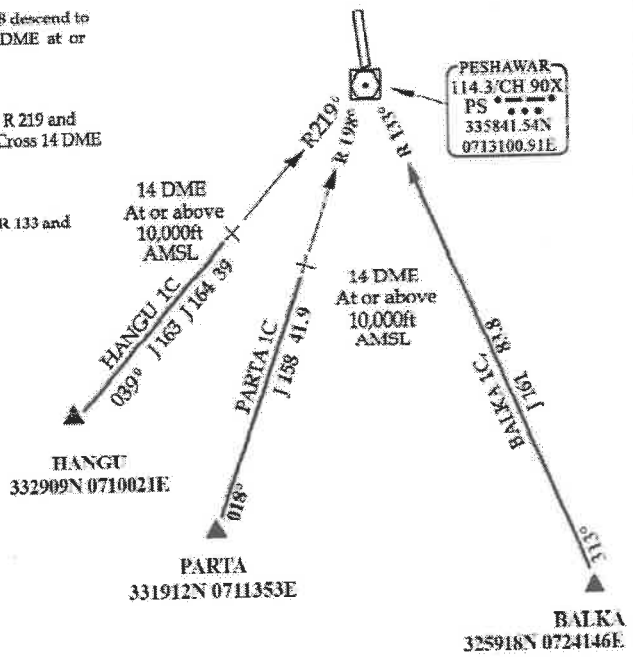


POMAR ONE GOLF ARRIVAL(POMAR 1G)
From POMAR proceed via Islamabad VOR R171 and then to JABAR on R265. Cross FATEH at or above 11,500ft AMSL. From JABAR intercept R145 'PS' VOR Descend to ATC assigned Level/Altitude.

PARTA ONE CHARLIE ARRIVAL
From PARTA proceed to 'PS' VOR on R 198 descend to ATC assigned Level/ Altitude. Cross 14 DME at or above 10,000FT AMSL

HANGU ONE CHARLIE ARRIVAL.
From HANGU proceed to 'PS' VOR/ DME R 219 and descend to ATC assigned Level/Altitude. Cross 14 DME at or above 10,000FT AMSL.

BALKA ONE CHARLIE ARRIVAL
From BALKA proceed to 'PS' VOR/ DME R 133 and descend to ATC assigned Level/altitude.



1.11. **Flight Recorders**. Flight Data Recorder (FDR) data was successfully retrieved and utilized for the purpose of the investigation.

1.12. **Wreckage and Runway Marks Information**. Not applicable.

1.13. **Medical and Pathological Information**. No injury reported to any person.

1.14. **Fire**. Not applicable.

1.15. **Survival Aspects**. Not applicable.

1.16. **Tests and Research.** The failure analysis of failed retraction bracket and selected associated parts was carried out by SAFRAN LANDING SYSTEMS (MESSIER-BUGATTI-DOWTY) and a detailed report **(Appendix 'E')** was rendered which will further be referred as MBD Report.

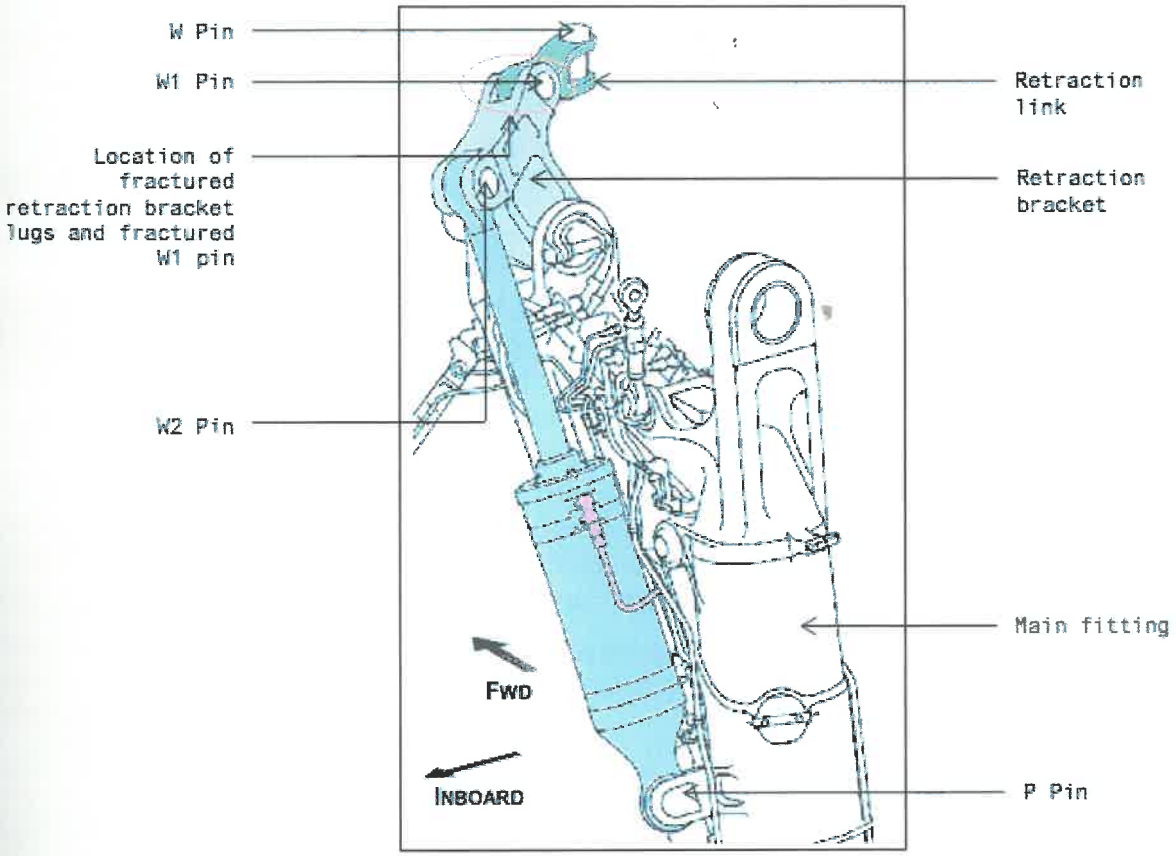
1.17. **Organizational and Management Information**. Not applicable.

1.18. **Additional Information**. Not applicable.

1.19. **Useful and Effective Investigation Techniques.** Standard investigation techniques were used.

2. ANALYSIS

2.1. The following picture shows the location of failed part and other related components of LHMLG.



Location of Components on the RMLG (MBD Report)

2.2. On post incident inspection the RMLG Lockstay Actuator internal seals were found protruding out and hydraulic fluid leak was observed from the damaged seals area.

On aircraft close up view of the failed Retraction Bracket

Position of Lockstay Actuator : LMLG

RMLG Lockstay Actuator, Protruded seal

2.3. The FDR data showed that the Landing Gear Selector was selected down at 11:48:13 UTC FDR time at 5136' barometric altitude. The Green Hydraulic Low Pressure was recorded at FDR time 11:53:11 UTC. The crew reported a loud jolt when landing gears were lowered for landing followed by ECAM Green hydraulic system leak and low pressure cautionary alerts. The crew report, FDR sequence of events and post incidence inspection suggests that Retraction Bracket failed first. The probable over extension of lock stay actuator and damage to its seal was consequence of the bracket failure. The Green Hydraulic fluid leaked from the damaged seal of stay actuator and resulted into Low Green Hydraulic Pressure.

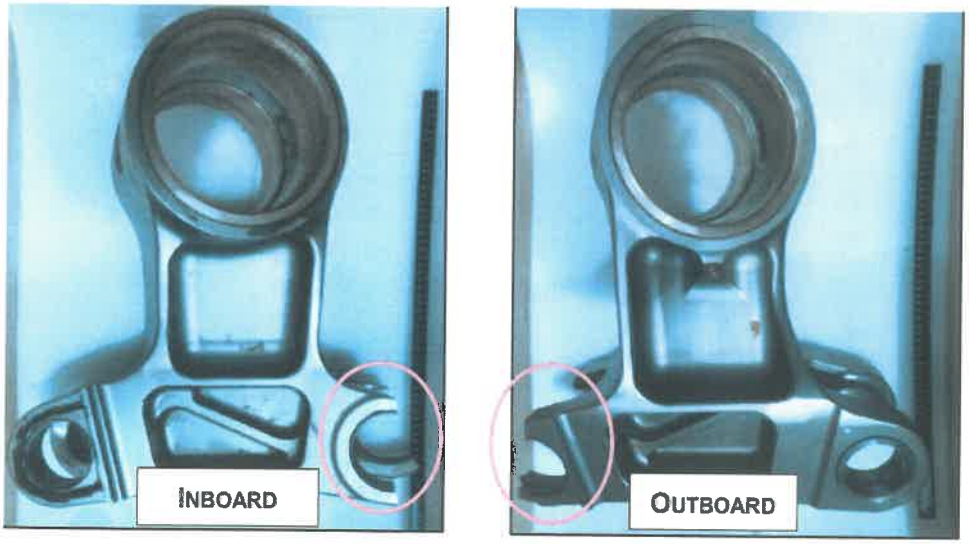
2.4. The failed Retraction Bracket parts along with associated parts as advised by manufacturer were dispatched to Messier-Bugatti-Dowty Limited Gloucester Materials Laboratory, further referred as MBD for investigation.

Part	PN	SN	FH	FC	FC limit
Retraction Bracket	201478286	HSM/DAM/0127/93	72,637	13,216	19,800
W pin	201489770	CH0372	24,235	4,812	42,800
W1 pin	201478614 *(according records)*	SER7771/00 *(according records)*	42,996	9,630	11,150
W2 Pin	201478615	10003743 MC-025314	42,996	9,630	42,800
P Pin	201478612	SER4676/00	42,996	9,630	42,800
Retraction Link	201489316 and 201676216	11SHL2127	5,096	1,467	10,700
Retraction Actuator Assembly	114256004 – 010	SPP1628	5,096	1,467	NA
Lock – Stay Actuator Assembly	114354001 – 010	320	54,480	8,944	NA

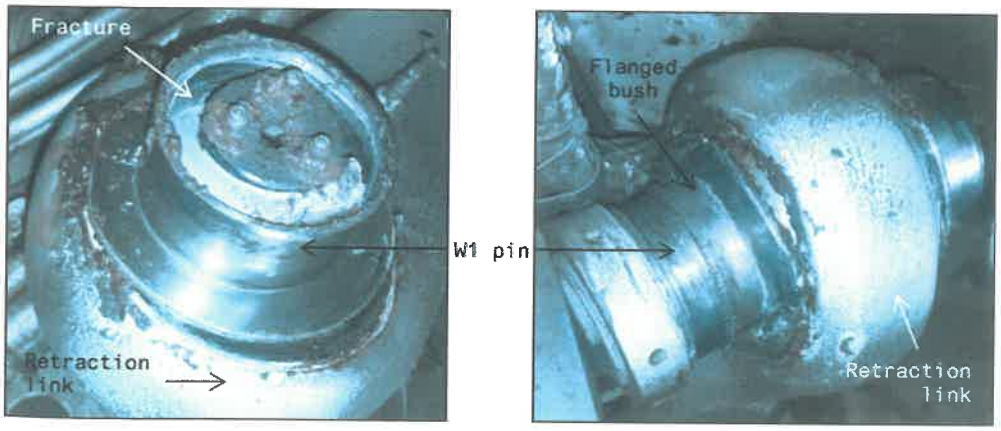
List of Parts submitted to MBD Material Laboratory

2.5. The significant points of findings and analysis of MBD Report are summarized below:

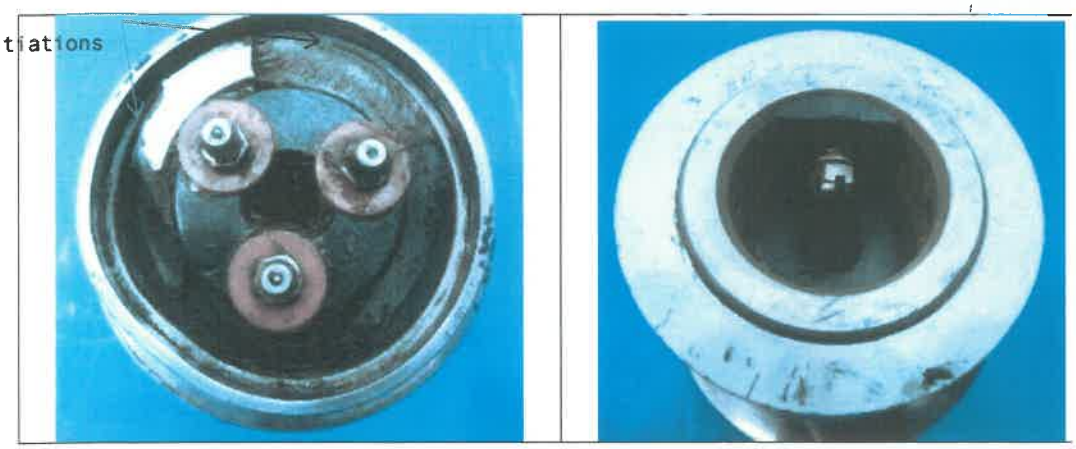
2.5.1. The retraction Bracket fractured at its two forward lugs. The W1 pin was found damaged, distorted and fractured at D-head end. The flange bush of W1 pin was found installed in wrong direction when received at MBD. However, on wing pictures indicated that it was installed correctly and wrong direction assembly was most probably performed after removal from aircraft while packing the parts for dispatch to MBD. The Lockstay Actuator had two rubber seals and one metallic seal protruding out.



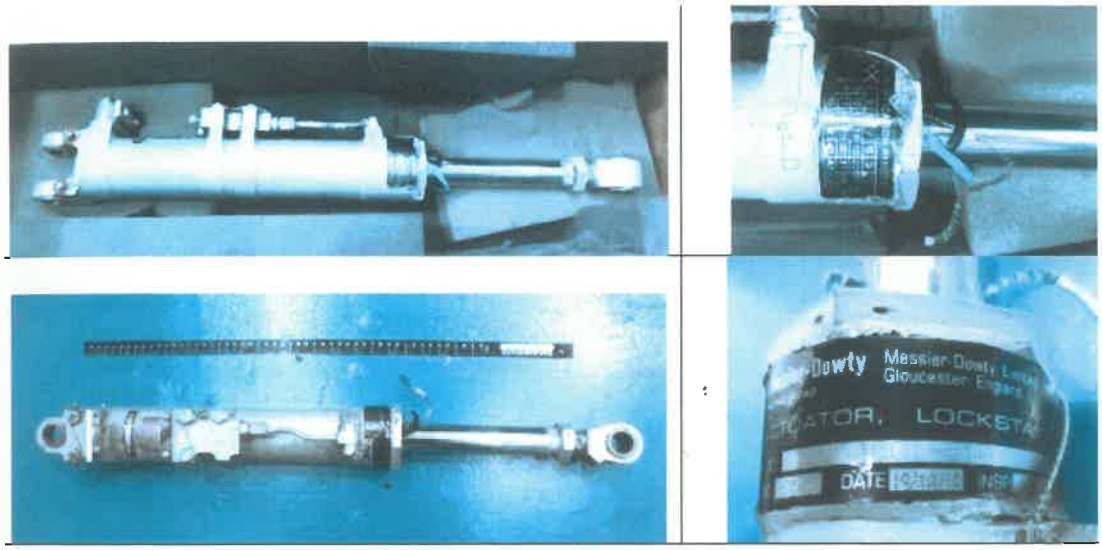
Fractured Retraction Bracket



On wing picture showing correct mounting of W1 pin



W1 pin (PN and D head missing)



Lockstay Actuator (PN 114354001-010; SN 320), Two rubber seals and one metallic seal coming out

2.5.2. The fracture surfaces of the Retraction Bracket were arbitrarily numbered from 1 to 4 as shown in the following pictures.

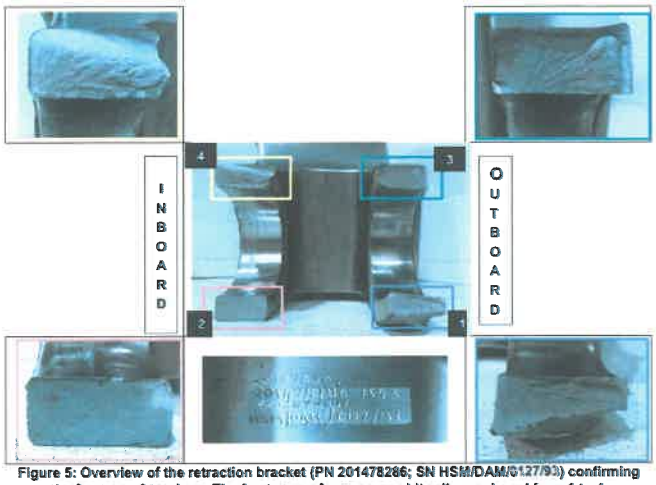


Figure 5: Overview of the retraction bracket (PN 201478286; SN HSM/DAM/0127/93) confirming the fracture of two lugs. The fracture surfaces were arbitrarily numbered from 1 to 4.

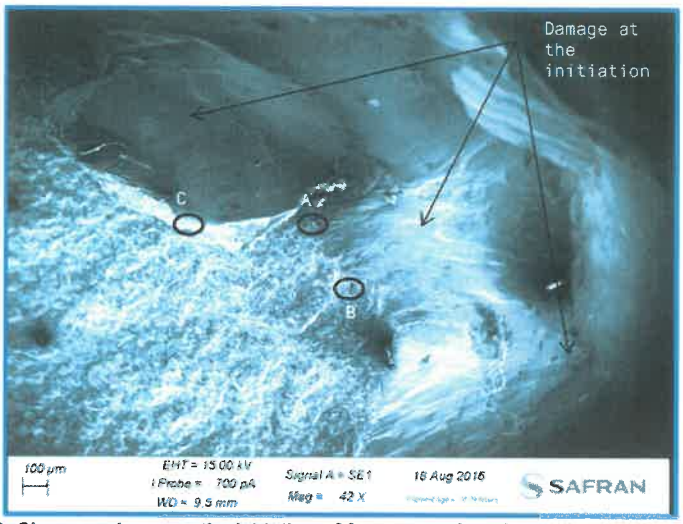


Figure 29: Close-up view near the initiation of fracture surface 2 showing fatigue locations.

2.5.3. Examination of the microscopic appearance of fracture surfaces suggested that fracture surface 2 was the first to occur. In addition, on fracture surface 2, there was evidence of fatigue cracking close to the fracture initiation site. The other three fracture surfaces only showed fracture due to ductile overload.

3. CONCLUSIONS

3.1 Findings

3.1.1 The aircraft was serviced properly prior to the mishap flight and there was no carried forward defect which could contribute to the incident.

3.1.2 The reported past maintenance history and operational history of the aircraft did not show any abnormality / intervention of the affected components which could contribute to the incident since last overhaul of RMLG in September, 2012.

3.1.3 Examination of the microscopic appearance of fracture surfaces suggested that one out of four fractures (surface 2) was the first to occur.

3.1.4 On this fracture surface 2, there was evidence of fatigue cracking close to the fracture initiation site.

3.1.5 The other three fracture surfaces only showed fracture due to ductile overload.

3.1.6 The Retraction Bracket material tensile strength and microstructure met the requirements of AMS4979H.

3.1.7 The hardness and the fracture toughness of the samples taken from the Retraction Bracket were in-line with what is expected for this material in the fully heat treated condition.

3.1.8 The fracture of the W1 Pin D-head end was due to overload and was a consequence of the fracture of the retraction bracket lugs.

3.1.9 The Lockstay Actuator seals protruded out as a consequence due to undamped extension of the RMLG after failure of the Retraction Bracket.

3.1.10 The Green system hydraulic fluid leaked from the damaged seals of the Lockstay Actuator and resulted in hydraulic fluid leak and subsequent low level and low pressure.

3.1.11 Maintenance Planning Document of Airbus Industries does not recommend any specific inspection [Visual, NDT etc.] to this MLG Retraction Bracket while installed on aircraft.

3.1.12 The Retraction Bracket is a Life Limited Part [LLP] of the Main Landing Gear Assembly. The Life Control and the Time Between Overhauls [TBO] is aligned with the MLG Assembly and it is 10 Years calendar time or 17,000 flight cycles which ever falls earlier.

3.1.13 This failed bracket was lastly overhauled along with the Right Main Landing Gear in September, 2012 and is left with 6584 flight cycles before reaching the life limit defined into the airworthiness limitation section Part-4.

3.1.14 **Cause of Occurrence**. Failure of the Right Main Landing Gear Retraction Bracket was the cause of the occurrence. One out of four broken lugs of this Retraction Bracket broke due to a crack initiated due to fatigue failure. Consequently, the other three lugs of this Retraction Bracket also failed due to over and un-even load conditions.

4. SAFETY RECOMMENDATION

4.1. The Operator in consultation with OEM may adopt the procedure of introducing some precautionary inspection to avoid such reoccurrence in future.