

**NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Aviation Engineering Division  
Washington, D.C. 20594

December 12-13th, 2005

**SYSTEMS GROUP FIELD NOTES**

**A. ACCIDENT:**

**NTSB Accident Number:** LAX05IA312  
**Location:** Los Angeles, California  
**Date:** Wednesday, September 21, 2005  
**Time:** 1818 Pacific Daylight Time  
**Aircraft:** Airbus A320, N536JB

**B. SUMMARY:**

On September 21, 2005, at 1818 Pacific daylight time, an Airbus A320, N536JB, operated by JetBlue Airways as flight 292, sustained minor damage to the nose landing gear during landing at Los Angeles International Airport, Los Angeles, California, with the Nose Landing Gear (NLG) at 90 degrees left steer from aircraft center line. The 2 pilots, 4 flight attendants, and 141 passengers sustained no injuries. Flight 292 departed Burbank, California, about 1531 PDT as a non-stop to John F. Kennedy International Airport, New York, New York under the provisions of 14 Code of Federal Regulations Part 121.

After an attempt to retract the landing gear, the flight crew received two error messages displayed on the Electronic Centralized Aircraft Monitoring (ECAM) system: a nose gear shock absorber fault and a nose wheel steering fault.

Flight 292 diverted to Long Beach, California, and during the final approach the control tower performed a visual check of the landing gear at the flight crew's request, which revealed that the nosewheels were rotated<sup>1</sup> about 90° to the left. The flight crew decided to divert to Los Angeles, California. The crew flew for several hours to burn fuel so that they could land at a lighter weight.

The airplane landed with the NLG Wheels rotated 90 degrees to the left of the airplane's centerline. The NLG tires were quickly deflated and torn apart and both wheels were worn away up to the wheel axle. During landing, the airplane's trajectory was not affected by the abnormal NLG configuration, and the airplane stayed on the runway centerline.

In support of the NTSB investigation into the accident of Jet Blue Airlines flight 292, several landing gear steering system components were removed from the aircraft and shipped to the Airbus facility located in Bristol, England on December 12th, 2005.

An investigative team was assembled to oversee the investigation of the nose landing gear assembly at the Airbus facility on December 12-13th 2005. Participants in the examination included representatives from the NTSB, AAIB, BEA, Airbus, and JetBlue Airways.

#### D. DETAILS OF THE INVESTIGATION:

##### **Monday 12-12-2005**

0930 Welcome to all attendees. Agreement to download the internal BITE Data of both LGCIU's provided by JBU-NTSB (recovered from MSN 1784)

1000 : Description of the test proposed and visit of the Test Rig Installation

1030 : Checking of the components provided by JBU-NTSB for the test. A photo of all the components has been taken before its use and installation on the test rig bench.

1110 : Debrief of the previous events related to NLG and shock absorber issue.

1130 : Downloaded the BITE of both LGCIU's on a partial bench (LGCIU 1 SN 3933 & LGCIU 2 SN 3929). Copy of the BITE data has been provided to both NTSB and Airbus.

1130 : Description of the interfaces between the Cams of the NLG ( see slide 17) and the new pre-land test sequence.

1140 : Review of the slide 22 by Peter Hart, related to Hydraulic interface for the NLG

1230 : Review of the Data recording + Hypothesis retained of the 21st September event, notably due to the discrepancies between JBU crew report and DFDR. Both CAPT and FO have reported that they were unable to move the LDG lever on position up, which is in contradiction with what is recorded.

Start of the test on the Test Rig bench (in the presence of JBU-DH, NTSB-MH, AI-FC&DC,Ultra electronics-JD). No issue.

Agreement that any JBU MSN 1784 components installed on the test rig will be photographed before and after its installation.

Discussion about "Shock absorber fault " event on MSN 1849 which occurred 11th Dec. Picture of the cracked upper support have been presented and discussed. Following the AD ref : 2005-24-06, a boroscope test has been conducted on the NLG due to "SHOCK ABSORBER FAULT"

1330 Proposal to have an evaluation from Airbus Performance Department, in order to check if Aircraft performance are different when gear are extended/retracted (based on DFDR recording parameters)

Discussion about LGCIU logics for triggering of "Shock Absorber Fault"

1430 : Review of 11th Dec 2005 event occurred on MSN 1849. FC confirmed Airbus JBU RCSM is aware of the issue and that Airbus customer support has been informed

1520 : Review of the 21st Sept event : Assumptions that the Flight Crew report was correct has been reviewed by all the parties previously the Test rig . CG proposed to consider the review it on an operational point of view, by using the JBU internal operational procedure when the A320 Take Off from Burbank. This has enable to demonstrate that crew has maneuvered the LDG lever to the UP position, which is in line with the DFDR data.

The SOP require to use the following sequence : LDG UP + ground spoiler disarmed - AP engaged . All this sequence is recorder in the DFDR, which has been reviewed during the meeting.

Ref : JBU A320 after TO SOP and ABG for Burbank

CC confirmed the causes which are at the origin of the concern of the shock absorber are due to the fatigue of the upper support.

Note : the fatigue test currently conducted by Airbus will be provided in attachment of this report.

CC confirmed the BSCU pre-land test has been reviewed in Software L4-8, which is already certified & available and Software L4-9 to be certified in 2006.

1600 : review of the Bite data downloaded from the LGCIU 1 and 2, and presentation by DC of the LGCIUs interfaces and logics.

1630 : end of the meeting.

### **Tuesday 12-13-2005**

0915 : all hydraulic component have been installed and tested. LGCIU to be installed. No abnormal test results have been observed during the previous tests.

1000 : installation of the LDG lever control.

An attempt was made to put the landing gear lever (from N536) up while in the baulked position. ARINC labels for the landing gear lever , uplock, downlock positions of the gear and doors were observed (from the test rig panel) for any change in position. No change in indication was evident.

1030 : agreement between AAIB and NTSB to test the LGCIU in Ultra Controls facilities, under AAIB responsibility. Both LGCIUs are in the custody of the AAIB. Airbus UK Dan Cropley will participate at the downloading of the LGCIUs Bite. The other components will be sent back to Howard Plagens - NTSB

1430 : Evaluation of the proposed frame for the analysis of the results. Airbus will include a description of all the parameters which are analyzed.

Pressurized the NLG strut to at 275 PSI, weight off wheels. Using a torque wrench , the wheel assembly was rotated left and right. The torque values were approximately 40 pounds-feet to the right and 60 pounds-feet to the left. The measurement will also be taken with the NLG in the retracted position on Wednesday 12-14-05. The upper support assembly installed in the NLG had all four lugs removed.

#### **Thursday 12-15-2005**

At the beginning of the tests, the BSCU did not start and the following Fault Codes were recorded in the BSCU bite: 160, 161, 930, 931, and 932. After a long reset, the BSCU started normally.

In fact this BSCU's behaviour is explained due to the partial ATEC Test (in order to not erase the BITE data) done in Barfield on Dec. 2005, the 6<sup>th</sup> to download the BITE data. For this partial ATEC Test, the functional OBRM were removed from the BSCU to be temporary replaced with Test OBRM. The test program has an impact on the 4 I/O Boards : indeed the I/O boards, depending of their location in the BSCU (COM or MON) and even if they have the same hardware configuration, use a different subset of the complete I/O board function set depending on their affected location in the BSCU (COM or MON). The ATEC test program "erases" this location memory of the I/O boards. Usually, after a complete ATEC test, the I/O boards are automatically reconfigured (COM or MON position). In this case, as the BSCU did not run a complete ATEC Test in Barfield (functional OBRM have only been re-plugged in the BSCU after the partial test), EMM BSCU S/N 393 was in an unusual configuration where the I/O boards were not properly re-affected to their functional location (COM / MON). In order to recover a normal behaviour of BSCU S/N 393, we should have waited about 30s (necessary time to re-affect correctly I/O boards) and then make a BSCU reset. That is why after a long reset, BSCU complete functionality was recovered with no further anomaly.

Parameters recorded reference D32RE0504065, dated 05-10-05, page 5 of the report. Additional information: Signal landing gear lever up, NLG downlock. Availability discredits of System COM 1 and System COM 2 of BSCU. (These discredits are provided to the Flight Warning Computer (FWC).

- First Test: Functional test of steering function during taxi – no discrepancies noted.
- Second Test: Preland test in normal configuration (hydraulic pressure available, nose wheels at 0 degrees) – no discrepancies. On the print, note the landing gear lever up signal (1). The BSCU (PN E21327003, EMM Standard L4-5/SN 393) requires a false signal to launch the preland test. In addition, the NLG downlock signal must be valid (1). No discrepancies were found during the steering preland test. Reference the preland test description provided by Airbus AMM.
- Third Test: Order a specific profile of steering orders. Replaced tiller with current generator to conduct test. Description located on page 6 of the test profile. Ten cycles were conducted. During the Type II test, a vibration phenomenon was visually observed only on the last 4 cycles with the nose wheel assembly approximately 0 degrees when returning from a right turn condition. No evidence of this was indicated on the recorded data. No discrepancies during the test were found.
- Fourth Test: Recreated the Fault Code 671 condition. A series of three tests were conducted without hydraulic pressure. Reference Page 12 of December 15-16 Test Program Presentation titled, “A320 JBU MSN 1784 – BSCU and Steering Module Investigations.” On the first test, the test bench recorded a variation of RVDT signal moving from 6.7 to 4.2 degrees instantaneously (2ms) which is impossible given no hydraulic pressure was applied and the rate is too fast. This was the only discrepancy noted. Further troubleshooting/testing will be conducted on 16 December 2005. With hydraulic pressure available and the nose wheel assembly position greater than 6.5 degrees, the BSCU automatically recentered the nose wheels to zero without triggering any fault code. Without hydraulic pressure available and nose wheels greater than 6.5 degrees, Fault Code 671 is triggered and the nose wheel assembly did not move. Conducted BSCU reset, the nose wheel assembly recentered, the sanction cleared (NWS recovered) but the fault code is stored within the BSCU bite. This fault code has been recovered by TSD (trouble shooting data) and compared to MSN 1784 TSD. The results are similar.

To investigate the RVDT signal moving from 6.7 to 4.2 degrees instantaneously (2ms) the steering test with no hydraulic pressure and the NLG wheel assembly position greater than 6.5 degrees was conducted ten times. For each of the test cycles, fault code 671 was triggered and the NLG wheel assembly remained in its position (did not return to center). Normal steering functions were observed.

- Completed the 6GC block and servo valve test.
  - Spooler LVDT signal function of the servo valve current (an anomaly was noted that showed a nonlinear spool displacement against the linear control input. (Further analysis required to determine if the anomaly is within tolerance specifications)

- NLG displacement speed function of the Servo-valve current: Checked the displacement speed function during varying currents (speed versus milliamps from 1ma to 8ma). Printout was not available; however, preliminary results indicate no discrepancies.

- Airbus is to provide results (data traces) of the test via the preliminary report after internal reviews. This will be mailed to NTSB.

### **Friday, December 16, 2005**

Introduction: Finalized 15 December field notes and 6GC block testing described above. After that testing was complete, pressure gauges were installed on the test rig to provide additional information regarding the anomaly in the Type II testing.

- A high resolution position transmitter was installed to provide additional data for the Type II anomaly troubleshooting
- A brief was given by Laurent Tizac, Airbus Landing Gear Engineer regarding a possible answers to the troubleshooting (rig) anomaly. Possible causal factors are lack of lubrication on the rig, the older design of the rack (20 years old, the only aircraft with this type of mechanism is A320 MSN 001), or the 6GC block. Troubleshooting/isolation procedures will be to replace the JBU 6GC on the test rig with another block and repeat the tests. If the anomaly remains then the test rig will be lubricated and the test reperformed. The troubleshooting procedures are to determine the integrity of the JBU 6GC block.