NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

MAINTENANCE RECORDS GROUP CHAIRMAN'S FACTUAL REPORT

June 16, 2020

A. ACCIDENT DCA13FA094

Location:	Newark Liberty International Airport, New Jersey
Date:	May 18, 2013
Time:	0104 Eastern Daylight Time
Aircraft:	Piedmont Airlines, operated as U.S. Airways Express flight 4560, a Boeing (DeHavilland) DHC-8-102, N934HA

B. MAINTENANCE RECORDS GROUP

The Maintenance Records Group met May 30-31, 2013 and November 8, 2013 at the Piedmont Airlines facility in Salisbury, Maryland. The following participants attended both group activities:

Chairman:	Tom Jacky National Transportation Safety Board Washington, D.C.
Member:	James Marvin Piedmont Airlines Salisbury, Maryland
Member:	Captain Frank Young Air Lines Pilots Association Apex, North Carolina

C. SUMMARY

On May 18, 2013, about 0104 eastern daylight time, N934HA, a Piedmont Airlines, Boeing (DeHavilland) DHC-8-102, operated as U.S. Airways Express flight 4560, a Title 14 CFR Part 121 scheduled domestic commuter passenger fight from Philadelphia, Pennsylvania, to Newark, New Jersey, had the left main landing gear fail to lower and lock prior to landing. The flight crew performed the applicable emergency procedures and tried to lower left main landing gear. All attempts were unsuccessful, and the crew elected to conduct gear up landing on runway 04L at Newark Liberty International Airport (KEWR), Newark, New Jersey. The airplane incurred substantial damage. There were no injuries to the 3 crewmembers or 31 passengers that were onboard.

The Maintenance Records Group met at the Piedmont Airlines facility in Salisbury, Maryland from May 30-31, 2013 and subsequently on November 8, 2013. In addition, the group chairman met at the operator's facility on November 21, 2014 for further discussions regarding this portion of the investigation. For each group activity, all documents developed during the activity were provided electronically to the group members.

The group determined that Piedmont conducted a maintenance task to inspect the main landing gear uplock roller assembly every 220 flight hours. According to Piedmont's documentation, the uplock roller did not require lubrication for the last 2,723 hours, and that the roller rotated freely. After the accident, Piedmont Airlines created new maintenance task to lubricate the uplock roller every 500 flight hours.

D. DETAILS OF THE INVESTIGATION

The group met twice at the Piedmont Airlines headquarters in Salisbury, Maryland to examine the maintenance records regarding the accident airplane. The group also reviewed the maintenance practices for the deHavilland DHC-8 airplanes.

Given the circumstances of the accident, the group concentrated its activities on the main landing gear system and alternate landing gear system.

The group reviewed the maintenance records and collected the following information:

1.0 Air Carrier Certificate

Piedmont Airlines was located at 5443 Airport Terminal Road, Salisbury, Maryland, 21804. A Part 121 operations certificate number, HNAA001A, was originally issued to Henson Aviation by the Federal Aviation Administration's (FAA) Baltimore Flight Standards District Office (AEA-FSDO-07), on August 5, 1989. The certificate was reissued on July 7, 1993 when Henson Aviation changed its name to Piedmont Airlines.

The certificate certifies that Piedmont Airlines is authorized to perform commercial air operations in accordance with Piedmont Flight Operations Manual and the 14 Code of Federal Regulations.

2.0 Aircraft and Engine Information

The airplane was manufactured by Boeing DeHavilland in February 1989 as serial number 139 and delivered to Henson Aviation. Henson Aviation (now Piedmont Airlines) has operated the airplane since then. The airplane had 61,671 total hours and 68,907 total cycles at the time of the accident.

The airplane engines were both Pratt & Whitney Canada Model PW120A. Both had engine rated power measured at 2,000 Horsepower. The engines were identified as follows:

Position	Engine S/N	Date of Manufacture	Total Engine Time	Total Engine Cycle	Hours since last Overhaul
1	120776	n/a	61485.5	n/a	13429.7
2	120711	n/a	57585.1	n/a	16163.7

3.0 Method of Record Keeping

Piedmont Airlines retained pertinent aircraft, engine, and component records using both manual and electronic methods. Paper records were made available for the group's activities, including airplane discrepancies, maintenance checks, and airplane logbooks. Piedmont Airlines used computer software called MERLIN to track and document airplane maintenance. The software provided storage, indexing, and retrieval of aircraft maintenance documents and records. Items written in the Piedmont Airlines Maintenance/Flight Log (known as the airplane logbook), including airplane discrepancies, were entered into MERLIN.

Within MERLIN, all tracked parts and upcoming maintenance checks can be listed via the Aircraft Component Log, known as CCACL. The CCACL provided times and dates for upcoming maintenance activities, time until replacement of components, and part and serial numbers for as-installed components. CCACL is a portion of MERLIN.

Airplane discrepancies discovered during airplane maintenance were documented using Piedmont Airlines, Inc. – Maintenance Work Card, also known as Form HA-300. Copies of the HA-300 were retained for record-keeping and were also entered into MERLIN.

4.0 Maintenance and Inspection Programs

The maintenance program was defined and described in the Piedmont Airlines Maintenance, Policies, and Procedures Manual (MPP).

The maintenance program was defined generally as follows:

"L" Check – accomplished within 70 operational hours after the last L or higher check was accomplished. Typically, an "L" check was accomplished during overnight maintenance.

Items of note included in each "L" Check are:

- general exterior inspection
- check tires for wear

- grease landing gear fittings
- NLG shock strut inspection
- MLG proper strut extension and condition
- wheel well gravel guard condition
- clean dirt from exposed portions of landing gear strut pistons

"B" Check – a "B" check was accomplished within 440 operational hours after the last B or higher check was accomplished. Piedmont accomplishes a staggered "B" check with different items for each check, and are known as B1, B2, B3 and B4 checks. Typically, a "B" check is accomplished during overnight maintenance.

Each B check included a landing gear door function test and nose landing gear inspection.

"C" Check – Piedmont Airlines conducted "C" checks at intervals of 5,758 hours from the last C check completion date. Each check required operational and functional checks for various aircraft systems and sub-systems. Piedmont Airlines scheduled 21 days to complete a typical "C" check.

Items of note for each "C" check included:

- Gear door inspections
- NLG drag strut unlock hydraulic flex line replacement
- MLG torque link inspection
- NLG shock strut fluid replacement
- MLG shock strut fluid replacement
- Ops check alternate gear extension system
- Landing gear sequence control ops check
- Functional check of landing gear selector valve
- Landing gear warning horn functional check
- MLG retraction actuator fitting bolt check

Based on a review of records, the following was the history of recent maintenance inspections for N934HA:

Check	Date of recent Inspection	Location	Total Time	Total Cycles	NOTES
L Check	05/06/2013	ROA	61584.4	n/a	Card 05-07-04
L Check	04/19/2013	ROA	61484.6	n/a	
B1 Check	03/21/2013	MDT	61294.5	68,457	
B4 Check	01/14/2013	MDT	60890.6	67,959	
B3 Check	11/11/2012	ROA	60498.0	67,467	
C Check	05/27/2011	Avcraft Myrtle Beach, SC	57399	63,839	

During the last C Check there were no relevant inspection findings except for one bolt that was found to require additional torque on the #1 MLG retraction actuator.

5.0 Recent Maintenance History for N934HA

Piedmont provided a spreadsheet of discrepancy records from MERLIN, dated from January 1, 2013 until the day of the accident. The following notes pertaining to the landing gear system were made:

A) Two write ups concerning the left main landing gear door advisory lights noted as follows:

• 1/9/13: LEFT MAIN AMBER DOOR ADVISORY LIGHT REMAINED ILLUMINATED AFTER GEAR RETRACTION. COMPLIED WITH CHECKLIST OPS NORMAL.

Action taken: R+R LT MAIN SOLENIOD SEQUENCE VALVE REF 32-10-51. ADJUSTED FORWARD GEAR DOOR AS REQUIRED REF. 32-10-21

• 1/24/13: LEFT HAND AMBER GEAR DOOR LIGHT REMAINED ILLUMINATED AFTER GEAR RETRACTION. CYCLED GEAR PER CHECKLIST OPS NORMAL AT THIS TIME.

Action taken: T/S AND FOUND FWD LEFT MAIN GEAR DOOR ACTUATOR NOT RIGGED CORRECTLY. RIGGED LEFT FWD MLG DOOR REF DASH8 MM 32-10-36. SWUNG GEAR SEVERAL TIMES OPS CHECK GOOD.

B) Recurring issues regarding the emergency brake accumulator pressure on the following dates:

- 1/1/13
- 1/12/13
- 2/15/13
- 3/2/13
- 3/3/13
- 4/23/13

Action taken: Multiple changes of accumulator charging valve assembly.

Several pages from the Piedmont Airlines Maintenance/Flight Log, from May 12, 2013 until the day of the accident, remained on the airplane. When the logbook was recovered after the accident, the pages were scanned electronically and provided to the group.

The group reviewed the logbook pages and found no items for further investigation.

Piedmont Airlines indicated that there were no maintenance escalations for the accident airplane at the time of the accident.

6.0 Component Maintenance Program

As noted above, the CCACL portion of MERLIN lists trackable components within the Piedmont Airlines maintenance program.

The following notable component items were listed in the recent maintenance history items provided by Piedmont Airlines:

1) 16 May 2013 – Modification/Installation of the TCAS 2000 System, replacement of the Number 2 transponder antenna.
2) 26 April 2013 – Modification/replacement of fasteners on top of both nacelles.

7.0 Minimum Equipment List (MEL)[1]

Piedmont Airlines has an approved MEL program. For the accident flight, the airplane had one open MEL item - MEL 49-1, for the auxiliary power unit (APU) which was recorded in the logbook earlier in the day

As a sub-set of the MEL, Piedmont Airlines has a non-essential furnishings (NEF) list. For the accident airplane, the NEF listed several items, none pertaining to ATA Chapters 32 and 54.

A copy of the open MEL/NEF list was provided to the group.

8.0 Supplemental Type Certificates (STC)[2]

A list of the airplane's Supplemental Type Certificates (STC), were supplied by Piedmont Airlines, and reviewed for items in ATA Chapters 32 and 54. No pertinent items were noted.

9.0 Airworthiness Directive (AD)[3] Summary

An Airworthiness Directive (AD) summary list and AD compliance report were provided by Piedmont Airlines and reviewed by the group. At the time of the accident, all relevant ADs had been complied with.

10.0 Service Difficulty Reports (SDR)[4]

[1] The FAA approved Minimum Equipment List contains a list of equipment and instruments that may be inoperative on a specific aircraft for continuing flight beyond a terminal point.
[2] The FAA issues Supplement Type Certificates, which authorize a major change or alteration to an aircraft, engine or component that has been built under an approved Type Certificate.
[3] Airworthiness Directive (AD) is a regulatory notice sent out by the FAA informing the operator of an action that must be taken for the aircraft to maintain its airworthiness status.

A review of FAA's SDR database regarding the DHC-8 ATA Chapter 32 was conducted by ALPA. The list from the database was provided to the group.

11.0 Vendors

Piedmont Airlines provided a list of all of their approved maintenance vendors.

12.0 Main Landing Gear Uplock Latch Maintenance

The group examined the elements of the maintenance for the main landing gear uplock latches, one per main landing gear.

A visual inspection of the main landing gear uplock actuator latch for wear was conducted as element 4.e of Maintenance Task Card 32-10-02I. The task was accomplished in each of the B checks – B1, B2, B3, and B4. Piedmont conducted a B check every 440 flight hours.

Piedmont also provided the certification of the uplock latch assembly. The certification provided documentation of the last time the worn groove on the uplock latch was measured. The document certified that the latch groove was measured within tolerance; the measurements were not noted on the certification documents. The inspector would have measured the groove using the Messier-Dowty Uplock Assembly Component Maintenance Manual (CMM) instructions. The certification was dated December 9, 2003.

Piedmont indicated that the main landing gear uplock latches were tracked, but only removed on condition.

13.0 Main Landing Gear Uplock Roller Assembly Inspection

In addition to the maintenance and inspection programs detailed in Section 4.0, Piedmont conducted a maintenance task to inspect the main landing gear uplock roller assembly every 220 flight hours. The task was accomplished by Maintenance Task Card 32-10-01L. The card instructions specified that, if the roller was seized or rotation was difficult, lubrication of the roller was required. The inspection of the main landing gear uplock roller assembly was accomplished in maintenance task card element 4.a. and lubrication of the roller was detailed in 4.b, if necessary.

For the accident airplane, Piedmont provided the paperwork associated with the accomplished Maintenance Task Card 32-10-01L. According to the documentation, the uplock roller did not require lubrication for the last 2,723 hours on the left main landing gear and the last 3,369 hours on the right main landing gear.

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[4] A Service Difficulty Report (SDR) is a report of the occurrence or detection of each failure, malfunction, or defect as required by 14 CFR 135.415.

The task card was performed on the left main landing gear on the following dates prior to the accident:

June 14, 2012
July 15, 2012
August 10, 2012
September 27, 2012
November 1, 2012
December 1, 2012
January 1, 2013
January 31, 2013
March 2, 2013
March 29, 2013
April 25, 2013

In all instances, the inspection paperwork indicated that the roller rotated freely and did not require lubrication.

In addition, the airline provided the following information regarding fleet removals of the uplock rollers during the time period from May 2013 to April 2014:

- Number of rollers removed and inspected = 51
- Number of the 51 rollers inspected that had bearings replaced = 10
- Number of the 51 rollers inspected that had seals replaced = 49
- Number of the 51 rollers inspected that had the sleeve replaced = 4

14.0 Alternate Gear Release Functional Checks

According to Piedmont, the most recent alternate gear release functional check on the accident airplane was accomplished as part of the return to service when the landing gear (shock) strut was installed on February 24, 2012. In addition, a functional test of the alternate gear release was accomplished during the last C check, dated May 27, 2011.

The alternate gear release passed both of the functional checks. Based on the documentation, the result of the test should be "that the gear released, no documentation of the force necessary or binding".

15.0 Alternate Gear Release Cable Visual Check

The visual inspection of the alternate release cable was accomplished by use of the following maintenance tasks:

- Maintenance Task 04-44-19I
- Maintenance Task 04-22-61I
- Maintenance Task 04-22-63I
- Maintenance Task 04-55-11I

- Maintenance Task 05-22-33I
- Maintenance Task 05-22-43I

Each of these maintenance tasks were most recently accomplished during the most recent C check, dated May 27, 2011. A copy of the record of each of these inspections was provided to the group. No findings were noted.

16.0 History of In-Flight Use of Alternate Gear Release

Piedmont checked the flight history of the accident airplane, from January 2007 through November 2013, for in-flight use of the alternate gear release system. According to the records, the alternate system was used in-flight once - in April 2009. The system worked as designed. No other use of the alternate system was noted, and, within the checked flight history, there was no mention of the uplock roller assembly.

In addition, Piedmont provided documentation, for the entire fleet, of in-flight use of the alternate gear release system. The documentation covered the time period from January 1, 2010 through May 31, 2013. The alternate gear release was part of the request for records related to ATA Chapter 32. In each case, the alternate gear release system worked as designed.

The group noted, in the flight history information, one other instance of alternate landing gear release in which a seized uplock roller assembly was noted in the corrective action notes. The event involved N912HA on April 7, 2013 and was noted in the database as follows:

> "ON APPROACH RH MLG WOULD NOT EXTEND CREW PERFORMED ALT EXTENSION RESULTING IN 3 GREEN LANDED WITHOUT INCIDENT."

For further information regarding the seized uplock roller removed from airplane N912HA, please see section 19.0.

17.0 Piedmont MRB Level Documentation

According to the Piedmont documentation, on the day of the accident, the Piedmont maintenance program operated per MRB Revision Level 26, dated 9/25/2012.

18.0 Changes Adopted by Piedmont Since Accident

Piedmont provided documentation of the changes made to maintenance and operation since the accident. The changes included:

1. A fleet-wide campaign to accomplish Work Card item/task 32-10-01L, step 4B (Inspect and lubricate roller assembly), successfully completed on all

aircraft by July 23, 2013, as part of Piedmont Planning Items 13-11 and 13-12 (need to define).

2. A fleet-wide campaign to accomplish Maintenance item/task Fleet scheduled for 32-30-09Q (Operational check of alternate extension) successfully completed on all aircraft by August 1, 2013, as part of Piedmont Planning Item 13-13.
3. Revised Work Card 32-10-02I, (Uplock Actuator Inspection), with a reference to the CMM for uplock wear limits. Also added roller inspection to the card. The revision (number 14) was dated September 24, 2013.
4. Piedmont Bulletin 32-59, published October 9, 2013, added to Dowty CMM procedure to add use of dental mold to measure the dimensions of the uplock groove.
5. Created new Work Card 32-10-10L as a stand-alone task to lubricate the uplock roller every 500 hours. Revision One dated January 16, 2014.
6. Revised Work Card 32-10-01L to refer to Aircraft Maintenance Manual for the procedure to lubricate the uplock roller. Revision 14 was published December 12, 2013.
7. Revised Work Card 32-10-02I to refer to AMM for the procedures to lubricate the uplock roller. Revision 15 was dated December 12, 2013.
8. On October 28, 2013, Piedmont issued Flight Information Letter 13-188, which Inspection of MLG rollers on preflight – Piedmont revised the flightcrew and maintenance controller walkaround inspection to include physically checking the freedom of the rollers.

19.0 Seized Roller on Another Piedmont Airplane - N912HA

As noted in Section 16.0, Piedmont provided a listing of the records related to ATA Chapter 32, for the fleet. The listing included a reference to a seized uplock roller removed from N912HA.

Piedmont indicated that, after removal from the airplane, the roller was submitted to the airline's maintenance shop for overhaul. The shop repair worksheet states the inspection "found bearings / seals bad".

Piedmont indicated that, for N912HA, the inspections work card 32-10-01 was accomplished 10 times in the calendar year prior to the alternate gear release event. The dates work card 32-10-01 was accomplished during the year prior were:

17 Mar 2013
14 Feb 2013
15 Jan 2013
16 Dec 2012
15 Nov 2012
10 Oct 2012
08 Sept 2012
10 Aug 2012

05 Jul 2012
27 Apr 2012
02 Apr 2012

In all instances, the paperwork indicated that the roller rotated freely and did not require lubrication.

For the main gear uplock hook on N912HA, it was last inspected at B-check with work card 32-10-02 on 2/5/2013 and no defects were noted.

20.0 Documents Provided to the Group

At the request of the group, Piedmont provided the following documentation:

1. Discrepancy List for N934HA, from January 1, 2013 – May 18, 2013 (from MERLIN)
2. Current Aircraft CCACL
3. Piedmont Airlines MPP
4. Airplane Maintenance Manual (AMM)
5. Piedmont Airlines Air Carrier Certificate and Operating Certificate
6. Last 3 B checks
7. Portions of the last C check, pertaining to ATA Chapters 32 and 54
8. Airworthiness Directive Status and Compliance Reports
9. Service Difficulty Report (SDR) from ALPA
10. MEL/CDL Manual
11. N934HA Damage Report (Piedmont Airlines)
12. Maintenance Inspection Program for DHC-8-100
13. N934HA Major Repairs List
14. MERLIN Report of Discrepancies that cause cancellations or delays for 2013
15. N934HA STC Log
16. Ops Spec of Piedmont Airlines fleet
17. List of all Vendors
18. Open MEL/NEF List (MERLIN)
19. Rotable Parts Tag for Removed Sequencing Valve
20. DMT42 HA-300 from C check
21. Maintenance Task 32-10-02I Documentation
22. Certification of Uplock Latch, Serial Number DCL242/93
23. Maintenance Task 32-10-01L Documentation
24. Maintenance Task 04-44-19I Documentation
25. MRB Amendment Level Documentation
26. Piedmont FIL 13-88
27. Piedmont Bulletin 32-59, Addendum to CMM
28. Maintenance Task 32-20-06X Documentation
29. Discrepancy List of all Alternate extensions, N934HA, 2007-Present
30. Piedmont MLG Lubrication Research
31. DeHavilland MRB Task 3210/01 (August 2007)

32. Piedmont Maintenance Task 32-10-01L, (Revision 13)
33. Piedmont Maintenance Task 32-10-02I, (Revision 12)
34. DeHavilland MRB Task 3210/01 (April 10, 2013)
35. Piedmont Maintenance Task 32-10-02I (Revision 14)
36. Piedmont Maintenance Task 32-30-09Q (Revision 9)
37. Maintenance Task 04-22-61I Documentation
38. Maintenance Task 04-22-63I Documentation
39. Maintenance Task 04-55-11I Documentation
40. Maintenance Task 05-22-33I Documentation
41. Maintenance Task 05-22-43I Documentation

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