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

August 28, 2014

HELICOPTER SPECIALIST'S FACTUAL REPORT

NTSB No: CEN13FA025

A. ACCIDENT

Operator:	Era Helicopters LLC
Aircraft:	AgustaWestland AW139, Registration N385RH
Location:	Houma, Louisiana
Date:	October 22, 2012
Time:	0602 central daylight time

B. HELICOPTER GROUP

Group Chairman:	Chihoon Shin National Transportation Safety Board Washington, District of Columbia
Member:	Ronald Price National Transportation Safety Board Washington, District of Columbia
Member:	Paul White Era Helicopters Lake Charles, Louisiana
Member:	Val Marshall Era Helicopters Lake Charles, Louisiana
Member:	Chris Lemieux AgustaWestland Philadelphia, Pennsylvania
Member:	Bob Hendrickson Federal Aviation Administration Washington, District of Columbia

LIST OF ACRONYMS

AFCS	automatic flight control system
ANSV	Agenzia Nazionale per la Sicurezza del Volo
ATP	acceptance test procedures
ATT	aircraft total time
BEA	Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile
CDT	central daylight time
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
KHUM	Houma-Terrebonne Airport
LA	Louisiana
lbs	pounds
MAU	modular avionics unit
mm	millimeter
NTSB	National Transportation Safety Board
RBI	Rotor Blades Inc.
RII	required inspection item
S/N	serial number

C. SUMMARY

On October 22, 2012, at about 0602 central daylight time (CDT), an AgustaWestland AW139 helicopter, registration N385RH, collided with terrain following a loss of control while the helicopter was being repositioned at Houma-Terrebonne Airport (KHUM) in Houma, Louisiana. Neither of the two pilots on board were injured. The helicopter was substantially damaged. The helicopter was registered to and operated by Era Helicopters LLC and was being operated under the provisions of 14 Code of Federal Regulations (CFR) Part 91 at the time of the accident. Visual meteorological conditions prevailed.

The helicopter was being repositioned from one landing pad to another landing pad about 20 feet away when the accident occurred. According to the flight crew, when the wheels touched down on the ground during the landing, a vertical vibration was felt. Diagnosing the vibration as a possible ground resonance condition, the flying pilot increased the collective; however, the vertical vibration worsened. The pilot positioned the helicopter away from the landing pad, as there was another helicopter being fueled next to it. The pilot made a left pedal turn and was able to set the helicopter down on the grass. The pilot stated the helicopter impacted ground very hard while yawing left.

Examination of the helicopter and its main rotor system components did not reveal a specific fault or anomaly that would have resulted in the severe and sudden vertical vibrations reported by the crew.

D. DETAILS OF THE INVESTIGATION

1.0 HELICOPTER INFORMATION

1.1 HELICOPTER DESCRIPTION

The AgustaWestland AW139 helicopter has a five-bladed[1], fully articulated main rotor system that provides helicopter lift and thrust, and a four-bladed, fully articulated tail rotor system that provides main rotor anti-torque and directional control. The helicopter is equipped with two Pratt & Whitney Canada PT6C-67C turboshaft engines. The AW139 has a dual hydraulic flight control system and the Honeywell Primus Epic integrated avionics system that contains an automatic flight control system (AFCS). The helicopter is type certificated under Federal Aviation Administration (FAA) Type Certificate No. R00002RD.

1.2 HELICOPTER HISTORY

The accident helicopter, serial number (S/N) 410013, had accumulated an aircraft total time (ATT) of 2,063.3 flight hours as of October 22, 2012.

2.0 INVESTIGATION FINDINGS

2.1 HELICOPTER EXAMINATION AT KHUM AND HELI-WORKS

[1] The main rotor blades are color-coded ‘orange’, ‘blue’, ‘red’, ‘black’, and ‘white’, the sequence of which is also their sequence of rotation.

On October 23-26, 2012, representatives from the FAA, Era Helicopters, and AgustaWestland convened at KHUM to examine the accident helicopter. The helicopter was subsequently moved to Heli-Works in Pensacola, Florida. On December 5, 2012, representatives from the NTSB, Era Helicopters, and AgustaWestland convened at Heli-Works to perform additional examinations of the accident helicopter.

Flight control continuity was confirmed from both the pilot's and co-pilot's cyclic and collective control sticks to the main rotor hydraulic actuators. Visual examination of the No. 1 and No. 2 hydraulic systems found no evidence of leaks. Operational checks of the No. 1, No. 2, and auxiliary hydraulic systems revealed no evidence of leaks or anomalous findings. The installation of the main rotor servo actuators were found to be secured and the servo actuators exhibited no evidence of binding when hydraulic power was applied. The damaged floor adjacent to the nose landing gear had restricted movement of the cyclic. When the damaged floor was freed, the cyclic was free to move and did not exhibit any evidence of restricted movement or binding. A check of the force trim in all axes for proper release and actuator centering revealed no anomalous findings.

Examination of the main gearbox attachment points and the anti-torque beam revealed no anomalous findings. The left, right, and top main gearbox chip detectors were inspected for the presence of chips or particles, none of which were observed. The main, intermediate, and tail gearbox oil levels were confirmed to be within proper servicing levels.

A roughness check of the swashplate duplex bearing and a torque check of the attaching components to the rotating swashplate revealed no anomalous findings. The stationary swashplate and scissors were inspected with no evidence of excessive play. A torque check of the main rotor servo actuator connections to the stationary swashplate and the support mounts revealed the connections met the minimum required torque. A torque check was performed for the 12 retaining bolts securing the main rotor head to the main rotor mast. All 12 bolts met the minimum torque.

Examination of the main rotor dampers revealed they were properly serviced and were secured to the main rotor hub and pitch horn. The main rotor dampers were removed from the helicopter and sent to the damper manufacturer, Mecaer Aviation Group in Borgomanero, Italy, for bench testing and further examination. The findings of this examination are discussed in Section 2.2 of this report.

The upper and lower rod ends of the main rotor pitch control links were examined for evidence of excessive axial play of the spherical bearings and for security of the rod end connection. The maximum axial play allowed for the spherical bearings is 0.20 millimeters (mm). The lower rod end of the 'orange' blade pitch control link was found free to rotate about 30 degrees. The upper rod end spherical bearing of the 'blue' pitch control link exhibited 0.30 mm of axial play. The upper rod end spherical bearing of the 'black' pitch control link exhibited 0.25 mm of axial play. The upper rod end spherical bearing of the 'white' pitch control link exhibited 0.25mm of axial play and was free to rotate about 10 degrees, but the locking wire remained intact. No anomalous findings were observed on the remaining upper and lower pitch control link rod ends.

The main rotor blade tension links were inspected with no evidence of damage. The main rotor elastomeric bearings, accommodating blade pitch, flap, and lead-lag motions, were

removed from the tension links and sent to the bearing manufacturer, Paulstra, for further examination and bench testing. The findings of this examination are discussed in Section 2.3 of this report.

The main rotor blade flap limiters were removed from the helicopter and examined. The flap limiter from the 'red' blade exhibited a heavy impact mark at the flap stop pin contact area. The flap limiters from the 'black' and 'white' blades exhibited a moderate impact mark in a similar area. The flap limiters from the 'orange' and 'blue' flap limiters did not exhibit evidence of damage.

The five main rotor blades were examined and found to be intact with no visual evidence of damage to its leading and trailing edges as well as its upper and lower surfaces. The main rotor blades were removed from the helicopter and sent to Bell Helicopter Broussard, formerly Rotor Blades Inc. (RBI), for further examination.

The airframe was visually examined at frame station (STA) 3900 and 5700 (reference **Figure 1**). STA 3900 exhibited no evidence of damage. The right side of STA 5700 exhibited damage consistent with damage from the ground impact; the left side of STA 5700 exhibited no evidence of damage.

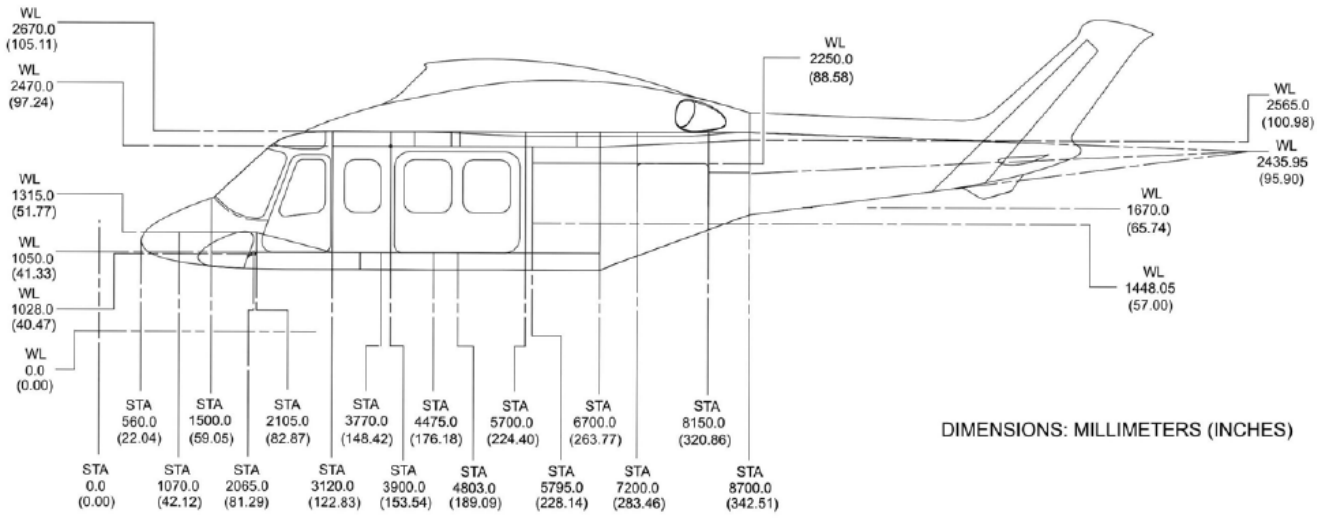

Figure 1. Frame station reference for the AW139. (image courtesy of AgustaWestland)

2.2 MAIN ROTOR DAMPER EXAMINATION AT MECAER AVIATION GROUP

Five main rotor dampers were bench tested and examined at Mecaer Aviation Group under the oversight of the Agenzia Nazionale per la Sicurezza del Volo (ANSV), the Italian aviation accident investigation agency. The examination found that the friction of the hub-side spherical bearing from the 'blue' blade damper (S/N 1602) was beyond the allowable limits. Bench testing under acceptance test procedures (ATP) was performed on all five dampers to map their response to tensile and compressive loads. The bench testing revealed the 'red' blade damper (S/N 1660B) and the 'white' blade damper (S/N 1724B) response curves were out-of-tolerance, specifically in the "knee region" of the ATP response curve.[2] The 'red' blade damper

[2] Pressure relief valves, internal to the damper, open when the external load to the damper reaches a certain value. This allows dampening fluid to flow across the piston, resulting in movement of the damper piston. In the ATP response curve,

was out-of-tolerance in its response to a tensile load while the 'white' blade damper was out-of-tolerance in its response to a compressive load. The manufacturer attributed the out-of-tolerance response to a worn valve seat. The remaining three dampers met the specifications of the ATP response curve. Attachment 1 contains the results from the main rotor damper examination and testing.

2.3 MAIN ROTOR BLADE ELASTOMERIC BEARING EXAMINATION AT PAULSTRA

Five main rotor blade elastomeric bearings were bench tested and examined at Paulstra in Etrepagny, France, under the oversight of the Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA), the French aviation accident investigation agency. The examination revealed no evidence of cracks within the elastomers of each bearing. Attachment 2 contains the results from the main rotor elastomeric bearing examination and testing.

2.4 MAIN ROTOR BLADE EXAMINATION AT ROTOR BLADES INC.

On May 16, 2013, representatives from the NTSB and Era Helicopters convened at Bell Helicopter Broussard in Broussard, Louisiana to examine the main rotor blades. The main rotor blades were visually examined but revealed no evidence of damage or anomalies on the blade surfaces. All five blades were tap tested[3] and no evidence of delamination or disbonding was observed. The blades were weighed on the static balance scale and compared against their weight at the last weighing. Minor changes in weight were observed as seen in **Table 1**. The static balance weight deviations were within limits of what could be compensated by a dynamic track and balance procedure on the helicopter.

Table 1. Main rotor blade weight information.

Blade	Pre-Accident Total Weight (pounds)	Post-Accident Total Weight (pounds)	Change in Total Weight (pounds)	Change in Total Weight (grams)
'Black' S/N P854	146.02 lbs August 10, 2012	146.06 lbs May 11, 2013	0.04 lbs	18.1 grams
'Red' S/N P575	145.19 lbs August 11, 2012	145.23 lbs May 11, 2013	0.04 lbs	18.1 grams
'Blue' S/N P574	145.16 lbs August 11, 2012	145.20 lbs May 11, 2013	0.04 lbs	18.1 grams
'Orange' S/N Q1287	144.89 lbs August 10, 2012	144.90 lbs May 11, 2013	0.01 lbs	4.5 grams
'White' S/N P838	145.88 lbs August 11, 2012	146.02 lbs May 11, 2013	0.14 lbs	63.5 grams

In an effort to determine the reason why the 'white' main rotor blade weight changed more significantly than the remaining four blades, the 'white' main rotor blade was x-rayed by

the "knee region" is the point when the external load results in damper piston movement. The rate of travel of the damper piston is controlled by the rate at which the dampening fluid flows from one side of the damper chamber to the other side of the damper chamber. The damper reacts to both tensile and compressive external loads.

[3] A tap test is a nondestructive inspection method used to detect defects, such as delamination and disbonds. A tap test involves tapping the surface of an adhesive joint with a coin or small hammer and listening for changes in pitch that reveal defects.

RBI for evidence of water accumulation or other anomalies, none of which were found. The reason for the weight change on the 'white' main rotor blade could not be determined in this investigation.

2.5 EXAMINATION AND TESTING OF MODULAR AVIONICS UNITS AT HONEYWELL AEROSPACE

Two modular avionics units (MAU), each containing two actuator input/output processors (AIOP), from the AFCS were removed from the helicopter and sent to Honeywell Aerospace for testing.[4] On December 3-4, 2013, representatives from the NTSB, Era Helicopters, and Honeywell convened at Honeywell facilities in Phoenix, Arizona to examine and bench test the four MAUs. Examination found the four MAUs to be in overall good condition. Bench testing found no evidence of pre-existing conditions that would have prevented proper operation during the accident flight. Attachment 3 contains Honeywell's examination report for the MAUs.

3.0 RECENT MAINTENANCE PERFORMED ON N385RH

According to the helicopter logbook records, on October 18, 2012 (ATT 2,062.2 flight hours) the 'orange' and 'white' main rotor pitch control links were adjusted, the required inspection item (RII) was complied with, and the pitch control links were safety wired. A maintenance check flight (also known as an "ops check flight") was subsequently performed due to the main rotor pitch control link adjustment and a re-indexing of the No. 2 tail rotor drive shaft. The ops check flight was signed off the same day as being "complete and satisfactory."

On October 21, 2012 (ATT 2,063.1 flight hours), the 'blue' main rotor blade damper (S/N 10568) was removed and replaced due to a reported leakage. Damper S/N 1602 was subsequently installed in the 'blue' main rotor blade position. An ops check flight was subsequently performed due to the main rotor damper replacement. The ops check flight was subsequently signed off as being "satisfactory" on October 22, 2012. The flight crew from the maintenance check flight stated that they felt a slight vibration from the main rotor system during the check flight; the flight crew attributed the vibration to a slightly out-of-track main rotor blade. There was no record of the main rotor blade out-of-track discrepancy, nor was there a main rotor blade track and balance performed subsequent to the ops check flight.

Attachment 4 contains the helicopter logbook records from October 17, 2012 to October 22, 2012.

Chihoon Shin
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[4] The four AIOPs were part number 7029194-1901 and consisted of S/N 07010735, S/N 05100394, S/N 07020813, and S/N 06080596.