Aviation Investigation Final Report

Location:	Houma, Louisiana	**Accident Number:**	CEN13FA025
Date & Time:	October 22, 2012, 06:02 Local	**Registration:**	N385RH
Aircraft:	AGUSTA SPA AW139	**Aircraft Damage:**	Substantial
Defining Event:	Unknown or undetermined	**Injuries:**	1 Serious, 1 None
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The flight crew was repositioning the helicopter to another landing pad when the accident occurred. According to the flight crew and flight data recorder (FDR) data, as the helicopter was touching down, it began to experience severe vertical vibrations and to oscillate violently. The pilot reported that he lowered the collective but that the vibrations and oscillations intensified. The pilot then increased the collective to lift the helicopter off the ground. The helicopter became airborne, but the violent oscillations and vibrations continued. The pilot initiated a left pedal turn to avoid another helicopter, at which time, the oscillations and vibrations were so severe that the pilots' headsets came off of their heads. The helicopter entered a spin and impacted the grass hard while moving laterally to the left. The pilots shut down and then exited the helicopter.

The blue main rotor blade damper was replaced the night before the accident. A maintenance test flight was performed following the replacement. The flight crewmembers who flew the test flight reported that there was a slight vibration from the main rotor system and that one of the five main rotor blades had a "slight dip" in its track. There was no record of the main rotor blade out-of-track discrepancy nor of a main rotor track and balance inspection being performed subsequent to this flight. Although an out-of-track blade could cause a persistent vertical vibration, an examination of the main rotor blades, elastomeric bearings, main rotor dampers, main rotor rod ends, main gearbox attachment points and antitorque beam, and automatic flight control system did not reveal any anomalies that could account for the vertical vibrations reported by the flight crew and recorded on the FDR.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The helicopter's sudden and severe vertical vibrations during landing, which resulted in a collision with terrain. The reason for the helicopter's sudden and severe vertical vibrations could not be determined during postaccident examinations.

Findings

Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Landing-flare/touchdown	Unknown or undetermined (Defining event)
Landing-flare/touchdown	Loss of control on ground
Landing-flare/touchdown	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On October 22, 2012, at 0602 central daylight time, an Agusta SPA AW139 helicopter, N385RH, collided with the terrain following a loss of control while the helicopter was being repositioned on the Houma-Terrebonne Airport (HUM), Houma, Louisiana. One of the airline transport rated pilots was not injured and the other suffered a serious injury. 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 Part 91 at the time of the accident. Visual meteorological conditions prevailed.

The accident flight crew reported they performed an aircraft preflight and reviewed the maintenance logbook prior to moving the helicopter outside to the A-5 pad. They completed the run-up and power/trend checks after which they lifted the helicopter off the ground and hovered laterally to center the helicopter on the pad. They then shut down the helicopter. Shortly after shutting down the helicopter, they were asked to move the helicopter to another pad. They started the helicopter once again, and the left seat pilot lifted the helicopter, hovered backwards, and made a right pedal turn to hover taxi to the pad.

The pilot lined the helicopter up over the edge of the pad and began a descent while moving forward. He lowered the helicopter and the main wheels touched down. He stated he was not sure if the nose wheel had fully touched down, but the helicopter began to "oscillate violently." The pilot stated he continued to lower the collective, but the vibrations and oscillations intensified. Initially thinking that they had encountered ground resonance, the pilot increased the collective to lift the helicopter off the ground. The helicopter became airborne, and the violent oscillation and vibration continued. The pilot stated he was able to move the helicopter rearward and to the left away from another helicopter that was being fueled. He initiated a left pedal turn at which time the oscillations and vibrations were so severe that the pilots' headsets came off of their heads. The helicopter entered a spin and impacted the grass hard while moving laterally to the left. The pilots shut down the helicopter and both were able to exit the helicopter on their own.

Numerous witnesses saw and heard the helicopter during the accident sequence. The witnesses described hearing an unusual noise that was described as "a compressor stall", a "whop, whop, whop", and a pulsing/surging sound. The witnesses stated the helicopter rose to an altitude between 20 and 70 feet above the ground and spun violently to the left. They stated the helicopter then descended and impacted the ground in an upright attitude.

PERSONNEL INFORMATION

The pilot-in-command held an airline transport pilot certificate with a helicopter rating. The pilot-in-command was type rated in Agusta AW139 helicopters. He was issued a first class airman medical certificate with no limitations on February 29, 2012. According to ERA the pilot had a total flight time of 3,153 hours of which 257 hours were in Agusta AW139 helicopters.

The pilot-in-command completed his initial AW139 ground school training with ERA Helicopters on February 23, 2012. He completed his initial AW139 checkride with ERA Helicopters on February 29, 2012, and his most recent proficiency check was on June 6, 2012.

The co-pilot, who was the pilot flying when the accident occurred, held an airline transport pilot certificate with multi-engine and helicopter ratings and commercial privileges for airplane single-engine land and airplane single-engine sea. a commercial pilot certificate with single-engine land and single-engine sea airplane ratings. He held a flight instructor certificate with a single-engine land, multi-engine land, helicopter, and instrument ratings. The pilot held a type rating in Sikorsky S-61 helicopters. He was issued a first class airman medical certificate with near vision limitations on March 22, 2012. According to ERA Helicopters, the pilot had a total flight time of 7,340 hours. He had a total rotorcraft time of 6,711 hours of which 25 hours were in Agusta AW139 helicopters.

The co-pilot completed his initial AW139 ground school training with ERA Helicopters on February 1, 2012. He completed his initial AW139 checkride with ERA Helicopters on March 17, 2012, and his most recent proficiency check was on August 5, 2012.

AIRCRAFT INFORMATION

N385RH was an AgustaWestland AW139, serial number (s/n) 410013. The helicopter had a total time of 2,063.3 flight hours at the time of the accident. The helicopter had a five-bladed, fully articulated main rotor system that provides lift and thrust, and a four-bladed, fully articulated tail rotor system that provides main rotor anti-torque and directional control. The helicopter was equipped with two Pratt & Whitney Canada PT6C-67C turboshaft engines. The helicopter had a dual hydraulic flight control system and the Honeywell Primus Epic integrated avionics system that contained an automatic flight control system (AFCS).

On October 18, 2012, at a helicopter total time of 2,062.2 hours, the "orange" and "white" main rotor pitch control links were adjusted. An operational check flight was conducted and the flight was signed off as being "complete and satisfactory."

On the night prior to the accident, the helicopter underwent maintenance during which "blue" main rotor damper, s/n 10568 was removed due to a reported leak. Damper s/n 1602 was installed in the "blue" main rotor blade position. An operational check flight was conducted following the maintenance. The crew from this flight stated there was a slight vibration from the main rotor. They returned to the maintenance base where they landed and shut down the helicopter. They stated that they were able to see that one of the blades had a "slight dip" in its track which they attributed to have been the cause of the vibration. They stated they informed maintenance personnel that the flight was satisfactory, and of the slight vibration and blade dip. The crew stated the helicopter was then towed into the hangar. There was no written record of the crew reporting a main rotor blade out-of track discrepancy, nor was there a main rotor track and balance performed subsequent to the operational check flight.

METEOROLOGICAL INFORMATION

At 0555, the HUM airport Automated Weather Observing System (AWOS) recorded the weather conditions as: wind 070 degrees at 3 knots; visibility 10 miles; clear sky; temperature 13 degrees Celsius; dewpoint 13 degrees Celsius; and altimeter 30.07 inches of mercury.

FLIGHT RECORDERS

Cockpit Voice Recorder (CVR)

The helicopter was equipped with a Penny & Giles MPFR combination flight data recorder and CVR. The solid state CVR recorded 2 hours of digital cockpit audio. The CVR was removed from the helicopter and sent to the NTSB Recorders Laboratory for the audio information to be extracted. The 2-hour recording contained several power interruptions, causing discontinuity in the time scale. As such, multiple correlations with the flight data recorder (FDR) were accomplished. The recording did contain a period of mechanics working on the helicopter, a maintenance test flight, movement of the helicopter out of the hangar, a repositioning flight, and the accident flight.

A partial transcript of the maintenance test flight was developed from the recording. The recording began at 0023:33 and ended at 0048:15. During the flight, the crew discussed the blade tracking issue stating it the helicopter had a "hop" to it and that they could "see it in the blades." The crew stated it looked like a track problem and they speculated that someone probably bumped trim tab.

After landing, the crew was heard having a discussion with a mechanic. The crew informed the mechanic that there was one blade that was "pretty good out of track." The stated it wasn't a damper problem and that it was just one blade. The crew then stated the operational check flight was complete and satisfactory.

At about 0537, the accident crew lifted-off the reposition the helicopter to another landing pad. Prior to the lift-off, the performed various preflight checks, started the engines, and performed the engine run checks. After shutting down the helicopter, the crew voices became distant, as if they had departed the helicopter. The CVR reordered an unidentified voice asking the crew to move the helicopter to a different landing pad. The crew agreed to reposition the helicopter.

At 0552:42, the crew began the process of starting the helicopter. The crew is heard running a checklist and starting the engines. The crew discussed that the second-in-command (SIC) would fly the helicopter. The crew communicated that the area was clear as the helicopter lifted off and maneuvered to the landing pad. As the crew is setting the helicopter down there is a rattling sound that increased in intensity. The recording continued with the crew struggling to maintain control of the helicopter as several aural warnings are sounded. The warnings included "rotor low", "rotor high", bank angle, and tail too low warnings. At 0602:02 the sound of the ground impact was recorded.

Sound Spectrum Study

A sound spectrum study was performed to examine the low frequency sound spectrum related to the main rotor operation. The AW139 helicopter is equipped with a 5-bladed main rotor system. When operating at 100% rotor speed (Nr), the rotor generated a 24.7 Hz frequency, and when operating at 102% Nr, the rotor generated a 25.2 Hz frequency. Two periods of sound recorded from the cockpit area

microphone (CAM) were examined, one from the maintenance test flight and the other from the accident flight.

The 19.133 second period of sound from the maintenance test flight was extracted from the CAM and three time periods, designated as A, B, and C, of that recording were examined. Period B showed 5 distinct peaks at approximately 5 Hz intervals to about 25. 2 Hz. Period C showed peaks similar to Period B, but of less intensity. Period A peaks were less defined compared to Periods B and C and were generally spaced less than 5 Hz.

The 6.247 second period of sound from the maintenance test flight was extracted from the CAM and three time periods, designated as A, B, and C, of that recording were examined. Period A showed a distinct peat at about 24.7 Hz. Periods B and C showed distinct frequency peaks below 25 Hz.

Flight Data Recorder (FDR)

The helicopter was equipped with a Penny & Giles MPFR combination flight data and cockpit voice recorder. The FDR recorded flight data in a digital format using solid-state memory chips as the recording medium. The FDR recording contained approximately 25 hours of data. The accident flight was recorded and its duration was about 3 minutes.

The FDR revealed no unusual indications from the recorded parameters until immediately before the weight-on-wheels switch activated, when a vertical oscillation was recorded which gradually increased in amplitude. The data also showed lateral and longitudinal accelerations simultaneous to the vertical oscillation, but the lateral and longitudinal accelerations were not as frequent or as severe as the vertical oscillations.

TESTS AND RESEARCH

On October 23-26, 2012, representatives from the FAA, Era Helicopters, and AgustaWestland convened at HUM 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 was found to be secure and the servo actuators exhibited no evidence of binding when hydraulic power was applied. Damage to the floor structure adjacent to the nose landing gear restricted movement of the cyclic control. However, when the damaged floor was cleared, the cyclic was free to move and did not exhibit any evidence of restricted movement or binding. A check of the 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 requirement.

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 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. The 'red' blade damper 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. The damper checks listed above are not field inspections and can only be conducted during a shop level inspection at eh manufacturer.

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 during a scheduled AW139 IETP 150 hour measurement check is 0.20 millimeters (mm). The lower rod end of the 'orange' blade pitch control link was found free to rotate about 30 degrees, but the locking wire was observed to be intact. 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 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.

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.

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 and revealed no evidence of damage or anomalies on the blade surfaces. All five blades were tap tested 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. The static balance weight deviations were within limits of what could be compensated by a dynamic track and balance procedure on the helicopter.

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 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.

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. 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 good condition. Bench testing found no evidence of pre-existing conditions that would have prevented proper operation during the accident flight.

Pilot Information

Certificate:	Airline transport	**Age:**	38
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	February 29, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 6, 2012
Flight Time:	3153 hours (Total, all aircraft), 257 hours (Total, this make and model), 1840 hours (Pilot In Command, all aircraft), 105 hours (Last 90 days, all aircraft), 26 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	56
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	March 22, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 21, 2012
Flight Time:	7340 hours (Total, all aircraft), 25 hours (Total, this make and model), 5375 hours (Pilot In Command, all aircraft), 60 hours (Last 90 days, all aircraft), 15 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	AGUSTA SPA	**Registration:**	N385RH
Model/Series:	AW139	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	41013
Landing Gear Type:	Retractable - Tricycle	**Seats:**	
Date/Type of Last Inspection:	October 14, 2012 Continuous airworthiness	**Certified Max Gross Wt.:**	14994 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo shaft
Airframe Total Time:	2063 Hrs at time of accident	**Engine Manufacturer:**	P&W CANADA
ELT:	Installed, not activated	**Engine Model/Series:**	PT6C-67C
Registered Owner:	ERA HELICOPTERS LLC	**Rated Power:**	2000 Horsepower
Operator:	ERA HELICOPTERS LLC	**Operating Certificate(s) Held:**	On-demand air taxi (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dawn
Observation Facility, Elevation:	KHUM,9 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	05:55 Local	**Direction from Accident Site:**	0°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots / None	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	70°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.06 inches Hg	**Temperature/Dew Point:**	13°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Houma, LA (KHUM)	**Type of Flight Plan Filed:**	None
Destination:	Houma, LA (KHUM)	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class D

Airport Information

Airport:	Houme-Terrebonne Airport KHUM	**Runway Surface Type:**	
Airport Elevation:	9 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Serious, 1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious, 1 None	**Latitude, Longitude:**	29.559999,-90.666114(est)

Administrative Information

Investigator In Charge (IIC):	Sullivan, Pamela
Additional Participating Persons:	Robert Hendrickson; FAA-AVP-100; Washington DC, DC Jonathan Conrad; ERA Helicopters; Lake Charles, LA John Eller; Honeywell; Phoenix, AZ Paul White; ERA Helicopters; Lake Charles, LA Val Marshall; ERA Helicopters; Houma, LA Chris Lemieux; Agusta Westland; Philadelphia, PA Marco Terzi; AgustaWestland Gregory Smith; ERA Helicopters; Lake Charles, LA Luigi Candiami; AgustaWestland
Original Publish Date:	June 1, 2015
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=85405