Aviation Investigation Final Report

Location:	Houma, Louisiana	**Accident Number:**	CEN22LA430
Date & Time:	September 24, 2022, 18:11 Local	**Registration:**	N811TA
Aircraft:	Agusta AW139	**Aircraft Damage:**	Substantial
Defining Event:	Electrical system malf/failure	**Injuries:**	6 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The on-demand passenger flight was in cruise flight when the flight crew and passengers smelled a "burning plastic" odor throughout the helicopter. The flight crew did not observe any smoke, confirmed that there were no abnormal cockpit indications, and that the helicopter exhibited normal flight characteristics.

A few minutes later there was a loud "whoof" sound accompanied by smoke emanating from the aft portion of the overhead circuit breaker panel. Within a few seconds the cockpit was engulfed with a "thick orange/brown smoke" that resulted in "zero visibility" in the cockpit. The flight crew simultaneously received a rotor low audio warning with a rapid overspeed of both engines and observed an upward movement of the collective control and a left movement of the cyclic control.

The flight crew was able to clear the cockpit of smoke, but the cyclic and collective controls required significant force to keep in position. The flight crew reported that their "full body weight" was required to keep the collective control down, but the helicopter did not descend or decrease its airspeed with the collective control down. The helicopter climbed a total of 3,500 to 4,000 ft before the flight crew forcibly pushed the cyclic control forward, which caused the helicopter to descend at a higher-than-normal airspeed.

After the helicopter arrived over the intended destination, the flight crew conducted a high airspeed descent while orbiting the airport to verify flight controllability and to have the tower controller confirm that the landing gear was extended. The flight crew was unable to control engine power in manual mode using the switches on the collective control, and they resorted to using the engine mode switches on the lower console panel to alternate between flight and idle modes. The flight crew decided that an autorotative landing would be the only way to reduce the helicopter's airspeed to a safe landing speed.

Ultimately, the flight crew began a descent from 400 ft above ground level (agl) while progressively decreasing the helicopter's airspeed by alternating the No. 1 engine between flight and idle modes, with the No. 2 engine selected to idle. The helicopter descended to about 50 ft agl and decelerated to an airspeed where an autorotation was conducted with both engines at idle. The helicopter landed on the runway with forward airspeed, skidded off the right side of the runway into a grass area, and came to stop upright. The flight crew and 4 passengers evacuated the helicopter uninjured. The helicopter's airframe sustained substantial damage when the main landing gear collapsed during the hard landing.

Examination of the helicopter revealed misrouted electrical wiring that abraded against a collective control torque tube (C3 torque tube). The wiring was chafed sufficiently that an electrical short started a localized fire, which resulted in thermal damage to the C3 torque tube and the eventual loss of collective control continuity. The inflight loss of collective control required the flight crew to use only the cyclic and engine controls to descend the helicopter.

Additional examination revealed that the left-side wiring support strip assembly, part number (p/n) 3P5315A10531, was incorrectly manufactured with its plastic electrical mounts, used to secure electrical wiring, on the upper side of the metal strip, instead of the lower side. Consequently, the incorrect location of the plastic electrical mounts misrouted the electrical wiring above the support strip, instead of under the strip, and to abrade with the metal rivets installed in the C3 torque tube. Although it did not contribute to the accident, the examination revealed the right-side wiring support strip assembly, p/n 3P5315A12931, was also incorrectly manufactured with its plastic electrical mounts on the upper side of the metal strip; however, unlike the left-side support strip, there was no evidence of chafed wiring.

These incorrectly manufactured wiring support strip assemblies were installed during the assembly of the accident helicopter, about 11 years and nearly 7,500 flight hours before the accident. When the helicopter was assembled, the manufacturing drawing for the left-side wiring support strip, only provided a single planform view of the assembly. The lack of additional views in the drawing for the left-side strip assembly allowed for ambiguity on which side of the metal strip the plastic electrical mounts should be installed. However, the manufacturing drawing for the right-side wiring support strip assembly contained two views, including one that showed the correct orientation of the plastic electrical mounts. Despite having an adequate drawing, the right-side wiring support strip was still incorrectly assembled with the plastic electrical mounts on the incorrect (upper) side of the metal strip. As such, the wiring support strip manufacturer's inadequate quality control of the assembled wiring support strips contributed to the accident.

The helicopter manufacturer's assembly facility contained job cards that included installation instructions for the wiring support strip assemblies and the electrical wires to their respective plastic electrical mounts. These job cards showed the correct routing for the electrical wires under the metal strip. However, there was no specific assembly instruction on the correct routing of the electrical wires. Except for circumstances in which an experienced production line technician would identify the wire routing discrepancy between the job card image and the incorrectly manufactured strip assembly, there was no instruction to ensure that the wire routing went under the strip assembly.

A review of the required scheduled inspections of the helicopter showed that while the operator completed the expected inspections of the flight controls, none of the required inspections would have caught misrouting of the electrical wiring as it was not a specified inspection task. Because these scheduled inspections found no evidence of damage or chafing of the flight controls in the vicinity of the misrouted electrical wiring, it is likely that the electrical wiring maintained sufficient clearance for most of the accident helicopter's service life. The wiring clearance was lost, for unknown reasons, closer to the date of the accident and, thus, the operator's ability to identify that the misrouted electrical wires were abrading with the C3 torque tube would be up to chance. Therefore, it is unlikely that the operator's scheduled inspections would have reliably detected the misrouted wires and/or their progressive chafing.

As result of the accident investigation, the helicopter manufacturer issued an emergency alert service bulletin to require inspections of the forward cabin roof ceiling wiring harnesses and their installation to identify potential wire chafing conditions. The European Union Aviation Safety Agency (EASA) and Federal Aviation Administration (FAA) subsequently issued airworthiness directives requiring operators to comply with the helicopter manufacturer's emergency alert service bulletin.

Additionally, following the accident, the helicopter manufacturer modified their drawings for the wiring support strip assemblies as well as the production-line job cards to include additional views that show the correct location of the plastic electrical mounts as well as verification of the electrical wire routing after installation of the strip assemblies. These safety actions should adequately prevent against incorrect manufacture of the strip assemblies and thus ensure proper routing of the electrical wires such that they cannot contact the flight controls.

Probable Cause and Findings

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

The inflight loss of collective control of the helicopter due to thermal damage of a collective control torque tube that abraded with misrouted electrical wiring, which resulted in an electrical short and inflight fire.

Contributing to the accident were the incorrectly manufactured wiring support strip assembly that misrouted electrical wires near the collective control torque tube, the ambiguity of the support strip assembly drawing that allowed for its incorrect manufacturing, the inadequate quality control processes to identify the incorrectly manufactured support strip assembly, and the helicopter manufacturer's inadequate assembly instructions that allowed the misrouting of the electrical wiring, due to the incorrectly manufactured strip assembly, on the helicopter production line.

Findings

Organizational issues	Equipment manufacture - Manufacturer
Organizational issues	Document/info verification - Manufacturer
Aircraft	DC power distribution system - Damaged/degraded
Aircraft	Main rotor control - Damaged/degraded

Factual Information

History of Flight

Prior to flight	Miscellaneous/other
Enroute-cruise	Electrical system malf/failure (Defining event)
Enroute-cruise	Fire/smoke (non-impact)
Enroute-cruise	Flight control sys malf/fail
Landing	Off-field or emergency landing
Landing-flare/touchdown	Hard landing

On September 24, 2022, about 1811 central daylight time, an Agusta AW139 helicopter, N811TA, was substantially damaged when it was involved in an accident near Houma, Louisiana. The pilot, co-pilot, and 4 passengers were not injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 135 passenger flight.

According to a statement provided by the flight crew, about 7 minutes before arriving at Houma-Terrebonne Airport (HUM), Houma, Louisiana, the flight crew and passengers smelled a "burning plastic" odor throughout the helicopter. The flight crew observed no smoke in the cockpit or cabin, confirmed that there were no abnormal cockpit indications, and that the helicopter exhibited normal flight characteristics. The flight crew decided to turn off the air conditioning in case it was the source of the odor.

The flight crew reported that a few minutes later there was a loud "whoof" sound accompanied by smoke emanating from the aft portion of the overhead circuit breaker panel. Within a few seconds the cockpit was engulfed with a "thick orange/brown smoke" that resulted in "zero visibility" in the cockpit. The flight crew simultaneously encountered a rotor low audio warning with a rapid overspeed of both engines and observed an upward movement of the collective control and a left movement of the cyclic control.

The left-seat-pilot was unable to clear the smoke from the cockpit by opening the small ventilation window on the left-side cockpit door. The left-seat-pilot was also unable to open his cockpit door due the helicopter's airspeed; however, he was able to remove the left-side cockpit window, which cleared the smoke from the cockpit.

After the smoke cleared from the cockpit, the flight crew pushed down the collective control and the cyclic control was pushed forward and to the right. The flight crew reported that both the cyclic and collective controls required significant force to keep in position. The power index (PI) was about 145% on both engines with the collective control full down, and the main rotor speed (NR) was slow to accelerate above 83% but it eventually recovered to 100%.

The helicopter rapidly climbed a total of 3,500 to 4,000 ft because the flight crew was unable to establish a descent using normal flight control inputs. The flight crew attempted to establish a descent by selecting one of the engines to idle using the engine mode switches on the lower console panel, but the NR quickly decreased from 100% to the upper 70s. The engine at idle was returned to a flight condition using the engine mode switch. The flight crew reported that "full body weight" was required to keep the collective control down, but the helicopter did not descend or decrease its airspeed with the collective control down. The flight crew noted that the only way to get the helicopter to descend was to forcibly push the cyclic control forward, but the helicopter descended at 170 to 186 knots indicated airspeed (KIAS).

The left-seat-pilot declared an emergency with the tower controller at HUM and requested fire and emergency medical services be notified. The flight crew then briefed the passengers about the emergency.

After the helicopter arrived over HUM, the flight crew conducted a high-airspeed descent from 6,000 ft to 1,000 ft, where an orbit of the airport was flown to verify flight controllability and to have the tower controller confirm that the landing gear was extended. The tower controller confirmed that the landing gear was extended. As the helicopter orbited the airport, the flight crew was unable to control engine power in manual mode using the switches on the collective control. The flight crew then attempted to reduce the helicopter's airspeed by reducing the No. 2 engine to idle using the engine mode switch on the lower console. With the No. 2 engine selected to idle the helicopter decelerated to about 140 KIAS with the No. 1 engine at maximum continuous power. The flight crew then decided that an autorotative landing would be the only way to further reduce the helicopter's airspeed to a safe landing speed.

On the first landing approach, the flight crew aligned the helicopter with the runway 36 centerline at 140 KIAS with the No. 1 and No. 2 engines in flight and idle modes, respectively. The No. 1 engine was selected to idle to further reduce airspeed for landing, but the NR rapidly decreased from 100% to about 75% before the flight crew selected the No. 1 engine to flight mode and a go-around was completed.

On the second landing approach, the flight crew began the descent from 400 ft agl while progressively decreasing the helicopter's airspeed by alternating the No. 1 engine between flight and idle modes with the No. 2 engine still selected to idle. Consistent with the first landing approach, NR rapidly decreased with both engines selected to idle; however, during the second approach, when NR decreased to about 70% the No. 1 engine was returned to flight mode until NR increased to 85% when the No. 1 engine was selected back to idle. By alternating the No. 1 engine between flight and idle modes, the helicopter descended to about 50 ft agl and decelerated to an airspeed where an autorotation was conducted with both engines at idle. The helicopter landed on the runway with forward airspeed and skidded off the right side of the runway into a grass area.

After the helicopter came to a stop upright, the right-seat-pilot applied the rotor brake, which stopped both rotors and the left-seat-pilot turned off all fuel and electrical switches. After ensuring that the passengers had safely egressed the helicopter, the flight crew noted that both engines were still running. The engines were shut down by moving the overhead engine control levers to the full off position.

Pilot Information

Certificate:	Airline transport	**Age:**	32,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	November 24, 2021
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 4, 2022
Flight Time:	(Estimated) 2160 hours (Total, all aircraft), 480 hours (Total, this make and model)		

Co-pilot Information

Certificate:	Airline transport	**Age:**	35,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	July 18, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 16, 2022
Flight Time:	(Estimated) 3706 hours (Total, all aircraft), 218 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Agusta	**Registration:**	N811TA
Model/Series:	AW139	**Aircraft Category:**	Helicopter
Year of Manufacture:	2011	**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	41269
Landing Gear Type:	Retractable - Tricycle	**Seats:**	14
Date/Type of Last Inspection:	August 24, 2022 Continuous airworthiness	**Certified Max Gross Wt.:**	14992 lbs
Time Since Last Inspection:	100.3 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	7491 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	C126 installed, not activated	**Engine Model/Series:**	PT6C-67C
Registered Owner:	Era Helicopters LLC	**Rated Power:**	1100 Horsepower
Operator:	Era Helicopters LLC	**Operating Certificate(s) Held:**	On-demand air taxi (135)

Helicopter Assembly Tasks and Manufacturing Job Cards

The helicopter was assembled at the AgustaWestland facility in Philadelphia, Pennsylvania, in 2011. The assembly task job cards active at that time were originally issued in 2007.

When the helicopter was assembled, the Completion and Finishing of Power C/A Card, No. 3G0630A04112C4R, contained instructions on the installation and routing of electrical power cables from the cockpit nose area to the cabin roof and subsequently to the power distribution panels. Figure 1 is a drawing excerpt from the job card depicting the cable routing in the cabin roof.

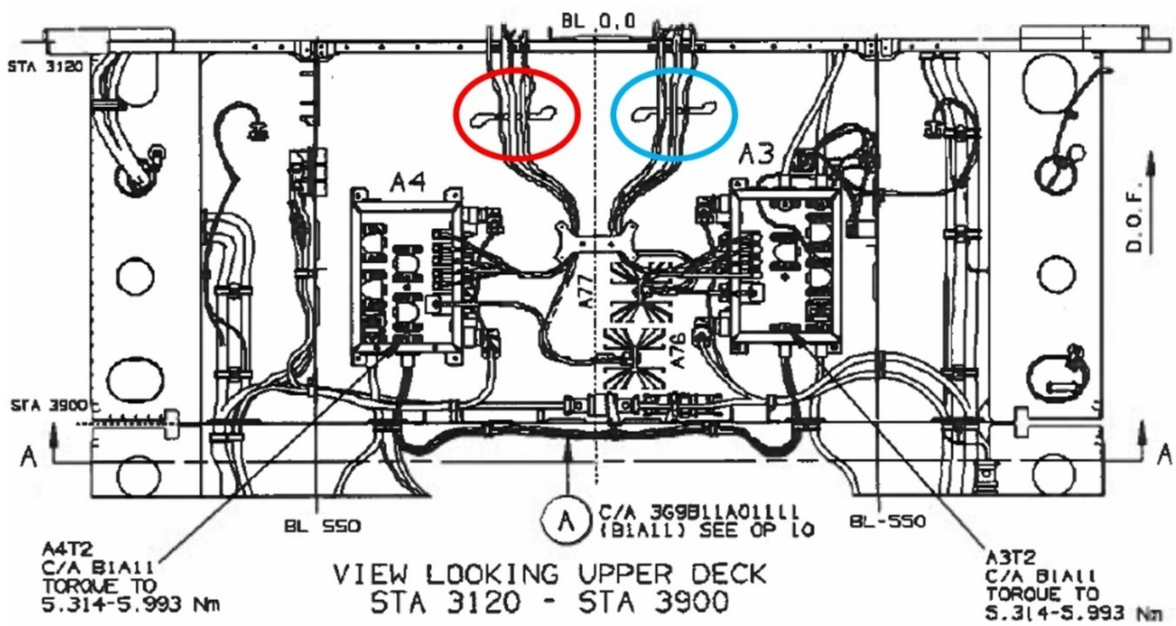

Figure 1. A drawing excerpt from the "Completion and Finishing of Power C/A Card" showing the power cable routing on the cabin roof with left and right wiring support strip assemblies.(Courtesy of Leonardo Helicopters, modified by NTSB)

The assembly cards contained views of the left and right wiring support strip assemblies installed with power cables routed through them. In the views looking upwards (from within the cabin), the power cables were depicted as solid lines with the strip assemblies as solid lines behind them, implying that routing of the power cables were under the strip assemblies, as shown in Figure 2 and Figure 3. The shape of the left and right strip assemblies was identical on the assembly job card, despite the right strip assembly being a different shape than the left strip assembly. The assembly job cards provided no specific instruction to verify that the power cables were routed underneath the strip assemblies.

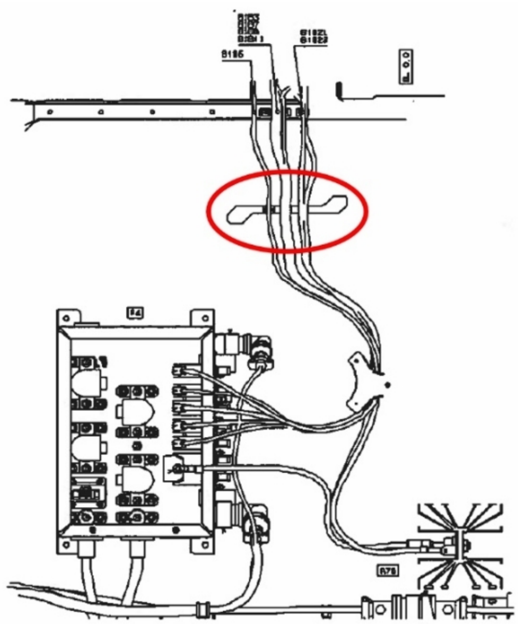

Figure 2. A detail excerpt from the Completion and Finishing of Power C/A Card showing the power cable routing under the right strip assembly. (Courtesy of Leonardo Helicopters, modified by NTSB)

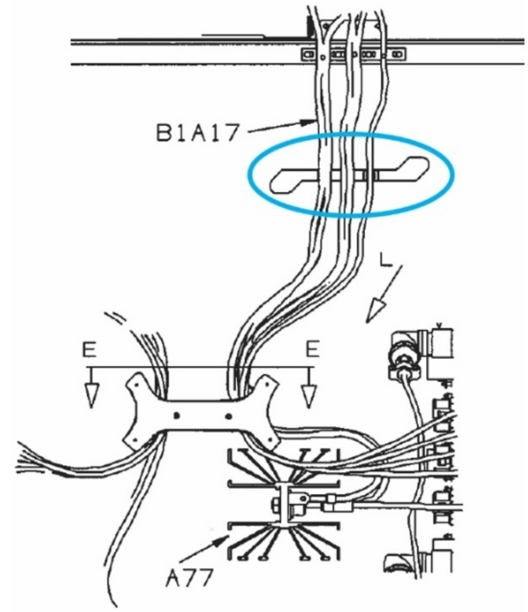

Figure 3. A detail excerpt from the Completion and Finishing of Power C/A Card showing the power cable routing under the left strip assembly. (Courtesy of Leonardo Helicopters, modified by NTSB)

When the helicopter was assembled, the Closings After Rain-Test Card, No. 41269352, did not include any diagrams or photos of the wiring assembly nor did it provide instructions regarding inspection of the wiring in the overhead panel.

The 3NB Pax Ceiling Panels Closeout Card, version 5, replaced the Closings After Rain-Test Card. The task card also did not include any diagrams or photos of the wiring assembly, nor any instructions regarding overhead wiring.

On December 20, 2014, after the helicopter was assembled, the 3NB Pax Ceiling Panels Closeout Card was updated to version 8, and included two installation diagrams, shown below as Figure 4 and Figure 5.

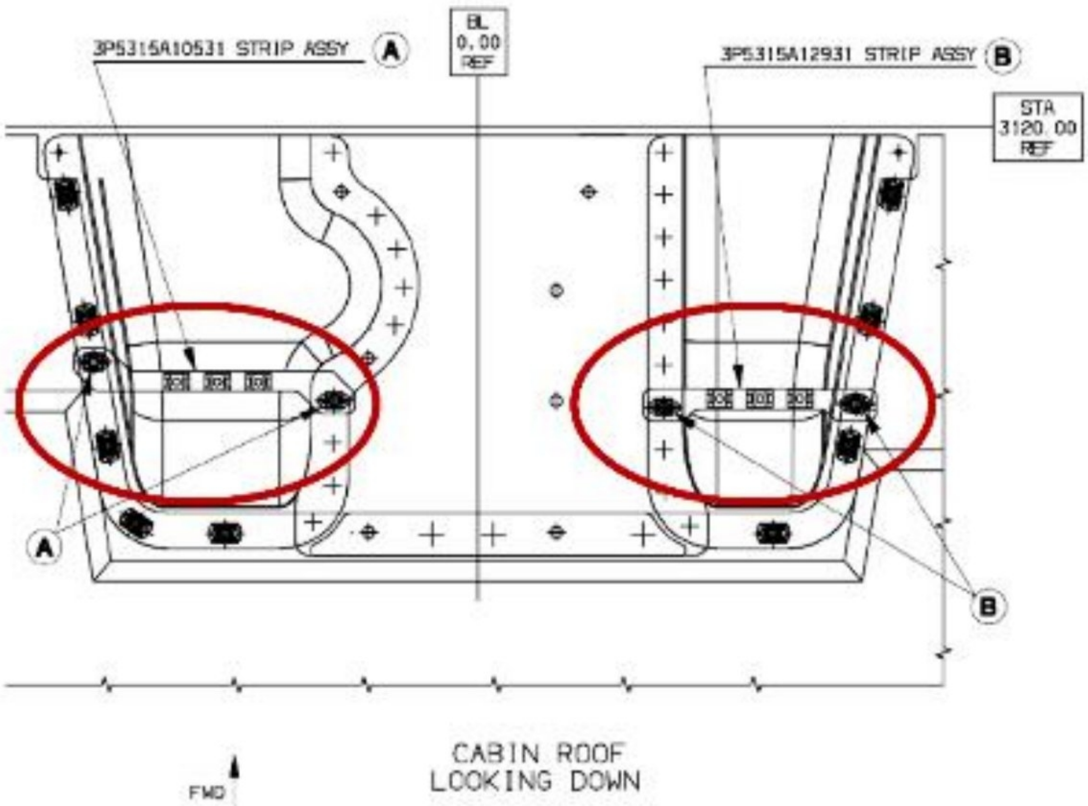

Figure 4. Diagram from 3NB Pax Ceiling Panel Closeout Job Card (Red ellipses were added for emphasis by NTSB)

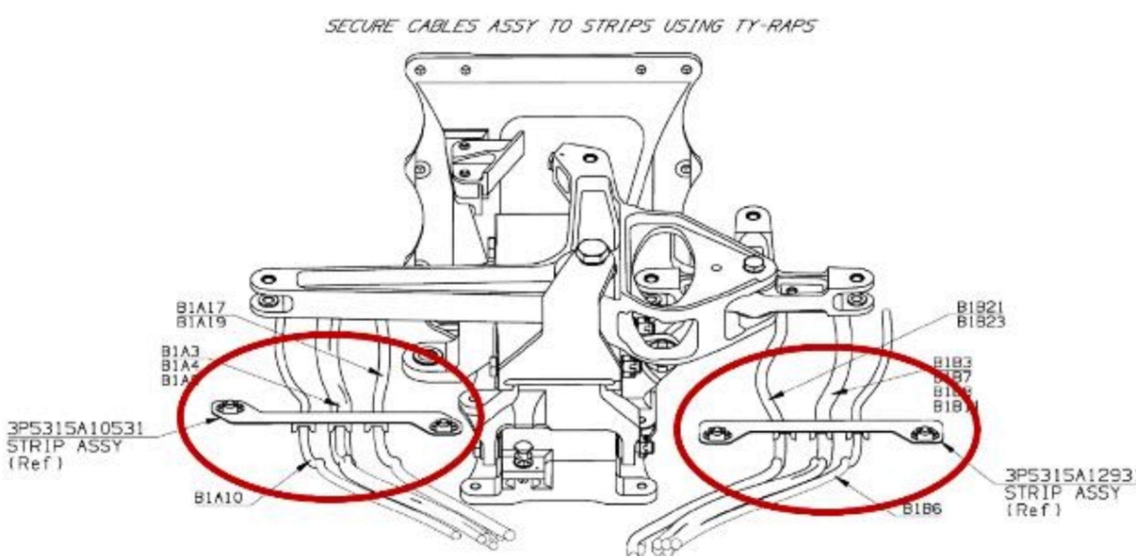

Figure 5. Diagram from 3NB Pax Ceiling Panel Closeout Job Card (Red ellipses were added for emphasis by NTSB)

The updated job task card also included the statement, “Ensure that the moving parts of the flight control rods in the area has at least 0.5 inch clearance from the surrounding fixed parts.” However, the updated job task card did not mention nor provide specific instructions for the inspection of wiring in the same area.

Wiring Support Strip Manufacture

At the time of its manufacture, the manufacturing job card for the left-side wiring support strip assembly, No. 3P5315A10531, contained only a single planform view of the strip assembly, as shown in Figure 6. According to Leonardo Helicopters, the solid drawing lines for the nut plates (anchor nuts) versus the dashed drawing lines for the electrical supports implied that the electrical supports were mounted on the side opposite that of the nut plates.

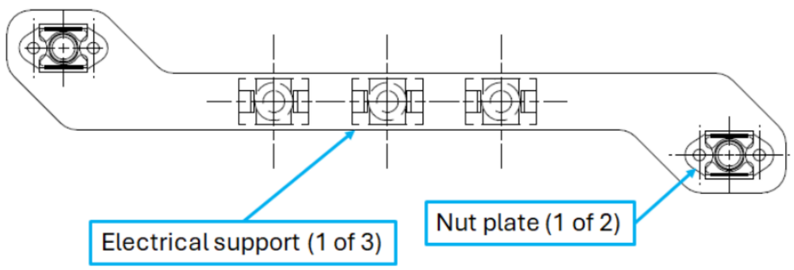

Figure 6. The single view of the left strip assembly in its manufacturing job card. (Courtesy of Leonardo Helicopters, modified by NTSB)

At the time of its manufacture, the manufacturing job card for the right-side wiring support strip assembly, No. 3P5315A12931, contained two views of the strip assembly, as shown in Figure 7. These two views of the strip assembly distinctly show that the electrical supports were mounted on the side opposite that of the nut plates.

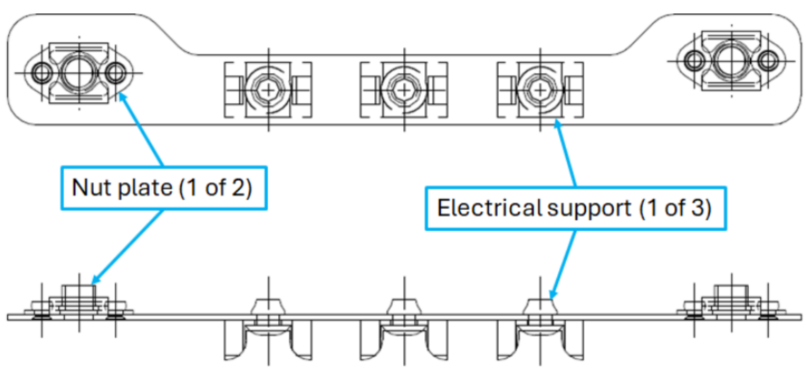

Figure 7. The two views of the right strip assembly in its manufacturing job card. (Courtesy of Leonardo Helicopters, modified by NTSB)

Recent Maintenance Inspections

The helicopter had an airframe total time (AFTT) of 7,491 hours at the time of the accident.

Era Helicopters, LLC (Era Helicopters), a subsidiary of Bristow Group Inc, operated and maintained the helicopter under a FAA-approved continuous airworthiness maintenance program (CAMP) for their AW139 helicopters. Originally approved on January 1, 2006, and with seventeen subsequent revisions, the documents for the original issue and subsequent revisions to the Era Helicopters CAMP for the AW139 (Era CAMP) typically contained an Era Helicopters logo on the header. On July 19, 2021, the Era CAMP was reissued and internally approved within Bristow (Bristow CAMP), with the reissued documents now containing a Bristow logo on the header. At that reissue, the revision numbering sequence was reset from Revision 15 to Revision 00 at Issue 1. On August 19, 2021, Issue 1 Revision 00 of the Bristow CAMP, for the AW139, was approved by the FAA Baton Rouge Flight Standards District Office (FSDO) and subsequently enacted within Era Helicopters.

In the Bristow CAMP, the airframe-related sections are based upon the Standard Inspection Program as defined in the Leonardo Aircraft Maintenance Planning Instruction (AMPI), Chapter 5. Section 3 of the Bristow CAMP defines the Phase (1-6) and Airframe Inspections (1-3 and A-D) for scheduled inspections and maintenance, as depicted in Table 1. The Phase Inspections 1 through 6 capture the 300- and 600-Flight Hour maintenance items, broken down into tasks to be completed in an eight-hour work shift. The only 100-hour item in Phase is the damper bearings inspection; other more involved tasks are completed as part of Airframe Inspection 1. Airframe Inspections 1-3 cover the flight-hour driven maintenance, while inspections A through D captures calendar maintenance items.

Inspection	Limit		Inspection	Limit
Phase Inspections (1-6)	100 Hours/12 Months		Airframe Inspection A	12 Months
Airframe Inspection 1	100 Hours		Airframe Inspection B	24 Months
Airframe Inspection 2	300 Hours		Airframe Inspection C	48 Months
Airframe Inspection 3	1,200 Hours		Airframe Inspection D	96 Months

Table 1. CAMP Inspection Timelines

AMPI Task 24-03, as per AgustaWestland (currently Leonardo) AW139 Interactive Electronic Technical Publication (IETP), requires "a general visual inspection (GVI) to detect corrosion or mechanical damage of bundles and condition, safety, and security of connectors every 2 years in accordance with Technical Publication 39-A-24-61-00 00A-310A-A", titled DC Electrical Load Distribution System. Technical Publication 39 A-24-61-00-00A-310A-A requires a visual inspection of No. 1 and No. 2 PDPs, specifically ensuring the electrical connectors on the PDPs are correctly attached, with no corrosion damage or chafing, and the adjacent wiring harness are properly attached to the structure with no signs of damage, chafing or overheating. No specialized tooling or additional requirements are specified.

Prior to issuance of the Bristow CAMP, the scope of AMPI Task 24-03, referenced to Technical Publication 39-A-24-61-00-00A-310-A-A, was contained in the Phase 1 Inspection of the Era CAMP. According to the aircraft logbook, Log Page No. 3053560, the Phase 1 Inspection [under the Era CAMP] was last accomplished on May 14, 2021, at an AFTT of 6,064.7 hours. The helicopter subsequently accumulated 1,426.3 flight hours and 498 days before the accident.

AMPI Task 24-03 was subsequently moved from the Phase 1 Inspection [of the Era CAMP] to Airframe Inspection B [of the Bristow CAMP] during the AW139 CAMP reissue. According to the maintenance records for N811TA, the last Airframe Inspection B was accomplished on August 1, 2021, at an AFTT of 6,246.4 hours. This inspection occurred after Bristow approval of the Bristow CAMP, but before FAA approval of the Bristow CAMP. The documents for this last accomplishment of Airframe Inspection B showed Revision 13 dated January 14, 2019, but the documents did not contain an Era or Bristow logo on their headers. According to the Era CAMP for the AW139, Airframe Inspection B was last at Revision 13 dated January 14, 2019, before the transition to the Bristow CAMP.

APMI Tasks 67-01 and -02 require an inspection of the flight controls and mixing unit and may require a mirror and portable light source for examining the main rotor controls. Era Helicopters required AMPI 67-01 and -02 to be performed during Airframe Inspection A. Per Step 2.7 of AMPI Task 67-02, an inspection for condition and damage of the collective torque tube C3 is required in accordance with the AW139 Maintenance Manual Chapter 39 Reference A-67-10-00-00A-31AA-A. Per the maintenance logbook, at an AFTT of 7,399.2 hours, Log Page No. 3115108, Airframe Inspection “A” was completed on August 28, 2022, with no anomalies or damage noted. Although these inspections took place in the vicinity of where damage was found during a postaccident examination, and included checking for chafing, none of these AMPI tasks required or suggested inspecting the routing of the wiring. The helicopter subsequently accumulated 91.8 flight hours and 27 days before the accident.Table 2 lists the recent maintenance inspections completed on the helicopter in reverse chronological order.

Inspection	Revision	Revision Date	Last Completed	AFTT (Hours)
Airframe Insp A	Bristow 01	1-Mar-22	28-Aug-22	7,399.20
Phase 4	Bristow 00	19-Jul-21	24-Aug-22	7,390.70
Airframe Insp 1	Bristow 00	19-Jul-21	24-Aug-22	7,390.70
Phase 3	Bristow 00	19-Jul-21	24-Jul-22	7,303.50
Phase 2	Bristow 00	19-Jul-21	23-Jun-22	7,223.40
Airframe Insp 2	Bristow 00	19-Jul-21	10-Jun-22	7,181.60
Phase 1	Bristow 00	19-Jul-21	22-May-22	7,133.20
Phase 6	Bristow 00	19-Jul-21	20-Apr-22	7,044.60
Phase 5	Bristow 00	19-Jul-21	17-Mar-22	6,952.50
Airframe Insp 3	Bristow 00	19-Jul-21	19-Jan-22	6,755.70
Airframe Insp B	(No Logo) Rev 13	14-Jan-19	1-Aug-21	6,246.40
Airframe Insp C	(No Logo) Rev 11	17-Mar-17	16-Sep-20	5,437.00
Airframe Insp D	Era Rev 11	17-Mar-17	30-Aug-19	4,794.80

Table 2. Recent Maintenance Inspections

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:	HUM,9 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	18:55 Local	**Direction from Accident Site:**	144°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	80°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.96 inches Hg	**Temperature/Dew Point:**	29°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Gulf of Mexico, GM	**Type of Flight Plan Filed:**	Company VFR
Destination:	Houma, LA (HUM)	**Type of Clearance:**	VFR
Departure Time:	17:16 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	Houma-Terrebonne Airport HUM	**Runway Surface Type:**	Concrete
Airport Elevation:	9 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	36	**IFR Approach:**	None
Runway Length/Width:	6508 ft / 150 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	4 None	**Aircraft Fire:**	In-flight
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	6 None	**Latitude, Longitude:**	29.566502,-90.660427(est)

The helicopter was recovered by the operator to a hangar where it was examined by National Transportation Safety Board investigators who were assisted by representatives from the FAA, the helicopter manufacturer, and the operator. The main landing gear was found extended and collapsed aft. The helicopter’s airframe structure exhibited substantial damage, consistent with a collapse of the main landing gear during a hard landing.

The pilot and copilot collectives are interconnected via the C1 torque tube located under the pilot seats, as shown in Figure 8. A single control rod, C2, runs vertically up the left side of the helicopter behind the left-seat pilot where it connects through a linkage to the C3 torque tube that runs laterally above and behind the right-seat pilot to the mixing unit.

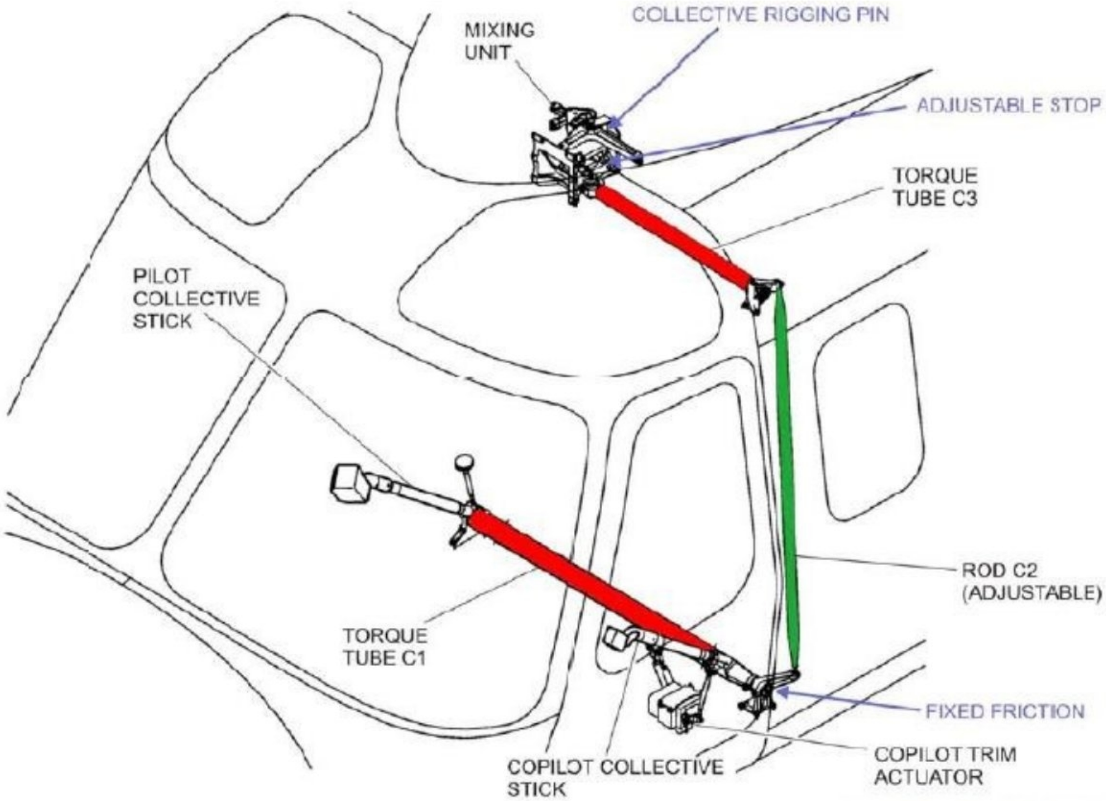

Figure 8. Collective Flight Controls

A visual examination revealed thermal damage and a longitudinal split of the C3 torque tube, as shown in Figure 9. The C3 torque tube was installed at both ends, with all fasteners installed and intact. A static test of the collective system without hydraulic pressure was conducted by moving the collective between the minimum and maximum pitch settings and observing the C3 torque tube. The outboard end of the C3 collective tube twisted while the inboard end by the mixing unit remained stationary with the C3 torque tube deformed torsionally along its length. The helicopter's cockpit flight controls are hydraulically-assisted via a dual hydraulic system; typically, the C3 torque tube does not rotate without hydraulic pressure engaged.

Electrical power to the helicopter is provided by two, 30 volt / 300 ampere direct current generators. Wire P190A6-G (p/n 3G9B11A1911) receives electrical power from the No. 1 generator through the T3 terminal on the No. 1 diode module and connects to the No. 5 distribution bar on the No. 1 essential bus in the cockpit overhead. Wire P190A6-G was found chafed through its insulation consistent with contact with the C3 collective torque tube, as shown in Figure 10. The chafed area was in line with a rivet line installed circumferentially on the C3 torque tube, as shown in Figure 10 and Figure 11. In addition to melted resin from the C3 collective torque tube, soot was found laterally along the entire overhead and on the panels that covered the C3 torque tube.

The wire assemblies routed to the overhead circuit breaker panels are intended to pass under wiring support strips; however, the accident helicopter's left-side wiring support strip had plastic electrical mounts installed on the upper side of the metal strip, as shown in Figure 9. The chafed wire was secured by one of the electrical mounts that was installed on the upper side of the left-side wiring support strip. Additionally, the right-side wiring support strip also had plastic electrical mounts installed on the upper side of the metal strip; however, unlike the left-side support strip, there was no evidence of chafed wiring.

Wire P190A6-G also was chafed further aft in the main cabin overhead, consistent with abrasion against the lower outer corner of a cooling fin on the No. 1 diode module (Diode A77; p/n 3G2430V00352). The external sheathing to the wire at this location was damaged, but the internal wiring was not exposed.

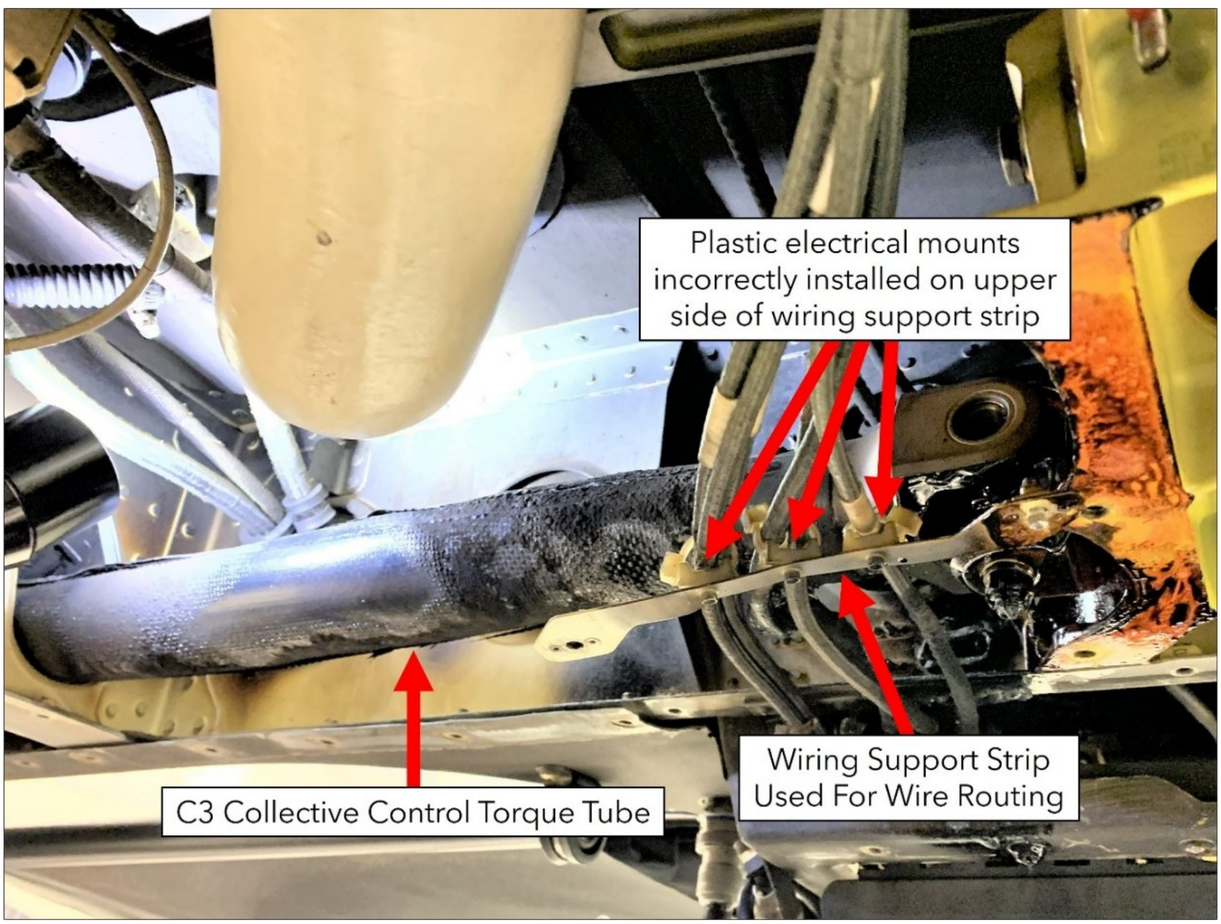

Figure 9. C3 collective torque tube and wiring support strip used for wire routing

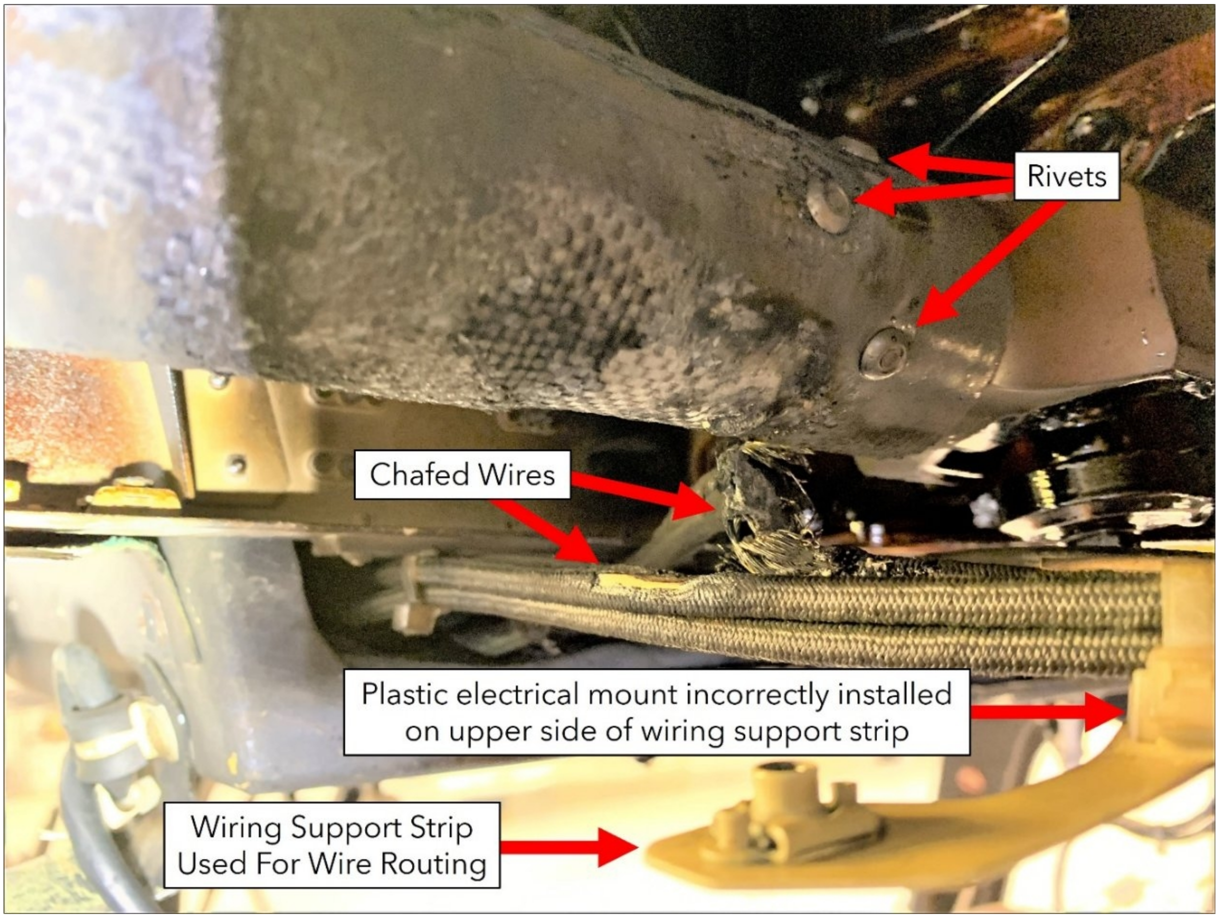

Figure 10. Chafed wires and rivets on C3 collective torque tube

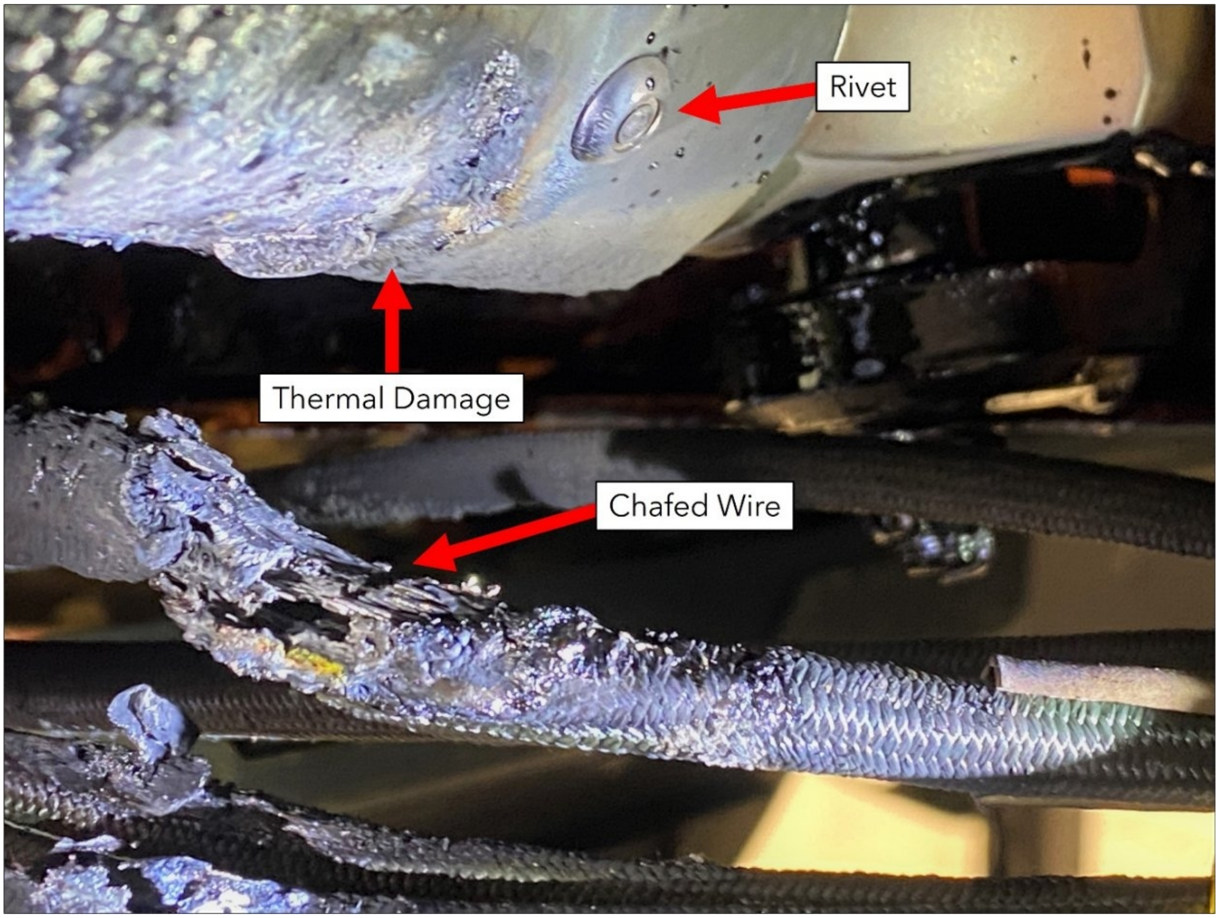

Figure 11. Chafed wires and thermal damage to C3 collective torque tube

Additional Information

Service Bulletins and Airworthiness Directives

After the accident, on October 11, 2022, the helicopter manufacturer, Leonardo Helicopters, issued Emergency Alert Service Bulletin (ASB) No. 139-731 to require inspections of the forward cabin roof ceiling harnesses and their installation to identify potential wire chafing conditions. The ASB requires a borescope inspection to identify if the cable assemblies were incorrectly routed above their respective wiring support strips. If a cable assembly was incorrectly routed above a wiring support strip, then the ASB requires additional examination of the cable assembly for evidence of wire chafing and damage to the collective C3 torque tube. Any wiring support strips with retaining clips incorrectly installed on the upper surface are to be removed from service and replaced with a support strip manufactured with retaining clips installed on the lower surface to ensure proper routing of the cable assemblies under the support strip. Finally, the ASB requires a visual inspection of the cable assembly adjacent to the No. 1 diode module for chafing and damage, and to ensure there is at least 10 mm of clearance between the cable harness and the diode module. Leonardo Helicopters reported that after the release of ASB No. 139-731 they received reports of an additional 23 affected helicopters: 8 with incorrectly routed wire bundles; and 15 with evidence of chafing at the aft cooling diode.

On October 12, 2022, the European Union Aviation Safety Agency (EASA) issued Emergency Airworthiness Directive (AD) No. 2022-0209-E based on the helicopter manufacturer's Emergency ASB No. 139-731. The Emergency AD requires a borescope inspection of the cable installation inside the forward cabin roof ceiling within 10 flight hours, and a visual inspection of the cable assembly adjacent to the No. 1 diode module for chafing and damage within 25 flight hours.

On November 2, 2022, the FAA issued AD No. 2022-22-03 with an effective date of November 17, 2022 that requires the actions specified in EASA AD 2022-0209-E, with the differences that where EASA requires contacting Leonardo for corrective action instructions, the FAA AD requires repairs done in accordance with a specific method, and while EASA requires reporting of the inspection results within 30 days, the FAA requires inspection results within 10 days.

Manufacturing Job Card Updates

The manufacturing job card, No. 3P5315A10531, was updated on October 24, 2022, to include a 3-dimensional (3D) graphic of the completed strip assembly, as shown in Figure 12.

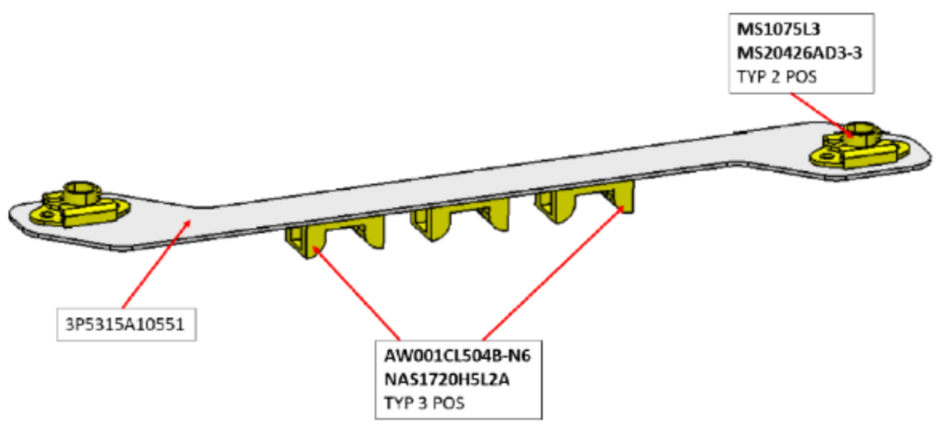

Figure 12. The 3D figure included with the updated strip assembly manufacturing card

The updated manufacturing card also includes the statement, "Note: Pay attention to correct assembly, the anchor nuts must be mounted on the side opposite to the electrical supports."

Additionally, revisions to the Production Assembly 3NB Pax Ceiling Panel Closeout Job Card, No. 3P5333A00134C1, now include a note (Figure 13) and a reference photo (Figure 14) showing proper wiring routing below the support strips.

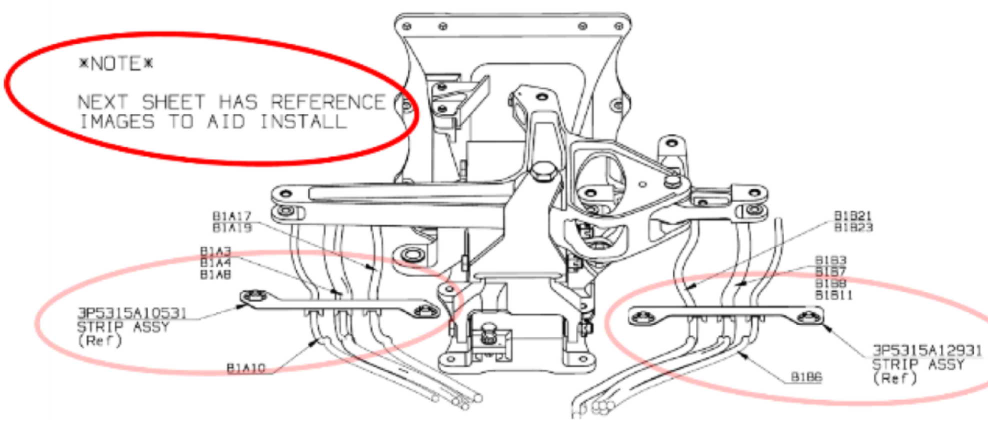

Figure 13. Updated diagram used in Production Assembly Job Card No. 3P5333A00134C1. Pale red ellipses depict the previous job card updates; dark red ellipses depict the Version 9 card revision.

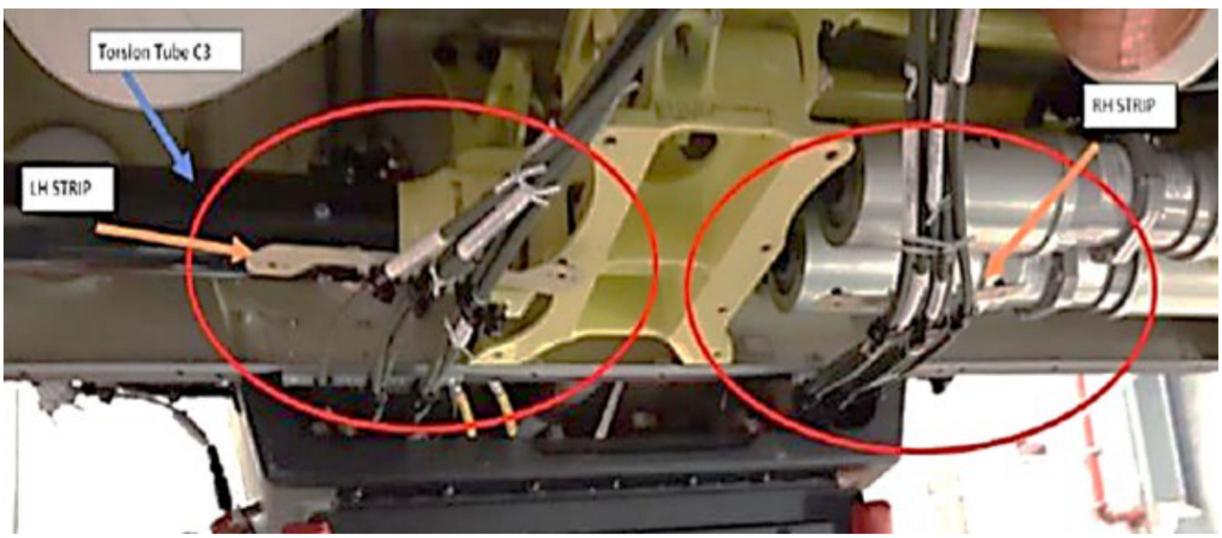

Figure 14. Reference photo included in Production Assembly Job Card No. 3P5333A00134C1, to aid installation of wiring. The reference photo was cropped by NTSB to show the specific area where the wiring support strips are located.

Administrative Information

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Additional Participating Persons:	Edwin D. Miller; Federal Aviation Administration - Accident Investigation Branch; Washington, DC Myron J. Billiot; Federal Aviation Administration - Baton Rouge FSDO ; Baton Rouge, LA Paul Cardenas; Bristow Group Inc.; New Iberia, LA James Stottlemyer; Bristow Group Inc.; Houston, TX Alessandro Cometa; European Union Aviation Safety Agency; Cologne, OF Mikael Amura; Agenzia Nazionale per la Sicurezza del Volo; Rome, OF Giorgio Dossena; Leonardo Helicopters; Cascina Costa, OF Nora Vallée; Transportation Safety Board of Canada; Gatineau, OF
Original Publish Date:	September 11, 2024
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=105994