

In accordance with the International Civil Aviation Organization (ICAO) provisions of Annex 13 to Convention on International Civil Aviation, the Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA) France appointed an Accredited Representative with Technical Advisors from Airbus Helicopters and Safran Helicopter Engines. The Accredited Representative and Technical Advisors were provided the opportunity to review the draft final report of the accident and provide comments in accordance with ICAO Annex 13, Chapter 6.3. At the request of the BEA, the comments that follow this page were included in the NTSB Public Docket for this investigation.

Comments	Section	Page	Extract	Reason or comment	Proposed amendment	EDITORIAL TECHNICAL SIGNIFICANT	Source of comment
1	Factual Information Wreckage and Impact Information	8	Review of data downloaded from the No. 1 engine EECU revealed a double N1 and N2 failure recorded about 67 seconds after liftoff, and about 25 seconds before the pilot heard the first "bang."	In the first version of the draft report, is the recording of a "FADEC FAIL." May you intend to detail it and mention the double N1 and N2 failure, we suggest to precise that these failures were simultaneous .	Review of data downloaded from the No. 1 engine EECU revealed a simultaneous double N1 and double N2 failure recorded about 67 seconds after liftoff, and about 25 seconds before the pilot heard the first "bang."	TECHNICAL	Powerplant Group Chair's Factual Report
2	Factual Information Wreckage and Impact Information	8	and would freeze the fuel control unit at the fuel flow at the time of the failure	Post accident investigation revealed that the hydromechanical metering unit (fuel control unit) resolver was frozen into position. The fuel flow measures during a rig test bench confirmed that the fuel flow was fixed all along the accident sequence, from 18s after take off, until the impact with the ground, approximately 2minutes 18seconds after take off. Therefore this fact is not an assumption. We suggest to replace would freeze by froze.	and froze the fuel control unit to the fuel flow at the time of the failure, which was 123 l/h, consistent with a climb power setting in the day's condition. Post accident investigation revealed that the hydromechanical metering unit (fuel control unit) resolver was frozen into position, and measures during rig test bench confirmed that the fuel flow was fixed all along the accident sequence, from 18s after take off, until the impact with the ground, approximately 2minutes 18seconds after take off.	TECHNICAL	Powerplant Group Chair's Factual Report
3	Analysis	1	This condition would also have frozen the fuel control unit to the fuel flow at the time of the failure, which was 123 l/h, consistent with a climb power setting	same reason as comment #3	This condition had frozen the fuel control unit to the fuel flow at the time of the failure, which was 123 l/h, consistent with a climb power setting, until the end of the flight, as revealed by the HMU examination.	TECHNICAL	Powerplant Group Chair's Factual Report
4	Analysis	1	the No. 1 electronic engine control unit reported a double N1 and N2 failure.	same reason as comment #2	Review of data downloaded from the No. 1 engine EECU revealed a simultaneous double N1 and double N2 failure.	TECHNICAL	Powerplant Group Chair's Factual Report
6	Analysis	2	Additionally, the fire suppression system was for inside the engine and would not have extinguished a fire outside of the engine.		Additionally, the fire suppression system was for inside the engine compartment and would not have extinguished a fire outside of the engine compartment .	TECHNICAL	
7	Analysis	2	In summary, the accident was the result of an inflight fire in the vicinity of the helicopter's No. 1 engine,		In summary, the accident was the result of an inflight fire in the vicinity of the helicopter's No. 1 engine exhaust and the air conditioner condenser fans	TECHNICAL	Powerplant Group Chair's Airworthiness Group Chair's Factual Report
8	Analysis	2	and the origin of the fire was likely the result of the engine overheating.	So far, no clear scenario was identified to explain the observed damages knowing that the fuel flow was frozen at 123 lph. 3 scenarios (or a combination of these) could explain the sequence of event on the engine No°1 that may cause the overheating: 1. Hot gas ingestion (T1 temperature of 220°C would be required) 2. External combustible fluid ingestion (an equivalent fuel flow of 282 lph would be required). 3. Air flow reduction at the engine inlet (a reduction of 43% would be required). Further examinations led by AHD and Metro will study these hypothesis, which have to be confirmed. The hot gas ingestion or external fluid ingestion could result from an external equipment failure/leak or external fire. The air flow reduction could result from foreign object debris (plastic bag, etc.) blockage of the No°1 engine air inlet. The tailboom airframe structure (composite) ignition could have resulted from the excess of temperature of the engine No°1 exhaust gas or an external fire from equipment located in the area of this engine. None of the scenarios could possibly be privileged in comparison with each other.	and the origin of the fire could possibly have multiple origin, and it was not possible to determine its source.	SIGNIFICANT	
	Analysis	2	Because the No. 1 engine was subjected to a postimpact fire and the source of the overtemperature could not be determined	The whole aircraft was subjected to the post crash fire. As the reason of the overtemperature was external to the engine, the whole wreckage could have contributed to the investigation of this cause.	Because the aircraft was subjected to a postimpact fire, and the source of the overtemperature could not be determined.	TECHNICAL	
10	Probable cause and Findings	2	An inflight fire outside of the engine firewalls, likely from overheating of the No. 1 engine for undetermined reasons, which resulted in a partial tailboom separation.	This conclusion seems somewhat incomplete to us, as it only considers the scenario in which the fire was caused by the engine overheating. To our knowledge, the investigations carried out have not ruled out another scenario in which the fire was caused by the failure of a component outside the engine. In this scenario, the engine overheating would be a consequence and not the cause of the fire.	The partial tailboom separation resulting from a fire in the vicinity of the engine No°1. The origin of the fire could not be determined. The fire could have been ignited as a result of an excess of temperature from the engine No°1 exhaust gas or from equipment located in the area of this engine	SIGNIFICANT	Powerplant Group Chair's Airworthiness Group Chair's Factual Report

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A	Wreckage and Impact Information	4	Factual Information (title)	Considering the comments hereunder, please take into account the same comments when the content was copy/paste from the analysis section.			
B	Analysis	1	This condition would also have frozen the fuel control unit to the fuel flow at the time of the failure, which was 123 l/h, consistent with a climb power setting	Erroneous statement. It was demonstrated that the fuel flow was frozen (and not "would have frozen").	This condition froze the fuel control unit to the fuel flow at the time of the failure, which was 123 l/h, consistent with a climb power setting, until the end of the flight, as revealed by the HMU examination.		Powerplant Group Chair's Factual Report
C	Analysis	1	About 90 seconds after liftoff, at 300 to 400 ft above ground level, the pilot heard a “bang” from the rear of the helicopter and noticed that the turbine outlet temperature (TOT) was rising on the No. 1 engine, but still within limits.	Not substantiated statement. It is unclear in the pilot statement how long the TOT stayed below the limit. It seems, according to the testimony, that the TOT just raised "through" the yellow arc as it was constantly going up.	About 90 seconds after liftoff, at 300 to 400 ft above ground level, the pilot heard a “bang” from the rear of the helicopter and noticed that the turbine outlet temperature (TOT) was constantly rising on the No. 1 engine.		Second pilot statement says : "§7 . The TOT gauge was the only one I noticed abnormal. §14. First bang, TOT on ENG1 started to rise within seconds. Memorandum of pilot's interview <i>The pilot was asked to recall the value or range of the left engine's TOT after hearing the first bang. He stated the TOT quickly approached the yellow area, even with the left engine set to idle. When the pilot was asked to describe how the left engine TOT rose, he stated the needle wasn't erratic, but it was consistently going up. When asked to recall the highest value, he thought the value was above 900° C, close to the maximum of 1,000° C, but he couldn't recall the exact number. He recalled that right before the engine fire warning light illuminated, he said to himself that he had “cooked” the left engine, so he believed the TOT value was very hot.</i> <i>He also recalled that the TOT of the right engine was within limits, and does not recall seeing any of the other engine gauges out of their normal limits with the exception of the left engine's TOT.</i> <i>He stated that he was looking for parameters that were out-of-limits the entire time, but did not recall which specific parameters were out of limits.</i>
D	Analysis	1	The pilot next scanned the cockpit instrument panel and noticed that the No.1 engine fire button had illuminated. He stated that he pressed the button to activate the fire suppression system; however, the TOT continued to rise near 1,000° C (maximum limit 895°C) on the No. 1 engine.	Incomplete and approximative description of the sequence of events. The sequence of event that is presented here is only partially corresponding to the pilot report (with addendum of the second interview and of the final timeline presented by the pilot). Additionally, there was the HIGH OVERTEMP warning that was also detected by the pilot and not mentionned in the analysis. Check AH analysis about this warning.	After setting the engine to IDLE, the pilot next scanned the cockpit instrument panel and noticed that the No.1 engine TOT was still rising. Approximatively a minute later, the fire button had illuminated along with the "HTG OVERTEMP" warning. He stated that he pressed the button to activate the fire suppression system; however, the TOT continued to rise near 1,000° C (maximum limit 895°C) on the No. 1 engine. During the accident sequence, as the engine examination showed, the TOT exceeded its maximum certified limit of 895°C.		Daron Roche law enforcement interview : <i>At this point, before the aircraft started to spin and before the second boom happened, I already knew I had cooked an engine. I knew because my TOT temperature outlet, outlet temperature was so high. [...] Basically, I'm getting rid of the fire, but my TOT is still climbing. I'm still trying to figure out what is going on. I'm not sure what's going on. I look up, I set myself up for final,</i> Daron Roche NTSB answer to questionnaire : <i>PILOT estimated TIMELINE and Fire Warning light The crewmember sitting in the front-left seat stated seeing smoke behind the helicopter, and within one second, the fire warning light illuminated, which was about three seconds before the tail boom separated. He stated there was also a heating overtemperature (HTG OVTEMP) indication that appeared the same time as the fire warning light illuminated. He stated there was not a generator overheat indication. He stated there was also a heating overtemperature (HTG OVTEMP) indication that appeared the same time as the fire warning light illuminated.</i> Powerplant factual report. Powerplant Group Chair's Factual Report Airworthiness Group Chair's Factual Report

E	Analysis	2	Examination of the No. 1 engine revealed that five turbine blades had fractured consistent with overhear fatigue from temperatures in excess of 1,295° C.	Wrong data. Confusion between High Pressure turbine and Power Turbine The temperature of 1295°C is the temperature under the platform surface temperature of the high pressure blades. The power turbine blade platforms went up to 1132°C of surface temperature.	Examination of the No. 1 engine revealed that five power turbine blades had fractured consistent with overhear fatigue from temperatures in excess of 1,132° C.		Powerplant Group Chair's Factual Report
F	Analysis	2	There was no evidence of fire within the No. 1 engine compartment prior to ground impact; however, exhaust gases in excess of 1,000° C could have been a factor in the initiation of the inflight airframe fire outside of the No. 1 engine compartment. Specifically, a fiberglass air conditioner housing and composite tailboom fuselage were located near the No.1 engine exhaust. While the composite fuselage offered more fire resistance than the fiberglass housing, neither were certified to withstand temperatures in excess of 1,000° C.	Not substantiated statement. Airbus Helicopter is leading a research to characterize the temperature exposure of parts mentioned in the accident sequence conditions. The exposure temperatures of the material inside the air conditioner (A/C) compartment are not substantiated yet. Moreover, the NTSB examination of the engine exhaust revealed that the exhaust metal temperature remained below 1000°C as there was no gamma prime dilution inside the material. Considering the position of the components relatively to the exhaust gas, it is then very unlikely that the fuselage or the A/C housing were exposed to exhaust gas temperature above 1000°C. It is the inflight fire which is responsible for excessive temperature exposure of those items, not the exhaust gases.	There was no evidence of fire within the No. 1 engine compartment prior to ground impact. The fiberglass air conditioner housing and composite tailboom fuselage were exposed to an inflight fire which submitted them to temperatures they could not withstand. Exhaust gases went punctually above a peak of 1,000° C. It is not yet known if this could have been a factor in the initiation of the inflight airframe fire outside of the No. 1 engine compartment.		NTSB material lab report Powerplant Group Chair's Factual Report
H	Analysis	2	In summary , the accident was the result of an inflight fire in the vicinity aft of the helicopter's No. 1 engine exhaust, near the air conditioner condenser fans, and the origin of the fire was likely the result of the engine overheating.	Not substantiated statement. There is no demonstration of the link between the engine overheating and the fire outside of the engine compartment.	and the origin of the fire could possibly have multiple origin, and it was not possible to determine its source.		
I	Probable cause and Findings	2	An inflight fire outside of the engine firewalls, likely from overheating of the No. 1 engine for undetermined reasons, which resulted in a partial tailboom separation.	Not substantiated conclusion. There is no demonstration of the link between the engine overheating and the fire outside of the engine compartment. The investigation showed the engine overheating was due to an external cause, it should be mentioned. Additionnally, this conclusion is not demonstrated in the final report so the word <i>likely</i> should be replaced by <i>possibly</i> .	An inflight fire outside of the engine compartment firewalls resulting in a partial tailboom separation.		Powerplant Group Chair's Airworthiness Group Chair's Factual Report