



Accident to the CESSNA 177 "CARDINAL"
registered **F-HKLA**
on Sunday 30 July 2023
off the coast of Fréjus

Time	Around 09:45 ¹
Operator	Aéroclub La Vallée du Loup (ACVL)
Type of flight	Instruction
Persons on board	Instructor, student pilot, passenger
Consequences and damage	Aeroplane destroyed, student pilot and instructor injured
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.	

Reduction in engine power, forced ditching, in instruction

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on ATM² (radar and communication) data, a video taken by the passenger and statements.

After rejecting an initial take-off as he was not sure that his door was locked, the student pilot lined up again and took off at 09:14 from runway 17 of Cannes-Mandelieu airport. The purpose of the session was to carry out a local flight in dual control in order for the student pilot to familiarize himself with the aeroplane. The instructor was sat in the right-hand seat and a passenger was sat behind the instructor.

After a coastal transit at an altitude of around 800 ft to point SW, they climbed to 2,000 ft (see Figure 1, point ①), and then levelled off by reducing engine power from 2,500 rpm to around 2,075 rpm³. After passing point DR, they contacted Nice South Information at 09:26 and a minute later, the student pilot started handling exercises in Fréjus bay. After a series of turns between 2,100 and 1,900 ft, he descended to an altitude of 1,000 ft and then climbed again to 2,000 ft (point ②).

Two minutes later, when the aeroplane was in level flight heading towards point DR and the student pilot was getting ready to descend for the coastal transit to return to Cannes (point ③), the engine suddenly misfired several times. The aeroplane was at this point 0.5 NM off the coast where there was no obstacle free area in which to safely land due to the urbanisation. The instructor took the controls and carried out a 180° turn (point ④) in order to head towards the disused runway of the naval air base at Fréjus, located approximately 3 NM away. After making several inputs on the engine controls, the rpm returned to normal.

¹ Except where otherwise indicated, the times in this report are in local time.

² The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.

³ Information based on spectrum analysis of sound band of video taken by the passenger.

Less than a minute later, the engine started misfiring again, but this time the misfires were accompanied by strong vibrations making it difficult to read the engine parameters. The instructor was unable to obtain a normal engine speed again. At 09:44, he reported to the Nice Information controller that the engine was misfiring and that they were aiming for the Fréjus airfield. The controller replied that he would inform the emergency services. The aeroplane rapidly lost altitude forcing the instructor to ditch at 1 km off the coast (and 1.6 km from the disused runway of the former Fréjus naval air base).

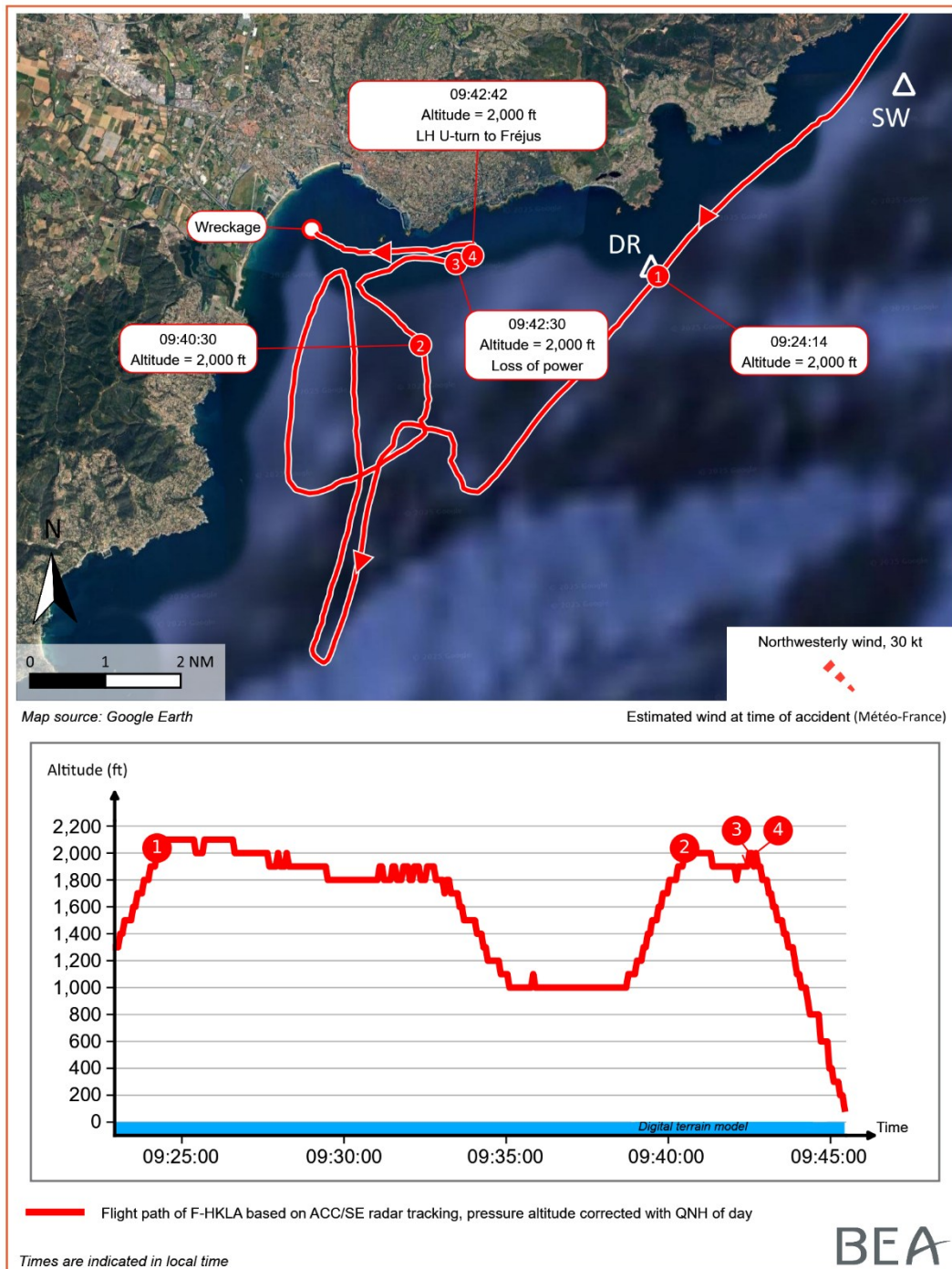


Figure 1: flight path of aeroplane

The three occupants evacuated the aeroplane without life-jackets⁴ and were rapidly picked up by yachtsmen who had seen the aeroplane ditch. The aeroplane, which was floating just below the surface, was then towed towards the shore by a Zodiac boat from the Maritime Gendarmerie Brigade. Despite attempts to keep it afloat while it was being towed, the aeroplane sank a few minutes later, approximately 600 m from the shore.

2 ADDITIONAL INFORMATION

2.1 Site and wreckage

The wreckage was resting on its landing gear at a depth of 30 m.



Figure 2: position of wreckage on seabed (source: Gendarmerie)

The wreckage was raised 13 days after the accident, and its examination determined that the damage observed was the result of the collision with the water's surface.

The flaps were in the "landing" position. The magneto switch was set to "OFF" when the instrument panel was examined after the aeroplane was raised. The master ignition switch and the electric fuel pump switch were set to "ON". The power lever was in the full throttle position. The mixture control was set to full rich, and the carburettor heat control was pushed in (cold). The fuel selector was set to "Both"⁵.

The fuel system was continuous and contaminated with seawater. The tanks were full of seawater, making it impossible to estimate the amount of fuel in the wings.

The engine was examined at the BEA several weeks after the accident. Due to the deterioration of the mechanical components resulting from their immersion in salt water, the examinations were limited. The disassembly of the engine's mechanical assemblies revealed no damage that could have led to a failure. In particular, no signs of defective lubrication or abnormal overheating were observed.

⁴ There were several life-jackets on board the aeroplane in accordance with requirement NCO.IDE.A.175 Flight over water, of EU regulation No 965/2012 (known as "Air-Ops") ([Version in force the day of the accident](#)).

⁵ Fuel is gravity-fed from the tanks to the fuel selector.

The magnetos and carburettor were examined at the ENAC engine workshop in Castelnaudary. Based on the examinations, which were not exhaustive due to the internal deterioration of the magnetos and carburettor, no anomalies were found. The spark plugs were functional.

2.2 Analysis of video recordings and photos

During the flight, the passenger took several videos and photos with her mobile phone. The first video was taken during the rejection of the first take-off run. The last video stopping at 09:28:31, was taken when the aeroplane was cruising.

The spectrum analysis of the audio tracks of the various videos did not show any engine operating anomaly.

2.3 Meteorological and sea conditions

Météo-France estimated that the weather conditions in Fréjus bay at the time of the accident were as follows: north-westerly wind of 30 kt at an altitude of 1,800 ft, no turbulence over the sea, CAVOK, temperature 30°C, dew point 17°C.

In these conditions, the risk of carburettor icing was in theory quite low at 2,000 feet (with 38% relative humidity), with an aeroplane in level flight without a reduction of power.

Several yachtsmen who were sailing reported gusts had reached 25 kt and that there were waves and a strong current. The instructor estimated a wind from 300° during the descent and indicated that the sea was calm when he ditched.

2.4 Occupant information

2.4.1 Student pilot

The 28-year-old student pilot was at the beginning of his training for the LAPL. He had logged two dual flight hours including one hour on type in the previous month. This was his second flight with the instructor.

He indicated having visually checked after the instructor, the quantity of fuel in the two wings and observed around the same quantity in each wing. Based on the journey logbook, they then estimated that the total remaining fuel was between 27.5 and 30 US gallons⁶. He indicated that the gauge needles were more or less vertical.

Note: this position of the fuel gauge needle indicates remaining fuel between the 1/4 position (i.e. theoretically around 6 US gal) and the 1/2 position (i.e. theoretically around 12 US gal).

He explained that the engine checks before lining up for the first time were nominal. He indicated that they were flying at a speed of 80 kt, with an engine speed of 2,100 rpm when it suddenly dropped to 1,500 rpm. After the instructor's actions, the engine speed returned to 2,100 rpm. During the second power loss, the engine speed initially dropped to 1,500 rpm and then, despite the instructor's actions, to idle.

⁶ Anglo-Saxon unit of volume, the symbol being US gal. A US gallon corresponds to around 3.78 l.

The student pilot explained that before coming into contact with the water, the instructor told him to unlock the doors and not to release the seatbelt, and told the passenger to get out the life-jackets⁷. The student pilot unlocked his door before the impact. He recalled that the aeroplane touched down at an indicated airspeed of 65 kt and then tipped slightly forward. The cockpit rapidly sunk below the surface of the water. He had fastened his seatbelt and sustained a minor injury to his forehead. He added that he knew where the life-jackets were located. He specified that he was not an excellent swimmer but that he nevertheless managed to rapidly exit via the left-hand door and swim under the left-hand wing.

2.4.2 Instructor

The 53-year-old instructor held an Airline Transport Pilot Licence (ATPL(A)) obtained in 2002 along with a Flight Instructor rating (FI(H)) obtained in July 2020. He had logged 991 flight hours as pilot-in-command on single engine piston aeroplanes, including 400 hours on the CESSNA (20 hours on type, including 4 hours 40 minutes on F-HKLA) and 22 hours in the previous three months, including 4 hours on type. He was president of the flying club and volunteer instructor. He had logged around 300 instruction hours. He had fastened his seatbelt and sustained a minor injury to his forehead. He indicated that he had observed that there was no fuel contamination when the fuel tanks were drained.

The instructor told the BEA that the aeroplane had flown two hours after it was last replenished and that on 21 July, he had added 40 l (i.e. 10 US gal) and then conducted a flight of approximately 50 minutes.

During the pre-flight check, he considered that at least 20 US gal of usable fuel remained, i.e. about two hours of endurance, based on a visual check in the tanks, that seemed to him to be consistent with the journey logbook indications, and of the fuel gauge. He further stated that the needle on the right-hand fuel gauge was almost in the middle, slightly to the right, and the needle on the left-hand fuel gauge was in the middle, slightly to the left.

During the engine tests, everything had been normal. He indicated that the entire flight was conducted with the fuel selector in the "Both" position and the mixture control set to full rich. He explained that the carburettor heat was not activated during the flight because the temperature and humidity conditions did not warrant it. He stated that after the full-throttle climb to 2,000 ft, they flew with an engine speed of 2,200 rpm. When the engine misfired and strong vibrations appeared, he turned around and started troubleshooting: the magneto selector was set to BOTH; he applied full throttle and activated the carburettor heat and the electric fuel pump; he then moved the magneto selector to the "R" and then "L" position. The engine speed increased again, and he returned the magneto selector to "Both", deactivated the electric fuel pump, and pushed the carburettor heat control back in. He specified that as the fuel selector was in the "Both" position, he did not change its position.

He had turned around to head towards the old Fréjus aerodrome and check the engine's operation. His plan was then to return to Cannes-Mandelieu via an inland course instead of following the coastline overhead the sea. He indicated that the second time the engine misfired, the engine speed dropped to 1,800 rpm and there were strong vibrations. He troubleshooted again, this time sequencing his actions one by one: he checked that the mixture was set to full rich and that the power control

⁷ The life-jackets, which inflate on manual activation, were in plastic pouches behind the backrests of the two front seats.

was at full throttle; he activated the carburettor heat control, but seeing it was to no effect, he pushed it in; he acted in the same way for the electric pump and magneto selector.

He did not change the fuel selector position. After these actions, the engine speed dropped to 1,000 rpm and the aeroplane descended at approximately 500-600 ft/min. He added that he cut off the battery and magnetos just before ditching, and that the engine stopped.

He explained that he did not indicate his position to the controller as the latter had not responded after he had declared a MAYDAY⁸. He did not have time to display 7700 on the transponder. He indicated that the emergency locator transmitter was set to AUTO⁹. He explained that he did not tell the other two occupants to put on their life-jackets as he was concerned that they might inflate them before evacuating the aeroplane and would then be trapped in the cockpit, under water. He ordered the evacuation when the cockpit was half-full and he exited last via the right-hand door. He specified that he knew how to swim.

2.4.3 Passenger

The 17-year-old passenger was a member of the instructor's family. This was her first flight on a light aircraft. She had fastened her seatbelt. She indicated that the instructor had not mentioned life-saving equipment during the briefing. She knew where the life-jackets were stored but explained that she did not hear the instructor ask her to take them. Before they ditched, he had instructed them to put on their life-jackets after ditching and to keep their seatbelts fastened. She indicated that she is a good swimmer.

2.5 Aircraft information

2.5.1 General

The aeroplane, built in 1968, was equipped with a Lycoming O-320 engine that had logged fewer than 300 h since its last overhaul in 2007 (see paragraph 2.5.3). The aircraft was equipped with lap belts. It belonged to two co-owners who had purchased it on 10 February 2023. They leased it to ACVL (a Declared Training Organization (DTO)) which had added it to its fleet.

The instrument panel was equipped with a JPI "FS 450 Fuel Flow" system, which does not record data. This system is used to manage the fuel (quantity uplifted and used, fuel flow information, warnings, etc.). It was also equipped with a fuel pressure indicator and two fuel gauges, one for each tank.

Fuel is gravity-fed from the tanks to the fuel selector. Downstream of this point, the fuel fills a small buffer tank, passes through a fuel shut-off valve, and then through a gascolator filter before being directed to the engine's mechanical fuel pump, which supplies the carburettor. If the fuel pressure drops (below 2 PSI), the auxiliary electric fuel pump is used (this is bypassed in normal operation).

The aeroplane flight manual recommends filling each tank up to the filler cap for a total capacity of 24.5 US gal in each fuel tank. A 21 US gal marker, in the form of a series of small holes just inside the filler neck, is provided to facilitate refuelling with reduced fuel loads.

⁸ No message of this type was recorded on the Nice Information frequency. In his last message recorded at 09:44:25, which was broken up, he seemed to indicate that he was heading for Fréjus. The controller acknowledged this message.

⁹ The transmitter was activated on ditching and was picked up by the air navigation services.

The aeroplane flight manual specifies taking off with the fuel selector control in the BOTH position to prevent accidental take-off with an empty tank.

The flight manual specifies that, *“The fuel capacity of this aircraft has been designed to provide the owner with a choice of the long range capability with partial cabin loading or reduced range with full cabin loading.”* To this end, *“A 10 US marker, in the form of a series of small holes just inside the filler neck, is provided to facilitate fueling to reduced fuel loads.”*

2.5.2 Estimated fuel quantity

It was not possible to analyse the contents of the aeroplane’s journey logbook, which was recovered by the instructor before the aeroplane sank but was subsequently misplaced when the yachtsmen took charge of the occupants. However, the amount of fuel remaining in the two tanks at the time of the accident could be estimated, based on the various documents¹⁰ collected during the investigation and the hour meter value after the accident.

The aeroplane had remained parked at Cannes-Mandelieu airport from 30 June 2021 to 10 February 2023.

According to previous copies of the journey logbook recovered during the investigation, the replenishment of the fuel tank ("FULL") is noted on 10 February 2023, but no refuelling was recorded on that date in the airport operator's database. According to the database of the Cannes airport operator, the tanks were refuelled with +43 US gal (+164 l) a few days earlier, on 24 January under the previous registration T7-SAR. The fuel tanks were therefore most likely replenished on 24 January but it was recorded as 10 February in the journey logbook. The aeroplane did not fly between these two dates. According to the entries in the journey logbook, following this refuelling, the hour meter reading was 2577.2.

According to the aeroplane flight manual, the total capacity is 49 US gal (of which 2 x 24 are usable). After this replenishment, there was therefore potentially a maximum of 48 usable US gallons.

Copies of the journey logbook indicated that there were then four flights in February for a total time of two hours, after which the hour meter reading recorded in the journey logbook was 2579.3 on 14 February. This is the last flight recorded on the recovered copies of the journey logbook pages.

From 13 March to 15 April, the aeroplane underwent work during which new registration markings were applied to the fuselage and wings. When the aeroplane was delivered at the end of this work, the hour meter reading was 2579.9 (value indicated on the CRS signed on 15 April).

On 20 March, the aeroplane was refuelled with +21 US gal (i.e. +80 l) under the former registration T7-SAR.

The registration certificate F-HKLA was issued on 7 June. In June, several flights were carried out for a total of 2.9 h¹¹.

¹⁰ This estimation is based on the hour meter value recorded after the accident and those recorded on various aeroplane maintenance documents, as well as on data from the airport's registers and refuelling tickets, and the flight logs of the pilots who had flown F-HKLA.

¹¹ One flight mentioned in the airport charges register on 13 June was not found in the other documents recovered. It was not included in the total of 2.9 h carried out in June.

On 8 July, the aeroplane was refuelled with +32 US gal (+121 l) under the registration F-HKLA. Two flights were then carried out on 8 and 11 July for a total of 2.1 h. The aeroplane was refuelled with another +10 US gal (+40 l) under the registration F-HKLA on 21 July before a flight of 1.1 h.

The accident flight lasted 0.6 h. The hour meter reading was 2586.8 after the accident. Thus, based on the various hour meter readings, the aeroplane had logged 9.6 h at the time of the accident, since the last full fuel load on 24 January 2023.

The checklist and flight manual for F-HKLA indicate an average fuel consumption of approximately 8 US gal/h in cruise at 2,000 ft. According to the instructor, the endurance calculations were carried out using a greater average fuel consumption of around 10 US gal/h.

Nevertheless, the entries recorded on the previous journey logbook pages in 2020 and the analysis of the hour meter values in 2023 established that in reality, the average fuel consumption was 11.3 US gal/h. The instructor indicated that he had never observed such a difference on the fuel flow meter in previous flights.

Taking a total flight time indicated by the hour meter of 9.6 h and a fuel consumption of 11.3 US gal/h, it can be deduced that the aeroplane had consumed 108.5 US gal since the last fuel replenishment.

However, based on the information gathered by the BEA during its investigation, the total amount of fuel added during this replenishment and the three subsequent refuelling operations is:

- 111 US gal in total (if the "FULL" indication meant full tanks up to the filler cap, i.e. 24 usable US gallons in each tank);
- 106 US gal in total (if the "FULL" indication meant full tanks up to the marker, i.e. 21 usable US gallons in each tank).

In these conditions, it is possible that a lack of fuel to the engine led to the fuel system unpriming.

2.5.3 Aeroplane maintenance history

F-HKLA was operated in Japan, then registered in Lithuania until July 2018, and subsequently in the Republic of San Marino. Furthermore, the aeroplane had not flown for 19 months, from 30 June 2021 to 10 February 2023 (the date of its sale to the two French co-owners at the time of the accident).

During this period, it had remained parked outdoors at Cannes-Mandelieu airport. It was protected by a cover over the cockpit and engine. No specific storage protection was implemented for F-HKLA's inactive period in a saline environment because, according to the previous owner, there was no intention of suspending its operation. However, the previous owner indicated that once a week he checked all fluid levels and started the engine, allowing it to warm up for several minutes.

Note: In November 2021, the engine manufacturer distributed recommendations to all owners and operators of Textron Lycoming engines regarding engine preservation in the event of an inactive period. This is [Service Letter No L180B, entitled "Engine Preservation for Active and Stored Aircraft"](#), which states that engines that fly only occasionally may not reach their normal service life due to corrosion.

The engine had exceeded by four years, the calendar limit defined by the manufacturer, Textron Aviation, which recommends an engine overhaul every 2,000 hours or 12 years.

Part ML of regulation (EU) No 1321/2014¹² requires the owner of an aircraft to declare the aircraft's maintenance program and to manage its continuing airworthiness. The owner is responsible for its content and in particular, for all deviations from the aircraft manufacturer's recommendations. The owner does not have to substantiate the resulting deviations nor implement alternative checks¹³.

No alternative inspections had been performed on the engine, including at the time of its registration on the French aircraft register. The CAMO in charge of registering the aeroplane on the French register indicated that it had orally provided the co-owners with information concerning the exceedance of the engine's calendar limit and that, given the engine was operating well, it had been considered that no specific work would be scheduled on the engine.

Note: OSAC indicated to the BEA that as the aeroplane was under the Minimum Inspection Programme (MIP), it was subject to Part-ML and was not directly concerned by the elements provided in document G-40-01. The owner could therefore, at their own risk, deviate from SI-1009 without having to provide justification.

The propeller was last overhauled in Poland on 2 June 2017 and the carburettor in Italy in 2020. In 2023, the following work had been carried out:

Dates	Type of inspection/work
11 January 2023	100 h/200 h/annual inspections as per Cessna MM
15 April 2023	100 h/1 year scheduled inspection as per PE MIP C177
18 July 2023	Compliance with SB 480 Iss. F: replacement of 15W50 oil and inspection of strainer

The extent of the engine damage after being immersed in salt water made it impossible to determine whether there was a link between the power reductions observed on F-HKLA and the exceedance of the calendar limit for the engine overhaul as well as the conditions under which the aeroplane had remained parked outdoors for 19 months.

2.6 ACVL operating procedures

The ACVL procedures manual in force at the time of the accident stipulated that the passenger briefing is mandatory and must cover evacuation and the use of life-jackets. It also outlined the options in case of engine failure during take-off from Cannes-Mandelieu airport, including ditching, particularly in the event of an engine failure after take-off from runway 17.

The instructor stated that he did not discuss flying over the sea during the briefing because this was covered in the second phase of the training. He did, however, mention the rescue equipment and specified that there were four life-jackets behind the front seats. He did not describe the ditching procedure or the deployment of the survival equipment because he had already done so during a previous flight with the student pilot on another aeroplane, accompanied by a second student pilot who had donned a life-jacket.

¹² Commission regulation of 26 November on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks ([Version in force the day of the accident](#)).

¹³ The [DSAC document G-40-01](#) gives explanations and examples with respect to such possibilities.

The instructor explained that there was no ditching emergency check-list in the aeroplane at that time, because there was none in the 1968 version of the aeroplane's Owner's Manual.

Exchanges with the manufacturer, Textron, revealed that emergency procedures were added to the Owner's Manual in the 1970 edition onwards. Internal discussions within the ACVL had been underway since F-HKLA was added to the fleet list regarding abnormal and emergency procedures to be included in its check-list.

The instructor relied on his general knowledge in the absence of an emergency check-list. The actions he performed were similar to those specified in the check-list published by the manufacturer in 1970.

3 CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.

After a flight time of around 30 min, the aeroplane's engine speed substantially decreased twice to the point that the instructor was no longer able to hold level flight. After the second decrease in engine speed accompanied by strong vibrations, the instructor was obliged to ditch the aeroplane as it was too far from the coast with respect to its lift-to-drag ratio, degraded by the headwind. In this area, the coastal environment did not offer immediate, usable and accessible land due to urbanization.

It was not possible to determine with certitude the cause of the loss of engine power during the flight. The engine damage after its immersion in salt water made it impossible to determine whether the aeroplane's maintenance and storage conditions could have influenced the engine's operation and performance (see paragraph 2.5.3).

However, after analysis of the hour meter values and the estimation of the real average fuel consumption, higher than that taken into account by the instructor, possibly linked to the condition of the engine (see paragraph 2.5.2), it cannot be excluded that the two reductions in engine power were the result of the fuel system unpriming after the quantity of usable fuel in the two tanks had been completely or nearly completely used.

Safety messages

Briefing on ditching procedures and the use of life-jackets

The BEA database includes eleven occurrences of light aircraft (including F-HKLA) ditching between 2014 and 2023, all of which were equipped with life-jackets. In eight of these occurrences, the occupants had put on their life-jackets before contact with the water. However, in three occurrences (including F-HKLA), they did not put them on before ditching, evacuated the aeroplane without them, and thus found themselves in the water without life-jackets.

Wearing a life-jacket after ditching greatly increases the chances of survival while awaiting rescue, even when in coastal transit and near the shore, as response times can vary.

Also, ensuring through the pre-flight passenger briefing that evacuation procedures, including the use of life jackets and, if necessary, the lifeboat, are known and understood by all aircraft occupants, will save valuable time in the event of forced ditching and allow the pilot to reduce his workload to better focus on troubleshooting and better comprehend the management of the flight path.

In an emergency situation, the pilot must not hesitate to instruct passengers to put on their life-jackets and obtain help for putting them on while he or she manages the aeroplane's flight path. Passengers must be prepared to use them, and the pilot ready to give the order.

The BEA investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.