Aircraft Accident Investigation Board, Norway HSL

REPORT

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All times given in this report is local time (UTC + 2 hrs), if not otherwise stated.

Aircraft	
-type & reg.:	EXTRA EA-400, D-ETAW
-year of man.:	2000
-engine:	Teledyne Continental Motors TSIOL-550-C, S/N: 803259
Radio call sign:	DAW
Date and time:	2 September 2001, at 10:50 hrs
Location:	Rørvik Airport Ryum, Norway. End of runway 22
Type of occurrence:	Aircraft accident, crash shortly after take off
Type of flight:	Private
Weather cond.:	No wind. Visibility: +10 km. Clouds: few at 4 000 ft. Temp: approx. 15-18 °C. QNH: 1001 hPa
Light cond.:	Daylight
Flight cond.:	VMC
Flight plan:	VFR
No. of persons onb. :	3
Injuries:	One passenger suffered minor injuries
Aircraft damage:	Total loss
Other damage:	None
Commander	
-sex/age:	Male, 47 years
-licence:	German PPL-A
-fl. experience:	A total of 705 flight hours, 50 of which were on the type in question
Information sources:	The Commander's "Report on aviation accident/-incident" NE 0382 and AAIB/N's own investigation.

SUMMARY

The D-ETAW, an EXTRA EA 400 aircraft type (see photo Annex 1), arrived at Rørvik Airport Ryum, (ENRM) from Nuremberg (EDNN) in Germany via Sandefjord Airport Torp ((ENTO), on Saturday 25 August 2001 at approx. 17:00 hrs. There were three persons on board and the Airport was unmanned at this particular time. The pilot and his two friends were spending a week's holiday fishing in Bindalen before returning to Nuremberg on the morning of 2 September.

The pilot had telephoned Trondheim ATC and filed a VFR flight plan from Rørvik to Værnes. Since there were no fuel services available at Rørvik Airport Ryum, he was going to refuel the aircraft at Værnes (ENVA) before flying on to Germany. The aircraft had been refuelled at Sandefjord Airport Torp on the flight north.

On arrival at Rørvik Airport Ryum, the pilot and his two passengers had approx. 45 kilos of fish as freight, as well as total baggage estimated to approx. 50 kg. This was loaded on board, partly on the floor of the cabin and the remainder in the baggage compartment at the rear of the cabin.

The fuel quantity was estimated to approx. 200 litres, 144 kg. The maximum take-off weight permitted is 1999 kg. The AAIB/N has calculated the actual take-off weight to 1984 kg. The balance was within limits.

While the passengers loaded the baggage and freight on board, the pilot performed an external inspection of the aircraft before taking the left seat and fastening his seat belt. One passenger sat in the right front seat. This passenger was instructed by the pilot on how to read the speed during acceleration on take-off. The other passenger sat with his seatbelt fastened, facing the rear in the foremost seat in the cabin.

The runway at Rørvik Airport Ryum is 880 x 30 m long. TORA is 832 m. The runway surface is tarmac.

The pilot went through the checklist "BEFORE STARTING ENGINE CHECKLIST" and then started the engine. Everything was normal and, after going through the subsequent points on the checklist, he taxied out to the end of runway 04 where he performed the "BEFORE TAKEOFF CHECK". In the position at the end of the runway, an engine check was carried out. All was set at 10:50 hrs. As the accident happened outside opening hours, the Airport was unmanned and no AFIS or recovery services were available. The pilot held the aircraft back on brakes and gave "full power". All indications were normal, according to the pilot. All the instruments indicated "high power". He released the brakes and checked the acceleration. At 50% of the runway's length, the passenger in the right front seat called an airspeed of 60 kts IAS, and at 75% of the runway, the pilot rotated the aircraft. At that point the speed was 78 kts.

The pilot estimates that the aircraft had gained a height of approx. 25 m when he experienced a loss of power ("leistungsverlust"), which he thought was related to a loss of turbo power, shortly after the stall warning light came on. The pilot realised that it was impossible to continue the flight, so he attempted to land on the remaining runway. 150 m of the runway still remained, and the aircraft landed hard at a steep angle on the runway.

The aircraft hit the runway hard on the main wheels and the tail. When the pilot realised that it would be difficult to stop on the remaining portion of the runway, he retracted the landing gear. The aircraft continued past the end of the runway, where it hit several large rocks along the breakwater, where the approach lights for runway 04 are positioned. Following hitting the rocks, the pilot registered fire in the engine, which was quickly extinguished when the aircraft entered the water along the breakwater. The left wing hit so hard into the breakwater that the aircraft rotated 180° and stopped in the opposite direction of the take-off.

The aircraft half filled with water immediately. The passengers and pilot unfastened their seat belts and evacuated through the emergency hatch on the right-hand side of the aircraft. The passenger seated in the cabin received only minor injuries during the evacuation, mainly caused by the jagged rocks (see photo Annex 2).

The aircraft was relatively new. It had flown 248 hours and made 215 flights. The inspection routines had been followed. In Dec 2000, 75 hrs since new, the aircraft made a landing, with the landing gear retracted. This was because of a landing gear malfunction. This resulted in a required shock loading inspection, which involved a dismantling of the engine.

As it happened, an eyewitness who was standing by the tower and watched the D-ETAW's departure observed the accident. He quickly entered the airfield, and at the same time raised the alarm with the local police. By the time the eyewitness had reached the scene of the accident, all three had managed to evacuate the aircraft. Apart from being wet, they were all more or less in good shape. They were transported to the local hospital in Rørvik, where they were examined and treated. After a while, the local police and rescue personnel from the airport arrived at the scene. The crash scene was secured and covered in foam. AFIS was also manned. The AAIB/N arrived at Rørvik the same evening, after which the investigation was launched.

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The next day, the AAIB/N interviewed the pilot, passengers and the eyewitness.

After the wing and stabilizer had been detached, the aircraft was taken to the AAIB/N's premises in Lillestrøm, where it was examined. A representative from the engine manufacturer, Teledyne Continental, participated in the investigation.

The results of the engine examination can be summarised as follows:

The engine was equipped with a fuel injection system where each cylinder is supplied with fuel by a fuel manifold valve. Fuel pipes (injection pipes) from this valve feeds each of the six cylinders. The fuel manifold valve has P/N 6465408-1672 and S/N K 109102C.

A fire of considerable intensity had occurred on the left side of the engine with center in front of both magnetos and behind the oil filler/dipstick.

Many of the aircraft's electrical wires and hoses had suffered substantial heat/fire damage. All insulation on the earthing wires of both magnetos was burnt away. These wires are shielded with insulation between the conductor and the external shielding. The lack of insulation connected both magnetos to ground. The left side magneto had suffered more damage than the right (see photos 10,11 and 12).

Several areas on the crank casing were stained blue following a fuel leakage (see photos 3, 8, 13 and 14).

When the fuel system, during tests, was pressurized, a major leak from the connection between the injection pipe for cylinder no. 6 and the fuel manifold valve was revealed. A loose nut caused the leak. The yellow paint alignment marks on the nut and the manifold valve were found intact, meaning that the nut had not rotated since the marks were put on. On new engines, Teledyne Continental utilizes whitish putty for this purpose, indicating that some party other than the manufacturer had loosened and retorqued the nut and applied the yellow paint.

On subsequent tightening the nut could be rotated approx. 60^{o}.

Several hoses on the left side (behind generator no. 2) had suffered considerable heat damage to the fore and less at the rear.

The alternators are cooled by air being drawn from the rear and in through the alternators. The cooling air is taken in the vicinity of the leakage area. Considerable heat damage was found on the fibreglass shroud behind and on top of the alternators. Moreover, the wires leading into the alternator had received substantial damage in the same area (see photos 2, 5, 6 and 7). All fire damage is at the rear of the left alternator.

There were indications of fire damage underneath cylinders 2, 4 and 6, but to a much lesser extent than on the top.

The engine cowling had received considerable fire damage on the inside around the oil and coolant filler caps.

The pipe supplying cabin pressure had separated from the intercooler's intake. The jubilee clip that should have fastened the hose was not found. Marks on the hose indicated that it probably loosened during the crash as a result of the violent movement.

The oil sump contained adequate amounts of engine oil. The oil level was higher than maximum as the sump had become deformed, in addition to the fact that the engine was not level. The content was not physically measured.

Many of the pipes and hoses were damaged in the crash.

All the hoses and pipes related to the air intake system, the turbo and intercooler systems as well as the air supply system for the cabin pressure were examined. No pre-accident damage or defects of importance were discovered.

There were no indications of any leakage in the exhaust system before contact with the ground. The exhaust duct had impact damage resulting from the accident.

The engine was not removed from the aircraft. Neither the magnetos nor the fuel injection system have been completely tested. Both of the magnetos were functionally tested and it was shown that both were permanently connected to ground, independent of the position of the magneto switch.

The AAIB/N did send the oil and fuel from D-ETAW to the Ministry of Defence laboratory for analysis. The results indicated abnormally high lead values and particles for both of them. Deviation from the standard has not contributed to the accident.

COMMENTS FROM THE ACCIDENT BOARD

The AAIB/N's investigations, in cooperation with an expert from the engine manufacturer, conclude that the experienced loss of engine power was caused by the grounding of one of the magnetos as a result of fire. The fire started when fuel began to leak from the fuel manifold valve and from there sprayed out over the engine's crank casing, wires, pipes etc. Thereafter it is most probable that alternator no. 2 ignited the fuel. The fire spread rapidly and the insulation around the first magneto and subsequently the second were destroyed with the result that they became permanently connected to ground. This first led to the engine losing power and then failing altogether.

The blue staining of the crankcase's top and the presence of yellow putty indicate that this loose connection dates from the time after the engine's shock loading inspection, following the gear up landing approx. 175 hrs previous to the accident. During this inspection the fuel manifold valve and fuel pipes were dismantled and reinstalled.

Presumably the leakage started gradually. Initially the extent of the leakage might have been so minor that the fuel had vaporised without being set alight. The blue staining of the cylinders conveys that there have been pools of fuel in the area, and that significant leakage undoubtedly occurred during the flight from Germany to Norway. On start-up from Rørvik Airport Ryum, the leakage continued and it is most probable that the fire started just before take-off.

The pilot did not observe the fire before he hit the large stones at the end of the runway, i.e. shortly before the aircraft continued out into the sea. This is explained by the engine cowling being unusually tight fitted on this liquid-cooled engine aircraft. The flames could not be seen before the engine cowling was struck sideways in the crash. The sea extinguished the fire immediately.

It can be seen as fortunate that the fire began at such an early stage during take-off and that the plane had not gained more height.

The investigation has not established when the deficient installation of the fuel line and the tightening of the nut to the manifold were performed. It is reason to believe, however, that this took place in connection with the shock loading inspection of the engine. If we assume that the nut was not properly tightened when the yellow paint was applied, following inspections would not reveal the deficiency. The only sign of a problem would be staining from fuel escaping through the leak. The engine cowlings are so tightly fitted and intricate

to remove that they prevent a through daily inspection of the engine. Fuel to air mixture in this environment could easily reach combustible levels as the leak progressed. The tight cowlings would delay detection of the fire and allow it to progress to a level where it crippled the engine.

Analyses of the fuel showed no abnormalities, except from a major content of lead, which is normal for engines running on AVGAS 100LL.

ANNEXES: Various photographs.