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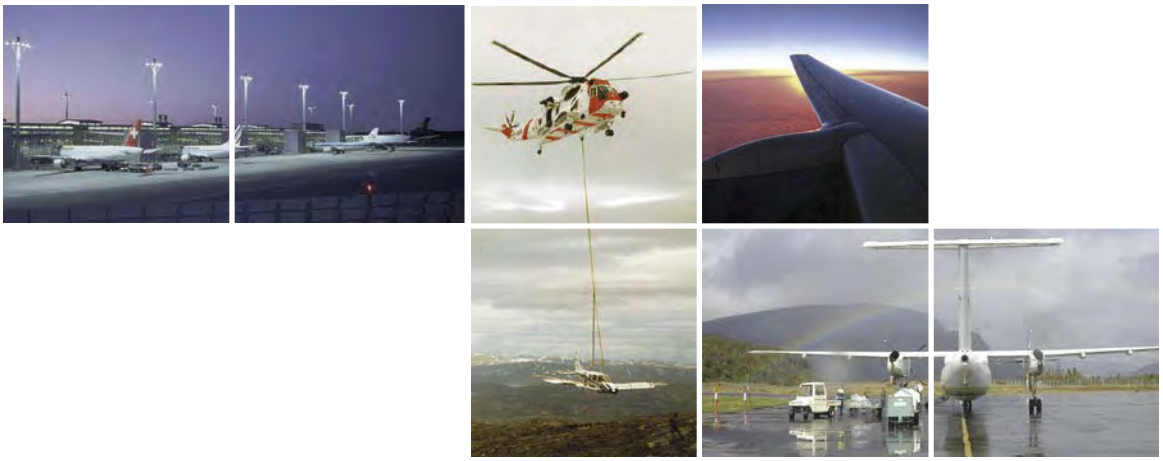
REPORT SL 2010/06



REPORT ON THE SERIOUS INCIDENT AT SKIEN AIRPORT GEITERYGGEN NORWAY (ENSN) ON 19 APRIL 2009 INVOLVING A CESSNA 172S SKYHAWK SP, LN-LVT

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This report has been translated into English and published by the AIBN to facilitate access by international readers.
As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

The Accident Investigation Board has compiled this report for the sole purpose of improving flight safety. The object of any investigation is to identify faults or discrepancies which may endanger flight safety, whether or not these are causal factors in the accident, and to make safety recommendations. It is not the Board's task to apportion blame or liability. Use of this report for any other purpose than for flight safety should be avoided.

Photos: AIBN and Trond Isaksen/OSL

REPORT

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This investigation is limited in its extent. For this reason, the AIBN has chosen to use a simplified report format. The report format indicated in the ICAO Annex 13 is only used when the scope of the investigation makes it necessary.

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

Aircraft information:		
- Type and reg.:	Cessna 172S Skyhawk SP, LN-LVT	
- Manufacturing year:	2000	
- Engine:	Lycoming IO-360-L2A	
Operator:	Grenland Flyklubb (aero club)	
Date and time:	Sunday, 19 April 2009 at 1525 hrs	
Location:	Skien airport Geiteryggen (ENSN)	
ATS airspace:	Geiteryggen TIZ, not controlled airspace category G	
Type of occurrence:	Serious incident, engine failure shortly after take-off	
Type of flight:	Private (aviation club)	
Weather conditions:	Wind: 150/8-15 kt. Visibility: more than 10 km. Clouds: none. Temperature: 12 ºC. QNH: 1023 hPa.	
Light conditions:	Daylight	
Flying conditions:	VMC	
Flight plan:	None	
No. of persons onboard:	2 (instructor/pilot-in-command + candidate)	
Injuries to persons:	None	
Damage to aircraft:	Defective filter and fuel strainer unit	
Other damage:	Fuel spill on runway	
Crew:	Pilot-in-command & flight examiner	Candidate
- Sex and age:	Male, 77 years old	Male, 47 years old
- Licence:	JAR-FCL PPL (A)	Expired PPL (A)
- Flying experience:	Total of 21 697 flying hours	Total of 135 flying hours

Information sources: Form ”NF-2007 Reporting of accidents and incidents in civil aviation” from pilot-in-command and AIBN's own investigation.

FACTUAL INFORMATION

The candidate's private pilot license had expired in August 2008. In order to have his license reissued, the candidate had undergone training at Grenland flyklubb (Grenland aero club). The day before the serious incident, the candidate had practiced handling engine failure after take-off.

A skill test was scheduled for the candidate on 19 April. The aero club had two Cessna 172s, one older model with a carburettor engine and one more recent model, LN-LVT, with an injection engine. The training had taken place with the older model, but it became necessary to use LN-LVT on the day of the incident. The procedures for starting the engine are relatively different between the two models, partly due to the fact that the more recent models have an electric auxiliary fuel pump. In accordance with the checklists for the aircraft, the engine needs to be primed with use of the auxiliary fuel pump switch to ON before starting up, and be switched to OFF again before engaging the starter. The candidate have explained that he was unaware of this. Although the checklist was read, the switch was left in the ON position after start-up.

After take-off from runway 19, the aircraft's engine failed at a height of about 550 feet above the airport. The candidate informed the aerodrome flight information service (AFIS) unit that he was turning back towards the runway. Another aircraft, which had recently landed, was therefore asked to quickly exit the runway. After a flight of about one minute, LN-LVT successfully landed on runway 01.

The two on board evacuated from the aircraft out on the runway. They observed that fuel had leaked out from the aircraft onto the runway, and that a lot of fuel continued to run under the engine cowlings. The aircraft's fuel shutoff valve (see Figure 1) was then closed and after some time the leak stopped. The airport's fire and rescue crew came quickly to the aircraft and covered the fuel on the runway with foam.

The investigation of the Accident Investigation Board revealed that the fuel strainer bowl had become loose (see Figures 2 and 3). The fuel strainer is located in the lower part of the engine compartment and is designed to capture any water and other contaminants before the fuel reaches the engine. There is a drain valve at the bottom of the unit. Figures 2 to 6 show the location and design of the fuel strainer.

Upon further inspection, it turned out that the outermost thread of the 6 mm long thread section of the top assembly had been damaged (see Figure 5). The fuel filter in the fuel strainer encloses the standpipe and is fastened between this and the brass section of the top assembly (see Figures 2 and 6). The distance between the top assembly (with filter fitted) and the standpipe before the threads engaged was less than 2 mm (see Figure 6). The inner threads of the standpipe[1] do not go all the way out to the flange (see Figure 4).

According to the Cessna 172 maintenance manual, the bowl, standpipe and fuel strainer filter shall be disassembled at least every 100th flight hour. Upon assembly, the standpipe is required to be

[1] Applies to Cessna 172s manufactured from 29th of November 1982 until 30th of Mars 2000.

screwed on finger tight. When the other parts have been fitted, the nut extension shall be torqued to 25-30 inch pounds.

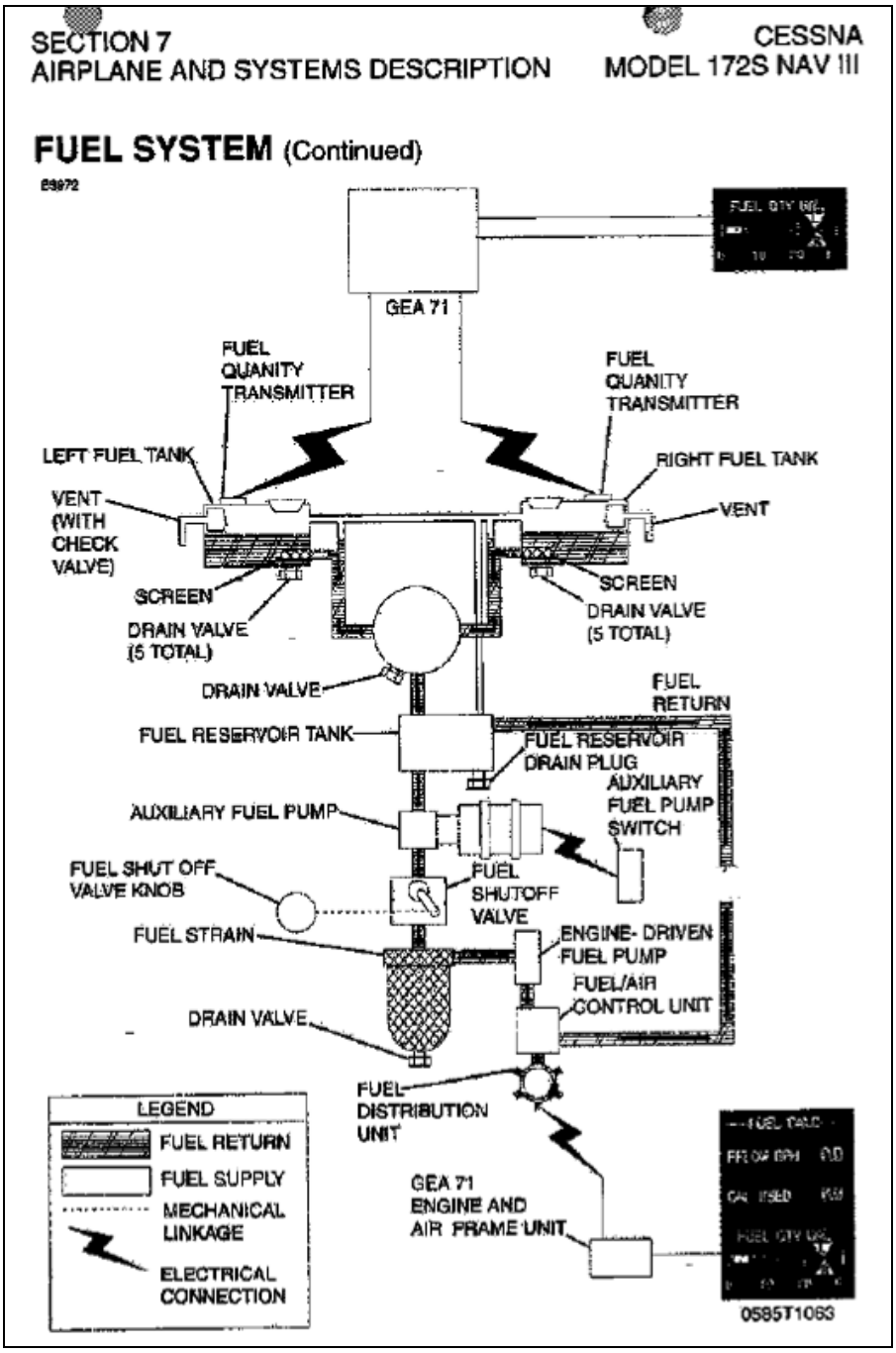
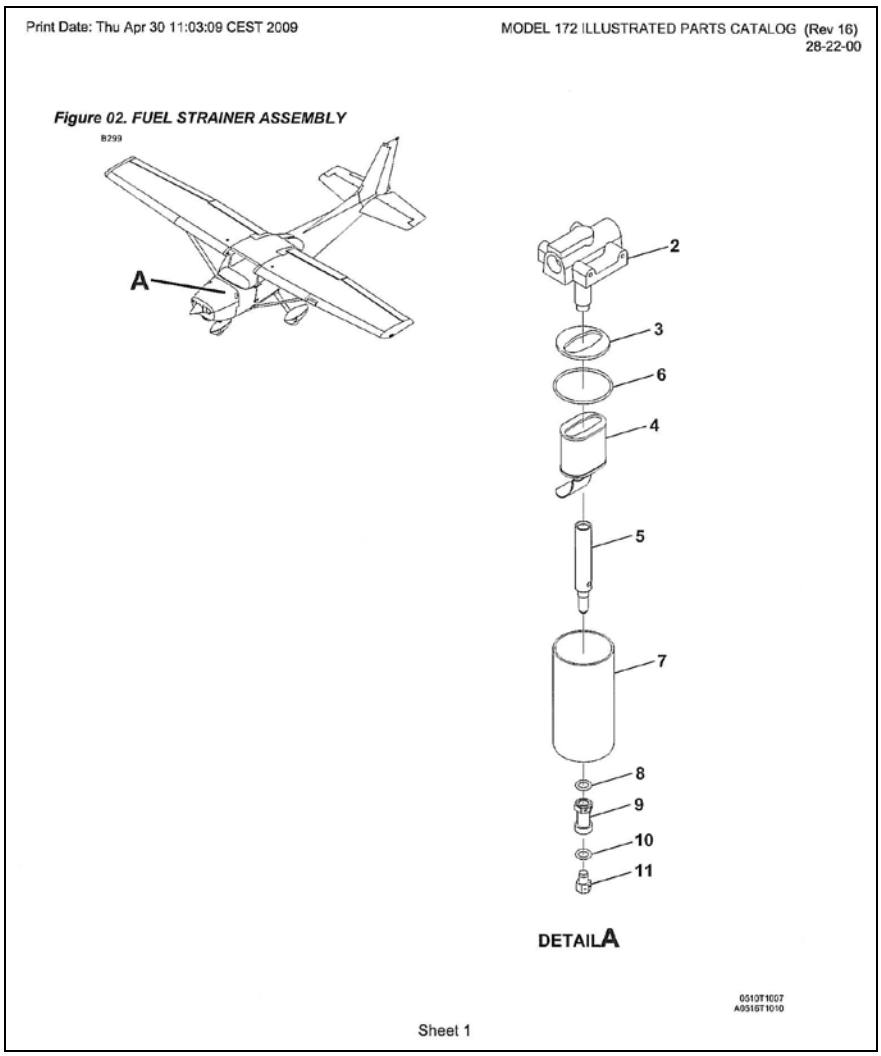


Figure 1: Schematic drawing of the fuel system.



No. 2: Top assy

No. 4: Filter assy fuel strainer

No. 5: Standpipe

No. 7: Bowl

No. 9: Nut extension

Figure 2: Schematic drawing of the fuel strainer in the parts catalogue.

When the aircraft underwent 100-hour inspection in October 2007, worn threads on the existing top assembly were observed. It therefore became necessary to replace some parts in the fuel strainer (see table below).

Maintenance performed and relevant data:

Date	Total hours	Description
17 October 2007	1 596	100-hour inspection performed. The following parts, factory new, were fitted: Top assy (part number 0756039-6) Gasket (part number 0756041-1) O ring(part number M83248/1-111)
..2008	About 1 696	100-hour inspection performed.
11 February 2009	1 796	100-hour inspection performed.
19 April 2009	1 822	Standpipe separated from top assy.

The parts replaced in October 2007 had thus been in the aircraft for a year and a half and 226 flight hours when the incident took place.

Figure 3: Bowl which had come loose from the top assy.

Figure 4: Standpipe (part number 0756036-2) with short thread section (inner threads starting 0.120'' from the flange).

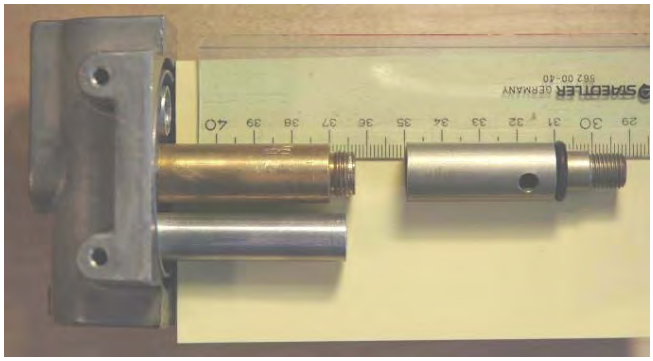


Figure 5: Top assy with poor threads section. Standpipe to the right. (Note: scratch marks along the brass shaft are from after the incident.)

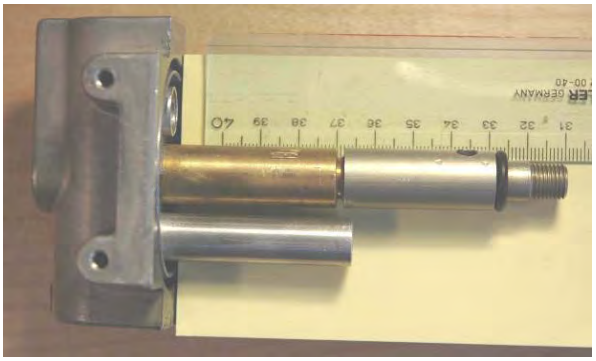


Figure 6: Remaining distance when the threads engage. (Note: Filter not shown, but shall be fitted between the two parts.)

LN-LVT was produced in 2000 and has production number 172S8438.

Cessna has informed the Accident Investigation Board that the bowl strainer assemblies on all their single-engine models have been produced with the same principle, where the top assembly and the standpipe have been fastened together with threads.

Further Cessna has informed that the following components were used in the period from 29 November 1982:

0756039-3	Strainer Ass'y	
0756037-1	Bowl	
0756039-1	Top Ass'y	
0756016-3	Insert	
0756036-1	Standpipe	(0.500-20UNF with 0.500" deep threads and 0.515" x 0.120" from the flange)

From 29 September 1989, the following components were used:

0756039-7	Strainer Ass'y	
0756037-1	Bowl	
0756039-6	Top Ass'y	
0756016-4	Insert	
0756036-2	Standpipe	(0.500-20UNF3B with 0.500" deep threads and 0.515" x 0.120" from the flange)

From 30 March 2000, the following components were used:

0756039-10	Strainer Ass'y	
0756037-1	Bowl	
0756039-6	Top Ass'y	
0756016-4	Insert	
0756036-5	Standpipe	(0.500-20UNF3B with 0.500 deep threads and 0.513" x 0.030" from the flange)

Cessna states that they have not received reports of similar incidents. Cessna believes that two threads engaging should be sufficient, as long as the nut extension torque is correct and a locking wire has been used, for the fuel strainer to remain intact.

Following the incident on 19 April 2009, a new standpipe with part number 0756036-5 was obtained. When the workshop received the new standpipe, this was fitted with threads all the way to the flange, unlike the standpipe with part number 0756036-2, which was installed at the time of the incident.

In its communication with Cessna a few months after the incident, the Accident Investigation Board presented a draft safety recommendation of changing the design of the fuel strainer so that the thread section of the top assembly and standpipe is extended and thus prevent separation.

On the basis of the above, Cessna requested to receive the fuel strainer from LN-LVT to perform a conformity inspection / non-destructive testing (NDT). In its report, Cessna reaches the following conclusions:

> *"Cessna Engineering does not believe this mishap occurred as a result of improper design. We find it much more likely the Strainer Assembly was incorrectly Safety Wired at the last 100 hour inspection. 26 hours of engine operation then led to this mishap as described. The only benefit more threads in this area would provide is for it to take longer for an improperly safety wired installation to come apart. Cessna has already complied with the Safety Recommendation by incorporating a Standpipe with more thread area; the above objections notwithstanding."*
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> ---------- ----------

> *"Cessna' s position is that improper maintenance technique, inspection, and re-installation contributed to the Fuel Strainer failure incident. It should be noted that the returned Fuel Strainer assembly had visible tool marks on both shafts which indicate some sort of improper maintenance."*

As emerges from the schematic drawing of the fuel system (Figure 1), the auxiliary fuel pump is located so that it provides pressure in addition to the gravitational pressure from the fuel tanks, via the fuel strainer in to the engine-powered fuel pump in the aircraft engine.

A comparable serious incident occurred on 5 September 2009. (Report SL 2010/07). A Piper Warrior II PA-28-161, LN-BTS operated by Bergen Aero Klubb (Bergen aero club) had just taken off from Bergen airport Flesland (ENBR) when the engine stopped. The two persons on board managed to land the aircraft on the remaining stretch of runway. The Accident Investigation Board investigations have shown that as a result of worn threads in a fastening clamp which holds the gascolator assembly[2] in place, the engine fuel supply starved and subsequently made it stop.

COMMENTS FROM THE ACCIDENT INVESTIGATION BOARD

The engine stopped as a result of the fuel supply being interrupted when the bowl around the fuel strainer came loose. It was the connection between the standpipe and top assembly which became separated, and the AIBN believes that the too short thread sections constitute an unfortunate design feature. Minor wear to the threads can accordingly result in the parts becoming separated. During the period 1982 to 2000, Cessna delivered all single-engine aircraft with top assembly (0756039-6) in combination with standpipe (0756036-1 and 0756036-2), where the threads start some distance away from the flange. When the serious incident happened to LN-LVT, the aircraft was equipped with a standpipe with a short thread section. From 30th of Mars 2000, this type of aircraft was delivered with the same top assembly, but with a standpipe" (0756036-5) where the threads run significantly closer to the flange.

AIBN believes that standpipes with short threads should be replaced to provide a higher degree of assurance of the components not coming loose.

With regard to the report from Cessna Aircraft Company, the Accident Investigation Board refers to the note in Figure 5 which states that the scratch marks on the LN-LVT components were made after the incident. The scratch marks thus have no bearing on the incident, and are no sign of faulty maintenance of the aircraft prior to the incident. Furthermore, the Accident Investigation Board cannot see that Cessna has any factual basis for claiming that the fuel strainer was erroneously fastened with locking wire. As emerges from Figure 3, the fuel strainer was duly fastened with locking wire.

As a result of the switch for the auxiliary fuel pump being on during take-off, extra pressure built up in the fuel strainer. This would normally not be of importance, but as the standpipe was poorly fastened to the top assembly, the increased pressure may have contributed to the parts being pressed from each other.

Loss of engine power in a single-engine aircraft just after take-off is a potentially dangerous situation. There is no guarantee that a turn back, as low as 550 feet above the airport, will succeed

[2] The function of gascolators in Piper aircraft corresponds to the function of fuel strainers in Cessna aircraft.

as it did in this case. In this connection, reference is made to the Civil Aviation Authority Norway article "The impossible turn".

In addition to the hazard posed by the engine failure, the AIBN believes that the fuel leak also caused a fire hazard.

SAFETY RECOMMENDATIONS

The following safety recommendation is made by the Accident Investigation Board[3]

SL safety recommendation No. 2010/09T

The joint between the top assembly and the standpipe in the fuel strainer came loose so that fuel supply to the engine was interrupted, resulting in the engine stopping just after take-off. Cessna has delivered several versions of the standpipe, of which 0756036-1 and 0756036-2 have short thread sections. The AIBN recommends that the EASA, who has given Type Certificate A.051 for the Cessna 172S, to consider the need for replacing the standpipes in question with a version with longer thread section.

Accident Investigation Board Norway (AIBN)

Lillestrøm 9 March 2010

[3] The Ministry of Transport and Communications forwards safety recommendations to the Norwegian Civil Aviation Authority and/or other involved ministries for evaluation and monitoring, see Norwegian Regulations regarding public investigations of accidents and incidents in civil aviation, § 17.