

REPORT

SL 2010/07



REPORT ON SERIOUS INCIDENT AT BERGEN AIRPORT FLESLAND ON 5 SEPTEMBER 2009 WITH PIPER PA-28-161, LN-BTS

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.

REPORT

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This investigation has had a limited scope, and for this reason, AIBN has chosen to use a simplified report format. This report format, in accordance with the guidelines given in ICAO Annex 13, is only used when necessitated by the scope of the investigation.

All times given in this report are local time (UTC + 2 hours) unless otherwise indicated.

Aircraft:

- Type and reg.: Piper Aircraft, Inc. PA-28-161, LN-BTS
- Year of manufacture: 1979
- Engine: Textron Lycoming O-320-D3G

Operator:

Bergen Aero Klubb

Date and time:

Saturday, 5 September 2009 at 0957 hours

Location:

Bergen Airport Flesland (ENBR)

Type of occurrence:

Serious incident, engine failure during take-off

Type of flight:

Private (training flight held by aero club)

Weather conditions:

METAR at 0950 hours: 33009KT 9999 FEW020 SCT070 13/09
Q1001 NOSIG RMK WIND 1200FT AMSL 33023KT

Light conditions:

Daylight

Flight conditions:

VMC

Flight plan:

VFR

No. of persons on board:

2 (instructor and student)

Personal injuries:

None

Damage to aircraft:

None

Other damage:

None

Crew:

- | | |
|---|--|
| <ul style="list-style-type: none"> - Sex and age: Male, 78 years old - License: JAR-FCL PPL(A) and FI(A) - Flying experience: Total flight hours 7 125.
Relevant type: 4 500 hours.
Last 90 days: 64 flight hours.
Last 24 hours: 2 flight hours | <p>Pilot-in-command & instructor: Student:
Male, 17 years old
No
About 30 student flight hours
(no solo flights)</p> |
|---|--|

Information sources:

NF-2007 Reporting of accidents and incidents in civil aviation and AIBN's own investigation

FACTUAL INFORMATION

The purpose of the flight was instruction in landing patterns at Bergen Airport. The student would soon be ready for his first solo flight, and the training manager was to be the flight instructor for this training flight. The training manager was the last person to have flown the club airplane LN-BTS the preceding evening. The airplane had been parked in the hangar overnight. It was not necessary to refuel before the flight on the day in question, as there was sufficient fuel left in the tanks for the scheduled flight (about 112 litres).

The student arrived at the clubhouse well in advance. He pulled the airplane out of the hangar and carried out the pre-flight inspection in accordance with the flying club's checklist. It is common that students do this on their own when they have progressed well into the course. Everything was normal until the student was about to drain the fuel strainer (gascolator), see Figure 2. He used a special drain device (GATS Jar) acquired by the club for that purpose. According to the checklist, the strainer should be drained twice, switching tanks in-between. This is also in accordance with the manufacturer's recommendations. The student has explained that upon draining the strainer for the second time, after having changed the position of the tank selector switch, fuel flowed outside the GATS Jar and out from beneath the cowling when he pressed in the drainage valve. He then opened the cowling at the side and observed that the fuel flowed over the top rim of the strainer bowl (gascolator bowl) when he pressed in the drainage valve. The leak stopped when he released the pressure. The bowl seemed loose, but he could see nothing wrong with the installation. He observed that locking wire had been wound around the clamp which held the bowl in place. He has explained that he sent an SMS to the instructor describing the problem he had discovered.

The student completed the rest of the pre-flight inspection without any further remarks. He then went inside and met the instructor. The instructor believed the problem of leaking fuel when draining the fuel strainer had been observed previously, and that this had been the case the day before as well. The student has explained to the Accident Investigation Board that he accordingly received the impression that the fault was of no importance as far as flying was concerned. The instructor and the student then walked out to the airplane together. There were no visible signs of leakage. Neither the student nor the instructor could remember whether the instructor checked the problem again by for instance touching the drain valve. The instructor did not try draining the strainer himself.

Start-up and engine check revealed nothing out of the ordinary. They taxied out and started the take-off from the end of runway 35. The student was at the controls. After achieving takeoff speed of 60 knots, the nose of the airplane was lifted towards the horizon in the usual manner. After about three seconds in the air, the engine suddenly quit. The instructor has explained that he took over the controls immediately and made an emergency landing straight ahead on the runway. There was still ample runway available. The instructor let the airplane roll towards the first turn-off, and was prepared to get out and push the aircraft to get completely clear of the runway. He tried to find out why the engine had stopped, and turned the ignition key. To his surprise, the engine started immediately. They then taxied back to the hangar. When they exited the airplane, they observed that a little fuel was dripping from the cowling under the engine.

The airplane was taken to the workshop for trouble shooting. Initially, the engine was started and a run up was performed. A magnet check was conducted, with no abnormal indications. The Accident Investigation Board attended the rest of the technical examination of the airplane. The following could be ascertained as regards the general condition:

- Stains were found in the paint, going back from the opening in the cowling where the fuel strainer sticks out and towards the front end of the left wing on the outside of the fuselage.
- the fuel level in both tanks was equal (estimated to be 3 cm below the neck), the fuel had a normal colour (blue)
- the air filter and intake ducts to the carburettor were examined without finding anything abnormal
- with the exception of a minor, insignificant engine oil leak, no sign of leakage was found in the cowling, tubes or hoses in the engine compartment.

The inspection of the fuel system (cf. Fig. 1) showed the following:

- the gascolator bowl seemed to be looser than normal, in spite the fact that all parts and the locking wire were installed (Fig. 2)
- parts of threaded section of the fastening clamp which holds the bowl in place (WIRE – bail, Part Number 100871-02) had been destroyed (Fig. 3)
- no foreign bodies, particles, water or other contaminants were found in the fuel contents of the gascolator, and the metal filter was clean.
- the drain tap on the gascolator was disassembled and examined with special emphasis on finding any foreign bodies which could prevent normal functioning and thus cause a leak. Nothing was discovered
- the fuel filter (metal strainer) in the carburettor was examined. Small particles were found, but not of a size and amount to affect the flow of fuel
- the carburettor was drained. The fuel was clear and without foreign bodies, particles or other contaminants. There was no sign of water
- the fuel filter in the electrical fuel pump was examined without finding any foreign bodies, particles or other contaminants.

The fuel strainer is located low in the engine compartment and is designed to capture any water and other contaminants before the fuel reaches the engine. The location of the fuel strainer is between the fuel tanks and the electrical fuel pump, see Figure 1:

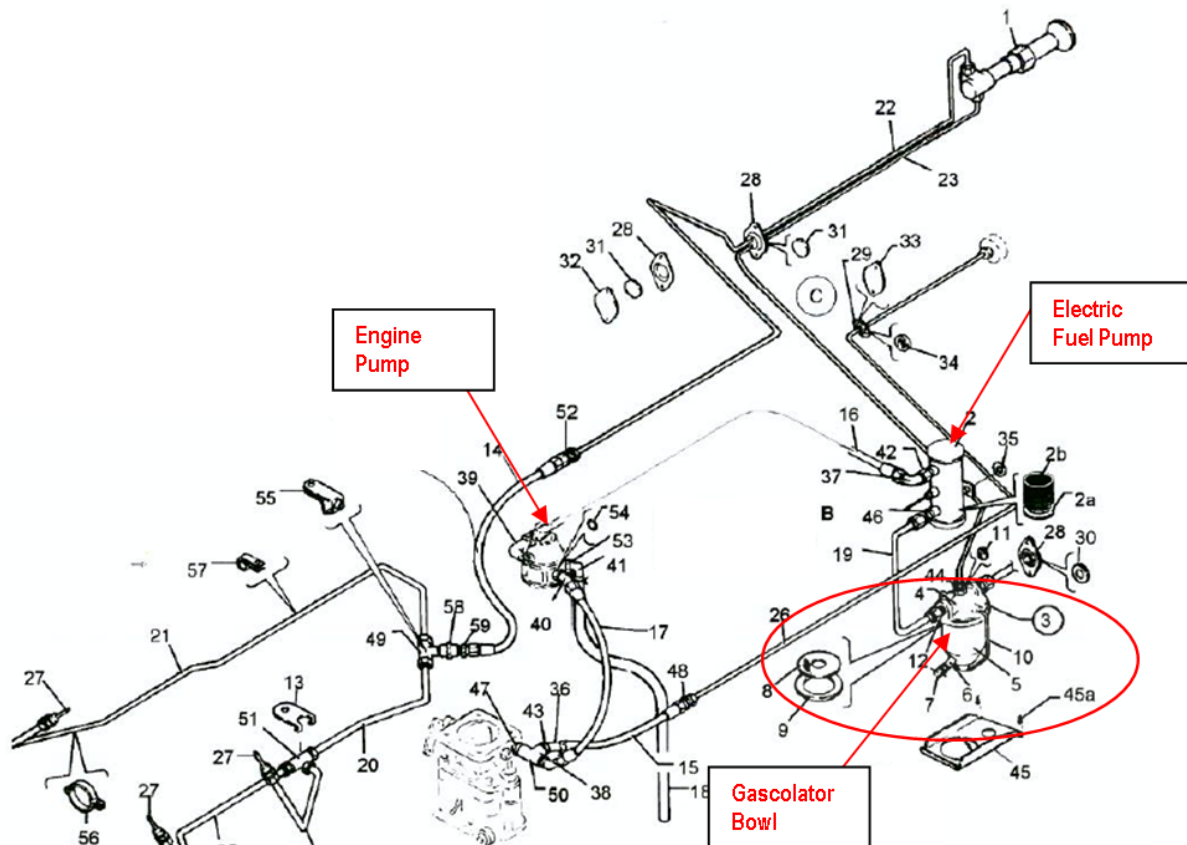


Figure 1: Section of the forward part of the fuel system on PA-28-161 (serial nos. lower than 16110). The gascolator circled in red

The gascolator bowl must be disassembled and the bowl and filter cleaned (cf. Figure 4) at both the 50-hour and 100-hour inspection (see "Piper Cherokee Warrior Service Manual Table III – Inspection report PA-28-151/161 Engine Group Item 25"). Checking the condition of the fastening clamp and tension nut is not mentioned in the maintenance documents.

Bergen Air Transport's PART 145 workshop carries out the 100-hour inspection of LN-BTS on a regular basis. The 50-hour inspection is carried out by three members of Bergen Aeroklubb who have special permits for simple maintenance (previously SPS courses under the auspices of NAK). The last inspection of LN-BTS was the 100-hour inspection on 19 August 2009, when the airplane had reached 4,802 running hours. The airplane had run 4,838 hours when the incident occurred. The next scheduled inspection was the 50-hour inspection upon reaching $4,850 \pm 5$ running hours. AIBN has reviewed the journal of remarks and actions for the airplane for the years 2008 and 2009. A comment dated 14 August 2008 stated that it was "difficult to drain the fuel strainer". The comment was signed off by the airplane workshop in connection with a 100-hour inspection without replacement of any parts. Moreover, there were no comments in the airplane's flight log mentioning a leak or other problems in connection with draining the gascolator.

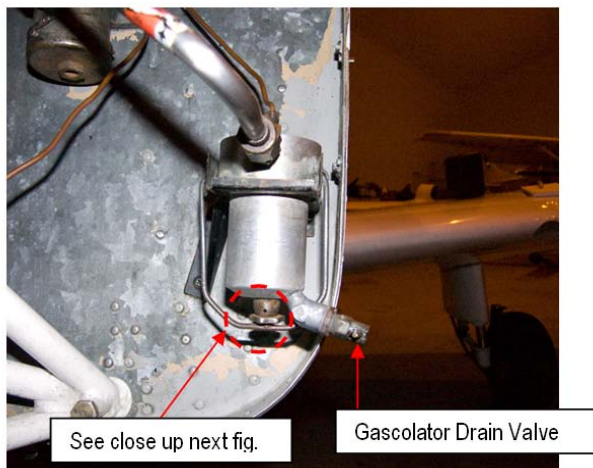


Figure 2: Location of the gascolator assembly on the firewall in the engine compartment (locking wire removed). The fuel tank is located in the wing which can be glimpsed in the background.

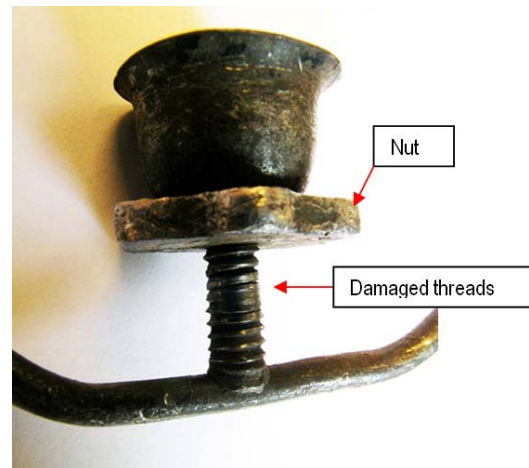


Figure 3: Damaged thread section in the fastening clamp which holds the bowl in place



Figure 4: Parts of the gascolator assembly: Fastening clamp, bowl with drain nipple, gasket, filter

The Accident Investigation Board knows that the Piper has used this fastening arrangement for the gascolator bowl for decades. LN-BTS was produced in 1979. Checking the fastening clamp is, as mentioned, not referred to in the airplane's maintenance documentation. Following this serious incident, a new fastening clamp was procured for LN-BTS. The price was about NOK 1500. Everyone involved has stated to the Accident Investigation Board that the finances of the club are good, and that the costs were not a factor in this incident.

In conversations with the Accident Investigation Board, the student stated that he had experienced the same problem with a leak from the fuel strainer drain during pre-flight inspection a few weeks earlier. His instructor at the time contacted technical personnel, and they fastened the gascolator bowl before further flying. The club's technical manager has stated that this happened four weeks earlier, which is before the latest 100-hour inspection. The comment and repair were not entered in the airplane's flight log.

In conversations with the Accident Investigation Board, the instructor has explained further what his comment that the problem was familiar was based on. He described how the drain valve often had to be pushed horizontally, towards the hole in the cowling in order to get any fuel out when draining the strainer. Force had to be applied, and minor leaks were not unusual. This was the case the preceding evening, but probably not to the same extent as on the morning of the incident. At the time, this created no problems. He was aware of the episode experienced by the student a few

weeks earlier, and had emphasised to the other instructors that they had to write a remark every time such problems arose. He mentioned that it often took time to have faults repaired, and that this was frustrating. Several of the remarks were recurring topics, for example that an oleo leg was low. In retrospect, the instructor reflected that the fuel leak should have been taken more seriously, and that the flight should have been cancelled.

The Accident Investigation Board has been informed by the technical manager of the club that he, as part of the club's follow-up of the incident, will participate in an instructors' meeting at the earliest possible opportunity to review the incident and draw lessons from the events. The meeting would include a discussion of the importance of taking deviations discovered pre-flight seriously. The club's technical manager considered it regrettable that the remark and the repair were not entered in the flight log the last time the problem occurred, and admitted that an opportunity to discover weakness in the fastening device had been missed. The technical manager is among the three club members who carry out 50-hour inspections. He had not noticed that the thread section on the clamp in question was worn. There was never any problem with tightening the nut under the bowl. A painted alignment mark ensured that the bowl was fitted so that the stub with the draining valve was in the right position, in the middle of the hole in the cut-out in the cowling. A locking wire was used both to prevent the tension nut from coming loose, and to prevent the hooks at the top of the clamp from coming loose from the fastening points above the bowl.

The technician at the PART 145 workshop was familiar with how the thread section of the fastening clamp could show signs of wear and tear on old Piper airplanes. He knew that in some cases, spacing washers had been installed to move the nut to a less worn area of the thread section. This serious air traffic incident has, however, resulted in more attention being directed at the risk of failure in the fastening of the gascolator bowl, and the practice of installing washers in-between will not be continued in his organisation. The technician also remarked that the pilots have too little knowledge of how the system works, and too poor general training in pre-flight inspection. He explained that when the fuel level is low and there is no pressure in the system, there will be little fuel from the strainer when draining. This is especially the case when one oleo leg is low or the airplane is parked facing uphill with the nose high.

AIBN has searched for similar cases in US accident and incident databases (NTSB and FAA). There were some examples of the fuel strainer drain valve having been found in an open position after engine failure during take-off. None of the reports mentioned a loose gascolator bowl.

On 19 April 2009, a serious air traffic incident took place at Skien Airport Geiteryggen (ENSN). That incident had some features in common with this incident (Report SL 2010/06). A Cessna 172S Skyhawk SP, registration LN-LVT, experienced engine failure at an altitude of about 500 ft after take-off. The two persons on board chose to turn back and executed a successful emergency landing on the runway. The Accident Investigation Board's investigation found that the connection between the top assembly and the bowl of the fuel strainer (corresponds to the gascolator) had come loose. The bowl fell down and the fuel supply to the engine was interrupted.

COMMENTS FROM THE ACCIDENT INVESTIGATION BOARD

The leak discovered during the pre-flight inspection and findings from the technical examination after the incident indicate that the gascolator bowl was loose, and that the engine stopped as a result of interrupted fuel supply. The gascolator bowl coming loose is probably connected to the damaged threads on the fastening clamp which is intended to hold the bowl in place. The nut, which is tightened to hold the bowl up, has most likely slid down the worn-out threads when the stub with

the drainage valve was pushed in and to the side upon drainage. This resulted in a leak in the top assembly gasket.

The Accident Investigation Board believes the fuel supply to the engine was normal as long the airplane was on the ground and gravity lead the fuel from the tank and down into the gascolator bowl. During take-off, with the engine at full power, as the nose was raised and both the mechanical and electrical fuel pump had to draw the fuel through the gascolator, the leak probably resulted in the pumps drawing air instead of fuel. This can explain both the engine failure and the fact that the engine could be started and ran normally again when the airplane was on the ground.

As the gascolator must be must loosened every 50 flight hours, the thread section on the fastening clamp and the tension nut is exposed to wear and tear over a period of time. The technician's discretionary assessment decides when the parts are due for replacement with regular operation. The Accident Investigation Board emphasises that personnel engaged in maintenance of aircraft materials must be vigilant and replace worn components, even if the components apparently "can take one more flight". In the opinion of the AIBN, the condition of the fastening clamp in question and the information that spacing washers are used to postpone replacement of such clamps give rise to concern.

The CAA-N made a comment in the draft consultation that the best measure to ensure that the condition of the parts in question are being checked, is that Piper includes this in the maintenance program. Changing the maintenance documentation is by the AIBN viewed as one of several possible measures to deal with the identified safety issue, however, the AIBN leaves it to the CAA-N to consider what changes or corrections that should be made to solve the issue.

Although it may be claimed that design, quality and maintenance routines for the parts which hold the critical gascolator bowl in place are not optimal, the Accident Investigation Board believes that there were relatively clear indications that something was wrong. The leak discovered during the pre-flight inspection a few weeks before the incident in question, the experience that it was necessary to apply force and sideways force which resulted in minor leaks during draining as well as the student's observations on the morning of the incident, should have resulted in a technical comment followed by trouble-shooting before the next flight.

The largest loads exerted upon the fastening points of the gascolator bowl probably come from the stress caused by draining the gascolator twice during every pre-flight procedure. It is therefore important that moving parts in the valve are maintained in a good technical condition so that they move as intended, and that the equipment used for draining does not damage the mechanism. It is also desirable that everyone who carries out draining of this type of fuel strainer is familiar with the construction and its weaknesses, so that they do not expose it to higher loads than absolutely necessary.

The initiative of the club to learn from the incident is expected to result in increased systems knowledge and a stronger focus on the importance of taking observed deviations seriously. Deviations handling is, as we know, a significant part of the safety culture in an enterprise. Training forms the basis for how students will handle observed deviations in the future, and the instructor as a role model and educator is an interesting topic in this connection.

The Accident Investigation Board believes the authority gradient between the student and the training manager may have been of significance when the leakage problem was not examined more closely before take-off. A desire to carry out the flight as planned so that the student could take his solo flight as soon as possible may also have been a factor. The Accident Investigation Board

believes this serious air traffic incident contains several elements of a technical and operational nature and human factors which make it well suited for educational purposes. The incident also illustrates the importance of using the entire available runway for take-off.

SAFETY RECOMMENDATIONS

The Accident Investigation Board Norway (AIBN) makes the following safety recommendation:¹

SL Safety Recommendation no. 2010/10T

The gascolator bowl came loose so that the fuel supply was interrupted and the engine stopped just after take-off. This is a safety problem which could result in a serious accident. Worn threads on the wire bail probably caused the problem. The AIBN recommends that the CAA-N considers measures to ensure that the components in question be checked during periodic inspection.

The Accident Investigation Board of Norway (AIBN)

Lillestrøm, 9 March 2010

¹ The Ministry of Transport and Communications ensures that safety recommendations are presented to the aviation authorities and/or other affected ministries for assessment and follow-up, cf. Section 17 of the Regulations relating to public investigation of air traffic accidents and incidents in civil aviation.