



Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2010:06e

**Accident to aircraft SE-GBL at
Gothenburg City Airport (Säve),
Västra Götaland County, on 6 July 2009**

Case L-09/09

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Statens haverikommission (SHK) Swedish Accident Investigation Board

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Statens haverikommission
Swedish Accident Investigation Board

20 May 2010

L-09/09

The Swedish Transport Agency

SE-601 73 NORRKÖPING, Sweden

Report RL 2010:06e

The Swedish Accident Investigation Board has investigated an incident that occurred on 6 July 2009 at Gothenburg City airport (Säve), Ö län (Västra Götaland County), to an aircraft registered SE-GBL.

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Agency herewith submits a report on the investigation.

The Swedish Accident Investigation Board will be grateful to receive, by 22 November 2010 at the latest, particulars of how the recommendations included in this report are being followed up.

Carin Hellner

Stefan Christensen

Copy to EASA.

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Report finalised May 2010

Aircraft; registration and type	SE-GBL, PA 34-200 Piper Seneca
Class, airworthiness	Normal, valid Certificate of Airworthiness
Registered owner/Operator	Auson AB
Time of occurrence	6 July 2009, at 14:28 hours, in daylight. Note: All times are given in Swedish daylight saving time (UTC + 2 hours)
Place	Gothenburg City Airport (Säve), O län (Västra Götalands county), (posn. N57° 47' E011° 52', 20 metres above sea level)
Type of flight	Private
Weather	According to METAR ESGP at 14:20: wind 260°, 9 knots, visibility more than 10 km, scattered clouds, cloud base 1800 feet, temperature/dew point 20/16 °C, QNH 1002 hPa
Persons on board:	
crew members	1
passengers	1
Injuries to persons	None
Damage to the aircraft	Substantially damaged
Other damage	None
Commander:	
Age, licence	85 years, PPL with instrument rating
Total flying time	3799 hours
Flying hours previous 90 days	13 hours, all on type
Number of landings previous 90 days	15

The Swedish Accident Investigation Board (SHK) was notified on 6 July 2009 that an aircraft with registration SE-GBL had an accident at 14:28 hours on that day at Gothenburg City Airport (Säve), Västra Götaland County.

The accident was investigated by SHK represented by Carin Hellner, Chairperson and Stefan Christensen, Investigator in Charge.

The investigation was followed by Nicklas Svensson, Swedish Transport Agency.

Summary

The pilot took off from Säve for a private flight to Sindal in Denmark. After take-off the pilot was unable to retract the landing gear. After repeated attempts at both retraction and extension, the pilot left the landing gear lever in the extended position and requested a return to land back at Säve. On the initiative of air traffic control a fly by was carried out for visual assessment from the control tower. However a definitive statement concerning the landing gear status could not be given from the tower.

The pilot then continued with an approach for landing. The indications in the aircraft showed that none of the landing gear wheels were down and locked. When interviewed the pilot stated that he thought this was an incorrect indication, which was why he did not use the emergency landing gear extension system. He said that he had never practised emergency extension of the landing gear while undergoing proficiency checks (PC). When the aircraft touched down all three landing gear struts folded and the aircraft slid along

the asphalt runway before coming to a halt 1,000 metres along it. No fire broke out and those on board – who with help from the rescue services were able to leave the aircraft themselves – were not injured.

A technical examination revealed that certain components in the electric motor that drives the pump for the hydraulic system was worn out, which meant that the landing gear could not be extended in the normal way.

The examination also discovered that the aircraft emergency checklist did not contain either the emergency landing gear extension procedure or that for landing with the landing gear position uncertain. On the basis of the regulations in BCL-M (Bestämmelser för Civil Luftfart - Materielbestämmelser – Swedish Civil Aviation Regulations – Equipment Rules) it was also determined that the checklists were incorrect and incomplete in several respects.

After a dialogue with the appropriate authority (Transportstyrelsen – the Swedish Transport Agency) it was revealed that in respect of checklists and emergency checklists there was no operative approval or inspection procedure.

The accident was caused by lack of knowledge and understanding in respect of the landing gear and its emergency extension system. Contributory factors were inadequate checklists and the absence of training in respect of emergency procedures.

Recommendations

It is recommended that the Swedish Transport Agency should:

- Ensure that rules are prepared in respect of the minimum requirements for the content of checklists for aircraft operated within the national supervision (Annex II). (*RL 2010:06e R1*).
- Ensure that an operational oversight process for checklists for aircraft operated within the national supervision, (Annex II), are prepared. (*RL 2010:06e R2*).
- Work towards that the importance of recurrent training of emergency procedures for aircraft with retractable landing gear is communicated to the PC controllers. (*RL 2010:06e R3*).

It is recommended that EASA should:

- Ensure that rules are prepared in respect of the minimum requirements for the content of checklists for aircraft operated within EASA's supervision (*RL 2010:06e R4*).
- Ensure that, in connection with e.g. the ARC review that existing checklists and emergency checklists are in accordance with AFM and found in a legible condition (*RL 2010:06e R5*).
- Work towards that training of emergency procedures for aircraft with retractable landing gear is introduced at Proficiency Checks regarding private aviation (*RL 2010:06e R6*).

1 FACTUAL INFORMATION

1.1 History of the sequence of events

1.1.1 *The take-off*

The pilot and his passenger arrived at Säve airport in order to carry out a private flight to Sindal airport in Denmark. The flight would be performed by a Piper PA 34 Seneca aircraft. After refuelling the pilot started the engines and requested permission to taxi out for take-off. It was planned to perform the flight under IFR¹. The pilot was instructed to taxi to the waiting area for runway 19, and then received departure clearance direct to waypoint DETNA and climb clearance to 4000 feet.

SE-GBL then received take-off clearance “right turn out, clear for take-off” and the pilot performed a normal take-off from runway 19, then being instructed to contact Gothenburg control on another frequency. About three minutes after take-off, however, the pilot called the control tower again and reported that he was having problems raising the landing gear, and that he wanted to return and land at Säve.

1.1.2 *Fault indications*

The pilot discovered when retracting the landing gear after take-off that something was wrong, since the red lamp on the instrument panel that indicates movement of the landing gear had not switched off. There is also a mirror on the left engine cowling in which he could see that the nose landing gear was not completely retracted.

The pilot made a further attempt to retract the landing gear by putting the landing gear lever into the extend position and then up, without any result. He then left the landing gear lever in the down position. The lamp indicating movement of the landing gear was however still lit. According to the pilot’s own account he was convinced that the landing gear was down and locked. However none of the three lamps that should light up green when the landing gear is down and locked were lit.

The pilot received clearance to turn right to enter a right hand circuit for landing on runway 19. At the initiative of the air traffic controller in the tower the pilot flew past the tower for a visual check of the landing gear position. During the fly past the air traffic controller reported: “No, it’s not hanging loose. We aren’t completely sure that the left main gear is really completely..... But they are a bit twisted, aren’t they?” The pilot of SE-GBL replied that “Yes, they are down, and are down as usual.”

1.1.3 *The landing*

After the fly past the pilot reported that he intended to make a “trial landing”, and received clearance from the control tower for approach to runway 19. The pilot carried out a visual approach to the runway, while the air traffic controller set off the warning alarm and informed the rescue services about the imminent landing.

During the preparations for landing, the control tower asked which landing gear was showing an incorrect indication, whereupon the pilot answered: “All.” The pilot did not make any attempt to perform emergency extension of the landing gear by means of the alternative procedure that is described in the

¹ IFR: Instrument Flight Rules

aircraft's Flight Manual. The checklist that was used in the aircraft had no section dealing with landing gear problems and/or emergency extension of the landing gear.

The approach and flare over the runway had, according to the pilot, been performed similar to a normal landing, with both engines idling. On touchdown all the landing gear struts folded and the aircraft slid on its fuselage underside, and stopped about 1000 meters into the runway. The rescue services arrived as soon as the aircraft had stopped and helped to evacuate those on board, who were both unhurt.

When the aircraft was to be removed from the runway it was lifted with the aid of a mobile crane. A technician then entered the cockpit and pulled out the emergency gear extension control, and all three wheels came down and locked. The aircraft could then be rolled into a hangar for a technical examination.

1.1.4 *Interview with the pilot*

The pilot was very familiar with his aircraft and considered that he had a good knowledge of the aircraft and how to manage its systems. The reason why he decided to extend the landing gear and then retract it again ("recycling the gear") was that he thought he had been taught that this could possibly resolve landing gear problems. The three green lamps that should light to indicate that the landing gear was down and locked never did light, instead the landing gear warning light remained lit.

After the fly by the pilot was not completely certain of the position of the landing gear, but he stated that he thought the problem was an incorrect indication. He had checked the position of the nose landing gear in the mirror on the engine cowling, and noted that it was not quite at the normal angle, but thought it was anyway locked in the down position.

The reason that the procedures prescribed in the Flight Manual for emergency extension of the landing gear were not followed was according to the pilot, that this never had been practised in connection with the Proficiency Checks. He also thought that a normal landing could be planned, since he believed that the fact that the three green lamps were not lit was because of a faulty indication. The pilot also said that he experienced the situation that had arisen as relatively stressful, which he thought had affected his decision-making ability.

In answer to the question of why the pilot had not used the emergency checklist, he replied that neither the procedures for emergency extension of the landing gear nor for emergency landing with retracted landing gear were on the emergency checklist. In his opinion the emergency checklist should only contain actions in the case of loss of an engine, electrical faults, etc. He had not previously experienced any problems with the landing gear on this particular aircraft.

The accident occurred at position N57° 47' E011° 52'; 20 metres above sea level.

1.2 Injuries to persons

	Crew members	Passengers	Others	Total
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	-
None	1	1	-	2
Total	1	1	-	2

1.3 Damage to the aircraft

Substantially damaged.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 *The commander*

The commander was 85 years old at the time and had a valid PPL with instrument rating.

Flying hours			
	24 hours	90 days	Total
All types	0	13	No information.
This type	0	13	3799

Number of landings this type previous 90 days: 15.
Flight training on type carried out on 05.09.74.

1.5.2 *Training and practice*

The pilot had been trained on this type of aircraft in connection with its delivery. Certificates and authorisations had thereafter been renewed on a regular basis. In connection with renewals the pilot had undergone PC (Proficiency Checks), involving a handling skills check together with an authorised examiner. The most recent PC was carried out on 29 August 2008 on PA 34.

During the interview with the pilot it was found that he had never practised the emergency landing gear extension procedures in the course of the PCs, nor had he discussed these actions with an instructor or examiner.

1.6 The aircraft

1.6.1 General

The aircraft	
Manufacturer	Piper Aircraft Corporation
Type	PA 34-200 Seneca
Serial number	34-7450147
Year of manufacture	1974
Gross mass	Max. authorised take-off/landing mass 1,915/1,855 kg, actual 1,780 kg
Centre of mass	Within permitted limits
Total flying time	2,173 hours
Number of cycles	-
Flying time since latest inspection	16:45 hours
Fuel loaded before event	102 litres of 100LL The flying time in accordance with the submitted flight plan would be 5 hours.

Engine

Manufacture	Avco Lycoming	
Engine model	IO-360-C1E6/LIO-360-C1E6 (Counter-rotating)	
Number of engines	2	
Engine	<i>No. 1</i>	<i>No. 2</i>
<i>Total operating time, hrs</i>	2,172:45	2,142:45
Operating time since overhaul	181:35	181:35
<i>Cycles since overhaul</i>	-	-

Propeller

Propeller manufacturer	Hartzell Propeller Inc
Propeller model	HC-C2YK-2CEUF/HC-C2YK-2CLGFU (Counter-rotating)
Propeller running time since basic inspection	54:55 hours

The aircraft had a Certificate of Airworthiness with valid approval certificate (ARC – Airworthiness Review Certificate).

1.6.2 Landing gear system

The system for retracting and extending the landing gear on the PA 34 is electro-hydraulic. An electric motor drives a hydraulic pump the by providing pressure in two directions causes the retraction and extension of the landing gear, namely the right and left main gears and the nose gear. In the retracted position the landing gear is retained only by hydraulic pressure. On extension the landing gear legs are driven into their correct positions by hydraulic pressure and locked in the extended position by overcentring of the leg extension struts and securing by downlock hooks (mechanical hooks which lock the landing gear into the correct position).



Fig. 1. Illustration showing the right side main landing gear of the aircraft.

If the normal extension system fails for any reason, there is a back-up extension system on the aircraft. The back-up system opens a valve in the hydraulic system to allow the pressure to equalise and the gear to extend by gravity. Extension and locking are facilitated by springs in the leg extension struts that force the landing gear legs into their overcentred and locked positions.

1.6.3 *Operation and monitoring of the landing gear system*

The landing gear is normally operated by means of a control on a special panel in the aircraft cockpit. Operation is by means of a lever shaped like a wheel that has two positions, up and down. The position of the landing gear is indicated by lamps on the instrument panel. When all three wheels are extended and locked, the three green lamps on the panel above the landing gear lever light up. There is also a mirror on the left engine cowling by means of which the pilot can visually check the position of the nose wheel.

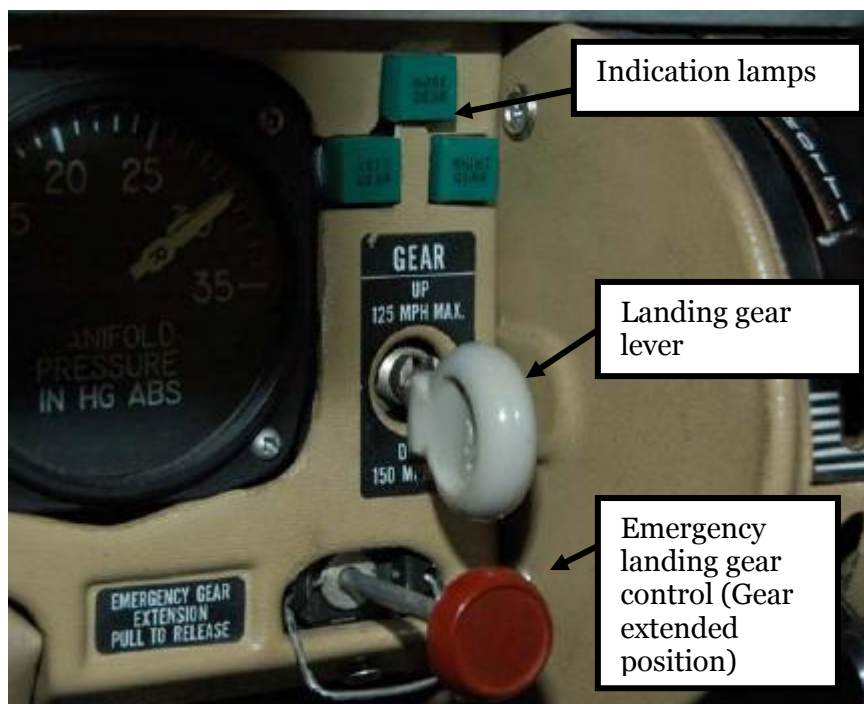


Fig.2. Landing gear panel.

While the landing gear is moving, i.e. it has not reached its final position during landing gear operation by the landing gear lever, a red warning lamp is lit on the instrument panel. When the landing gear has reached its final position the warning lamp is extinguished. During normal flight with all the landing gear legs retracted, none of the indication lamps on the instrument panel are lit.

1.6.4 Inspection of the landing gear control system

According to the technical inspection list of the aviation authority, inspection of the system for extending and retracting the landing gear (Hydraulic Power Pack) is prescribed at various intervals, depending on the type of use to which the particular aircraft is subjected. The inspection includes among other things checks on the status and length of the carbon brushes in the electric motor that in this case caused the system to fail. This check must be carried out after:

- 100 flying hours if the aircraft is used for flight training purposes.
- 500 flying hours during normal flying.

On this particular aircraft, SE-GBL, a major inspection of the system was performed at 1,500 flying hours, and thereafter a normal system inspection (including the carbon brushes) 492 flying hours later. At the time of the accident the aircraft had flown 182 hours since the most recent inspection of the system. According to the owner the aircraft had not been used for any kind of flight training.

1.6.5 Emergency actions

Should the normal landing gear extension procedure not work, there is an alternative method. This procedure is described in the section “*Emergency Procedures – FAA approved*” in the Flight Manual that belongs to the aircraft.

After checking certain functions, the following actions must be taken for emergency extension of the landing gear:

- a. Reduce power; airspeed not to exceed 100 MPH.
- b. Place Landing Gear Selector Switch in “GEAR DOWN LOCKED” position.
- c. Pull emergency gear extension knob.
- d. Check for three green lights.
- e. Leave emergency gear extension knob out.

In that particular section of the Flight Manual there is also a description of the actions to be taken in the case of an emergency landing with the landing gear retracted or in an uncertain position:

- a. Approach with power at a normal airspeed.
- b. Leave flaps up (to reduce wing and flap damage).
- c. Close the throttles just before touchdown.
- d. Turn off the master and ignition switches.
- e. Turn fuel selector valves to “OFF”.
- f. Contact the surface at minimum airspeed.

1.6.6 Checklists

The aircraft SE-GBL had been bought new by the pilot in 1974, and after this he was the only person to have flown it. The only exceptions were check flights performed after major inspections. SHK obtained the operational documentation that belonged to the aircraft, including the Flight Manual and checklists.

According to the pilot the checklists accompanied the aircraft when it was delivered, and had been prepared by the aircraft importer. The checklists are combination documents that contain both instructions for normal operation and for emergency situations.

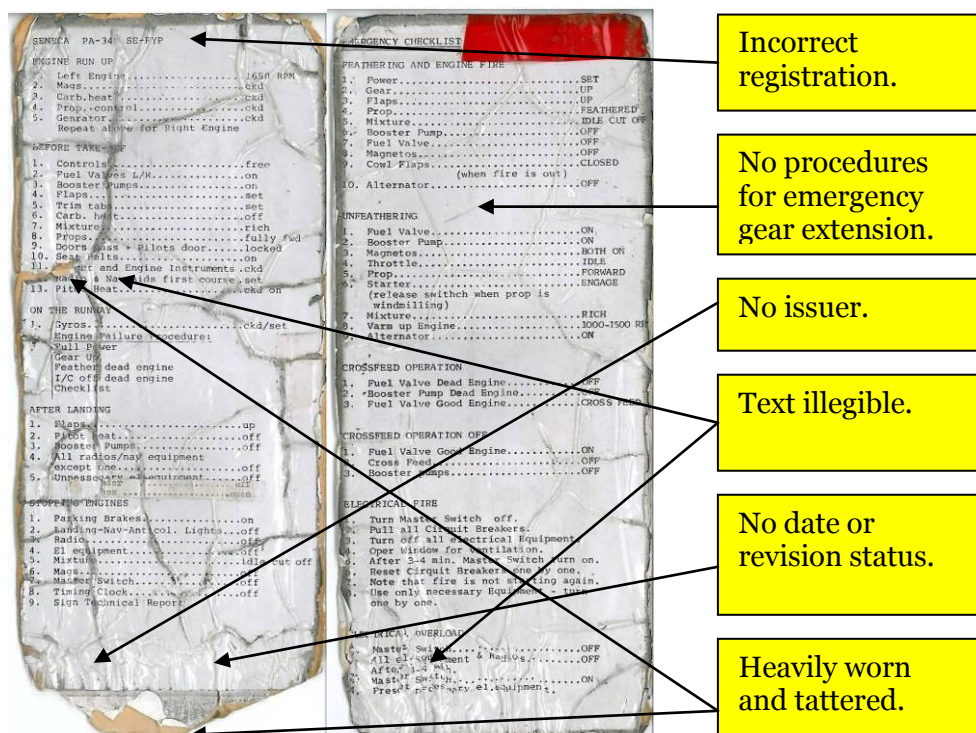


Fig. 3. Normal checklist and emergency checklist.

The checklists in this particular aircraft consisted of two plastic laminated paper sheets, one of which was headed “EMERGENCY CHECKLIST” and was distinguished by a strip of red tape. On the rear of each checklist was written: “Seneca PA 34 SE-FYP”. Both the normal and emergency checklists were very worn, and in places illegible. Neither of the checklists were dated, nor did they show the issuer or revision status.

A few of the emergency procedures that were stated in the approved Flight Manual had been written into the emergency checklist. There were however no instructions and/or advice concerning the emergency procedures for alternative landing gear extension or landing with the landing gear in retracted/uncertain position.

1.7 Meteorological information

According to the SMHI (Swedish Meteorological and Hydrological Institute) analysis:

General

Low pressure and some unstable weather over southern Sweden.

METAR

Säve airport at 14:20: wind 260°, 9 knots, visibility more than 10 km, scattered clouds with base at 1800 feet, temperature/dew point 20/16 °C, QNH 1002 hPa.

1.8 Aids to navigation

Not applicable

1.9 Radio communications

The radio communications between SE-GBL and air traffic control were recorded and have been obtained by SHK. The following is an extract from the radio traffic at the time of the accident. Parentheses are used to indicate that the interpretation of phrases or words is uncertain.

GBL: Transmission from the pilot of aircraft SE-GBL
 TWR: Transmission from the air traffic controller in Säve air traffic control tower
 591: Transmission from rescue vehicle 591 at the airport

Time	From	Radio traffic
10.22.51	GBL	Right turn out, cleared for take-off.
10.26.22	GBL	Säve from BL again. I can't get my gear up here and the red lamp is lit that shows the gear (should be up). I think I want to go down to land again.

10.26.36	TWR	BL, yes, that's understood. You can turn right and make a right hand circuit to runway 19.
10.26.42	GBL	(Right) circuit to 19.
10.26.44	TWR	Yes, are you're sure that they are still down, so to say, or do you want to check that with us first?
10.27.13	GBL	.. green indication here, actually, so it looks as if it could be some strange connection ...
10.27.20	TWR	OK, if you wish you can go past the tower here and we can take a look anyway, so we can see in any case about how it looks.
10.29.48	TWR	No, it's not hanging loose. We ... aren't completely sure that the left main gear is really completely.... But they are a bit twisted, aren't they?
10.30.00	GBL	Yes, they are down, and are down as usual.
10.30.04	GBL	(So I'll do) a trial landing.
10.30.08	TWR	Yes, do that, you are clear for approach to runway19.
10.31.20	TWR	And BL, which landing gear do you have a fault indication for?
10.31.26	GBL	All.
10.31.29	TWR	My colleague here says that he thinks the main gear looked as if it was hanging crooked.
10.31.36	GBL	Yes, I have a mirror but it looks like??
10.32.36	591	591, we are following the plane, they have belly landed.

1.10 Aerodrome information

The airport status was in accordance with AIP²-Sverige/Sweden.

1.11 Flight recorders and voice recorders

None. Not required.

² AIP – Aeronautical Information Publication

1.12 Accident site

1.12.1 Accident site

The accident occurred during approach and landing at runway 19 at Gothenburg City Airport (Säve). The aircraft used the asphalted runway (2039 x 40 metres) for the landing. After touchdown the landing gear folded and the aircraft slid along the runway, finally stopping after about 1000 metres, on the right side of the runway.



Fig. 4. Gothenburg City Airport (Säve).

1.12.2 The aircraft



Fig. 5. The aircraft after the emergency landing.
Photograph: Säve Rescue Services.

As a result of the accident, the following damage to the aircraft was initially found:

- Damage to the landing gear and the landing gear doors
- Damage to both propellers
- Secondary damage to both engines
- Damage to the wing flaps
- Scraping damage to the underside of the aircraft
- Possible structural damage to an unknown extent

1.13 Medical information

On 24 September 2008 the pilot had undergone the medical examination that in accordance with LFS (Luftfartsstyrelsens författningssamling - the Swedish Civil Aviation Authority Statute Book) regulations 2008:28 and JAR-FCL 3 must be taken annually by private pilots aged over 50.

The medical examination checks the same variables regardless of age. Research has shown that age affects *vision*, *hearing* and *cognitive*³ ability. The periodicity however increases for certain examinations depending on age.

Within commercial aviation, from the age of 60 onwards flying is only permitted in two-pilot system. The highest permitted age for commercial flying is 65. Nothing in the examination had indicated that the mental and physical condition of the pilot was impaired before or during the flight.

³ Cognitive: The human way to collect, process and use information.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 General

No personal injuries were sustained during the accident. In the case of a gear-up landing the risk of fire is however always increased due to intense spark generation in combination with possible fuel leakage. For this reason gear-up landings may sometimes – on condition that they are known to be about to take place – be carried out on grass surfaces or, when landing at larger airports, as an exception on a foam-laid runway. It should also be taken into account that the steering capability of the aircraft on the ground in such situations is reduced, or completely lost, with an obvious risk of collision with objects or installations outside the runway.

In this particular accident a gear-up landing was not planned for, since the pilot stated that he thought that the landing gear was extended and locked. Air traffic control took the precaution of issuing an alarm (warning/crash alarm) to the airport fire services and also an alarm to the rescue services alarm and control centre to report the imminent landing. This action is in accordance with the airport procedures in the case of a landing gear problem, where the risk factor is assessed as being higher than in normal circumstances.

In the case of a fault in the landing gear, the possibility of only part of the landing gear being faulty must be considered. This can raise the level of risk even higher since an accident in such situations often results in the aircraft leaving the runway in an uncontrolled manner.

The Emergency Locator Transmitter of type Narco ELT 10 was not activated in the accident.

1.15.2 Actions by the rescue services

The local airport fire service was informed that an aircraft had a landing gear problem and was planning to land in three minutes. Three rescue vehicles turned out to wait at a position 30 metres west of holding point B for runway 19.

After the gear-up landing the rescue vehicles followed the aircraft along the runway. Those on board were helped out of the aircraft by the rescue service personnel. Apart from towing the aircraft away from the runway, no other efforts were required from the rescue services in connection with the accident.

1.16 Tests and research

1.16.1 Examination of the system

After the accident an authorised aircraft workshop was given the task, under SHK supervision, of carrying out an examination of the aircraft landing gear and its associated auxiliary and control systems. After raising the aircraft on jacks the operation of normal retraction system was tested, the result being that the landing gear did not retract. During the retraction test it was found that the relay that energises the electric motor operated but the motor itself did not start. Only a faint whirring sound could be heard.



Fig. 6. The electric motor after dismantling. Photo: EMS AB.

The electric motor cover was removed so that the unit could be examined. It could then be seen that the internal moving parts, the commutator and the carbon brushes, were completely worn out.

1.16.2 Regulations concerning checklists – LFS (Luftfartsstyrelsens författningssamling - the Swedish Civil Aviation Authority Statute Book)

In the Swedish Transport Agency regulations for private aviation with aircraft (LFS 2007:58, paragraph 45) among other things it is prescribed that: The commander must be responsible for the use during flight of checklists in accordance with BCL-M 1.5 (Bestämmelser för Civil Luftfart - Materielbestämmelser – Swedish Civil Aviation Regulations – Equipment Rules Section 1.5). In Section 3 paragraph 2 "Equipment and Instrumentation" in the same LFS regulations it is also prescribed that: The commander must have access to the Flight Manual and checklists in accordance with BCL-M.

1.16.3 Regulations concerning checklists – BCL (Bestämmelser för Civil Luftfart - Swedish Civil Aviation Regulations)

In BCL-M (Equipment Rules) prescribes among other things the documentation to be kept on board an aircraft in order that it may retain its certificate of airworthiness. The certificate of airworthiness then remains valid on the issue of an ARC – Airworthiness Review Certificate, that is issued by a representative of the Transport Agency or by an approved technical maintenance organisation (CAMO- Continuous Airworthiness Management Organization).

In respect of checklists, the following is prescribed in BCL-M 1.5, items 4.5.1 and 4.5.2:

- *The checklist must be prepared by a manufacturer, importer or by the owner in co-operation with these, or a flying instructor, and be written in Swedish or English. The checklist must be dated and carry the aircraft's national or registration designation.*

- *The checklist must contain the necessary information for safe operation of the aircraft both before and during take-off, during flight and during and after landing, along with emergency situations (emergency checklist). The emergency checklist must have a red frame or in another way be clearly distinguishable from the list of normal operations.*

During inspection of aircraft the form "Granskningsrapport luftvärdighet" (Review report airworthiness) is used. These types of inspections are technical, and are therefore performed by specially trained technical personnel. Inspection of checklists is not present on the review report form, only the Flight Manual and its revision status. There are no instructions concerning a check that the contents of the checklists agrees with the approved Flight Manual contents.

SHK has interviewed representatives of the Transport Agency aviation department who perform the inspections mentioned above. The interviews showed that checklists are only noted as existing. The contents, status, appearance or other operational relevance are not noted. According to the interviews there is no operational checking of any kind or transmission of information to the Transport Agency operational departments, in respect of checklists and emergency checklists that apply to privately flown aircraft.

1.16.4 Proficiency Check (PC) contents in respect of pilots with private pilot's licences

SHK has obtained the contents of the PCs that are carried out on pilots with the certification class that this particular pilot had at the time of the accident. The form (L1647-2) is based on the joint European regulations in JAR-FCL⁴ and is used for both type training purposes and for PC.

In Section 5 of the form, Abnormal and Emergency Procedures, there is training and simulation of various emergency situations. In respect of the system faults that could occur, Section 5.4 contains some – non-mandatory – problems that could be practised, e.g. "Fire or smoke", "Loss of power". Other system faults are not specified, but are grouped under the heading "System malfunctions as appropriate".

1.17 Organisational and management information

Not applicable.

1.18 Other aspects

1.18.1 Equal opportunities aspects

Not applicable.

1.18.2 Environmental aspects

There were no releases and no known environmental influence was found.

⁴ JAR-FCL: Joint Aviation Regulations - Flight Crew Licensing.

1.18.3 Previous events

In 2004 an accident occurred at Optand airport outside Östersund involving a Cessna that was carrying parachutists. In that accident four of those on board were killed, and three suffered serious injuries. In its report (RL 2006:12) SHK made the following recommendation to the then Swedish Civil Aviation Authority as a result of the accident:

“In its inspections to ensure that correct emergency checklists are present in all aircraft (RL 2006:12 R4)”

SHK received a reply to the recommendation on 14 November 2007 as follows:

“The Swedish Civil Aviation Authority does not intend to take any action as a result of the recommendation, on the following grounds:

During inspections performed by the Swedish Civil Aviation Authority, emergency checklists are already currently checked against Flight Manuals in accordance with the requirements of BCL-M 1.5. item 4.5. This is described in the Swedish Civil Aviation Authority inspection procedures.”

1.18.4 The inspection procedures

As a result of the reply that was received from the Swedish Civil Aviation Authority in respect of the above-mentioned recommendation, SHK investigated how the inspection procedure for checklists and emergency checklists in private aircraft was structured.

After a request was made to the Transport Agency, the reply was received that the inspection procedures are managed by means of the technical inspections of aircraft that are performed. Those checklists that SHK has seen contain a box that must be checked to confirm that a checklist and an emergency checklist are on board. No other checks regarding checklists are made during the inspection.

This procedure has been confirmed by the personnel who perform the technical inspections of aircraft and were interviewed by SHK. The procedure that is referred to in the response given in the final paragraph of Section 1.18.3 above – that emergency checklists are checked against the Flight Manual concerned – could not be verified as taking place in the conversations held by SHK with the operational section of the Transport Agency aviation department. There is no defined procedure whereby checklists and emergency checklists are checked against the contents of Flight Manuals. Nor is there any inspection of these checklists in respect of the contents of BCL-M 1.5, items 4.5.1 and 4.5.2.

According to the certification rules issued by EASA⁵, it falls on the operator to establish the necessary checklists and emergency checklists. There are no specific rules or review processes defined for the content of emergency checklists for private aircraft.

⁵ EASA: European Aviation Safety Agency

2 ANALYSIS

2.1 The flight

2.1.1 Conditions

The pilot had planned a private flight to Sindal in accordance with normal practice. No known difficulties were present in respect of weather or operational conditions.

The aircraft had been fully refuelled and had no technical notifications or faulty functions. The pilot had owned the aircraft through his company since 1974 and must be considered to have been very familiar with the normal operational handling of the aircraft type, and its limitations.

2.1.2 Take-off and climb out

The investigation has not found any deviations from the regulations or procedures at the start of the flight in respect of preparations, taxiing out and take-off. The faulty operation of the landing gear hydraulic system during retraction after take-off therefore probably came as a surprise to the pilot. Nor had he experienced any problems or faults with the landing gear of the aircraft previously.

The attempt by the pilot to retract the landing gear by recycling it a number of times is not a procedure that is described in the Flight Manual, but may anyway be considered to be an established practice as a first action regarding the fault that had now occurred. When the fault could not be rectified, the pilot decided to return and land, and therefore left the landing gear lever in its down position. He found however that a normal indication was not obtained, since the red warning lamp was lit and the three green lamps had not lit.

The pilot has not been able to fully explain the rest of his actions in the situation that obtained, but thought that he had sufficient grounds to assume that the problem was due to an indication fault. The flight past the control tower to make a visual check was not at the initiative of the pilot, but suggested by air traffic control. This implies that the pilot did not at that stage think that there was anything wrong with the landing gear. During the fly past little new information was provided to the pilot, other than that the air traffic controller thought that it wasn't hanging loose, but that he was not "a hundred per cent certain".

It was not possible to clarify whether the communication with the control tower affected the pilot's decision in any direction. SHK can however say that it is very difficult to determine from the ground whether an extended – or partly extended landing gear is actually locked in its extended position, which can sometimes place the air traffic controller in a dilemma. The responsibility for continued actions after a fly past however always rests on the commander.

This occurrence can however in the opinion of SHK lead the LFV ANS⁶ to inform air traffic controllers on control tower duty that when observations are made from the ground during a fly by, these can only be of an informative character, and that any decisions based on these observations are still the responsibility of the aircraft Commander.

⁶ LFV ANS: Luftfartsverket, Air Navigation Services.

2.1.3 *Approach and landing*

The fact that the pilot did not use the emergency landing gear system was due, by his own account, to the fact that he had never practised this procedure, and that it was not included in the aircraft emergency checklist. These factors reflect serious deficiencies in both the continuing training process and the operational documentation. Operational education and training of pilots must, among other things, have the purpose of being able to identify and manage an emergency situation that could arise, and with the aid of adequate documentation solve the problem.

In this particular case the pilot's ability to solve the problem in a satisfactory manner was limited. Without the necessary training and with incomplete documentation as a support, he made the incorrect decision to continue with an approach as if the landing gear was extended and locked. SHK also found that the pilot, during the approach, reported to the control tower that he had fault indications for all three parts of the landing gear, i.e. no green lamps on the landing gear panel. Even though the pilot decided to believe that this was an incorrect indication, there was a procedure in the Flight Manual for landing with the landing gear in an uncertain position. This procedure was not however included in the checklist, and was not known by the pilot.

In his communication with the control tower the pilot used the expression "trial landing". The pilot was not able to define this as a term for a special type of landing, but simply meant that he would descend and land. The landing gear probably folded up immediately on touchdown, since none of the legs were locked in the extended position.

2.1.4 *Actions by the pilot*

It is fairly easy to conclude that there were deficiencies in the way the pilot handled the emergency situation that had arisen. The execution of the emergency landing, without any indication that the landing gear was extended and locked, was not supported by any documentation or training. The location of the emergency landing gear control on the instrument panel was not such that it could be considered difficult to access and/or not user-friendly. Despite these conditions, the pilot was not able to identify and deal with the fault condition in accordance with the procedure prescribed in the Flight Manual.

SHK however considers that the conditions enabling the pilot to manage the situation correctly were probably limited. It is known that, among other things, cognitive ability decreases with advancing age, which can affect the decision process. There are strong indications that the pilot – obviously affected by stress in the situation he faced – was rapidly approaching the limit of his capacity and ability to make the correct decision. In such a situation, training and relevant documentation must provide the necessary support to the pilot. With relevant system training and correct emergency checklist entries, the risk level of this accident could have been considerably reduced.

2.2 **The technical fault**

Analysis of the technical fault that caused incorrect operation showed that the carbon brushes were worn out in the electric motor that drives the hydraulic pump. This fault was of a type that the pilot could not take any action that would extend the landing gear by using the normal aircraft system.

The indications and warning system that are associated with the operation of the landing gear appear to have functioned correctly. It can also be said that the fault was of such a nature that the emergency landing gear extension system was designed to cover.

The inspection interval in respect of the electric motor was in the higher category, since this particular aircraft was not used for flight training purposes. However the components in the electric motor became worn and caused faulty operation of the unit long before the next inspection was due. SHK cannot however express an opinion on the length of the interval since it not known what the status of the electric motor was at the time of the previous inspection.

2.3 Emergency procedures

2.3.1 General

The emergency procedures in an aircraft are intended to give the pilot – or the flight crew – support and guidance in situations that are outside the normal operational area of the aircraft. The procedures are drawn up by the manufacturer and approved by certified authorities. Emergency procedures are normally grouped in a special section in the aircraft AFM (Airplane Flight Manual) or – depending on the type of aircraft – in a pilot’s handbook. Common to all, however, is that the procedures are intended to provide guidance in emergency or abnormal situations that concern the aircraft systems or events that may occur.

The instructions that cover normal operations of an aircraft are naturally important. Usually, however, those actions that are within the “day-to-day” operational areas become relatively quickly well-known and routine operations for pilots. In emergency situations, however, things happen that are both unusual and unexpected – and can sometimes require immediate action – so it is important to have easily accessible and correct emergency checklists on board.

2.3.2 Emergency checklist for SE-GBL

According to BCL-M such lists must contain: *“The information necessary for safe operation of the aircraft - - - in emergency situations.”*

The actual checklists in SE-GBL were found – apart from their generally unacceptable status – to not contain actions in the case of faulty operation of the landing gear system. SHK is of the opinion that no more detailed explanation is required as to why emergency instructions in the case of landing gear problems must be present on emergency checklists, when operating aircraft with retractable landing gear.

The checklists in SE-GBL (that were originally drawn up for a different individual aircraft), according to the pilot, accompanied the aircraft on its delivery. The lists were probably not checked or approved by any authority in respect of their formal status and relevant contents. The current BCL (Bestämmelser för Civil Luftfart - Civilian Aviation Regulations) documentation admits that a number of different organisations can “process” checklists and emergency checklists for aircraft without them being checked and/or approved by any authoritative body. This can mean that the same type of aircraft may have completely different checklists, depending on who wrote the documents. SHK considers that this does not promote flight safety.

In this particular case, with an elderly pilot flying a twin-engined aircraft as single pilot, the need for correct emergency instructions is even more acute.

2.3.3 *Training in emergency procedures*

The regulations that exist in respect of recurring competence checks/training (PC) for PPL holders are based on the common European rules in accordance with JAR-FCL. The obligatory items that must be carried out during a PC do not include systems training in the case of situations with landing gear problems.

SHK considers that landing gear problems belong to a systems category in which pilots – particularly those in the private sector – must have good knowledge and training in order to solve problems that may arise. Training in connection with PC can provide pilots with both practical flying experience and a theoretical briefing. There is a place for such reinforcement in the existing regulations via the PC form box for “Systems malfunctions as appropriate”.

In connection with this particular accident, the pilot stated that never, in connection with a PC, had he practised or discussed procedures for emergency extension of the landing gear, nor landing with the gear retracted or in an uncertain position. Such training of repetitive nature would probably reduce the risk of the kind of accident of which this is an example.

2.3.4 *The inspection procedures*

As can be seen in earlier sections of this report, deficiencies were discovered concerning the inspection procedures for checklists and emergency checklists. No more detailed explanation is required in order to realise that the checklists in SE-GBL (see Section 1.6.6) had not been subjected to either checking or inspection. The procedure referred to by the Transport Agency in respect of inspection has been shown to be a technical inspection that did not include the task of checking and/or enforcing a requirement in accordance with operational standards.

SHK will therefore in this report recommend that the Transport Agency takes relevant steps to both reinforce the requirements in respect of emergency instructions carried on board aircraft, and also to reinforce the inspection procedure for these.

3 CONCLUSIONS

3.1 Findings

- a) The pilot was qualified to perform the flight.
- b) The aircraft had a valid Certificate of Airworthiness.
- c) A fault occurred in the hydraulic system electric motor.
- d) The electric motor had run for 182 hours of an inspection interval of 500 hours.
- e) The landing gear warnings and indications operated correctly.
- f) The pilot did not use the emergency landing gear extension system.
- g) The emergency checklist did not contain information concerning emergency landing gear extension, nor for action in the case of a retracted/uncertain landing gear position.
- h) The emergency checklist was deficient in several respects.

- i) The pilot had not practised emergency extension of the landing gear during PC.
- j) The inspection authority did not have operational approval and inspection procedures in respect of checklists and emergency checklists.

3.2 Causes of the accident

The accident was caused by lack of knowledge and understanding in respect of the landing gear emergency extension system. Contributory factors were inadequate checklists and the absence of training in respect of emergency procedures.

4 RECOMMENDATIONS

It is recommended that the Swedish Transport Agency should:

- Ensure that rules are prepared in respect of the minimum requirements for the content of checklists for aircraft operated within the national supervision (Annex II). (*RL 2010:06e R1*).
- Ensure that an operational oversight process for checklists for aircraft operated within the national supervision, (Annex II), are prepared. (*RL 2010:06e R2*).
- Work towards that the importance of recurrent training of emergency procedures for aircraft with retractable landing gear is communicated to the PC controllers. (*RL 2010:06e R3*).

It is recommended that EASA should:

- Ensure that rules are prepared in respect of the minimum requirements for the content of checklists for aircraft operated within EASA's supervision (*RL 2010:06e R4*).
- Ensure that, in connection with e.g. the ARC review that existing checklists and emergency checklists are in accordance with AFM and found in a legible condition (*RL 2010:06e R5*).
- Work towards that training of emergency procedures for aircraft with retractable landing gear is introduced at Proficiency Checks regarding private aviation (*RL 2010:06e R6*).