Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2007:8e

Aircraft accident to SE-GIT at Umeå airport, AC county, Sweden, on 13 March 2006

Case L-06/06

SHK investigates accidents and incidents with regard to safety. The sole objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

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Translated by Interpreter Centre, City of Göteborg, from the original Swedish at the request of the Swedish Accident Investigation Board.

In case of discrepancies between the English and the Swedish texts, the Swedish text is to be considered the authoritative version.

Statens haverikommission (SHK) Swedish Accident Investigation Board

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Statens haverikommission
Swedish Accident Investigation Board

2007-07-06 L-06/06

Swedish Civil Aviation Authority

601 73 NORRKÖPING

Report RL 2007:08e

The Swedish Accident Investigation Board has investigated an accident that occurred on 13 March 2006 at Umeå airport, AC county, involving an aircraft with registration SE-GIT.

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

The Board will be grateful to receive, by January 7 at the latest, particulars of how the recommendation included in this report is being followed up.

Göran Rosvall Stefan Christensen

Contents

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L-06/06
Report finalised 6 July 2007

Aircraft; registration and type	SE-GIT, Piper PA 31-310
Class/airworthiness	Normal, valid Certificate of Airworthiness
Owner/Operator	Örebro Aviation AB
Time of occurrence	13 March 2006, at 16:55 hours, in daylight *Note:* All times are given in Swedish standard time (UTC + 1 hour)
Place	Umeå airport, AC county (posn. 63° 47.6′ N, 020° 16.8′ E, 7 m above sea level)
Type of flight	Commercial passenger transport
Weather	According to SMHI's analysis: Wind 160°/4 knots, visibility > 10 km, cloud none under 5000 feet, temperature ±0°C, QNH 1040 hPa
Persons on board:	
crew members	2
passengers	6
Injuries to persons	None
Damage to aircraft	Substantially damaged
Other damage	None
Commander	
Sex, age, licence	Male, 57 years, CPL-IRME
Total flying time	9035 hours, of which 6950 hours on type
Flying hours previous 90 days	90 hours, all on type
Number of landings previous 90 days	32
Co-pilot:	
Sex, age, licence	Male, 29 years, CPL-IRME
Total flying time	450 hours, of which 225 hours on type
Flying hours previous 90 days	75 hours, all on type
Number of landings previous 90 days	30
Cabin crew members	-

The Swedish Accident Investigation Board (SHK) was notified on 14 March 2006 that an aircraft with registration SE-GIT had an accident at 16:55 hours on 13 March 2006 at Umeå airport, AC county.

The accident has been investigated by SHK represented by Göran Rosvall, Chairperson, Agne Widholm, Chief technical investigator until and including 21 May 2007, and Stefan Christensen, chief investigator from 22 May 2007.

The investigation was followed by Max Danielsson, representing the Swedish Civil Aviation Authority.

Summary

When landing gear was selected down during the approach to Umeå airport no indication was received that the left mail landing gear was down and locked. After some low passes it was confirmed, with help from ground observations, that the left landing gear was only half open and hanged out in an angle of approximately 45° from the underside of the wing. In spite of repeated efforts from the pilots, including emergency gear extension procedures, the situation remained unchanged. The commander decided to perform an emergency landing on the snow covered strip to the right of the runway. The landing was done with gear up and full flaps. After an initially straight sliding in the snow, the aircraft veered to the left and came to final stop a few meters from the asphalt edge of the runway.

At the inspection it was established that the landing gear door had fatigue damages and had broken when the gear was extended. The actuating rod in the hydraulic cylinder that manoeuvres the gear door then got stuck in a position between half open and closed, blocking the landing gear from being extended.

Recommendations

It is recommended that EASA:

- Takes action so that the hinge assemblies of this particular type are inspected at suitable intervals in respect of crack generation. *(RL 2007:08e R1).*

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 The flight

The aircraft took off from its home base at Örebro in the morning in order to perform a series of flights carrying passengers on behalf of the National Swedish Prison and Probation Administration. For the flight in question the pilot had taken off from Kramfors with six passengers on board, with the commander as pilot flying (PF). The flight to Umeå proceeded with no problems in good weather conditions.

A visual approach was initiated to runway 14 at Umeå. When the landing gear was selected down at a height of about 1000 feet during turn, there was no indication that the left main landing gear was down and locked correctly. When all three sets of wheels are extended and locked, three green lamps light on the instrument panel, one for each set of wheels. On this occasion the green lights for only the nose gear and the right side main gear lit. The lamp to indicate that the left main gear was down and locked did not light.

Because of the fault indication, the commander decided to "re-cycle" the gear, i.e. retract it and then extend it again. This procedure was performed twice, but with the same result – only two green lights. Once it was then concluded that the left main gear would not operate to its down and locked position, a go around was initiated and Umeå air traffic control was informed of the situation that had arisen. On flying past the tower after go around, the air traffic controller could see that the door for the left main gear was half open, hanging at an angle of about 45° down from the underside of the wing.

1.1.2 Measures taken after the fault indication

After the go around, the air traffic controller instructed the aircraft to turn towards the south, where an area was assigned for new attempts to extend the left main gear. During the next attempt with re-cycling of the landing gear, a red lamp lit up to indicate that the landing gear door was incorrectly positioned (see 1.6.3). Another fly by was performed, but there was no change in the fault visible from the tower. During the attempt to extend the faulty landing gear, the commander also decided to change the g loads, which was done by briefly exerting positive and negative loads to the aircraft. These manoeuvres had no effect on the faulty operation either.

At the request of the crew a technician was called up into the control tower. The aim was that the technician would assist the air traffic controller to observe the landing gear position, and if necessary be able to communicate directly with the crew. Passes were made with the gear extended and retracted. Regardless of the chosen configuration, the left main gear was observed to be in the same position, i.e. retracted, with the door hanging half open. According to the pilots these passes were performed at heights between 600 and 800 feet.

Also the Emergency Gear Extension procedure, described in the emergency check list was performed, without resulting in any change in the situation.

1.1.3 Emergency landing

After about one hour circling around and over Umeå airport, with repeated attempts to resolve the situation, the commander decided to perform an emergency landing. After evaluating the alternatives, it was decided to land

on the snow at the right side of runway 14. The reason the commander preferred the snow was that the landing would be softer and that the possible risk of sparks being generated would be minimised. The landing was planned to take place with the gear retracted so as to avoid a "ground loop", i.e. the aircraft slewing round after landing. The tower reported the snow depth as being 30-50 cm in the area.

The passengers were informed about the planned emergency landing, and via air traffic control the area was cleared, by among other things moving certain airport maintenance vehicles. The rescue services, who had already earlier been informed of the situation, were placed on highest alert. The pilots had agreed that the commander would be the PF during the approach and landing, and remain on board in order to complete the emergency measures. The co-pilot should assist the passengers in an emergency evacuation after the aircraft had come to full stop.

The approach was visual with full flaps. As the aircraft entered the area where it was to land, the propellers were feathered and the engines shut down. However the propellers had not stopped rotating completely when the aircraft touched down in the snow. The landing was gentle and the aircraft initially slid straight along the snow. As the speed reduced, the aircraft slewed to the left and continued sliding towards the runway, finally coming to stop a few metres from the asphalt edge of the runway, turned about 90° to the left of the landing direction. The distance that the aircraft slid along the snow after touch-down was measured at 192 metres. The passengers were evacuated without any further problems through the rear door, at the same time as the rescue services arrived at the aircraft wreckage. At the time of landing, there was enough fuel still on board for about one hour's flight. No-one was injured in the accident.

The accident occurred in position 63° 47.6′ N, 020° 16.8′ E, 7 m above sea level.

1.2 Injuries to persons

	Crew members	*Passengers*	*Others*	*Total*
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	–	–	–	–
None	2	6	–	8
Total	2	6	–	8

1.3 Damage to aircraft

Substantially damaged.

1.4 Other damage

None. No known environmental effects.

1.5 Personnel information

1.5.1 Commander

The commander, male, was 57 years old at the time and had a valid CPL-IRME Licence.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	6	90	9035
This type	6	90	6950

Number of landings this type previous 90 days: 32.
Flight training on type carried out in 1993.
Latest PC (Proficiency Check) carried out in 2006 on PA 31.

1.5.2 *Co-pilot*

The co-pilot, male, was 29 years old at the time and had a valid CPL-IRME Licence.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	6	75	450
This type	6	75	225

Number of landings this type previous 90 days: 30.
Flight training on type carried out in 2005.
Latest PC (Proficiency Check) carried out in 2006 on PA 31.

1.5.3 *Cabin crew members*

Not applicable

1.5.4 *The crew members' duty schedule*

Both pilots had been rested in accordance with the applicable regulations on that particular day had accumulated nine hours on duty at the time of the accident.

1.6 Aircraft information

1.6.1 *General*

AIRCRAFT		
Manufacturer	Piper Aircraft Corporation	
Type	Pa 31-310	
Serial number	31-751241	
Year of manufacture	1975	
Gross mass	Max. authorised take-off mass 3155 kg, actual approx. 2900 kg	
Centre of mass	Within permitted limits	
Total flying time	12610 hours	
Flying time since latest inspection	40 hours	
Fuel loaded before event	212 kg of 100 LL	
ENGINE		
Manufacture	Lycoming	
Model	TIO-540	
Number of engines	2	
Engine	*No. 1*	*No. 2*
Total operating time, hrs	787	520
Operating time since overhaul	787	520

PROPELLERS	
Propellers	Hartzell
Propeller 1	66 hours
Propeller 2	66 hours

The type of aircraft is a small twin engined passenger aircraft with seats for two pilots and six passengers. The aircraft had a valid Certificate of Airworthiness

1.6.2 Landing gear

The landing gear is operated hydraulically, and each landing gear leg has a separate hydraulic cylinder. The power in the hydraulic cylinders is transferred to the respective landing gear legs via a mechanical linkage system. The main landing gears have two landing gear doors each. When the gear is extended the inboard moving door opens, the landing gear locking mechanism is released and the gear lowers. The outer landing gear doors are mechanically attached to the gear. The inboard landing gear door is pulled up hydraulically once the gear is locked, either in the retracted or extended position.

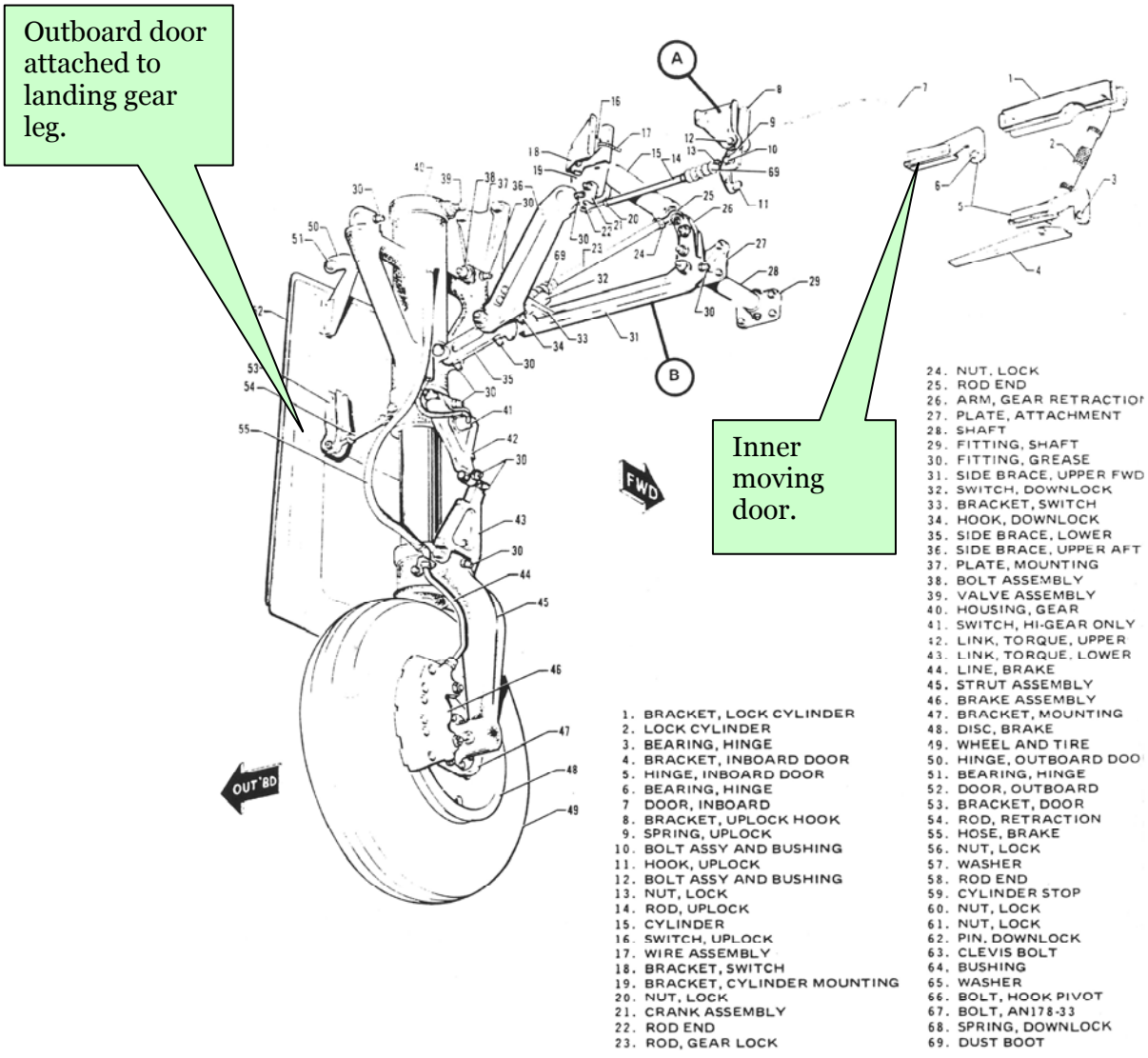

Fig 1. Left main landing gear

1.6.3 Operation and indications

The landing gear is operated by a lever on the instrument panel. In order to retract the landing gear it is necessary to pull out the lever, at the same time as the landing gear lever is moved upwards. To lower the landing gear the lever is moved downwards. The lever remains in its upper or lower position until the gear is in and locked, or out and locked respectively, when the lever returns to its neutral position.

Next to the lever there are four indication lights. The three lower lights show green when the respective gears are down and locked. When the gears are in and locked, no lights are lit. The upper light (transit light) shows red while the gear is moving between the in and locked and down and locked positions respectively. The red light may also light while flying, if any of the inboard landing gear doors are open when the gear is in the retracted or extended position. (See fig 2).

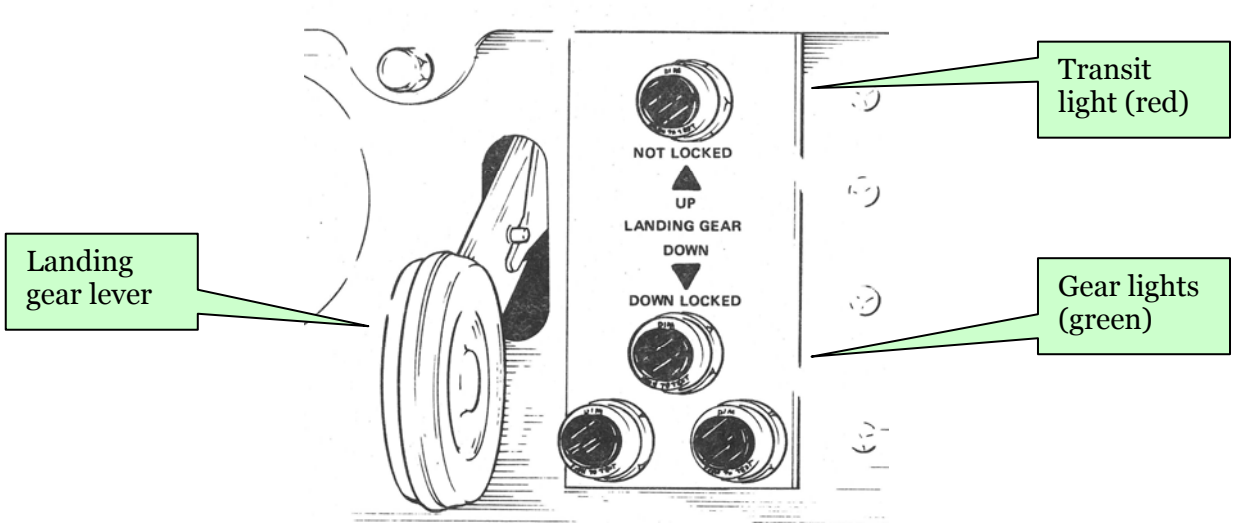

Fig 2. The landing gear panel in the cockpit

1.6.4 Emergency lowering of the landing gear

The Emergency Gear Extension system is exclusively intended for use in cases where there is no available hydraulic pressure. During emergency gear extension the ordinary landing gear lever is set in its lower position in order to position the valve correctly. Then the hydraulic pressure is increased with a handpump until the gear is down and locked, and the three green lights are lit.

1.6.5 Earlier problems

This aircraft type has previously had problems with the securing arrangements for the inboard landing gear door. In the Piper Aircraft Corporation Service Bulletin No. 682, issued on 24 July 1980, a technical directive was promulgated concerning the inspection/exchange of the hinge assemblies for the inboard main landing gear doors. This action was to be taken within 100 hours or, if it came sooner, at the next inspection. The inspection comprised crack inspection of the hinge assemblies on which the doors hang.

The reason for this measure was that reports had been received by the manufacturer concerning cracked and/or broken inboard landing gear door hanging hinge assemblies. If a hinge assembly broke there was a risk that the door could move to a position in which it was not possible for the gear to be lowered, or alternatively that hydraulic pressure could be lost. The

manufacturer therefore produced a new improved hinge assembly for mounting to the inboard landing gear door.

If no cracks were found on inspection, the 100 hour interval between inspections would continue until hinge assemblies of the improved type were installed on the doors. If cracks were found no flights were permitted until new hinge assemblies had been installed. After installing the new hinge assemblies, the requirement for inspection of the door hinge assemblies terminated.

In this particular incident it could be established that the inboard landing gear doors on the aircraft had the improved model hinge assemblies. It could however be established that the front hinge assemblies on both doors had fracture surfaces with signs of fatigue (see 1.16.1).

1.7 Meteorological information

According to SMHI's analysis: Wind 160°/4 knots, visibility > 10 km, no clouds below 5000 feet, temperature ±0°C, QNH 1040 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Communication between the Umeå air traffic control tower, the rescue services and the aircraft respectively was recorded and supports the pilots' accounts of the sequence of events. The events were also videotaped by the airport rescue services.

1.10 Aerodrome information

The airport status was in accordance with AIP[1]-Sverige/Sweden.

1.11 Flight recorders

None. Not required.

[1] AIP – Aeronautical Information Publication

1.12 Incident site and aircraft wreckage

1.12.1 *Incident site*

Umeå airport.

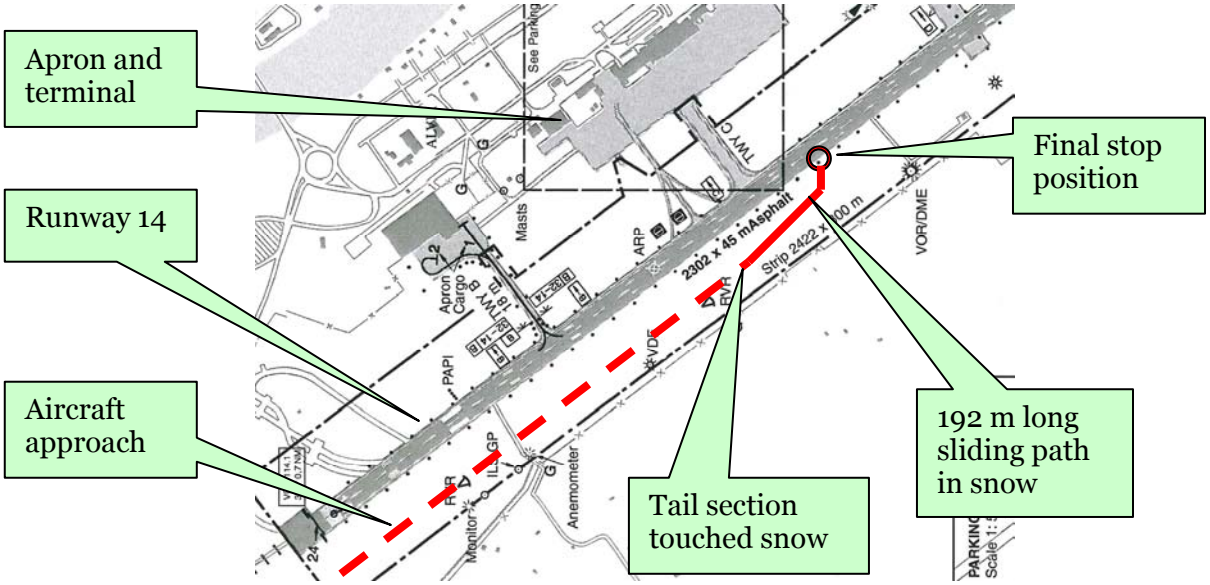

Fig. 3.

The sketch above is a section of the airport chart in the AIP of Umeå airport. The place where the aircraft landed is a grassed area parallel to the asphalted runway, and at the time of the incident was covered by 30-50 cm of snow. The size of the area is 2422 x 300 m and can be used as an emergency landing strip, in the case for example of the ordinary asphalt runway being obstructed. The area has a relatively even surface, but is traversed here and there by for example access roads to various airfield installations.

Touchdown occurred at about 1000 metres from the beginning of the area. After sliding on the snow, the aircraft stopped about 100 metres south of taxiway C.

1.12.2 *Aircraft wreckage*

Fig 4. The aircraft after the emergency landing

During the emergency landing the aircraft incurred damage to the engines and propellers. Structural damage also occurred to the fuselage and wing flaps.

1.13 Medical information

Nothing was discovered to indicate that the psychological or physical condition of the pilots was degraded before or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 General

Landing on the snow took place with the nose high, and was relatively gentle. The retardation by the snow was powerful, but not of such a nature that there was any risk of injury to those on board. Since the left main landing gear door was half extended, there was a risk that the aircraft would swerve and slide on to the runway, with possible spark generation and fire risk as a result. A swerve did occur at the end of the slide along the snow, but the aircraft never reached the edge of the asphalt runway.

The risk of spark generation when landing on snow cover with this type of aircraft can generally be assessed as almost negligible. At the time of landing, there was enough fuel still on board (about 100 litres) for about one hour's flight.

The passengers were informed by the co-pilot before the emergency landing and all of them wore well secured seat belts during the landing.

The Emergency Locator Transmitter (ELT) of type Kannad 406 was not activated in the incident.

1.15.2 Actions by the rescue services

Air traffic control at Umeå received in good time the notification that an emergency landing was probably necessary. The local rescue services were informed of the expected emergency landing and consultation took place with the local district rescue services and the police.

As the emergency landing took place, the following resources were available:

- Three rescue vehicles from the airport rescue services.
- Three fire vehicles from the local district rescue service.
- Four ambulances.
- Two police cars.

The efforts of the rescue units were co-ordinated so that the airport force would take care of any necessary fire extinguishing and the local district unit would be responsible for evacuation assistance and rescue of those on board. The vehicles arrived at the aircraft about 15 seconds after it had come to stop. With the assistance of the co-pilot all the passengers could leave the aircraft through the ordinary rear door.

1.16 Tests and research

1.16.1 Main landing gear mechanism

After recovery of the aircraft it was transported to a hangar at the airport for technical inspection under SHK supervision. During the inspection it was established that the left main landing gear front hinge assembly (New Improved Door Hinge assembly P/N 47529-32) had broken. The hinge assembly on the right main landing gear had also broken. The front hinge assemblies on both doors showed fracture surfaces with signs of metal fatigue.

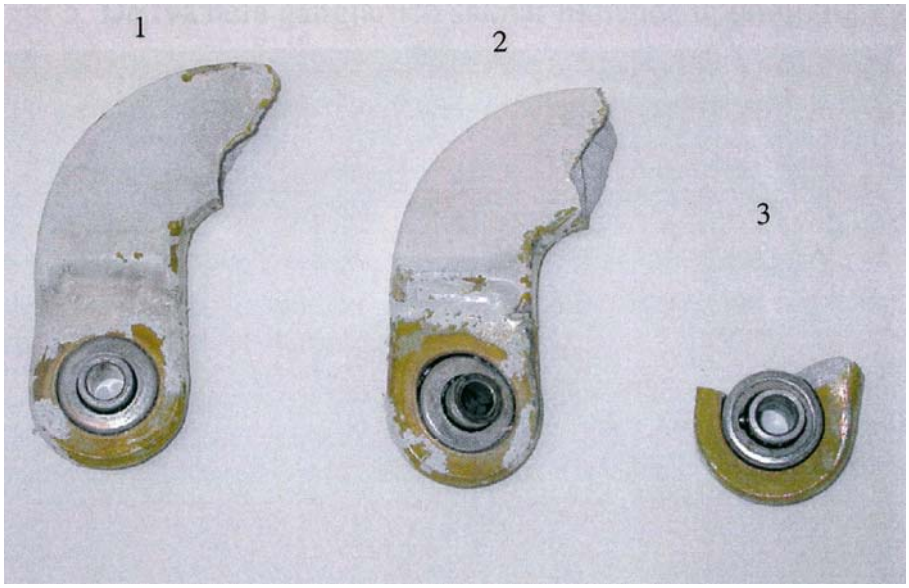

Fig 5. Broken front hinge assembly from the left main landing gear door (1). Front hinge assembly from the right main landing gear door (2). Rear hinge assembly from the right main landing gear door (3)

The hydraulic actuating cylinder for the left main landing gear door, which had the task of operating the door, was bent. Both the doors with their hinge assemblies, the hydraulic actuating cylinder for the half-open left door and a sample of hydraulic oil were sent to a materials laboratory for examination.

1.16.2 Material analysis

The fracture surfaces on the broken front hinge assembly showed an area of fatigue that began from the inside of the hinge knuckle. The extent of the fatigue was greatest in the left door hinge assembly (see fig. 6). The fatigue marks extended down to a depth of about 10 mm in the left door hinge assembly and about 5 mm in the right door hinge assembly. In both the hinge assemblies, the fatigue damage had developed over a long time. The break in the right main landing gear door rear hinge assembly (no. 3 in fig. 5) was a straightforward overload failure.

In addition to the fracture surface character it was found that the hinge assembly for the left main landing gear door, with the greatest area of fatigue, was not deformed, while both hinge assemblies for the right door were deformed and twisted. The absence of deformation usually indicates that the fatigue cracking had reached a critical depth.

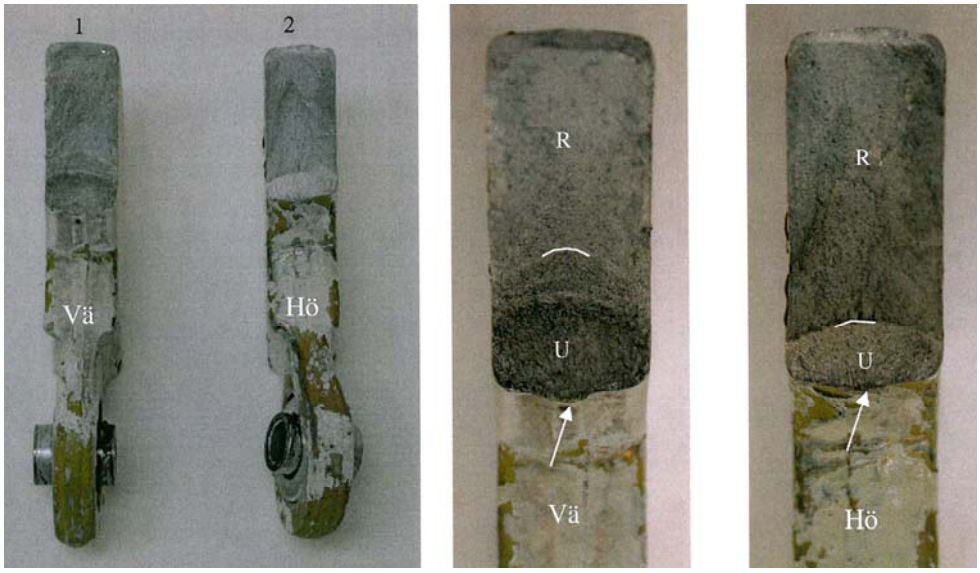

Fig 6. Left main landing gear door front hinge assembly (Vä = left) and right main landing gear door front hinge assembly (Hö = right). The starting point (arrow) and boundary between fatigue (U) and remaining fracture (R) are marked

Examination of the fracture surfaces under high magnification in a sweep electron microscope showed that both fractures originated from a raised portion of the inner diameter of the hinge assemblies. The two complete hinge assemblies did not show this type of raised portion. Similar raised areas in forged material normally derive from joints in the manufacturing tooling.

1.16.3 Hydraulic cylinder and hydraulic fluid

The actuating rod of the hydraulic cylinder that controlled the operation of the left door was bent. The bent actuating rod had wedged against the opening at the end plate of the hydraulic cylinder.

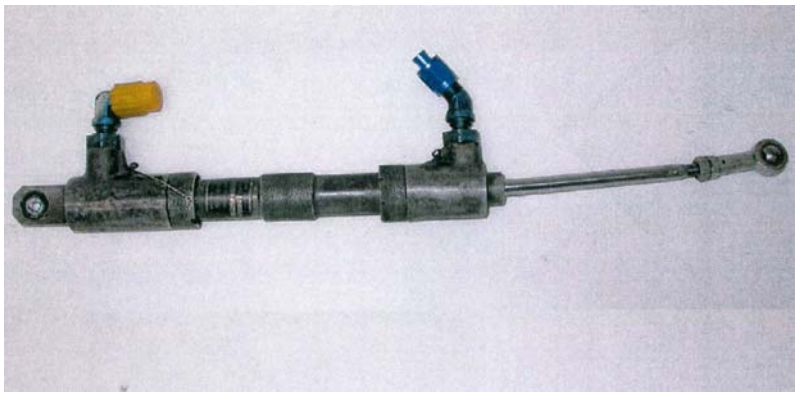

Fig 7. The hydraulic cylinder for the left door

Once the cylinder had been dismantled and all the tension relieved, it could be established that the actuating rod was bent more than it was when installed.
The actuating rod had a notch near to the threaded end where the rod end (at the right in fig. 7) is screwed on. The notch shows the depth of the actuating rod when it is fully in. The distance from this notch to the

edge/opening of the hydraulic cylinder end plate was measured to be 83 mm.

The actuating rod also had a shallow notch nearest to the end of the piston. The distance between the two notches was about 150 mm, i.e. the piston was jammed about halfway between its end positions. The most severe bending of the actuating rod, assuming that the bending took place over the edge of the end plate opening, matches the position of the actuating rod with a completely open door.

The hydraulic fluid sample was filtered and analysed. The particles that were found were normal for a hydraulic system of this type.

1.16.4 Repairs to the left landing gear door

During examination of the left main landing gear door it was seen that a repair had been carried out to the inside of the door. The repair was localised to the area of the hinge that had the most fatigue in the fractured surface. A green-painted plate had been riveted under the hinge assembly and bent around the inner edge of the door (see fig. 8). This repair had meant that the hinge assembly would be located an estimated 1.5 to 1.8 mm above its original position.

Fig 8. Left main landing gear door showing the repair

1.17 Organisational and management information

1.17.1 Administrative and operational management

The company is based in Örebro, where the head office and flight operations management are located. The business consists of charter and taxi flights with PA 31 aircraft all over Europe.

1.17.2 Technical management:

The company purchases the services of an aviation technical maintenance company based at Täby airport in Örebro. The technical company is a “Part 145” company, meaning that it is approved in accordance with joint European regulations for carrying out technical maintenance operations. The company is licensed for both line maintenance and heavy maintenance of jet, turboprop and piston powered aircraft, along with helicopters.

The technical company had performed the repair to the left main landing gear door mentioned in 1.16.4 above. In Work Order 2004, page ¾, No 9, there is the following remark in the field for work/remarks dated 13 June 2005:
"Cracks in L/H inner LDG door fwd fitting attachment"
The remarks had the following response:
"Repaired i.a.w. AC 4313, dated 13 June 2005"
A free interpretation of this means that cracks were found in the front fitting attachment for the left main landing gear door. The response was that a repair had been performed in accordance with AC 4313. In an interview with the company it transpired that a crack had been discovered in the plate at the hinge assembly securing point. The hinge assembly had been dismantled and a new plate riveted over the location of the crack, after which the hinge assembly was secured to the new plate.
AC stands for Advisory Circular, which is a handbook for the implementation of repairs and maintenance, issued by the FAA (Federal Aviation Administration, USA, equivalent to the Swedish Civil Aviation Authority). The methods described in this handbook mainly concern measures to be taken where instructions have not been published by the aircraft manufacturer. In certain specified conditions these instructions can be considered to be "approved data".

1.18 Additional information

1.18.1 Regulations concerning repairs to aircraft

According to the applicable regulations, a repair that involves a change to the design of an aircraft must receive approval. This approval can be obtained in the following manner:

- Application to have a design change approved by EASA[2] (if the change is classed as "minor").
- The work is ordered from an Approved Design Organization (DOA), witch in the case of minor changes confers approval without any further involvement by EASA.
- Through contact with the aircraft manufacturer (Type Certificate Holder), whose instructions in such cases are considered to be "approved data".

AC 43.13 cannot be regarded as "approved data", as this document only deals with methods of performing various kinds of work. However the document can be used as a guide when performing repair work, and thereby form part of the basis for approval. The authoritative basis determining that even minor changes must receive approval is EU 1702/2003 (applicable in Sweden since 24 September 2003), § 21.A.95, minor changes. It can nevertheless be noted that AC 43.13 did provide "approved data" up to the date when the regulations in EU 1702 were implemented into Swedish legislation.

[2] EASA = European Aviation Safety Agency

2 ANALYSIS

2.1 Operational

2.1.1 Conditions

When the technical fault occurred in the landing gear, the pilots' abilities to resolve the situation were very limited. The attempts that took place to try to lower the landing gear, in the form of re-cycling and g loading, are not described in the manufacturer's emergency procedures, but can be assessed as reasonable for a crew to attempt in that particular situation.

The attempt to use the hand pump was in accordance with the emergency check list for the aircraft, but since the fault was not caused by a lack of pressure in the hydraulic system this action had no effect.

Fly-bys took place at a safe height and contributed to the pilots receiving confirmation that a serious technical fault had occurred in the left main landing gear. This confirmation was via the visual inspection and dialogue with the summoned technician during the fly-bys.

2.1.2 The landing

The commander made the decision to land on the snow along the emergency landing area parallel to runway 14 with the landing gear retracted. Considering the situation that prevailed, SHK finds that this decision was reasonable in light of the increased risk of fire due to spark generation that could have arisen when landing on asphalt.

The other consequences for the aircraft and those on board in the case of a landing on the runway are difficult to judge, but SHK considers that the commander's decision was well founded and probably reduced the consequences of the accident.

2.2 Technical

2.2.1 The technical fault

When the aircraft was about to land at Umeå and the landing gear was selected down the inboard landing gear doors opened first. In connection with this, the left main landing gear door front hinge assembly probably fractured, due to fatigue cracks that had been present for a long time. This left the door hanging on the rear hinge assembly and at the end position of the hydraulic cylinder actuating rod.

The actuating rod moved towards completely open door, but the door did not open, as the hinge assembly closest to the hydraulic cylinder was broken, so that no leverage effect took place. In connection with this the actuating rod bent in its maximum extended position. When the door then closed during the pilots' re-cycling attempt, the bent actuating rod jammed in between its extended and retracted positions. This held the door in its half-open position and blocked the main landing gear at the next gear lowering attempt, since the wheel came to rest on the top of the half-open door.

The reason for the fracture of the front hinge assembly was a fatigue crack. According to the investigation it could be established that the crack began at the inside of the hinge knuckle. Closer analysis showed that the starting point of the fatigue in both doors was a raised portion of the knuckle. It is probable that this protrusion originated from the division of two halves in the tool that was used during manufacture (forging) of the front hinge assemblies in question.

2.2.2 Technical inspection

It had previously been known that the main landing gear suspension arrangements in this type of aircraft are exposed to relatively high stress levels. Earlier hinge assembly models had been changed when cracks were found. SHK has not found any directive in respect of continued checks at prescribed intervals after the bulletin that was issued in 1980.

In the case of the current incident it could be seen that the hinge assemblies on both doors had fatigue damage. During the first lowering, the left side hinge assembly failed completely. The right side front hinge assembly showed similar damage and SHK assesses that it was only a question of a limited number of cycles before the right side door would also have failed completely.

As far as SHK can tell, inspection of the aircraft, in the absence of a directive to check the hinge assemblies, was performed in accordance with the applicable regulations. The fatigue damage to the hinge assemblies had however developed over a long time, so that one could ask why no cracks were detected during inspections of the aircraft.

2.2.3 Repair of the door

According to the findings of SHK, the company that was responsible for the technical inspection of the aircraft detected cracks in the sheet metal of the left inboard main landing gear door. With reference to the fact that the work description in document AC 43.13 forms “approved data”, the design of the door was altered by riveting a new plate over the old plate in the area of the damage.

As mentioned earlier, AC 43.13 is not to be regarded as anything other than a task description, and possibly the basis for an approval, so that the work carried out on the door may be seen as lying outside the company’s licensing and authorisation.

On the other hand SHK considers that the fact that the front hinge assembly on the right side main landing gear door also showed signs of metal fatigue indicates that the heightening of the hinge assembly location that came about as a result of the repair did not to any great extent affect the metal fatigue in the fractured left door hinge assembly.

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) Fatigue cracks had arisen in the front hinge assemblies of both main landing gear doors.
d) The crack in the left main landing gear door front hinge assembly had propagated so far as to cause its final fracture.
e) The aircraft performed an emergency landing on snow adjacent to the runway, with its landing gear in the retracted position.
f) An earlier directive had been issued concerning inspection and replacement of hinge assemblies.
g) A repair involving a design change to the construction was carried out on the inside of the left main landing gear door.
h) The technical company was licensed to carry out technical servicing and inspection of this type of aircraft, but not to implement design changes without approval.

3.2 Causes

The incident was caused by an inadequate directive from the manufacturer in respect of crack inspection of the inboard main landing gear door front suspension arrangement.

4 RECOMMENDATIONS

It is recommended that EASA:

- Takes action so that the hinge assemblies of this particular type are inspected at suitable intervals in respect of crack generation. *(RL 2007:08e R1).*