



# **BULLETIN**

**Serious incident**

**14-12-2017**

**involving**

**PIPER PA46 350P JetProp DLX**

**D-EVSM**

## **FOREWORD**

This bulletin reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the safety investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The safety investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this bulletin for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

A reprint with source reference may be published without separate permit.

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## BULLETIN

### General

File number: 2017-110  
UTC date: 14-12-2017  
UTC time: 09:50  
Occurrence class: Serious incident  
Location: Over the North Sea, approximately 85 nautical miles (nm) southwest of Aalborg (EKYT)  
Injury level: None

### Aircraft

Aircraft registration: D-EVSM  
Aircraft make/model: Piper PA46 350P (JetProp DLX conversion)  
Current flight rules: Instrument Flight Rules (IFR)  
Operation type: Business  
Flight phase: En route  
Aircraft category: Fixed wing  
Last departure point: Memmingen Allgäu (EDJA)  
Planned destination: Stavanger Sola (ENZV)  
Aircraft damage: Minor  
Engine make/model: Pratt & Whitney Canada PT-6A-21

### SYNOPSIS

### Notification

All times in this report are UTC.

The Area Control Centre at Copenhagen, Kastrup (EKCH), notified the Aviation Unit of the Danish Accident Investigation Board (AIB) of the serious incident on 14-12-2017 at 10:41 hours.

The AIB notified the Danish Transport, Construction and Housing Authority (DTCHA), the German Bundesstelle für Flugunfalluntersuchung (BFU), the Canadian Transportation Safety Board (TSB), the American National Transportation Safety Board (NTSB), the European Aviation Safety Agency (EASA) and the Directorate-General for Mobility and Transport (DG MOVE) on 19-12-2017 at 13:47 hours.

## Summary

Noise and fumes, as a consequence of a failed vent/defog blower, prompted the pilot to initiate a high-speed emergency descent and to select the landing gear into down position.

For unknown reason and most likely during the landing gear extension, the hydraulic down line fractured leaving the landing gear in a partially extended position.

The below contributed to an unsuccessful emergency extension of the landing gear:

- The unresolved condition of the perceived electrical emergency.
- The pilot not using the autopilot to fully extent.
- The pilot not fully understanding the functioning of the landing gear emergency extension system.
- The possible ambiguity of the on board JetProp emergency procedures checklist.
- The deteriorating weather conditions at Aalborg (EKYT).
- Task saturation/high workload influenced the pilot's ability to analyse why the landing gear emergency extension was unsuccessful.

During landing, the aircraft skidded off the right side of the runway and came to a stop in the runway safety area.

The serious incident occurred in daylight under instrument meteorological conditions (IMC).

## FACTUAL INFORMATION

### History of the flight

The serious incident flight was a private business IFR flight from Memmingen Allgäu (EDJA) to Stavanger Sola (ENZV).

The pilot occupied the left pilot seat, and a passenger occupied the right pilot seat. Two passengers sat in the passenger cabin with open access to the cockpit.

Until approximately 09:40 hours, the flight was uneventful.

En route under IMC at Flight Level (FL) 260 over the North Sea on a position approximately 85 nm southwest of Aalborg (EKYT), Copenhagen Control instructed the pilot to descend to FL 240.

The pilot expected icing conditions during the descent and the approach to ENZV, which required sufficient electrical power for the aircraft ice protection systems. For that reason, the pilot switched off the electrical cabin heating and started descending to FL 240.

The pilot noticed an outside air temperature of -43° Celsius (C) and considered no need of the aircraft ice protection systems for the next 15 minutes. The pilot switched on again the electrical cabin heating and noticed a generator load of approximately 90 amperes (amps).

At 09:45 hours, the pilot was transferred to Stavanger Air Traffic Control Centre (ATCC) (134.350 MHz).

Shortly after, the pilot and the front seat passenger heard a *metallic grinding* noise seemingly coming from the engine section of the aircraft.

Within 30 seconds, the pilot sensed a smell of electrical fumes. Over a period of a few seconds, the intensity of the smell increased.

After recognizing the smell, the pilot feared the situation might evolve into an electrical emergency, potentially filling the cockpit with smoke.

The pilot disconnected the autopilot and initiated a high-speed emergency descent, selected the landing gear into down position, and turned right onto a heading of 090° toward the Danish coastline.

The pilot declared an emergency – *smoke in the cockpit* – to Stavanger ATCC.

Stavanger ATCC repeatedly instructed the pilot to fly on radar heading toward Kristiansand Kjevik (ENCN), which was the nearest Norwegian airport.

In order to avoid potential icing conditions along the Norwegian coastline, the pilot opted to proceed toward the Danish coastline, and the aircraft continued heading eastbound.

Suspecting a generator failure, the pilot started reducing the electrical load as much as possible (load shedding). This included switching off the batteries (to avoid a potential battery runaway), all aircraft ice protection equipment (except for the pitot heat), and the electrical cabin heating equipment.

After load shedding, the noise was no longer apparent, but the electrical smell was still present.

The pilot observed an amber warning light on the lower left part of the Master Caution Panel reading “GEAR” or “HYDRAULIC”.

The pilot scanned the left hand side circuit breaker panels and noticed that the “HYDRAULIC PUMP” circuit breaker had tripped (opened).

Due to the increasing number of tasks, the pilot decided to concentrate on managing the perceived electrical emergency and the control of the aircraft, postponing the handling of the landing gear/hydraulic issue.

At approximately 09:54 hours while passing through FL 176 and noting the distance to the nearest airport, Thisted (EKTS), the pilot reduced the aircraft rate of descent.

Having decided to divert to an airport in Denmark, the pilot requested a transfer to Danish Air Traffic Control (ATC).

Stavanger ATCC instructed the pilot to contact Copenhagen Control (134.675 MHz).

At 09:56:46 hours, the pilot contacted Copenhagen Control declaring *emergency – smoke in cockpit*.

Copenhagen Control acknowledged the emergency and provided radar control guidance (radar vectors and distance information) toward EKYT.

During the period from 09:57 hours until 10:06 hours, the following occurred:

- In order to obtain relevant information and secure Air Traffic Service (ATS) coordination, numerous telephone calls between Copenhagen ATC, Aalborg ATC and EKTS aerodrome office took place.
- To obtain undisturbed radio communication, the pilot requested a transfer to the emergency frequency 121.500 MHz. Copenhagen Control granted the transfer. At FL 140, the pilot several times unsuccessfully tried to establish radio contact with Copenhagen Control on the frequency 121.500 MHz. Two other aircraft crew responded to the pilot calling Copenhagen Control. The

pilot subsequently re-established radio contact with Copenhagen Control on frequency 134.675 MHz.

- The pilot communicated with Thisted Radio (118.125 MHz). The radio operator at EKTS informed the pilot of the weather conditions at EKTS (000°/00KT 5000 BKN 006 SN) and that EKTS was a visual meteorological condition (VMC) airport without any instrument landing facilities. Based on the weather conditions and the available landing facilities, the pilot decided not to attempt a landing at EKTS.
- The intensity of the electrical smell decreased to *only light*, which the pilot perceived to be an effect of the electrical load shedding.

At 10:06:09 hours, the pilot contacted Aalborg Tower (118.300 MHz) declaring the emergency – *smoke in cockpit*.

The air traffic controller (ATCO) acknowledged the declared emergency and informed the pilot of the EKYT weather conditions (260°/02KT 1000 –SN VV1400 01/01 Q978).

At 10:06:43 hours, the pilot requested landing information at EKYT.

The ATCO informed the pilot of runway direction, Instrument Landing System (ILS) frequency, and localizer inbound course. The pilot provided upon request the number of souls on board (SOB) and remaining fuel (4 SOB and 2 hours of remaining fuel).

At 10:08:12 hours, the ATCO instructed the pilot to fly present heading to intercept final and to descend to 2000 feet.

At 10:08:25 hours, the pilot asked if icing conditions were to be expected at EKYT. The ATCO replied *negative, no icing reports*.

At 10:09:14 hours, the pilot reported doing a rapid descent to get out of potential icing conditions. The aircraft descended through FL 080.

At 10:12:08 hours, the pilot reported *we were able to stop fumes and smoke*. The aircraft descended through 1900 feet mean sea level (msl) radar presented altitude.

At 10:12:24 hours, the ATCO asked, if the pilot was able to continue under Visual Flight Rules. The radar presented altitude was 1300 feet msl.

The pilot replied that he *overshot the descent* and would climb to 2000 feet msl.

At 10:13:05 hours, the ATCO issued a heading correction and an approach clearance for the ILS runway 08L approach.

At 10:17:00 hours, the aircraft was established on the ILS to runway 08L.

At 10:17:18 hours, the pilot received a landing clearance for runway 08L. The pilot replied *that he would get clear of clouds first because of more problems* and requested information on the airport field elevation.

At 10:18:48 hours, the pilot reported runway lights in sight.

At 10:19:08 hours, the pilot reported no landing gear down indication and requested an ATCO visual inspection of the landing gear position. The ATCO cleared the aircraft for a low approach.

At 10:19:55 hours, the ATCO reported that the main landing gear appeared to be partly down but the nose landing gear was in up position. [See appendix 1.](#)

During the period from approximately 10:20 hours until approximately 10:30 hours, the aircraft flew four left hand tight circuits overhead runway 08L, while the following occurred:

- The radar presented ground speed varied between 94 and 132 knots, and the radar presented altitude varied between 200 and 600 feet msl.
- The pilot attempted to extend the landing gear with reference to the JetProp emergency procedures checklist (quick reference format) and the Pilot's Operating Handbook (POH).
- Repeated observations by the ATCO and the airport rescue and fire fighting services (RFFS) confirmed no change to the landing gear position.
- The pilot declined an ATCO offer of a higher altitude. The pilot preferred to stay below the cloud base maintaining visual contact with the runway system.
- The pilot received an ATCO warning of a flock of geese in front of the aircraft. The pilot spotted the geese and took avoiding action.
- Due to intensifying snowfall, the visibility and ceiling at EKYT deteriorated.

At 10:30:22 hours, the pilot reported *we are running out of options and visibility, we need to land.*

At 10:31:02 hours, the pilot received a landing clearance for runway 08L and the pilot prepared for a power on landing with a low rate of descent.

At 10:32:10 hours, the aircraft landed on runway 08L with the main landing gear partially extended and the nose landing gear in the up position.

Upon touchdown at an indicated airspeed of approximately 60 knots, the right main landing gear slowly retracted.

The propeller contacted the runway, and the aircraft skidded off the runway to the right, eventually ground-looping 180° to the right.

The left main landing gear retracted, and the aircraft stopped in the grass-surfaced runway safety area, approximately midfield and 20 meters south of the runway edge.

The pilot and the passengers left the aircraft unharmed through the cabin entrance door.

### Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal			
Serious			
None	1	3	

### Damage to aircraft

During the sequence of events:

- All four propeller blades bended in the opposite direction of rotation and slightly rearwards.
- The lower part of the right main landing gear door bended almost 180° to the right (outwards and up).
- Surface contact scratched and forced the right wing flap to retracted position.
- Surface contact scratched the outward part of the right wing and the right aileron bottom part, the leading edge of the left aileron, the bottom of the aircraft fuselage and the bottom of the engine air intake.

### Other damage

The runway and the runway safety area suffered minor damage from contact with the propeller tips and the aircraft structure.

### Personnel information

#### License and medical certificate

The pilot - male, 57 years - was the holder of a valid German European Union Commercial Pilot License (CPL (A)) issued on 26-2-2014.

The class and type ratings PA-46 single engine turbine (SET) pilot in command (PIC) and instrument rating (IR) were valid until 31-8-2018.

The medical certificate (class 1) was valid until 12-6-2018.

### Flying experience

	Last 24 hours	Last 90 days	Total
All types	0	12	2298
This type	0	12	400
Landings this type	0	11	

### **Aircraft information**

#### General information

Registration:	D-EVSM
Type:	Piper Malibu Mirage
Model:	PA-46-350P (JetProp DLX conversion)
Manufacturer:	Piper Aircraft Corporation
Serial number:	46-22072
Year of manufacture:	1989
Engine manufacturer:	Pratt and Whitney Canada Inc.
Engine type:	PT-6A-21
Propeller manufacturer:	Hartzell Propeller Inc.
Propeller type:	HC-E4N-3N/N8292B
Aircraft total flight hours/cycles:	2488:38 / 2308
Airworthiness review certificate:	Valid until 27-10-2018
Latest maintenance action:	Annual inspection / 100 hours performed at 2486:54 aircraft total hours on 6-11-2017
Technical flight log:	No remarks
Maximum take-off mass (MTOM):	1950 kilos (kg)
Maximum landing mass (MLM):	1860 kg
Basic empty mass (BEM):	1333 kg
Mass at the time of the serious incident:	1750 kg
Center of Gravity (CG) range, 1750 kg:	346,4 centimetres (cm) - 369,6 cm aft of datum
CG at the time of the serious incident:	358,9 cm aft of datum

On the night before the serious incident flight, the pilot refueled the aircraft, performed an engine run-up, and checked the function of the aircraft de-icing and anti-icing systems and the system load of the electrical system.

The pilot did not observe any abnormalities.

#### Electrical system

The Pilot's Operating Handbook (POH) – in extract:

#### *7.19 ELECTRICAL SYSTEM*

*The JetProp electrical power system is 28 V.D.C. with a negative ground. Power is supplied by a 200-amp starter-generator and a 70 amp backup alternator. Each circuit is protected by a circuit breaker. Power for starting and emergency backup is provided by two independent battery systems, each system has a 24 volt Concorde RG-46 sealed unit located under the aft seats.*

The Concorde RG-46 battery system was according to the manufacturer “a recombinant gas (RG® Series) valve regulated lead acid (VRLA) batteries”.

### Hydraulic system

The POH – in extract:

#### 7.9 HYDRAULIC System (S/N 4608008 and up)

*The hydraulic system (refer to Figure 7-3a) provides the power to retract and extend the landing gear. The electric motor driven hydraulic pump assembly is located aft of the rear baggage compartment and is accessible through the baggage compartment aft closeout panel. The pump assembly has an integral reservoir with filler plug, sight gauge and vent. The pump assembly incorporates pressure switches, bypass relief valves, and thermal relief valves in both the UP and DOWN sides. A shuttle valve is also incorporated to allow for unequal volume of hydraulic fluid displaced during UP and DOWN gear actuation. Normal system operating pressure is controlled by the pressure switches. Maximum system operating pressure is limited by the bypass relief valves, and maximum system holding or trapped pressure is limited by the thermal relief valves. The motor which drives the hydraulic pump is reversible and runs in one direction to supply gear UP pressure and in the opposite direction to supply gear DOWN pressure. The direction in which the pump runs is controlled electrically by the position of the gear selector switch on the instrument panel.*

Fluid diagram of hydraulic system. [See appendix 2](#)

An amber “HYDRAULIC PUMP” annunciator light illuminated during pump operation, i.e. during gear operation, or if system pressure dropped below normal system operating pressure (causing an automatic hydraulic pump activation).

3.3v Hydraulic System Malfunction (3.49) POH. [See appendix 3](#)

3.3v Hydraulic System Malfunction (3.49) JetProp (quick reference format). [See appendix 4](#)

### Landing gear

The POH – in extract:

## 7.11 LANDING GEAR

*The aircraft is equipped with hydraulically operated, fully retractable, tricycle landing gear. Locking-type actuators are used for main and nose gears. The actuator assembly provides mechanical gear-down locking at the fully extended position and is hydraulically unlocked. The actuator also acts as the gear brace in the extended position. Hydraulic pressure for gear operation is furnished by an electrically powered hydraulic pump (refer to Figures 7-3 and 7- 5). The gear is activated by a landing gear selector handle located to the left of the control quadrant on the instrument panel (Figure 7-4). The gear handle is mechanically linked to the gear selector valve under the right forward baggage compartment floor. Selecting UP or DOWN position directs hydraulic system pressure to the appropriate side of the landing gear actuating cylinders.*

*The landing gear is held in the retracted position by hydraulic pressure. In the event of hydraulic system pressure loss, the landing gear will remain up as long as the selector is in the UP position. To extend and lock the gear, in the event of hydraulic system failure, it is only necessary to relieve the hydraulic pressure in the gear hydraulic system. An EMERGENCY GEAR extension control, located directly beneath the gear selector, is provided for this purpose. Springs assist in nose gear and nose gear door extension and in locking the gear in the down position. Pulling the EMERGENCY GEAR control releases the hydraulic pressure holding the gear in the up position and allows the gear to free fall. After pulling the EMERGENCY GEAR extension control, place the landing gear selector in the DOWN position and pull the HYD PUMP circuit breaker to keep the pump from operating continuously.*

*The hydraulic reservoir for landing gear operation is an integral part of the hydraulic pump. If the gear is not in the full-up or the full-down position a red GEAR WARNING light on the annunciator panel illuminates.*

3.3n Emergency Landing Gear Extension (3.31) POH. [See appendix 5](#)

3.3n Emergency Landing Gear Extension (3.31) JetProp (quick reference format). [See appendix 6](#)

### Cabin heating and ventilation

The POH – in extract:

## 7.25 ENVIRONMENTAL SYSTEM

*A vane-axial blower (VENT/DEFOG BLWR) in the left duct below the forward baggage floor supplies airflow to the windshield defogger and for ventilation. This air source is capable of being heated by mixing it with hot air from the heat exchanger.*

*On some airplanes, a supplemental electric heater is located forward of the pressure bulkhead immediately downstream of the vent/defog blower. Because the vent/defog blower must be operating when the supplemental heater is used, both the VENT/DEFOG BLWR and AUX CABIN HEAT*

*switches must be ON to supply power to the heating element. The electrical load of the heater and the blower is 36 amps. Operation of the supplemental heater requires operation of the generator.*

### **Workload management and emergency procedure application**

The pilot experienced an extremely high workload from the beginning of the serious incident until landing. The first few minutes were confusing, and the pilot tried to analyse why multiple failures simultaneously occurred (electrical, hydraulic and landing gear).

The pilot attempted to manage the various tasks by prioritising his efforts according to perceived urgency and importance.

Considerations for the pilot were:

- To descend to lower altitude and to reach the nearest suitable airfield for landing.
- To prevent further electrical fumes or smoke from entering the cockpit and to avoid an electrical fire to develop. Subsequently to clear the cockpit and cabin of any fumes or smoke.
- To avoid icing conditions.
- To secure readable and undisturbed communication with ATC.
- To manage the hydraulic system failure and the landing gear configuration.
- The deteriorating weather conditions at EKYT.

During the emergency descent towards the Danish coastline while attempting to manage the perceived electrical emergency, the pilot experienced some issues concerning ATC communication.

In order to obtain Norwegian ATC cooperation regarding the diversion toward Denmark, the pilot felt a need of allocating unnecessary mental capacity toward this task.

Additionally, the pilot felt that obtaining information concerning weather conditions and instrument landing facilities required unnecessary attention, like securing clear and undisturbed ATC communication.

According to the pilot, the latter partly was due to local environmental conditions like snowfall, dry air and high aircraft speed during descent, causing *static* radio disturbance.

The pilot's perceived workload decreased when reaching weather conditions during the latter part of the ILS approach that melted accumulated airframe ice.

After having obtained visual reference with EKYT the pilot subsequently flew overhead runway 08L at low altitude while trying to extend the landing gear.

Having verified the landing gear selector handle to be in the DOWN position, the pilot reset the "HYDRAULIC PUMP" circuit breaker (pushed it back into the set position).

Because nothing happened, the pilot tried to cycle the landing gear selector handle up and down, but still without any effect.

The pilot's perception of the landing gear system was that pulling the Emergency Gear Extension control activated a one-time emergency *bottle*, which would force the landing gear into the down and locked position.

Therefore, the pilot released the safety clamp of the Emergency Gear Extension control and pulled it "with full force" approximately 3 cm out to a position that the pilot felt was the full out position.

The pilot got surprised, when nothing seemed to happen to the landing gear, and the pilot did not hear any noise related to the activation of the *bottle*.

In an attempt to force the landing gear into the down and locked position, the pilot reversed course using 50-60° of bank, i.e. pulling up to two G while circling overhead runway 08L.

Having perceivably performed all appropriate actions and with reference to the quick reference emergency procedures checklist and the POH, the pilot attempted to troubleshoot.

The pilot could neither identify any omitted actions nor find an alternative procedure that would extend the landing gear and he did not comprehend what was wrong with the system apart from a *total disintegration*.

Due to deteriorating weather conditions and birds in close proximity, the piloting of the aircraft became increasingly difficult.

The pilot felt that he was running out of options and decided to land the aircraft before conditions deteriorated beyond his control.

From the beginning of the emergency descent until landing, the pilot mainly or entirely flew the aircraft without the assistance of the autopilot.

## **Meteorological information**

### Aftercast

#### General:

A nearly stationary occlusion stretches from the southern part of Norway over Skagerrak to Zealand.

A westerly current of cold unstable air bordered the occlusion from the southwest.

Weather and cloud layer: Occasional/frequent cumulus nimbus (CB) clouds with tops at FL 260 overhead the German Bay and the Wadden Sea, causing showers of rain and snow and possibly hail.

Northbound towards the occlusion the frequency of CBs decreased.

From abeam Ringkjoebing Fjord/Stauning Airport (EKVJ) the base of the frontal cloud layer was at 12000 feet, decreasing northbound.

From approximately 20 nm south of EKTS and for the remaining part of the flight to EKYT, the frontal clouds probably were quite solid – overcast stratocumulus/altocumulus/nimbostratus with bases at 1500-4000 feet and tops above r FL 150. Scattered/broken stratus clouds with bases at 0100-1500 feet formed the bottom of this area.

Widespread precipitation (snow) present in the area covered by solid frontal clouds. Locally, from 500 feet down to surface level, precipitation in the form of rain and snow.

Embedded CBs might be present in the solid frontal cloud layer.

Freezing level: In the occlusion at surface-1200 feet, along the west coast of Jutland at 1500-2000 feet.

Icing: In the solid frontal cloud layer, moderate icing likely from the freezing level and up to 11.000-15.000 feet. In CB risk of severe icing.

Turbulence: Moderate or severe in CB.

Visibility at surface: In the occlusion area - in precipitation - between 0500-3000 meter visibility.

### Radar chart

A radar chart incorporating “aftercast significant weather graphics”. [See appendix 7](#)

### Terminal Aerodrome Forecast (TAF)

TAF ekyt 140816z 1409/1506 vrb08kt 6000 -rasn sct005 bkn010 tempo 1409/1506 1200  
snra br bkn002=

### Aviation Routine Weather Report (METAR)

METAR ekyt 140950z 26003kt 0750 r08/p1500n r26/p1500n -shsn fg vv014 01/01 q0978  
r26l/290195=  
SPECI ekyt 140955z 26003kt 1000 r08/p1500n r26/p1500n -sn vv014 01/01 q0978 r26l/290195=  
SPECI ekyt 140956z 26003kt 1000 r08/p1500n r26/p1500n -sn vv014 01/01 q0978 r26l/290195=  
SPECI ekyt 140957z 26003kt 1000 r08/p1500n r26/p1500n -sn vv014 01/01 q0978 r26l/290195=  
METAR ekyt 141020z 25002kt 1500 -sn vv014 01/01 q0978 r26l/290195=  
METAR ekyt 141050z 25004kt 1500 r08/1300n r26/1200n -sn sct001 bkn004 01/01 q0979  
r26l/290195=

## **Communication**

### General

The pilot was in contact with Copenhagen Control (frequency 134.675 MHz and 121.500 MHz), Thisted Radio (frequency 118.125 MHz) and Aalborg Tower (frequency 118.300 MHz).

The AIB recovered ATS voice recordings. The ATS voice recordings were of good quality and useful to the AIB safety investigation.

### Frequency 121.500 MHz

According ICAO Annex 10 chapter 4, Volume V (in extract):

*4.1.3.1.2 The frequency 121.500 MHz shall be provided at:*

- a) all area control centres and flight information centres;*
- b) aerodrome control towers and approach control offices serving international aerodromes and international alternate aerodromes; and*
- c) any additional location designated by the appropriate ATS authority, where the provision of that frequency is considered necessary to ensure immediate reception of distress calls or to serve the purposes specified in 4.1.3.1.1.*

According to the Danish Aeronautical Information Publication (AIP) chapter General (GEN) 1.5 (in extract):

### *7. Guarding of the VHF Emergency Frequency 121.500 MHz*

*7.1 Aircraft flying over the North Sea and Skagerrak within København FIR, shall continuously guard the VHF emergency frequency 121.500 MHz, except for such periods when the aircraft is carrying out communication on other VHF frequencies, or when airborne equipment limitations or cockpit duties do not permit simultaneous guarding of two frequencies.*

According to the Danish Air Navigation Service Provider (ANSP):

Copenhagen Area Control Centre (ACC) maintained 24-hour listening watch on frequency 121.500 MHz). The ANSP operated Copenhagen ACC, which was located at EKCH.

During the hours of ATS operation, all other control tower and approach units operated by the ANSP maintained listening watch on frequency 121.500 MHz including the control tower and approach units at EKYT.

All transmitter/receiver antennas for frequency 121.500 MHz were located at the respective airports, including the one at EKCH used by Copenhagen ACC.

The transmitter/receiver antenna for frequency 134.675 MHz (Copenhagen Control) was located at Børsmose, on the west coast of Jutland. The ATCO position handling of 134.675 MHz was placed at Copenhagen ACC.

The AIB established the location of one of the two aircraft responding to the calls of the pilot on frequency 121.500 MHz to be approximately 20 nm south of EKYT at FL 210.

## **Aerodrome information**

### General information

The Aeronautical Information Publication - Denmark (extract):

Location indicator:	EKYT
Position:	57 05 34.04N 009 50 56.99E
Elevation (msl):	10 feet
Runway 08L:	083.3° GEO / 080.4° MAG - 2650 x 45 M
RFFS:	CAT 7 and boats

### ICAO aerodrome chart

[See appendix 8](#)

## Flight recorders

There were no flight recorder installations on board the aircraft. The installation of flight recorders was not a requirement.

## Wreckage and impact information



Within few minutes upon landing, EKYT RFFS examined the aircraft with a thermal camera.

According to the RFFS, no smell of burned material was present in the aircraft. A very faint smell of electrical fumes was present in the aircraft.

No trace of fire or burned material was found in the aircraft. The highest temperature recorded by the thermal camera was 45-46° C (radio stack).

## Medical and pathological information

Shortly after the emergency landing, a medical doctor examined the pilot and the three passengers. The examination was of a general character and with regard to possible carbon monoxide intoxication.

The examination results did not give rise to remarks and the medical doctor released all four occupants.

The police tested the pilot for alcohol intoxication. The test result was negative.

## Survival aspects

The pilot and the passengers used hip and shoulder harnesses.

Neither seats nor seatbelts were overstressed or suffered from malfunctioning.

The aircraft cabin was intact.

## **AIB safety investigation**

### Technical safety investigation

By use of lifting equipment, the aircraft was transported to a local hangar.

When lifting the aircraft, both main landing gear extended by gravity force to approximately 80° down position. The nose landing gear remained in the up position, possibly due to a strap blocking the nose landing gear doors from fully opening.

In the hangar, the aircraft was placed on wooden pallets, and all three landing gear fully extended.

### Preliminary inspection

The AIB performed a preliminary visual inspection of the aircraft, the engine compartment and the aircraft cockpit and cabin. Furthermore, the AIB performed an inspection and cycling of the emergency gear extension control, a visual inspection of the hydraulic pump and a power on test of the aircraft electrical system.

The inspection revealed:

- No distinct smell or signs of any burned material, smoke or electrical overload.
- All circuit breakers were in the set position.
- The gear handle was in DOWN position.
- The Battery Master switch, the Standby Alternator switch and the aircraft de-ice and cabin heating system switches were in the OFF position.
- The Generator switch, the Fuel Pump #1 switch, the Pitot Heat switch, the Radio Master switch and various lighting switches were in the ON position.
- No signs of any abnormalities in the engine compartment.

The emergency gear extension control was in a position extending approximately 3 cm from fully in.

See picture to the right (note measurement tape “start” at approximately 3 cm due to bending tip).

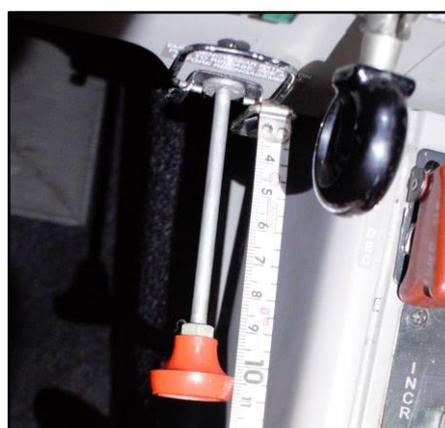


By applying a medium amount of force to the control, the AIB extended the emergency gear extension control another approximately 3 cm.

It was not possible for the AIB to extend the control any further.

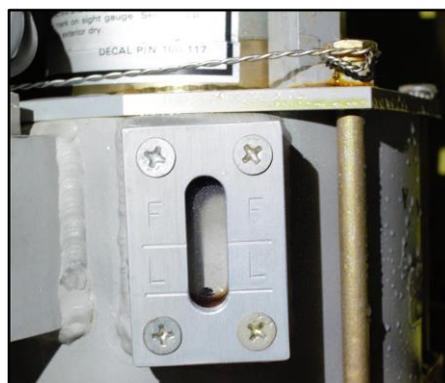
Following this, the control was in a position extending approximately 6 cm from fully in.

See picture to the right.



Removal of the cabin aft partition wall gave access the hydraulic pump and reservoir.

The reservoir sight gage had a small amount of fluid trapped indicating less than “L” (low). The reservoir was empty. See picture to the right.



The power ON test of the aircraft electrical system did not identify any potential source of smoke or smell.

## Aircraft inspection

Subsequent of the preliminary inspection, the AIB performed an aircraft damage and technical inspection and system tests of the electrical system, hydraulic/landing gear, environmental system and the avionics.

Apart from consequential damage following the gear up landing, the only damage identified was to the aircraft hydraulic system and the vent/defog blower.

Electrical system:

After connecting external power to the aircraft, the batteries were selected to OFF position. Electrical power was still available to all aircraft systems.

Hydraulic system:

The hydraulic reservoir was serviced (re-filled), and the hydraulic pump and reservoir were tested for function and leakage. There was no signs of hydraulic leakage in the area around the hydraulic pump. However, after approximately 30 seconds of pump operation, the reservoir was empty.

An inspection of the aircraft revealed a pool of hydraulic fluid in the fuselage area below the right pilot seat. A fracture was located on the hydraulic “down” line between the hydraulic pump and the hydraulic manifold. [See appendix 9](#)

See pictures of the failed hydraulic line below.



Picture taken from left hand side



Picture taken from above

The AIB serviced the hydraulic reservoir and performed a functional test of the landing gear retraction mechanism (“up and locked”) using the normal procedure, i.e. by selecting the landing gear handle into UP position. The landing gear retracted.

An emergency landing gear extension test was performed according to the 3.3n Emergency Landing Gear Extension (3.31) JetProp (quick reference format). [See appendix 6](#)

- The nose landing gear extended into down and locked position.
- The main landing gear extended into almost full down position.
- A gentle push on each main landing gear was required to secure each main landing gear into down and locked position.
- All three green landing gear “DOWN” lights located above the landing gear selector in the cockpit illuminated.
- The red landing gear “GEAR WARNING” annunciator light extinguished.

The pump output pressure on the downline was tested. The test showed that the down pressure switch would remove electrical power from the hydraulic pump when pressure reached 1400 PSI (design criteria).

As part of testing, the pump was operated for 5 minutes without hydraulic fluid. This did not result in tripping of the circuit breaker.

During this test, it was not possible to measure the electrical current, and for this reason, it was not possible to confirm why the 35 amps circuit breaker tripped during flight.

The maximum designed current draw from the pump was 60 amps, according to a stamp on the pump.

Environmental system:

Activating the cabin vent/defog blower produced a distinct rattling noise of loud volume.

In order to view the video recording of the vent/defog blower; please make sure that an appropriate internet connection is available.



Click on the picture to activate the link.

Metallic interference (metallic parts scraping against other metallic parts) produced the noise and negatively affected the output of the blower and the airflow across the supplemental heater element.

When turning the supplemental heater on, with the defog blower on, electrical fuming was confirmed.

Avionics system:

A test of the radio transmitter function when set to frequency 121.500 MHz did not give rise to remarks.

## **ANALYSIS**

### **General**

The license, the qualifications and the medical status held by the pilot had, in the opinion of the AIB, no influence on the sequence of events.

The documented technical and known maintenance status of the aircraft and the aircraft mass and balance had no influence on the sequence of events.

### **Frequency 121.500 MHz**

While the pilot experienced no major problems communicating with the ATCO on Copenhagen Control frequency 134.675, apart from other traffic using the same frequency, the pilot was unable to establish communication with the ATCO on the frequency 121.500 MHz.

The AIB finds it highly likely that this was due to the physical distance from the aircraft to the respective used transmitter/receiver antennas.

The aircraft was located approximately 80 nm from the antenna at Børsmose (frequency 134.675 MHz) and approximately 170 nm from the antenna at EKCH (frequency 121.500 MHz), when the pilot tried to establish communication with the ATCO on frequency 121.500 MHz.

The distance from the aircraft to the responding aircraft located approximately 20 nm south of EKYT was approximately 58 nm.

The theoretical geometric radio range (line of sight) for the aircraft at FL 140 to a station at sea level would be 148 nm.

Therefore, the aircraft was within radio range of the 134.675 MHz antenna and the aircraft located south of EKYT, but not within radio range of the 121.500 MHz antenna at EKCH.

The AIB assumes the transmissions of the pilot on frequency 121.500 MHz were audible to several other ANSP units monitoring 121.500 MHz, but as the pilot called Copenhagen Control, no response was audible on the recording from the frequency 121.500 MHz at EKCH ACC.

On frequency 121.500 MHz and under the expectation of radio contact with Copenhagen Control, the pilot only made use of the station identifier and the aircraft registration.

Radio coverage on frequency 121.500 MHz was available in the area.

However, the radio call made by the pilot might have shadowed the actual distress of the aircraft to other ANSP providers and other aircraft in the area. In other words, the radio call made by the pilot appeared to be a standard radio call transmitted by mistake on a wrong frequency, and thus did not capture their full attention.

The ANSP reception coverage in general of the frequency 121.500 MHz seems uncompromised.

### **Electrical system**

After switching off the batteries, electrical power was still available to all aircraft systems.

Having kept the batteries switched on would not have posed a threat to the safety of the flight, because lead acid batteries were not subject to thermal runaways.

### **Cabin vent/defog blower**

The AIB technical investigation revealed a faulty cabin vent/defog blower.

It is likely that the blower failed shortly after the pilot re-activated the electrical cabin heating (cabin vent/defog blower and supplemental electric heater) at FL 240.

The noise from the failed blower was similar to what the pilot heard, and the reduced effect of the blower reduced the airflow downstream to the supplemental electric heater.

Without sufficient airflow, the temperature of the supplemental electric heater increased and caused an electrical smell in the cockpit.

The noise of the failed blower and the electric smell from the supplemental electrical heater element led to a pilot perception of a more developed serious electrical emergency and prompted the subsequent mitigating actions.

After the pilot turned off the electrical heating, the smell diminished over time to a level causing a pilot assumption of the electrical issues to be under control.

### **Hydraulic system**

After the pilot initiated the high-speed emergency descent and in order to increase the rate of descend, i.e. to use the landing gear as a speed brake, the pilot selected the landing gear into down position.

The AIB finds it likely that the fracture of the hydraulic down line occurred shortly after the hydraulic pump started to produce pressure for gear down operation.

Hydraulic fluid escaped through the fracture emptying the pump reservoir and reducing pressure on the down side to zero. This caused the landing gear to be stuck in the partly extended position (main landing gear partly down and nose landing gear up) by the trapped hydraulic fluid in the hydraulic up line. This fluid would have been released back into the reservoir if the emergency gear valve had been operated.

The AIB technical investigation of the hydraulic system did neither reveal the root cause for the failure (fracture) of the hydraulic down line nor the reason why the “HYD PUMP” c/b tripped during the sequence of events.

The most probable cause of the hydraulic tube fracturing, based on the appearance and location of the fracture, was determined to be a tubing material defect causing a fatigue fracture.

Several minutes of dry pump operation most likely tripped the hydraulic pump circuit breaker. The pump had a maximum nominal current draw of 60 amp during maximum load. A 35 amp circuit breaker was installed in the electrical system for the pump.

The pump would not be loaded to maximum electrical current without pressure build up in the system.

However, because the pump would normally only operate for less than a minute at the time, it is probable that current drawn over an extended period of time would cause the 35 amp circuit breaker to trip due to increasing heat.

### **Landing gear system**

The AIB inspection and test of the landing gear system, both during normal and during emergency operation, did not reveal any faults within the system.

In the opinion of the AIB, an emergency extension of the landing gear would have been possible after the hydraulic failure.

### **Emergency procedures checklist**

Both the JetProp emergency procedures checklist and the POH expanded emergency procedures checklist included the necessary actions for an emergency landing gear extension.

However, only the POH expanded emergency procedures checklist included the information on a force of up to 25 lbs was required to extend the control knob through the region of high resistance in order to reach the stop and extend the landing gear.

In a high stress work environment unless a checklist is unambiguous, the risk of using an inappropriate procedure, mixing procedures or confused system understanding increases.

In the opinion of the AIB, the onboard JetProp emergency procedures checklist was a source to ambiguity, because emergency procedures for two different hydraulic systems were included in the checklist.

Even though, in the landing gear emergency extension checklist, a small vague “x” was marked over the word “For” in the line “For S/N 46-8408001 – 46-860867...” this was in the opinion of the AIB not sufficient to preclude any misunderstanding. [See appendix 6](#)

No markings were visible in the hydraulic system malfunction checklist. [See appendix 4](#)

Knowledge of the aircraft serial number or the make of the installed hydraulic system should not be a prerequisite for selecting the appropriate emergency procedure.

Checklists produced by an aircraft manufacturer often include different procedures for a system group, because different systems might be installed in identical types of aircraft.

Therefore, the operator of an aircraft should take every possible precaution to make checklists as unambiguous as possible.

With regard to the on board JetProp emergency procedures checklist, this was not performed fully.

### **Workload management and emergency procedure application**

The AIB considers the pilot experienced on the aircraft type and an experienced pilot in general.

During the sequence of events, the pilot had to divide his attention between flying the aircraft, communicating with ATC, dealing with various system malfunctions, dealing with potential icing conditions and diverting to an unfamiliar airport.

The pilot perceived the workload to be massive. The AIB shares this perception.

In the opinion of the AIB, the decision to initiate a high-speed emergency descent toward mainland Denmark was reasonable.

Flying the emergency descent manually while load shedding and communicating with ATC required most of the available mental capacity of the pilot. Using the autopilot to the maximum extent possible would have reduced the pilot’s workload.

The above factors prevented a thorough troubleshooting and identification of the vent/defog blower as the actual failed component.

For that reason and until landing, the pilot handled the aircraft on the assumption of having temporarily mitigated the electrical smoke but electrical smoke could possibly evolve again.

This assumption most likely influenced the pilot's decision of not using the autopilot and to land as soon as possible.

Later on, the emergency landing gear extension, the manual flying and the low level manoeuvring prevented the pilot from performing a thorough analysis of why the landing gear would not extend.

It was not possible for the pilot to free enough mental resources to extract the needed information from the POH while circling overhead EKYT in deteriorating weather conditions.

The pilot's decision on landing the aircraft, before the weather conditions became too severe, and while the pilot still felt in control, was an appropriate decision that mitigated the potential consequences of an uncontrolled landing.

## CONCLUSIONS

Noise and fumes, as a consequence of a failed vent/defog blower, prompted the pilot to initiate a high-speed emergency descent and to select the landing gear into down position.

For unknown reason and most likely during the landing gear extension, the hydraulic down line fractured leaving the landing gear in a partially extended position.

The below contributed to an unsuccessful emergency extension of the landing gear:

- The unresolved condition of the perceived electrical emergency.
- The pilot not using the autopilot to fully extent.
- The pilot not fully understanding the functioning of the landing gear emergency extension system.
- The possible ambiguity of the on board JetProp emergency procedures checklist.
- The deteriorating weather conditions at Aalborg (EKYT).
- Task saturation/high workload influenced the pilot's ability to analyse why the landing gear emergency extension was unsuccessful.

## APPENDIX 1

[Return to history of flight](#)

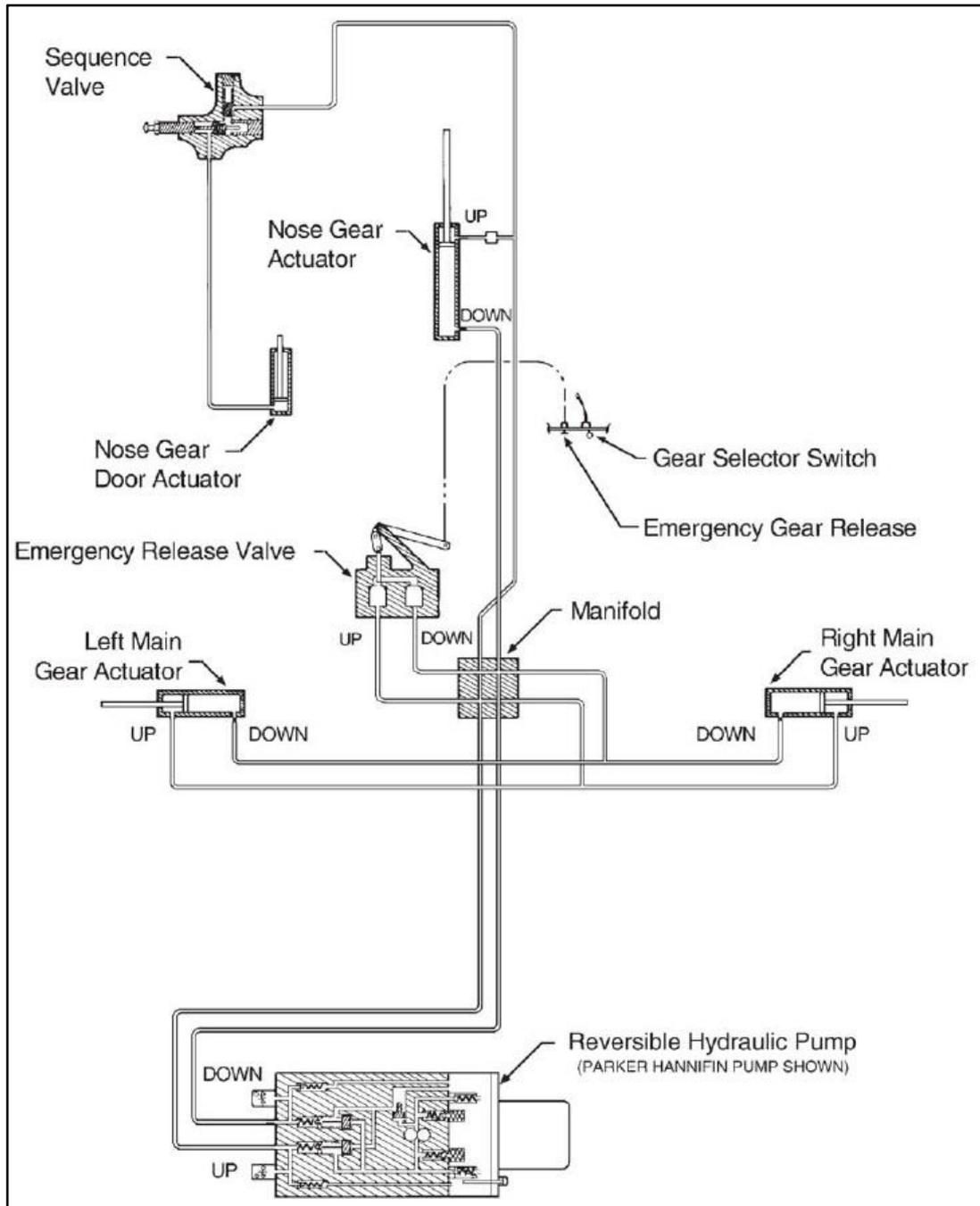
Picture of aircraft while circling overhead EKYT – landing gear position unchanged until landing



## APPENDIX 2

[Return to hydraulic system](#)

Fluid diagram of hydraulic system



[Return to hydraulic system](#)

Emergency procedures checklist – Hydraulic system malfunction (3.49) POH

**3.3v Hydraulic System Malfunction (3.49) (Continued)**

**HYDRAULIC SYSTEM MALFUNCTION (serial numbers 4608008 and up)**

Hydraulic pump annunciator light illuminates continuously, or cycles on and off rapidly:

Hydraulic Pump Power circuit breaker..... PULL.  
Land as soon as practical and investigate the cause.

Prior to landing, the hydraulic pump power circuit breaker must be reset in order to extend the landing gear. If pump continues to run after gear is locked down, pull the Hydraulic Pump Power circuit breaker. If gear fails to extend, refer to emergency landing gear extension (3.3n).

[Return to hydraulic system](#)

[Return to emergency procedures checklist](#)

Emergency procedures checklist – Hydraulic system malfunction (3.49) JetProp

**EMERGENCY PROCEDURES CHECKLIST** ~~JetProp~~

**3.3v - HYDRAULIC SYSTEM MALFUNCTION (3.49)**

**(For S/N 46-8508048 — 46-8608046, with Piper Kit No. 765197 NOT Installed):**

**HYD PUMP Annunciator Light illuminates Continuously or Cycles On or Off Rapidly:**

1. HYD Pump Circuit Breaker ..... PULL
2. LAND As Soon As Possible & Determine Cause.

**(For S/N 46-8608047 — 46-8608067 and 4608001 — 4608007, and Aircraft with Piper Kit No. 765 178V, 765179V or 765197 Installed):**

**HYD PUMP Amber Annunciator Light Illuminates Continuously:**

1. HYD PUMP Circuit Breaker ..... PULL & RESET
2. Normal Pump Operation ..... VERIFY

**HYD Pump Annunciator Illuminates Second Time:**

3. HYD PUMP Circuit Breaker ..... PULL
4. LAND As Soon As Possible and Determine Cause

**(S/N 4608008 and Up)**

**HYD PUMP Annunciator Light illuminates Continuously or Cycles On or Off Rapidly:**

1. HYD Pump Power Circuit Breaker ..... PULL
2. HYD Pump Power Circuit Breaker ..... RESET Prior to  
..... Extending Landing Gear
3. HYD Pump Power Circuit Breaker ..... PULL, If Pump  
..... Continues to Run After Gear is Locked Down
4. LAND As Soon As Possible & Determine Cause.

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**APPENDIX 5**

[Return to landing gear](#)

Emergency procedures checklist– Emergency landing gear extension (3.31) POH

**3.3n Emergency Landing Gear Extension (3.31)**

**Note**

If emergency gear extension is required due to electrical power failure, the gear position indicator lights will not illuminate.

**Prior to emergency extension procedure:**

Battery Master Switch..... CHECK ON  
Circuit Breakers..... CHECK  
Day/Night Dimming Switch (in daytime)..... DAY

**CAUTION**

The emergency gear extension procedure will require the pilot to pull the emergency gear extend control knob through a region of high resistance (up to 25 pounds) in order to reach the stop and extend the landing gear.

**If landing gear does not check down and locked:**

**(Aircraft Serial Numbers 46-8408001 – 46-8608067 and 4608001 – 4608007 with Gar-Kenyon hydraulic system)**

Airspeed..... Below 100 KIAS  
Hydraulic Pump Power Circuit Breaker (25 amp)..... PULL  
Landing Gear Selector..... UP  
Emergency Gear Extend Control..... PULL  
(While fishtailing airplane)  
Landing gear selector ..... DOWN

**(Aircraft Serial Number 4608008 und UP)**

Airspeed..... Below 90 KIAS  
Hydraulic Pump Power Circuit Breaker (25 amp)..... PULL  
Landing Gear Selector..... DOWN  
Emergency Gear Extend Control..... PULL  
(While fishtailing airplane)

Emergency procedures checklist – Emergency landing gear extension (3.31) JetProp

**EMERGENCY PROCEDURES CHECKLIST**    ~~JetPROP~~

**3.3m - PROPELLER OVERSPEED (3.29)**

1. Power Control ..... REDUCE
2. Oil Pressure ..... CHECK
3. Propeller ..... DECREASE RPM
4. Airspeed ..... REDUCE
5. Power Control ..... AS REQ'D TO MAINTAIN RPM
6. LAND AS SOON AS PRACTICAL

**3.3n - EMERGENCY LANDING GEAR EXTENSION (3.31)**

1. Battery Master ..... CHECK ON
2. Circuit Breakers ..... CHECK
3. Day/Night Dimming Switch ..... SET TO DAY

For S/N 46-8408001 — 46-8608067 and 4608001 — 4608007;  
(Gar-Kenyon Hydraulic Systems):

4. Airspeed ..... LESS THAN 100 KIAS
5. Hydraulic Pump Circuit Breaker ..... PULL
6. Landing Gear Selector ..... UP
7. Emergency Gear Extension ..... PULL  
..... WHILE FISHTAILING AIRPLANE
8. Landing Gear Selector ..... DOWN

For S/N 4608008 and UP;  
(Parker Hannifin Hydraulic Systems):

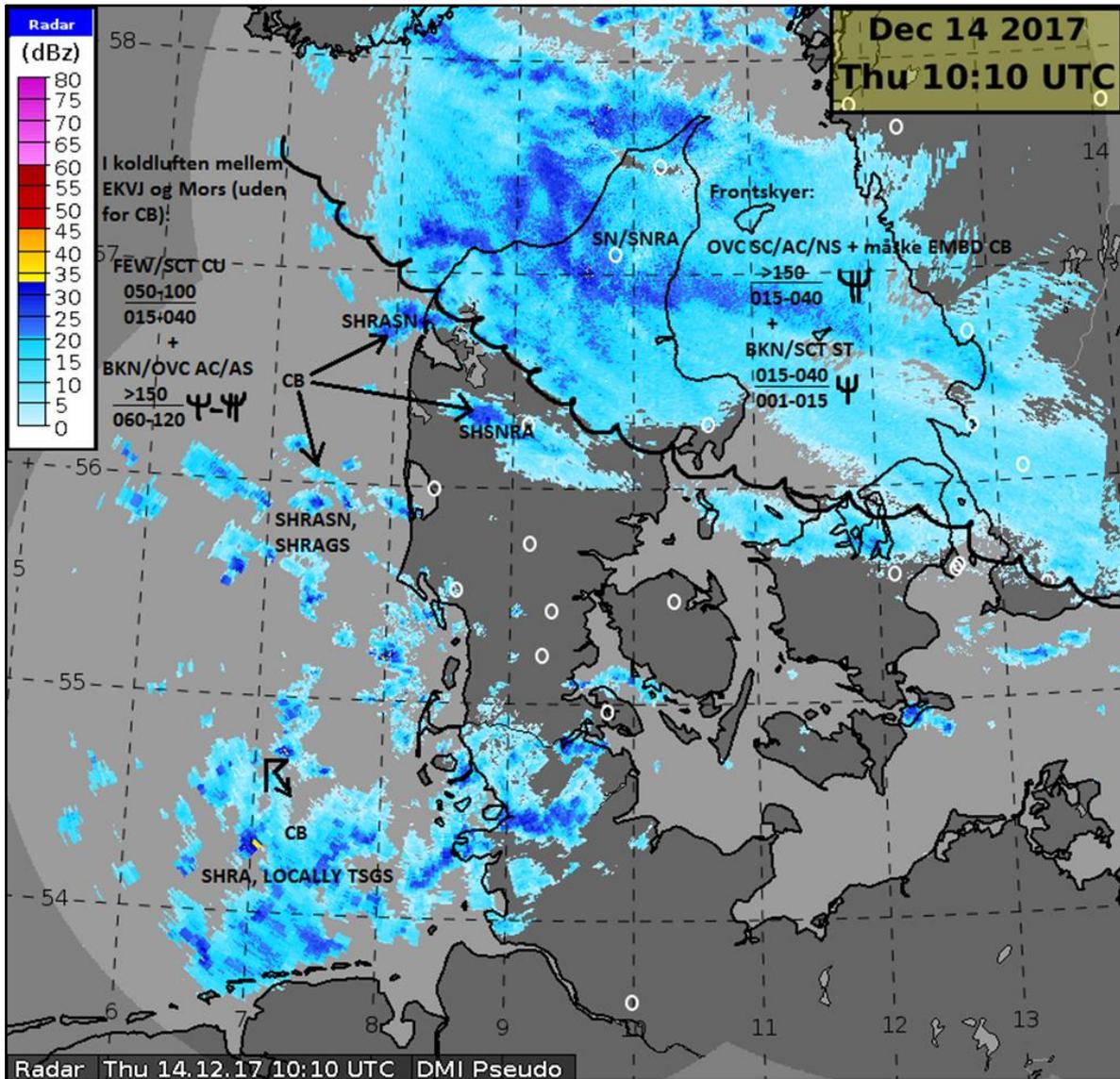
4. Airspeed ..... LESS THAN 90 KIAS
5. Hydraulic Pump Circuit Breaker ..... PULL
6. Landing Gear Selector ..... DOWN
7. Emergency Gear Extension ..... PULL  
..... WHILE FISHTAILING AIRPLANE

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APPENDIX 7

[Return to radar chart](#)

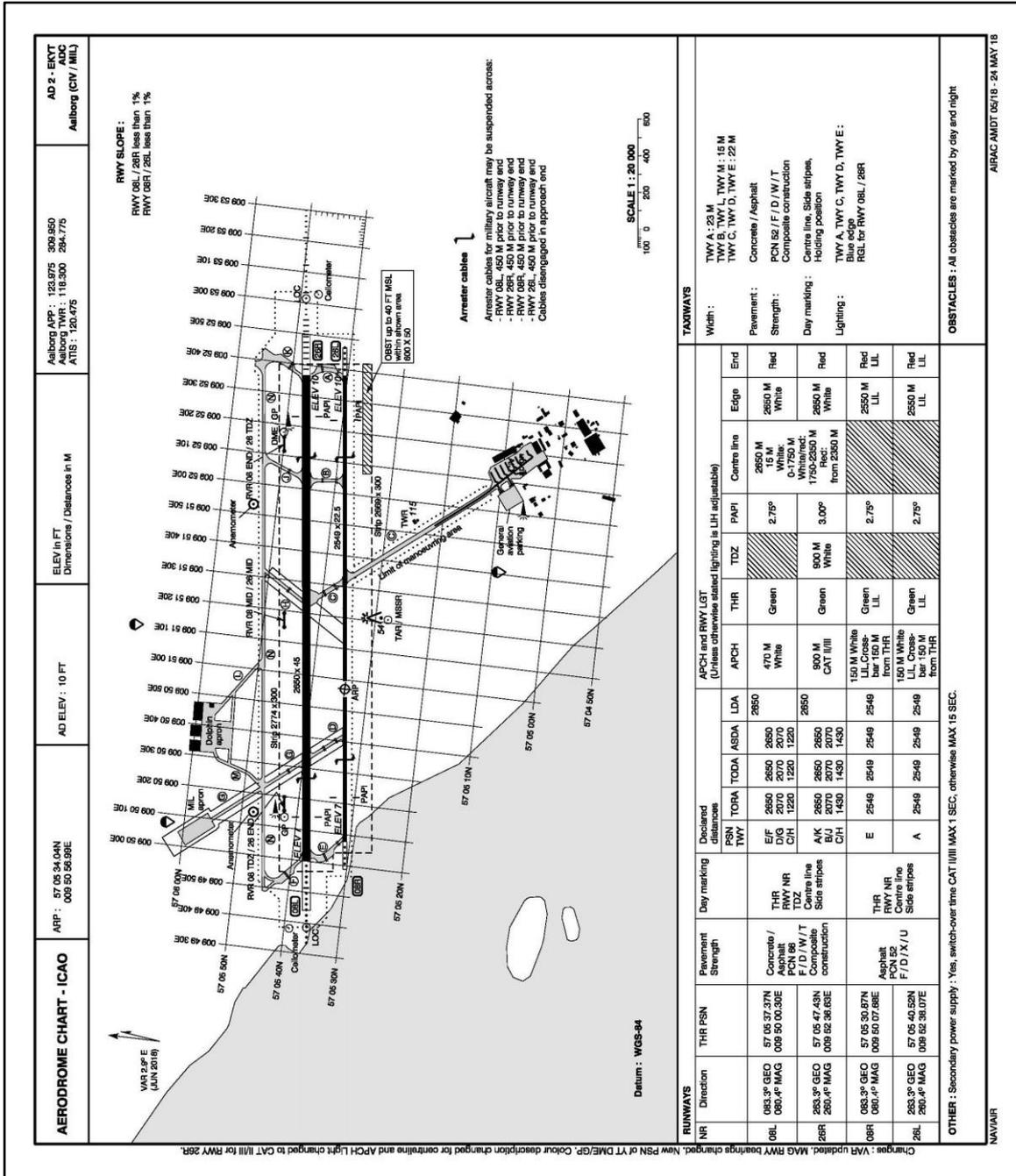
Aftercast “significant weather radar chart”



# APPENDIX 8

[Return to ICAO aerodrome chart](#)

EKYT ICAO aerodrome chart



## APPENDIX 9

[Return to aircraft inspection](#)

Hydraulic system schematic, location of fracture.

