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Report RL 2001:19e

Accident involving helicopter SE-JFY at Stockholm/Skavsta airport, D county, Sweden, on the 28th of August 2000

Dnr L-089/00

The report is also available on our Web site: www.havkom.se

Translated by Dennis Lynn Anderson.
From the original Swedish at the request of the Board of Accident Investigation.

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

2001-06-29 L-089/00

Swedish Civil Aviation Administration

601 79 NORRKÖPING

Report RL 2001: 19e

The Board of Accident Investigation (Statens haverikommission, SHK) has investigated an accident that occurred on the 28th of August 2000 at Stockholm/Skavsta airport, D county, Sweden, involving a helicopter with registration SE-JFY.

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.

Olle Lundström

Monica J Wismar Henrik Elinder

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Report finalized 2001-06-29

Aircraft: registration, type	**SE-JFY,** Eurocopter EC 120B
Class/airworthiness	Normal, valid certificate of airworthiness
Owner/Operator	Widinge Skärgårdstransport AB, Box 3227, 103 64 Stockholm
Date and time	2000-08-28, 14.36 hours in daylight Note: All times in the report are given in Swedish Daylight Savings Time = UTC + 2 hours
Place of occurrence	Stockholm/Skavsta airport, D county, Sweden, (pos 5847N 1654E, 42 meters above sea level)
Type of flight	Utility aviation
Weather	According to SMHI:s analysis: Wind 170°/13 knots, Visibility > 10 km, Clouds 3–4/8 with bases at 2,700 feet, Temp./Dewpoint +20°/+12 °C, QNH 1023 hPa.
Persons onboard: crew	1
passengers	–
Injuries to persons	Minor
Damage to aircraft	Substantial
Other damage	Damage to hangar
Pilot in command:	
Age, certificate	40 years old, BH and A (CPL (Helicopter) and PPL (Aeroplane))
total flying time	Approximately 1,280 hours, of which 680 hours fixed-wing and approximately 600 hours helicopter and 120 hours on the type
flying hours previous 90 days	24 hours, of which 20 hours on the type
number of landings previous 90 days	35, of which 32 on the type

The Board of Accident Investigation (SHK) was notified on the 28th of August 2000 that a helicopter with registration SE-JFY had been involved in an accident at Stockholm/Skavsta airport, D county, Sweden, at 14:36 hours on that same day.

The accident has been investigated by SHK, represented by Olle Lundström, Chairman, Monica J. Wismar, Chief investigator flight operations, and Henrik Elinder, Chief technical investigator aviation.

The Board was assisted by Johan Agin as operative expert.

The investigation was followed by Gun Ström, Swedish Civil Aviation Administration.

Summary

The pilot intended to land the helicopter at the airport of Stockholm/Skavsta. The landing was to take place on a helipad trailer beside a hangar. He hovered forward in headwind and landed on the trailer. Before he had

reduced the rotor speed and locked the collective he opened the right-hand cabin door in order to check the placement of the helicopter on the trailer.

During this manoeuvre the helicopter's left landing gear skid lifted unexpectedly from the trailer and the helicopter turned a bit to the left. The pilot then hovered the helicopter a meter or so above the trailer and with neutral rudder deflection allowed the helicopter to spontaneously turn to the left. His intention was to allow the helicopter to swing around 180° and thereafter climb in tailwind and perform a new approach and landing on the trailer.

When he applied right rudder deflection after half a revolution the left-hand rotation did not stop as he had expected. The helicopter continued to rotate to the left at an increasing rate and the pilot suspected that a serious problem had arose with the tail rotor system. When he then attempted to fly the helicopter out of the motion the rotation transitioned to an uncontrolled oscillating rotation at 5–10 meters height over the ground.

After a few rapid revolutions he decided to terminate the flight and moved the control stick aft and to the right as he simultaneously moved the collective down. The helicopter then impacted the ground and tipped over on its right side. The main rotor blades impacted the ground and were shattered.

No technical faults were found on the helicopter.

The accident was caused by the fact that the pilot did not hastily enough and with sufficient rudder input stop the left-hand yaw, which began in connection with the helicopter's unplanned lift-off.

Recommendations

None.

1 FACTUAL INFORMATION

1.1 History of the flight

The pilot took-off with the helicopter from Brokinds Gård in Rimforsa on the 28th of August 2000 at 14:04 hours to fly to a helicopter maintenance workshop at Stockholm/Skavsta airport. He sat in the right-hand pilot's seat. The flight, which took approximately 30 minutes, elapsed normally. When he arrived at the airport he received information that the wind was from 160 degrees with a force of 10 knots and was cleared to land next to the hangar on the northern part of the airport. He flew in over the airport and passed the intersection of runways 08/26 and 16/34. Thereafter he performed a landing circuit and turned for a right base parallel to runway 16 and a final towards a helipad trailer that was placed on the taxiway on the side of the hangar. He hovered forward in headwind and landed the helicopter on the trailer.

Before he had reduced the rotor speed and locked the collective he held the control stick between his legs and opened the right-hand cabin door with the right hand to check the placement of the helicopter on the trailer. His left hand was still on the collective. When he thereafter brought his right hand to the collective in order to lock it in the parking position, the helicopter's left landing gear skid lifted from the trailer and the helicopter turned a bit to the left. He then hovered the helicopter a meter or so above the trailer and with neutral rudder deflection allowed the helicopter to spontaneously turn to the left. His intention was to allow the helicopter to swing around 180° and thereafter climb in tailwind and perform a new approach and landing on the trailer.

When he applied right rudder deflection after half a revolution the left-hand rotation did not stop as he had expected. When the helicopter had turned a ¾ revolution he applied full right rudder but without a noticeable result. The helicopter continued to rotate to the left at an increasing rate and he suspected that a serious problem had arose with the tail rotor system. He did not dare to reduce the engine capacity as he did not know if the helicopter still was above the trailer. He then attempted to fly the helicopter out of the motion by lifting the collective with neutral rudder and moving the control stick forward. At this time the rotation transitioned to an uncontrolled oscillating rotation at 5–10 meters height over the ground.

After a few rapid revolutions he decided to terminate the flight and moved the control stick aft and to the right as he simultaneously moved the collective down. The helicopter then impacted the ground and tipped over on its right side. The main rotor blades impacted the ground and were shattered.

With the exception of a broken thumb the pilot escaped without injuries and was able to exit the helicopter by himself.

The accident occurred at location 5847N 1654E; 42 meters above sea level.

1.2 Injuries to persons

	Crew	*Passengers*	*Others*	*Total*
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	1	–	–	1
None	–	–	–	–
Total	1	–	–	1

1.3 Damage to aircraft

Substantial.

1.4 Other damage

Minor damage to adjacent hangar.

1.5 The pilot

The pilot was 40 years old at the time and had valid BH- and A-certificates (commercial helicopter and private fix-wing license).

Flying hours previous	*24 hours*	*90 days*	*Total*	
All types	3	24	1,280	of which approx. 600 helicopter
This type	3	20	120	

Number of landings this type previous 90 days: 32.
Flight training on type concluded in 1998.
Latest periodic flight training (PFT) was carried out during May of 2000 on the Eurocopter EC 120.

1.6 Aircraft information

1.6.1 General

AIRCRAFT

Manufacturer:	Eurocopter
Type:	EC 120B
Serial number:	1 137
Year of manufacture:	2000
Gross weight:	Maximum authorized 1,715 kg, actual 1,200 kg
Center of gravity:	Within allowable limits but somewhat tail-heavy
Total flying time:	13 hours
Number of cycles:	10
Fuel uplifted before event:	JETA1

ENGINE

Manufacture:	Turbomeca
Model:	Arrius 2F
Number of engines:	1
Total operating time, hrs.:	13
Number of cycles:	*10*

ROTOR

Rotor manufacture:	Eurocopter

Main rotor/Tail rotor
Total operating time, hrs.: 13
Number of cycles: 10

The helicopter was newly manufactured and the pilot had made the delivery flight to Sweden from the manufacturer in France during the two days prior to the accident. The aircraft had a valid certificate of airworthiness.

1.6.2 Rotor system

The main rotor on this type of helicopter rotates clockwise. The tail rotor is of the so-called fenestrated type. In this type construction the rotor is built within a "drum" (fanduct) placed on the tail fin. A fenestrate rotor normally has a greater number of rotor blades than a tail rotor with ordinary design.

1.7 Meteorological information

According to SMHI analysis: Wind 170°/13 knots, Visibility > 10 km, Clouds 3–4/8 with bases at 2,700 feet, Temp./Dewpoint +20°/+12 °C, QNH 1023 hPa.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Customary communication took place between the pilot and the air traffic controller at Stockholm/Skavsta airport.

1.10 Aerodrome information

The airport had operational status in accordance with the Swedish AIP (Aeronautical Information Publication).

1.11 Flight recorders

Not installed. Was not required.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

A 55 cm high helicopter trailer measuring 5.0 x 3.5 meters was placed in the direction of the wind on a taxiway approximately 50 meters to the left of the hangar. The helicopter impacted on the taxiway immediately north of the trailer. Marks in the asphalt show that the rotor had contacted the ground and twisted the helicopter around somewhat, prior to it coming to a stop.

1.12.2 Aircraft wreckage

Extensive damage resulted to the helicopter's structure, tail boom, tail fin and stabilizer. All of the main rotor blades were shattered.

1.13 Medical information

Nothing indicates that the mental or physical condition of the pilot had been impaired prior to or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

The pilot used a 4-point type safety harness.

The emergency transmitter of type ELT 10 was not activated during the accident.

1.16 Tests and research

After the occurrence a visual control of the helicopter's rotor and flight control systems was made without any fault or abnormal condition being observed. A complete rigging control was subsequently done together with a representative from the helicopter manufacturer. All rigging parameters were found to be within applicable tolerances.

1.17 Organizational and management information

Not applicable.

1.18 Additional information

1.18.1 Tail rotor function

A helicopter's tail rotor serves two tasks: partially to create a torque moment that balances the torque that is caused by the driving of the main rotor, and partially to make it possible for the pilot to control the helicopter in the yaw plane. If the tail rotor function is disturbed, problems can arise in controlling the helicopter in the yaw segment.

Several types of aerodynamic disturbances can ensue in the function of the tail rotor in connection with low airspeed flight. If such disturbances are not attended to by the pilot and corrected in time, they can lead to the helicopter ending-up in an uncontrolled rotation around its vertical axis. Historically this has been the cause of several helicopter accidents and is something that has been brought to attention in publications, one of them the American Civil Aviation Administration's (FAA) publication Advisory Circular, AC No. 90-95, "Unanticipated right yaw in helicopters".

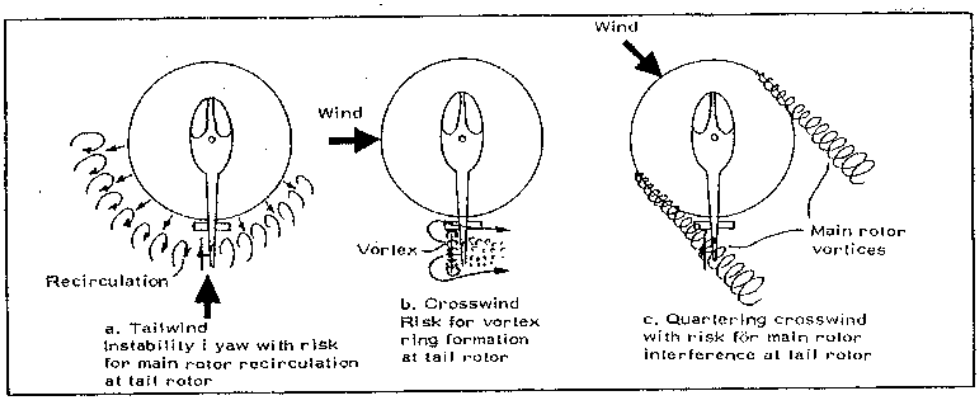
In this publication, among other things, the following three wind cases are treated that can lead to loss of yaw control:

Wind from behind (Tailwind)

The helicopter's tail boom serves as a "weathervane" that strives to twist the helicopter into the wind. If, during a yaw, a helicopter enters a tailwind, the velocity of the yawing will normally increase.

Wind fr0m the side (Crosswind)
Crosswind from the left on helicopters whose main rotors rotate counter clockwise results in the airflow through the tail rotor being pressed backwards and causes recirculation of air through the rotor, which diminishes the effectiveness of the tail rotor. On helicopters whose main rotors rotate clockwise a similar risk applies with crosswind from the right.

Wind diagonally from the front (Quartering crosswind)
With a quartering crosswind from the front, tip vortices from the main rotor blades can be driven rearwards to the tail rotor and cause so-called vortex interference, which diminishes the tail rotor's effectiveness. On helicopters whose main rotors rotate counter clockwise the risk of this originates principally from a quartering crosswind from the left. On helicopters whose main rotor rotates clockwise a similar risk applies with a quartering crosswind from the right.



For certain types of helicopters these problems are addressed in the flight manual, however not in the flight manual for the helicopter type in question. According to the manufacturer, the helicopter type has not been subject to this type of disturbance in any greater extent than other similar types of helicopters.

In the case at hand the manufacturer has told the pilot that the rotation should have ceased by itself after a few revolutions, if he had applied full right rudder during a longer time. The pilot himself had no knowledge of this phenomenon.

1.18.2 Emergency check list

The emergency check list for the helicopter type specifies the following measures to be taken when the control of the tail rotor is lost:

3.4 TAIL ROTOR CONTROL FAILURE

Symptom: the helicopter will yaw to the left with a rotational speed depending on the amount of power and the forward speed set at the time of failure.

3.4.1 HOVER - IGE[1]

LAND IMMEDIATELY

1. Twist Grip……	IDLE STOP POSITION
2. Collective…….	INCREASE to cushion touch-down

3.4.2 HOVER - OGE[2]

Simultaneously

1. Collective ….	REDUCE depending on available height
2. Cyclic …….	FORWARD to gain speed
3. Cyclic…….	ADJUST to set IAS to Vy and control yaw

LAND AS SOON AS POSSIBLE
Carry out an autorotative landing

3.4.3 IN CRUISE FLIGHT

1. Cyclic…….	ADJUST to set IAS to Vy and control yaw
2. Collective ….	REDUCE to maintain flight level

LAND AS SOON AS POSSIBLE
APPROACH AND LANDING
Carry out an autorotative landing

[1] IGE = In Ground Effect
[2] OGE = Out of Ground Effect

2 ANALYSIS

A comprehensive investigation, including flight control rigging, has been accomplished of the rotor and flight control systems of the helicopter, without any fault or abnormal condition being found. Neither did the pilot, during the delivery flight of the helicopter to Sweden shortly before the accident, experience anything abnormal.

When the pilot opened the right-hand door to check the parking position of the helicopter he had not locked the collective or reduced the rotor speed. He had secured the control stick between his legs. The unplanned lift-off of the helicopter's left landing gear skid during this moment was probably caused by the fact that the pilot unconsciously lifted the collective a little with his left hand and pulled the control stick diagonally backwards with his legs when he opened the door. Furthermore the helicopter was lightly loaded and somewhat tail-heavy. A momentary wind gust from the front can also have been contributory.

When this occurred, instead of steering the helicopter into the wind and climbing forward or backward, the pilot hovered the helicopter above the trailer and allowed it to yaw to the left. In doing so the helicopter got the wind from the right. There is much that points towards the fact that the helicopter, during this maneuver, was placed in a flight position that according to section 1.18 entails a risk of an aerodynamic disturbance of the tail rotor function and loss of yaw control. As is evident from that section, helicopters whose main rotors rotate clockwise – as in the case of the helicopter in question – can be sensitive to wind from the right.

Aerodynamic disturbance of the tail rotor function is therefore the probable explanation to why the pilot did not get the expected rudder response when he after less than one-half of a rotation intended to stop the yaw. The disturbance may have started as a vortex interference between the main and tail rotor and continued as a recirculation around the tail rotor. This resulted in the yaw rate possibly becoming greater than what the pilot intended. Contributory to this and to his difficulty to stop the yaw could have been that at about the same time the rotor's lift was increased, which created a further yawing moment to the left. The situation worsened after a half-rotation, when the helicopter was subjected to tailwind, which normally leads to an increase in the rate of yaw. The pilot's attempt to stop the left yaw was initiated too late or with too little rudder input.

The helicopter was consequently in an uncontrolled rotation around its own vertical axis on a low altitude. According to the emergency check list the pilot should have reduced the power setting and tried to put the helicopter down on the ground. However, SHK sympathize with his giving up that alternative as he in that situation did not know if the helicopter still was above the trailer.

The pilot's attempt to fly the helicopter out of the rotation by lifting the collective and moving the control stick forward worsened however the situation and resulted furthermore in the rotation becoming oscillatory. His decision in that situation to immediately abort the flight by moving the collective down is understandable.

3 CONCLUSIONS

3.1 Findings

a) The pilot was qualified to perform the flight.
b) The helicopter had a valid certificate of airworthiness.
c) The helicopter was newly manufactured and had been delivery-flown to Sweden shortly prior to the accident.
d) No technical faults were found on the helicopter.
e) The pilot was taken by surprise by the helicopter lifting-off from the helicopter trailer.

3.2 Causes

The accident was caused by the fact that the pilot did not hastily enough and with sufficient rudder input stop the left-hand yaw, which began in connection with the helicopter's unplanned lift-off.

4 RECOMMENDATIONS

None.