



GRAND-DUCHY OF LUXEMBOURG

MINISTRY OF TRANSPORT

INVESTIGATION COMMISSION
ON THE ACCIDENT WHICH OCCURED 6 NOVEMBRE 2002
AT LUXEMBOURG
TO THE FOKKER 27 MK050 REGISTERED LX – LGB
OPERATED BY LUXAIR

PRELIMINARY REPORT

January 2003

WARNING

This report details facts and circumstances established to this date in relation to the technical investigation.

According to Annex 13 to the Convention relative to the International Civil Aviation Organization, and to the Luxembourg law dated 8 march 2002 on technical investigations in relation to accidents and severe incidents which happened in the domains of civil aviation, maritime transport and railways, the technical investigation is not conducted in a way to establish errors or to evaluate individual or collective responsibilities. It's sole objective is to draw lessons from the occurrence in order to prevent future accidents.

Consequently, the use of this report for purposes other than prevention may lead to wrong interpretations.

This is a translation from the official report published in French.

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ABBREVIATIONS

AOM	All Operator Message
ATC	Air Traffic Control
BCMG	Becoming (TAF message)
BKN	Broken (TAF message)
BR	Mist (TAF message)
CVR	Cockpit voice recorder
DFDR	Digital Flight Data Recorder
DME	Distance Measuring Equipment
FAF	Final Approach Fix
FDR	Flight Data Recorder
FG	Fog (METAR message)
FL	Flight level
FSK	Frequency Shift Keying
ft	Feet
GA	Go Around
GPWS	Ground Proximity Warning System
HDG	Heading
hPa	Hectopascal
IAF	Initial Approach Fix
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
kts	Knots
LH	Left Handed
METAR	Meteorological aviation report
NDB	Non Directional Beacon
NM	Nautical Mile
NOSIG	No significant change (METAR message)
OVC	Overcast (METAR message)
PCU	Propeller Control Unit
PEC	Propeller Electronic Control
QFU	Runway magnetic direction
QNH	Pressure setting to indicate elevation above mean sea level
RVR	Horizontal visibility on the runway
RN	National road
RH	Right Handed
SB	Service Bulletin
SCT	Scattered (TAF message)
TAF	Terminal aerodrome forecast
UTC	Universal Time Coordinated
VHF	Very High Frequency
VOR	VHF Omnidirectional Range

SYNOPSIS

Date of accident

Wednesday 6 November 2002 at 09 H 06⁽¹⁾

Aircraft

Fokker F27 Mk050 registered
LX-LGB

Accident site

Niederanven, three point five kilometres to
the east of threshold runway 24 of
Luxembourg Airport

Owner

LUXAIR

Operator

LUXAIR

Type of flight

Public transport of passengers
Flight LG9642/LH2420 Berlin - Luxembourg

Persons on board: 22

2 cockpit crew, 1 cabin crew, 19 passengers

Summary

During an ILS approach to runway 24, whilst established on the centreline, the aircraft disappears from the radar screens. It is located again at three point five kilometres to the east of threshold runway 24, seven hundred metres north of the centreline.

Persons on board	Persons			Aircraft Destroyed	Load Destroyed	Third parties -
	Fatal	Injured	Not injured			
Crew	2	1	-			
Passengers	18	1	-			

¹ Unless otherwise specified, times mentioned in this report are UTC times.

ORGANISATION OF THE INVESTIGATION

According to article 26 of the Chicago convention of the ICAO and its annex 13, the Grand-Duchy of Luxembourg, country of occurrence, has started a technical investigation. An investigation commission has been created by ministerial decree. It has asked the French bureau of investigation for the safety of civil aviation (BEA) for assistance.

Investigators assisted by experts from the Dutch aircraft manufacturer Fokker and by technical and operational experts from Luxair have examined the site of the accident to secure material evidence. At the same time, the flight data recorders have been taken to the BEA for reading and analyses.

Representatives from the engine manufacturer Pratt & Whitney and from the propeller manufacturer Dowty joined the investigators and work continued on the first findings of the recorders and on the aircraft wreckage that had been transported into a hangar at Luxembourg airport.

The Netherlands participates in the investigation as State of manufacture of the aircraft. Germany, having suffered many victims, has delegated observers.

The technical investigation and the judicial investigation are closely coordinated with mutual respect to their individual procedures and objectives.

Investigations concerning the airframe, engines, propellers and different aircraft equipments were started immediately. This process is still ongoing as to date of this report.

The first factual findings of the investigation are shown in this report.

1. BASIC INFORMATIONS

1.1. HISTORY OF THE FLIGHT

The Fokker 27 Mk050 registered LX-LGB and operated by Luxair leaves Berlin on 6 November 2002 at 7 h 40 on flight LG 9642/LH 2420 with destination Luxembourg.

Cruising level is at FL 180. At 8 h 50, Frankfurt Control asks the crew to stop descent at FL 90 and at 8 h 52 the flight is transferred to Luxembourg Approach.

At 9 h 00, the aircraft descends through FL 75 and after radar vectoring to the runway centreline, continues its descent to three thousand feet. At this time the aircraft flies in the clear above a fog layer. RVR is two hundred seventy five meters. The crew evokes a go-around if the RVR is not three hundred meters whilst passing ELU (it's minima for a category II approach are three hundred meters).

At 9 h 04 min 57 s, the ATC controller transmits an RVR of three hundred meters. Power levers are brought to the idle position, flaps 10 are selected and the landing gear is lowered.

Immediately after the landing gear is lowered, the pitch angle of the two propellers simultaneously reaches a value that is lower than the minimum values for flight. This propeller pitch setting brings a rapid decrease of speed and altitude.

During the following seconds, the left engine stops, then the right engine stops. The flight data recorders, no longer powered, cease functioning. At 9 h 05 min 42 s (radar time base), the aircraft disappears from the radar screen. It is immediately found in a field seven hundred meters to the north of runway centreline 24 and three point five kilometres to the east of the threshold.

1.2. INJURIES TO PERSONS

Injuries	Crew	Passengers	Other persons
Fatal	2	18	-
Serious	1	1	-
Minor / None	-	-	-
Total	3	19	-

1.3. DAMMAGE TO THE AIRCRAFT

The aircraft is destroyed.

1.4. OTHER DAMMAGE

There has been no damage to third parties.

1.5. PERSONNEL INFORMATION

1.5.1. Pilot in command

Male, 26 years, airline transport pilot licence dated 16 March 1999.
Entry date at Luxair: 1 April 1995.

Total flight hours:	4242
Hours on type:	2864
Last 3 days:	0
Last 28 days:	54
Last 30 days:	57
Day of the accident:	1 hour and 36 minutes before the last flight.

The pilot in command resumed flying on 6 November 2002, after a rest period of 91 hours (standby).

Last checks:

Proficiency check:	1 June 2002
Line check:	12 June 2002
Type rating F27 Mk050:	20 February 1999
Medical check:	19 June 2002, valid until 5 July 2003.

1.5.2. Co-pilot

Male, 32 years, airline transport pilot licence dated 19 January 2001.
Entry date at Luxair: 4 December 2000.

Total flight hours:	1156
Hours on type:	443
Last 3 days:	0
Last 28 days:	50
Last 30 days:	54
Day of the accident:	1 hour and 36 minutes before the last flight.
Last flight before the accident:	1 November 2002

Last checks:

Proficiency check:	22 June 2002
Line check:	13 June 2002
Type rating F27 Mk050:	19 June 2001
Medical check:	30 November 2001, valid until 14 January 2003

1.5.2. Cabin crew

Female: 32 years.
 Entry date at Luxair: 16 February 1995.
 Last checks: 18 Mai 2002.

1.6. AIRCRAFT INFORMATIONS

1.6.1. Airframe

- Manufacturer: Fokker Aircraft BV (Netherlands)
- Type: F27 Mk050
- Serial N°: 20221
- Airworthiness certificate:
 - o Delivered on 26 June 1991
 - o Valid until 19 June 2003
- Flight hours up to 6 November 2002: 21 836
- Cycles up to 6 November 2002: 24 068

1.6.2. Engines

Manufacturer: Pratt & Whitney Canada

Engine	Type	Serial Number	Operating hours	Cycles
Left	PW 125B	124315	20 372	22 060
Right	PW 125B	125004	18 454	20 077

1.6.3. Propellers

Manufacturer: Dowty Propellers

Propeller	Type	Serial Number	Operating hours	Cycles
Left	R352/6-123-F/1	DRG8487/89	18 008	16 958
Right	R352/6-123-F/1	DRG11867/89	17 923	19 470

1.6.4. Mass and centre of gravity

The aircraft was within the weight and balance envelope as determined by the manufacturer.

1.6.5. Maintenance and airworthiness

The evening before the accident an « 230 flight hours inspection » was performed with a satisfying result.

The list of reported issues mentions an inoperative antiskid system on the right hand landing gear up to the 5 November 2002 (date of the inspection). This anomaly was first detected on 27 September 2002 and the RH antiskid harness been replaced. On 24 October 2002, the same system was inoperative again. Despite changing the outboard wheel speed sensor, the system remained inoperative. The problem was resolved on 5 November 2002 by replacing the RH inboard wheel speed sensor.

1.7. METEOROLOGICAL INFORMATIONS

1.7.1. General situation

Luxembourg was under the influence of high pressures, with a low centred over Iceland and a low-pressure system moving slowly to the east.

This generated persistent fog, which only cleared during the early afternoon hours.

1.7.2. Situation at the aerodrome

METAR from 8 h 50:

00000KT 0100 R24/250N FG OVC001 04/04 Q1023 NOSIG

TAF from 9 h 00:

060900 06 1019 18002KT 0100 FG BKN001 BCMG 1114 2000 BR BKN009 BCMG 1416 20010KT 9999 SCT015 BKN040=

1.8. AIDS TO NAVIGATION

The approach procedure for the ILS DME runway 24 is based on following means (see Jeppesen chart annex 1):

- a VOR/DME DIK 114,400 MHz materialising the IAF and collocated with an NDB 307 kHz
- an ILS/DME ILW 110,7 MHz
- an NDB ELU 368,5 kHz at 5,5 NM from the threshold, representing the FAF

All these equipments were operating normally at the time of the accident.

1.9. RADIO COMMUNICATIONS

During the last minutes of the flight, LG 9642 was in contact with the Frankfurt en-route Centre, the Approach Control and the Control Tower of Luxembourg.

The aerodrome operates following radio communications frequencies:

- Approach Control frequency 118.9 MHz
- Control Tower frequency 118.10 MHz

These equipments were operating normally at the time of the accident.

Excerpts from the communications with the different organisations are given below with the CVR time base (Annex 4 shows the radio communications transcription and the slight misalignment with the CVR time base has not yet been adjusted).

Communications with Frankfurt Centre:

At 8 h 44 min 25 s, Luxair 9642, at FL 140, contacts sector K74 of Frankfurt who asks to route directly to ELU and to maintain the flight level. At 8 h 46 min 43 s, he is authorised to descend to level 100, then to level 60 at 8 h 49 min 06 s.

At 8 h 50 min 39 s, the controller transmits: « Luxair 9642 by request of Luxembourg stop your descent level 90 set course to Diekirch ». The crew acknowledges.

At 8 h 52 min 15 s, the controller transfers the aircraft to Luxembourg Approach Control: « Luxair 9642 for lower and radar vectors contact Luxembourg 118,9 good bye ».

Communications with Luxembourg Approach Control

At 9 h 01 min 25 s, the approach controller asks « Niner six four two turn right heading two two zero to intercept cleared for approach, report established on the localizer ».

At 9 h 02 min 32 s, the crew announces « The Lux euh nine six four two is now established on the localizer ». He is then transferred to Control Tower frequency, which he contacts at 9 h 02 min 51 s.

Communications with Luxembourg Control Tower

At 9 h 02 min 57 s, the tower controller replies « Luxair nine six four two gudden Moien, continue approach. The wind is calm RVR beginning two five zero meters, mid section two five zero meters, stop end two two five meters ».

At 9 h 03 min 08 s, the crew replies « ... that's copied Luxair nine six four two... but we need three hundred meters for the approach ».

At 9 h 03 min 18 s, the controller transmits « Nine six four two copied... uh so continue approach and I'll keep you advised we didn't have three hundred uh... uh during the last time ».

At 09 h 03 min 28 s, the crew announces « Euh Roger nine six four two, we keep you advised we're proceeding to ELU now and ... uh standing by nine six four two ».

At 09 h 04 min 57 s, the controller transmits an RVR of 300 m to the crew: « Luxair nine six four two RVR three hundred meters two seven five meters stop end two seven five meters ».

At 9 h 05 min 05 s, the crew announces « Nine six four two Roger so we continue ».

At 9 h 05 min 08 s, the controller replies « Nine six four two you are cleared to land wind one eight zero degrees....knots».

The co-pilot acknowledges this message at 9 h 05 min 13 s. It is the last communication with Control.

1.10. AERODROME INFORMATION

The airport has a single runway oriented 241° / 061° of a length of 4000 meters. Altitude of threshold runway 24 is 1214 feet.

The two runway orientations are each equipped with an ILS;

- for runway 06, an ILS category 1,
- for runway 24, an ILS category 3.

The airport is equipped with a primary and a secondary approach radar, used by Approach Control for i.e. radar vectoring on initial and intermediate approach and for separating incoming and outgoing IFR traffic.

1.11. FLIGHT RECORDERS

According to regulations, the Fokker 27 Mk050 was equipped with two flight recorders:

	FDR	CVR
Model	Fairchild F800	Fairchild A100A
Reference (P/N)	17M-800-251	93-A100-80
Serial number (S/N)	3672	56866



The recorders have been taken in the afternoon of 7 November to the BEA. Extractions of the tapes and the readings have been done right away.

1.11.1. Reading operations

1.11.1.1. FDR

The recorder, still fixed to its support structure, was in good shape. Inside of the protected box, the tape was in place and in an apparent perfect condition. The reel on which the magnetic tape is rolled inside the recorder has been extracted and placed on an appropriate reading device. The six channels have been decoded into six binary files with a synchronisation rate close to 98%.

The parameters announced by the manufacturer were exploitable, with the exception of longitudinal and lateral accelerations, control wheel position, control column position, pitch trim wheel position and rudder position.

The end of exploitable information corresponds to time 9 h 05 min 26 s (this last second included).

1.11.1.2. CVR

The cockpit voice recorder was still fixed to its support structure. Not much damaged, its state nonetheless required the box to be cut apart. After extraction, the tape has been transferred onto a new standard reel.

The magnetic tape of the CVR Fairchild A-100 comprises four channels, which correspond to the four channels recorded during thirty minutes.

The reading of the tape has been done on an adapted REVOX reading device, after adjusting the tape speed thanks to the 400 Hz signal corresponding to the onboard power supply. Furthermore, the CVR included on channel 2 an FSK signal (Frequency Shift Keying). This signal is composed of acoustic bips spaced exactly by 4000 ms permitting to fine tune the tape speed. In addition, these bips code UTC time that can be read by a specialised decoding device.

1.11.2. Exploitation of recordings

1.11.2.1. Flight data recorder

Hereafter are listed some significant parameters of the last 30 seconds of the recording.

At 9 h 05 min 00 s: reduction of engine power

- Heading: 239°
- Speed: 165 kts
- Pressure altitude: 2742 ft
- Propeller torque (left and right): 17% et 15%
- Propeller speed (left and right): 85% et 85%
- Fuel flows (left and right): 493 lb/h et 447 lb/h
- Flaps position: 0

At 9 h 05 min 09 s: start lowering flaps

- Heading: 240°
- Speed: 152 kts
- Pressure altitude: 2 712 ft
- Propeller torque (left and right): 0% et 0%
- Propeller speed (left and right): 85% et 85%
- Fuel flows (left and right): 208 lb/h et 182 lb/h
- Flaps position: 1

At 9 h 05 min 16 s: start lowering landing gear

- Heading: 238°
- Speed: 145 kts
- Pressure altitude: 2 635 ft
- Propeller torque (left and right): 0% et 0 %
- Propeller speed (left and right): 85% et 85%
- Fuel flow (left and right): 214 lb/h et 188 lb/h
- Flaps position: 12

At 9 h 05 min 17 s, the left propeller « blade angle » parameter switches from «normal» to «low pitch»², signalling a propeller blade angle setting less than 10°.

- Heading: 236°
- Speed: 144 kts
- Pressure altitude: 2 617 ft
- Propeller torque (left and right): 0% et 0%
- Propeller speed (left and right): 50% et 49%
- Fuel flows (left and right): 202 lb/h et 174 lb/h
- Flaps position: 12

The right hand propeller « blade angle » parameter switches from «normal»to «low pitch» a second later.

At 9 h 05 min 20 s: start of flaps retraction

- Heading: 237°
- Speed: 131 kts
- Pressure altitude: 2 512 ft
- Propeller torque (left and right): 3% et 0%
- Propeller speed (left and right): 86% et 95%
- Fuel flows (left and right) : 352 lb/h et 334 lb/h
- Flaps position: 12

² This is a binary parameter, meaning there are only two possibilities: « normal » or « low pitch ».

At 9 h 05 min 26 s: last recorded values

- Heading: 244°
- Speed: 125 kts
- Pressure altitude: 2 145 ft
- Propeller torque (left and right): 0% et 0%
- Propeller speed (left and right): 6% et 98%
- Fuel flows (left and right): 7 lb/h et 352 lb/h
- Flaps position: 0

1.11.2.2. Voice recording

In the beginning, only a partial transcription has been done with the time base provided by the FSK. This transcription shows communications in the English language with ATC. A more complete transcription showing also crew communications in the Luxembourg language has been performed on 12 and 13 November 2002 in presence of a member of the investigation commission, assisted by a pilot from the operator and an expert from Fokker. This transcription has then been translated into French and English (see annex 2).

During the last five minutes of the recording, following communications between the pilots are noted:

At 09 h 01 min 42 s, after having been cleared for approach, the co-pilot remarks that the controller takes them in ahead of other aircraft (then in the Diekirch hold).

At 09 h 02 min 09 s, the pilot in command announces « *Loc ass alive an captured* » (Loc is alive and captured).

At 9 h 02 min 12 s, the pilot in command says that they will inform air traffic control that if they don't have 300 meters at ELU, they will execute a go-around and proceed to Diekirch.

At 9 h 03 min 04s, after the transmission of the last RVR information, the pilot in command says twice « *Oh, dat brengt neischt* » (Oh, this doesn't bring a thing), and at 9 h 03 min 16 s, he adds « *So, mir gin weider fir bis ELU, wa mir dann neischt hätten, dann ehhhhhh* » (Tell them, we continue to ELU, if we have nothing, then eh).

From 9 h 04 min 30 s to 9 h 04 min 53 s, the crew performs the approach checklist.

At 9 h 04 min 46 s, the pilot in command announces to the co-pilot « *Yo, bon mir machen en go around, missed approach* » (Yes, well we do a go-around, missed approach).

At 9 h 04 min 57 s, the controller transmits an RVR of three hundred meters at runway threshold.

At 9 h 05 min 00 s, power and rotation speed of the engines diminish. A sound similar to putting the power levers to « idle » is heard. Consequently and during an interval of sixteen seconds, flaps are extended and the landing gear is lowered.

At 9 h 05 min 02 s, the co-pilot says «...net duer» (... not sufficient).

At 9 h 05 min 08 s, the crew is cleared to land.

At 9 h 05 min 17 s, one second after the landing gear starts to come down, an increase of rotational speed of at least one propeller is perceived, then numerous noises of selections and power variations are heard.

At 9 h 05 min 19 s, the pilot in command says « Wat ass dat?? » (What's that).

At 9 h 05 min 27 s, the beginning of a GPWS alarm appears, one second later the CVR stops.

Two portions of recording are then noted, one of 0,9 second duration, the other of 0,7 second duration and separated by 11,2 seconds and representing recorded portions from the beginning of the CVR and not newly overwritten.

At no moment of the flight, the crew mentions any failure of aircraft systems.

1.12. WRECKAGE AND IMPACT INFORMATIONS

1.12.1. Site description

The aircraft touched down approximately on a heading of 295°, as indicated by the general direction of the debris. The first impact marks are found on the south edge of the road RN1. They represent the two main landing gears and the fuselage tail cone.

Scraping marks on the road, notably from the left wing tip show that the aircraft scratched across the road before hitting an embankment at the north side of the road RN1.



Aerial view of RN1 and the site

The major part of the damage results from this blow during which the aircraft lost three blades from the right propeller and two from the left propeller, wheels from the left and right landing gear.

Furthermore, the aft portion of the fuselage was disrupted at the trailing edge of the wings by this shock.

After this bounce, the empennage and part of the right outboard wing broke away, the aft portion of the fuselage turned around and the aircraft came to rest 25 meters further away in a ploughed field.



Aerial view of the right hand side of the aircraft



Aerial view of the left hand side of the aircraft

1.12.2. Wreckage examination

Note: The investigators have done the observations listed below. It is possible that certain observations do not correspond to the situation before impact as through the shock or through some rescue operations, lever positions may have been affected.

Exterior:

The fuselage and the wings remained attached. The aft portion including the rudder and the horizontal stabiliser was detached. On the fuselage a more important deformation is noted on the right hand side as compared to the left side. The central part of the fuselage was burnt.

The flaps (left and right wing) are retracted. The main landing gears have been ripped out.

The engines suffered light damage, except the lower parts that were in contact with the ground. On the left hand side, all propeller blades are broken at their root. On the right hand side, three propeller blades out of six remain attached to the hub. All blades, of composite construction, are damaged. Some are delaminated and others are totally destroyed. Blade pitch angle of the LH propeller is close to feather. Blade pitch of the RH propeller is in the beta range.

No damage has been detected on the parts exposed neither to the relative wind nor in the engine intakes, which may be attributed to bird impact.

Cockpit:

Power lever positions are not relevant, as all cables have been stretched and rescue services were active in this area to retrieve the pilots. Left and right fuel levers are in the open position.

Elevator trim position is incoherent with the trim tab position. As for the power levers, its position may have been affected by traction or rupture of the cables and by the rescue operations.

Rudder trim position is five units to the left. Flaps selector is in the OFF position. The « Ground Idle Stop » selector is in the OFF position.

- Left instrument panel

Altimeter indicates 998 feet, and is set to 1023 hPa. The stand-by altimeter shows 690 feet and is set to 1037 hPa.

The speed indicator shows 110 kts, the speed bug is positioned at 101 kts. The stand-by speed indicator shows zero kts.

- Central instrument panel

The two engine parameters (propeller speed, high pressure turbine and turbine temperatures) are close to zero. The RPM indicator of the low-pressure turbine shows 92% for the two engines.

Brake pressure indicator and fuel totaliser show zero.

The two engine torque indicators show 25% (minimum reading of the indicators and powered down position), the OFF flag being apparent.

The temperature and oil pressure indicators show zero.

Landing gear selector is in the «down» position.

- Left instrument panel

The speed indicator shows 125 kts, with the speed bug positioned at 91 kts.

The altimeter indicates 380 feet and is set to 1023 hPa.

The RMI indicates 295°, the single needle shows 080° and the double needle shows 295°.

- Glare shield panel

The left and right EFIS are switched to mode NAV.

- Overhead panel

Landing lights, taxi lights, anti-collision lights, navigation lights, strobes, non-smoking sign and fasten seat belt sign are «ON».

The handles of the engine fire extinguishers are not pulled. The fire loop push buttons are in the normal position.

The ignition switches LH and RH of the Engine Control Panel are in the «ON» position.

The PEC switches are in position « NORMAL » (PEC's are operational).

Fuel pump switches are « ON ».

Hydraulic pump switches are « ON ».

Cockpit windshields and pitot heating switches are « ON ».

Engine anti-icing is « ON », wing anti-icing is « OFF ».

1.13. MEDICAL AND PATHOLOGICAL INFORMATIONS

The results of the analyses performed on the blood samples taken from the crew are normal.

1.14. FIRE

When the aircraft came to a halt, a fire started. It destroyed the central part of the fuselage.

1.15. SURVIVAL ASPECTS

The layout shown hereafter represents the seating as known from the check-in. It does not necessarily reflect the actual seating. Considering the number of passengers, the possibility exists that one or the other passenger may have been seated on a different seat as shown by the check-in seating.

The aircraft hit the embankment with the aft portion of the fuselage (behind the trailing edge of the wing), this part being partially disrupted and turned over 90° to the right (in flight direction)

At 9 h 06, a witness notified the accident to the national emergency centre. On site intervention of the fire brigade started at 9 h 18 after positioning of the fire engines.

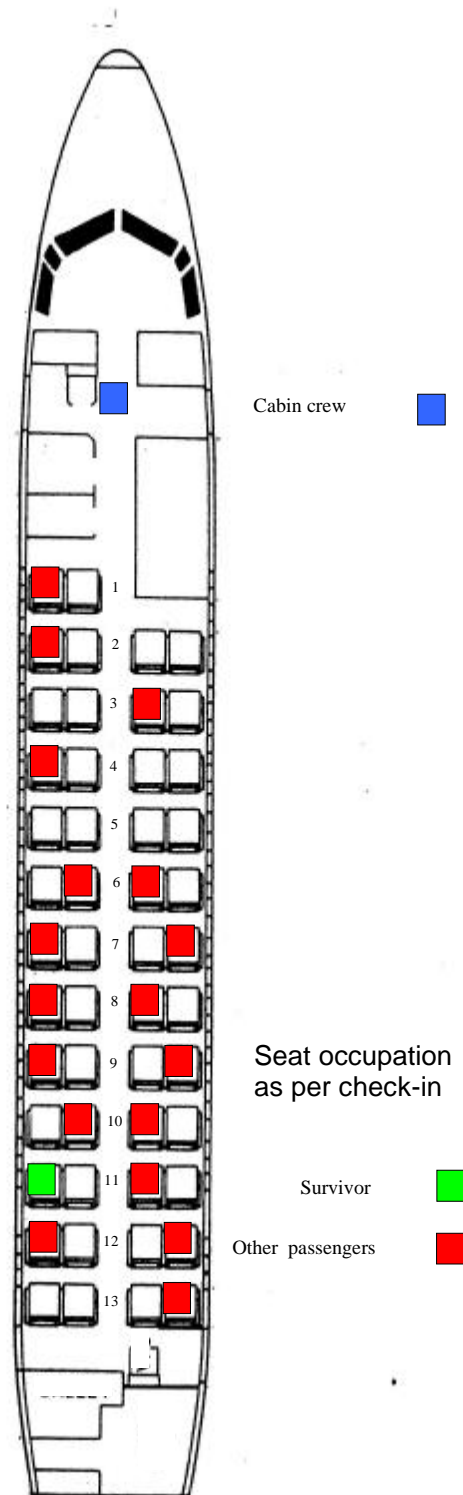
Rescue services found passengers, ejected from the fuselage, behind the left wing. Some passengers were still attached to their seat and others were not. The cabin crewmember was found in the corridor next to the fuselage front entrance. The pilot in command wore his full harness, the co-pilot only his ventral belt.

Not ejected passengers died either through the impact shock or during the ensuing fire. Ejected passengers died either through the impact shock or shortly thereafter with the exception of one passenger who survived.

The cabin crewmember did not survive.

The co-pilot did not survive.

The cockpit did not burn and a hole was cut in the fuselage to retrieve the pilot in command who survived.



1.16.2. Propeller regulation systems

1.16.2.1. General

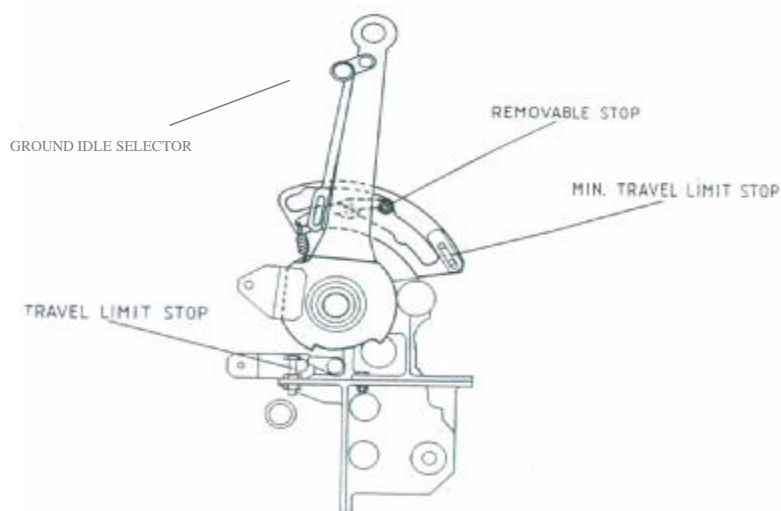
The engine drives a variable-pitch, constant-speed propeller with six blades. A propeller speed indicator is located at the centre main instrument panel. Two possibilities exist to control the propeller:

- Above flight idle, constant speed control is regulated automatically in flight.
- On the ground, below flight idle and in the beta mode range, propeller pitch is directly controlled by the power lever position.

When propeller pitch is above 10 degrees, the resulting aerodynamic force from their rotation is oriented to the front and the propeller pulls. For pitch angles below 10 degrees, the resulting aerodynamic force tends towards zero and starts acting backwards if propeller pitch is further reduced. An aerodynamic braking force is created.

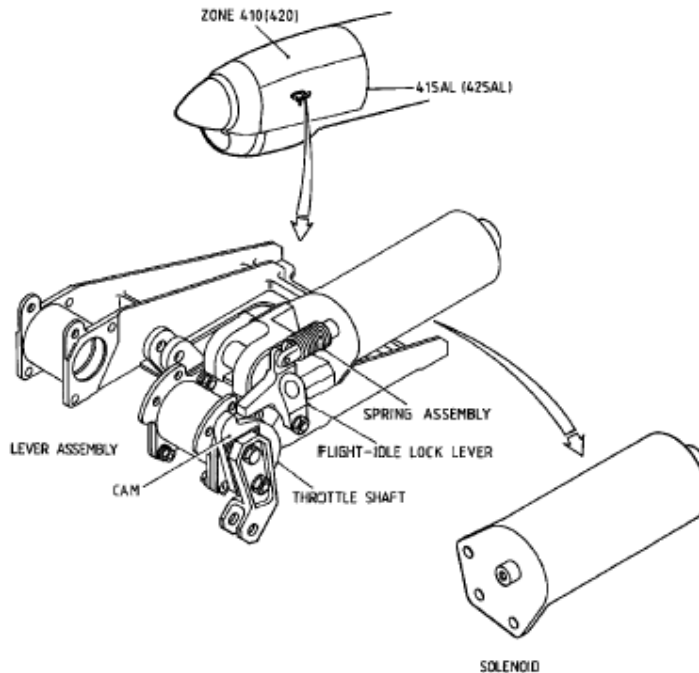
In flight, power lever positions below flight idle are prevented by two means:

- a primary mechanical security (ground idle selector) on the power levers



Power levers and ground idle selector

- a secondary electrical security (flight idle stop solenoid) on each engine.



To select the beta mode after landing, with the power levers in the flight idle position one has to grab and lift the ground idle selectors fixed to power levers and move the levers backward. This first mechanical stop on the power levers is doubled by a flight idle stop fixed to each engine and activated by solenoids designed to deny access in flight to the pitch range inferior to the in flight pitch range.

Once the solenoids are powered up, the flight idle stops are released and power levers may be moved backwards below the pitch range for flight.

Power supply to the solenoids is assured when:

- one of the sensors mounted on the shock absorbers of the left and right main landing gear detects a depression of the shock absorber during landing, or
- the two wheel speed sensors mounted in the wheel axles on one main landing gear detect a wheel speed in excess of 17 kts.

1.16.2.2. Constant speed control

Above flight idle, the Propeller Electronic Control unit controls propeller speed by varying the blade angle.

Speed is controlled to 100% during take-off, maximum continuous and go around power settings. Propeller speed is controlled to 85% during climb and cruise.

Propeller synchronizing is totally automatic.

1.16.2.3. Propeller pitch

Propeller pitch angle varies in flight from + 15 degrees (approach and landing) to approximately + 45 degrees. Propeller pitch is controlled by balancing oil pressure against the coarse seeking force that results from the counterweights, which are attached to the roots of the blades.

A gearbox driven high-pressure pump, driven by the propeller gear box and being part of the overspeed regulation and supplied with engine oil, provides the required oil pressure. In the event of an oil pressure loss, the counterweights will move the blades to an angle of + 55 degrees, thus eliminating propeller overspeed and minimising the drag created by the wind milling propeller. The dedicated drive of the high-pressure pump assures control as long as the propeller is wind milling.

In case of an in flight engine failure, the propeller regulating mechanism initially tries to maintain a constant speed of the propeller in relation to the indicated airspeed until it is feathered either automatically or manually.

A variable blade-angle stop is provided to prevent an inadvertent low blade angle in flight. The minimum blade-angle of this stop is +15 degrees flight-idle and is +17 degrees for all high power settings.

1.16.2.4. Control in mode beta

Below flight idle, the power lever controls propeller pitch directly from approximately + 15 degrees to -17 degrees (full reverse). When the beta range is entered, a blue low pitch light, located on the central instrument panel, comes on. In this mode, the commands of the electronic propeller controls are ignored. Propeller speed is approximately 95 percent when the power levers are set to full reverse.

1.16.2.5. Overspeed protection

In flight, a propeller overspeed governor comes into operation when propeller speed reaches 104 percent. The gearbox-driven governor reduces the oil flow to the pitch changing mechanism.

If there is no propeller speed reduction, the propeller speed reaches 108 percent and the overspeed governor intervenes directly in reducing fuel flow. On the ground, when the propeller is beta controlled, overspeed protection is accomplished at 108% by reducing the fuel flow

1.16.2.6. Feathering system

An electric feathering pump, working automatically if such mode is armed or selected by the crew, assisted by the centrifugal force of the counterweights fixed to the propeller blade roots, bring pitch angle to a position of 82 degrees, minimizing thereby aerodynamic drag (feathered propeller).

1.17. INFORMATIONS ON LUXAIR

Luxair was created in 1962 and started flights on a Fokker 27 from Luxembourg to Paris. Regular routes to the major European capitals and to the Mediterranean holiday destinations were added along the years.

The Airline Operator Certificate was valid on the date of the accident. Therein are listed, three Boeing 737/500, two Boeing 737/400, four Fokker 27 Mk050 and eight Embraer 145.

The aircraft maintenance agreement was valid at the date of the accident.

1.18. ADDITIONNAL INFORMATIONS

1.18.1. Previous occurrences

On 1 August 1992, the company Aircraft Breaking Systems Corp. (ABSC) issued a service bulletin Fo50-32-4. A modification to the antiskid control box was introduced by adding one capacitor and one diode, one each per wheel board. This modification permitted that wheel speed sensor disconnect would be properly detected.

This service bulletin was not incorporated in an airworthiness directive.

On 29 June 1994, the company ABSC issued a revision N°1 of the service bulletin F50-32-4. It was a text modification of the service bulletin from 1992, saying that these added components prevent a condition during power up of the skid control box whereby a signal pulse is inadvertently sent to the ground control relay thus affecting the flight idle stop solenoids.

This service bulletin was not incorporated in an airworthiness directive.

On 20 December 1994, Fokker published a service letter N° 137 informing operators about the possibility of inadvertent release during flight of the mode beta locks. Fokker identified there a working characteristic leading to a release of the flight idle stop.

On 2 August 1999, Fokker published a service bulletin F50-32-035 proposing a change of the grounding connections of the Anti-skid box. This change has been proposed because cases have been experienced of intermittent or no braking action from the normal braking system caused by EMI disturbance signals in the wiring from the wheel speed sensors to the antiskid box.

This service bulletin was not incorporated in an airworthiness directive.

2. SAFETY MEASURES TAKEN SINCE THE ACCIDENT

On 14 November 2002, technical services from Fokker Services issued an All Operators Message (ref. AOF 50.022) to recall, amongst other, to all operators of Fokker 27 Mk050 aircraft, the characteristics of the security systems of the propellers.

To this date, the investigation commission has issued three recommendations:

- The first, safety recommendation N°1, dated 15 November 2002, stipulating that:

In order to avoid the failure of the Flight Idle Stop security, the Investigation Commission recommends that the opportunity should be evaluated to render the modification of the Antiskid Control Box stated in the Service Bulletin be mandatory for all Fokker 50 aircraft.

Furthermore and without waiting for this modification, the Investigation Commission recommends that the crewmembers should be informed about the potential functioning of the system as mentioned above and about the content of Fokker message to all operators AOF50.022 dated 14 November 2002.

- The second, dated 28 November 2002, recommends the publication of an airworthiness directive stipulating that:
 - o service bulletin N° Fo50-32-4-revision 1 from ABSC and
 - o service bulletin N° F50-32-035 from Fokker,be made mandatory for all Luxembourg registered Fokker 50 aircraft.

This airworthiness directive has been published on 29 November 2002.

Informed in parallel about this recommendation, Luxair has proceeded with the modifications of their aircraft between 15 November and 8 December.

- The third, safety recommendation N°2, dated 23 January 2003, stipulating that:

In order to improve the functioning of the secondary safety Flight Idle Stop, the investigation commission recommends, that the announced publication of Service Bulletin Fo50-32-7 be speeded up and that its application be made mandatory for all Fokker F27Mk050 type aircraft.