Aircraft accident at Kajaani Airport, Finland, 3. November 1994

Micro-summary: **This McDonnell Douglas MD-83 left the runway on landing.**

Event Date: **1994-11-03 at 0657 local**

Investigative Body: **Finland Accident Investigation Board (AIB), Finland**

Investigative Body's Web Site: **http://www.onnettomuustutkinta.fi/**

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Major Accident Report

Nr 2/1994

Translation of the Finnish original report

Aircraft accident at Kajaani Airport, Finland, 3. November 1994

F-GHED

DC-9-83 (MD-83)

According to Annex 13 of the Civil Aviation Convention, paragraph 3.1, the purpose of aircraft accident and incident investigation is the prevention of accidents. It is not the purpose of the aircraft accident investigation and the investigation report to apportion blame or to assign responsibility. This basic rule is also contained in the Investigation of Accidents Act, 3 May 1985 (373/85). Use of the report for reasons other than improvement of safety should be avoided.

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GLOSSARY OF ABBREVIATIONS

ACC	-	Area Control Centre
AD	-	Airworthiness Directive
ADF	-	Automatic Direction Finder
ADI	-	Attitude Director Indicator
AFIS	-	Aerodrome Flight Information Service
AGL	-	Above Ground Level
AOL	-	All Operator Letter
ATC	-	Air Traffic Control
ATS	-	Autothrottle system
BEA	-	Bureau Enquêtes-Accidents
CEO	-	Chief Executive Officer
cm	-	centimeter
CRM	-	Crew Resource Management
CVR	-	Cockpit Voice Recorder
DFDR	-	Digital Flight Data Recorder
DME	-	Distance Measuring Equipment
ELT	-	Emergency Locator Transmitter
EPR	-	Engine Pressure Ratio
FAA	-	Federal Aviation Administration, USA
FCOM	-	Flight Crew Operating Manual
FD	-	Flight Director
FIS	-	Flight Information Service
FIZ	-	Flight Information Zone
FL	-	Flight Level

FOM	-	Flight Operations Manual
ft	-	feet (0,3048 m)
h	-	hour(s)
hPa	-	hectopascal
HSI	-	Horizontal Situation Indicator
ICAO	-	International Civil Aviation Organization
IFR	-	Instrument Flight Rules
ILS	-	Instrument Landing System
kg	-	kilogram(s)
km	-	kilometer(s)
kt	-	knot(s) (1,852 km/h)
lb	-	pound(s) (0,4536 kg)
LOFT	-	Line-Oriented Flight Training
m	-	meter(s)
mm	-	millimeter(s)
MAC	-	Mean Aerodynamic Chord
MCT	-	Max Continuous Thrust
min	-	minute(s)
NAV	-	Navigation
nm	-	nautical mile(s) (1,852 km)
NTSB	-	National Transportation Safety Board, USA
OFP	-	Operational Flight Plan
PA	-	Public Address
PAPI	-	Precision Approach Path Indicator
PIC	-	Pilot-In-Command
psi	-	pound(s) per square inch

QNH	-	Corrected mean sea level pressure
REC	-	Regional Emergency Center
RTO	-	Rejected Takeoff
RWY	-	Runway
s	-	second(s)
SB	-	Service Bulletin
TOGA	-	Takeoff and Go-Around
UTC	-	Co-ordinated universal time (Finnish time -2 h)
VFR	-	Visual Flight Rules
VHF	-	Very High Frequency
VOR	-	VHF Omnidirectional Radio range

SYNOPSIS

On Thursday November 3, 1994 at 06.57 local time an aircraft accident took place at Kajaani airport in which a Douglas DC-9-83 (MD-83) aircraft, registered F-GHED, owned by Gie Libellule 1 and operated by Tunisian Air Liberté Tunisie was severely damaged. There were 164 passengers and seven crew members on board. Three passengers suffered minor injuries.

The Council of State (Government) appointed an investigation commission in ac-cordance with the Investigation of Major Accidents Act (373/85) 5 §. Retired airline pilot Lars Westermarck was appointed investigator-in-charge, chief of accident investigation Seppo Hämäläinen from the Civil Aviation Administration deputy investigator-in-charge. Airline pilot Timo Uramaa from Finnair, inspector Esko Lähteenmäki from the Civil Aviation Administration, trouble shooting coordinator Heikki Tenhovuori from Finnair and detective chief inspector Eero Klemetti from the National bureau of investigations, Oulu were appointed members of the commission. Inspector Esko Lähteenmäki has performed the duties of secretary of the commission. Student of technology and psychology Tero Lybeck has assisted in writing the report and translated the report from Finnish into English.

The commission arrived at Kajaani airport on the day of the accident at 11.50 local time.

The commission consulted airline pilot Matti Sorsa from Finnair as an expert on the human factors contribution to the accident, cabin safety supervisor Heli Thilman from Finnair as an expert on the evacuation and the duties of the cabin personnel and chief of rescue Veikko Liinakoski from Helsinki-Vantaa international airport as an expert on the rescue operations.

The investigators from the National bureau of investigations, Oulu, and from Kajaani police department performed the necessary hearings with the commission. The Finnish Air Force performed the aerial photography of the runway and the accident site upon request of the commission. The investigators of Kajaani police technical investigation center and the commission searched the runway at Kajaani airport and drew a sketch of their findings. A detachment from Kainuu Brigade searched the strip for parts which had separated from the landing gear.

The commission removed the Digital Flight Data Recorder (DFDR) and the Cockpit Voice Recorder (CVR) from the aircraft. Their data was read out by the French Accident Investigation Center (Bureau Enquêtes-Accidents).

Brake, spoiler, landing gear and navigation systems were inspected. Parts and components of them were removed. Some were sent to Finnair Maintenance and some to the National Transportation Safety Board (NTSB) in the United States for detailed inspection. The representatives of the NTSB and the Federal Aviation Administration (FAA) supervised the tests and inspections at the aircraft and component manufacturers.

The aircraft accident investigation team of the aircraft manufacturer, which has the authorization of the NTSB, assisted the commission in Kajaani and Helsinki. The aircraft accident investigation authority of Tunisia visited the accident site and gave the information concerning the aircraft and the crew upon request of the commission.

The chief of the French aircraft accident investigation authority Paul Arslanian, the chief of the Tunisian aircraft accident investigation authority Ezzendine Lagha and Seppo Hämäläinen interviewed the personnel of Air Liberté Tunisie and TUNISAIR in Tunisia.

The commission sent the draft of this aircraft accident report to the accident investigation authorities of Tunisia, France and the United States for comments according to International Civil Aviation Organization (ICAO) Annex 13 on 22 March 1996. The comments received have been taken into account in the final report.

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Preflight preparation

Both pilots had had a two days rest before the accident flight. The captain told he had spent his time off resting and with sports. He felt rested and in good health prior to the flight. The first officer told he had had a cold and had taken antibiotics and cold medication during his time off. He said he had taken medication last time nine hours before the flight but felt he was rested and fit for duty.

The first officer checked in for duty on November 2 1994 approximately two hours before the departure of the flight at 23.00 Tunisian time (24.00 Finnish time, 22.00 UTC). He checked the computer based Operational Flight Plan (OFP) which had been made with the latest available weather information. He additionally performed the required recalculations. The captain checked in for duty on November 2 1994 approximately one and a half hours before the departure of the flight at 23.30 Tunisian time. He checked the necessary weather information, air navigation information, mass calculations and flight plans together with the first officer.

According to the computer based OFP the fuel needed for the flight Monastir-Kajaani was 31.170 lb (14.139 kg). According to the recalculation performed by the captain and the first officer (company procedure to use 2000 ft lower cruise flight level than planned) it was 34.500 lb (15.649 kg). Kuopio was the alternate airport. Fuel required for the flight from destination airport (Kajaani) to Kuopio was 1700 lb (771 kg). Route reserve was 1550 lb (703 kg) and the final reserve fuel was 2900 lb (1315 kg). Takeoff fuel was 37.320 lb (16.928 kg) without the correction used by the company. Taxi fuel was 500 lb (227 kg) which meant that the minimum block fuel was 37.820 lb (17.155 kg). The captain decided on 46.000 lb (20.866 kg) block fuel because the intention was to fly also from Kajaani to Savonlinna without refueling. According to the OFP corrected by the pilots the takeoff weight was 159.612 lb (72.400 kg).

Before the flight the captain divided the flight duties so that the first officer was to fly the flight from Monastir to Kajaani and the captain from Kajaani to Savonlinna and Monastir.

1.1.2 Departure and cruise

The flight left Monastir approximately ten minutes ahead schedule at 00.56 Tunisian time. The cruise was normal. The first officer was the piloting pilot. During the flight the cockpit crew had coffee and refreshments. Captain had breakfast approximately 1-2 hours after departure. First officer did not eat. The crew made no notes on the operative computer based flight plans during flight.

1.1.3 Initial approach

Kajaani Aerodrome Flight Information Service (AFIS) officer had arrived on duty earlier than usual because of the arriving flight. The necessary checks were made by the AFIS officer well in advance before the arrival of the flight and the presence of the airport personnel was confirmed. The normal opening time of Kajaani AFIS was 7.00 local time (05.00 UTC) but it was opened already at 06.42 because of the flight arriving early.

When the crew had got the clearance from Tampere Area Control Centre (ACC) to descend from FL 330 (Flight Level) to FL 110, the descent was commenced at 124 nm (nautical miles) from Kajaani airport. The initial descent was flown with a vertical speed of 2000 feet per minute, speed Mach .76 and partial thrust. Descent with flight idle was used later on. At approximately FL 150 the captain noticed light icing. Anti-icing was momentarily selected on for engines and wings. Icing lasted only for a very short time. The first officer did not notice any icing. When the aircraft descended through FL 100 the speed was reduced to 250 kt (knots). Autopilot and autothrottle were engaged. Distance to Kajaani airport was 33 nm.

Rovaniemi ACC gave the crew Kajaani airport QNH 1023 hPa and reported that there was no known traffic below FL 95. When the captain asked the Air Traffic Control (ATC) officer whether he had been given a Flight Level, the ATC officer cleared the aircraft to descend to 5000 ft on altimeter setting QNH 1023 hPa.

The crew selected Runway (RWY) 07 for landing and decided to fly the initial approach and to intercept ILS localizer according to the official approach procedure via VOR/DME Kainuu 10 nm arc. The first officer reduced speed to 210 kt and the slats were extended at a distance of approximately 20 nm from VOR/DME Kainuu. The initial approach via the arc was flown at 2100 ft according to the approach procedure. Just before turning inbound for the final

approach the first officer called for 15 degrees of flaps and reduced speed to 170 kt. The turn inbound was flown in this configuration and with this speed.

1.1.4 Final approach and landing

Autopilot captured RWY 07 ILS localizer below the glide slope while the speed was 170 kt. When the aircraft approached the glide slope the first officer called for extension of the landing gear. Shortly after this he called for 28 degrees of flaps. Speed of 150 kt was selected for autothrottle. In this configuration the autopilot captured ILS RWY 07 glide slope.

Approximately 1,9 nm before outer marker the first officer called for 40 degrees of flaps which is a normal flap setting for landing. A speed of 141 kt was selected for autothrottle. According to the Air Liberté Tunisie FOM the final approach speed would have been threshold speed + 5 kt which would have given 136 kt. According to the aircraft landing speed booklet the threshold speed would have been 131 kt with the actual weight.

Approximately 20 s before the outer marker the first officer called for the before landing check list which the captain performed. The runway was sighted slightly before the outer marker. The aircraft passed the outer marker in normal landing configuration with autopilot engaged and with a speed of 141 kt. The autopilot was tracking RWY 07 localizer and glide slope. The captain reported outer marker at 06.54.

Kajaani AFIS officer reported that the runway was vacated, reported actual wind and said that the approach and runway lights were on 100 % intensity. Captain thanked, stated that he had the field in sight and said: ”cleared to land, thank you.” Kajaani AFIS officer responded by saying: ”confirming.” Ground wind was light, runway was dry and braking action was good.

The pilots had the runway in sight and the aircraft was clearly below the clouds. Auto-pilot and autothrottle were still engaged. The first officer asked the captain 16 s after passing the outer marker whether the before landing check list was performed which the captain confirmed. After this the captain and the first officer discussed something about Savonlinna airport. It was not possible to determine the contents of the conversation because of the bad sound quality of the CVR.

Approximately 50 s after passing the outer marker the captain said: ”descend slightly below glide slope.” Autopilot was disconnected 52 s after passing the

outer marker at an altitude of approximately 490 ft Above ground level (AGL). The speed was 143 kt and the aircraft was on localizer and glide slope. The autothrottle was engaged and a speed of 141 kt was still selected. The first officer continued the approach manually.

The captain told he had stated to the first officer that the aircraft was still slightly above glide slope and that the first officer should increase the rate of descent. However, according to the DFDR the aircraft was on localizer and glide slope. The captain decided to land the aircraft himself and stated this to the first officer. This statement about the change of duties cannot be heard on the CVR. The change of duties obviously took place at a height of approximately 150 ft. The captain decided to move the aiming point slightly further on the runway because the aircraft was, according to his observation, slightly above the glide slope. The aircraft was so close to the runway threshold that the captain could not in his opinion increase the rate of descent much in order to reduce height.

According to the DFDR the autothrottle thrust mode changed to go-around mode at a height of approximately 120 ft. During the approach a speed of 141 kt was selected for the autothrottle which required a thrust of approximately 1,25-1,30 EPR (Engine Pressure Ratio). When the autothrottle mode changed to go-around the distance to the threshold was 520 m. Thrust setting increased to 1,98 EPR in the left engine and 1,97 EPR in the right engine in approximately six seconds. The speed increased to 149 kt and the aircraft climbed slightly above the glide slope.

When the captain was retarding the throttles against the autothrottle movement to idle thrust the aircraft passed the RWY 07 threshold at a height of 50 ft and with a speed of 155 kt. The aircraft had 24 kt of overspeed compared to the landing speed booklet threshold speed. According to the DFDR the autothrottle was still in go-around mode. Idle thrust was obtained four seconds after the maximum go-around thrust. The speed was 155 kt and the height was 30 ft.

Immediately after the engines obtained idle thrust, the thrust started to increase again and increased to a value of 1,59 EPR in the left and 1,51 EPR in the right engine. This thrust was obtained three seconds after the engines had been on idle thrust. The speed was 150 kt, height was 14 ft and the aircraft was at a distance of 490 m from the threshold. According to the DFDR the autothrottle was still in go-around mode.

The autothrottle was disengaged three seconds before touchdown. Thrust setting was 1,57 EPR in the left and 1,49 EPR in the right engine. Speed was 152 kt, height five feet and the distance from the RWY 07 threshold 670 m. The aircraft touched down at a distance of 600 m from the normal touch-down point, 900 m from the threshold and with a speed of 153 kt (26 kt of overspeed). The thrust setting was 1,46 EPR in the left and 1,35 EPR in the right engine.

Aircraft attitude was 1,4 degrees nose down at touchdown. When the aircraft is on the ground the attitude is normally 0,7 degrees nose down. The nose gear touched down first. Touchdown force was normal. The aircraft touched down on the left side of runway centerline so that the inboard tire of the right main gear touched down on the centerline.

The captain applied brakes immediately after touchdown and did not release them before the aircraft had stopped. The aircraft started to shudder and vibrate severely approximately three seconds after touchdown. The wings had lift because of the considerable overspeed and because the spoilers were not deployed. The engines were on partial thrust, 1,34 EPR in the left and 1,45 EPR in the right engine.The captain retarted the thrust to idle which was reached six seconds after touchdown. The aircraft was at a distance of 1450 m from the runway threshold and the speed was still 147 kt.

Reverse thrust was applied 10 s after touchdown when the aircraft was at a distance of 1620 m from the runway threshold and the speed was still 136 kt. The remaining runway length was 880 m. The highest reverse thrust was reached 16 s after the touchdown and it was 1,2 EPR in the left and 1,3 EPR in the right engine. It was maintained for three seconds. The captain realised that the remaining runway length was not sufficient for stopping and decided to steer the aircraft with the rudder out of the runway to the right in order to avoid crashing into the electrical equipment on the runway extension. Actually the aircraft turned mostly because only the right brakes were operating. The nose of the aircraft turned right whichafter the aircraft sideslipped from the asphalt to the grass area left side first.

The aircraft turned right 140 degrees from the runway heading and came to a complete stop outside the runway on a heading of 210 degrees. The tail of the aircraft was abeam the runway end and the right wingtip over the runway surface edge. The landing gear dug into the ground in the grass area causing the downlock of the left main gear to break, the gear to fold inboard into wheel well and the aircraft to bank onto its left wing.

After the aircraft had come to a stop the AFIS officer asked whether everything was ok in the aircraft and the aircraft on the runway. The captain replied that the aircraft was outside of the runway and that they needed assistance.

When the aircraft had come to a stop the crew immediately shut down the engines. The captain ordered to evacuate the passengers through the left side exits of the aircraft. The cabin crew took action accordingly. The first officer went to the cabin in order to assist in the evacuation. The left side forward cabin door could not be opened. The aft entrance was also intended to be used for evacuation but the stairs could be lowered only partially. The evacuation took place through the aft galley service door and the left overwing exits. The captain was the last one to leave the aircraft and he came out through the aft galley service door.
The landing gear and the left wing were damaged during the landing roll and when the aircraft came to a stop. The left wing fuel tank got a fuel leak. There were also permanent deformations on the fuselage skin near the trailing edge of the left wing.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	3	-
None	.7	161	

1.3 Damage to aircraft

The aircraft was severely damaged.

1.4 Other damage

400 litres of fuel leaked to the ground from the aircraft. Part of the fuel was absorbed into peat and part was sucked off from a pit which was dug on the ground. 218 cubic meters of fuel contaminated soil was changed at the accident site. No fuel leaked into the ground water.

Figure 1. The aircraft has turned 140 degrees right from the runway heading and has stopped outside the runway. The tail is abeam the runway end.

Figure 2. The left main landing gear has folded inboard into wheel well and the left wing has been damaged. Left wing fuel tank has got a leak. The evacuation took place through the aft galley service door and the left overwing emergency exits excluding two passengers who came out through the right overwing emergency exits.

Figure 3. The right main landing gear has dug into the ground. The fuselage is lower than normal.

Figure 4. The evacuation of passengers through the aft stairs was not possible because the stairs did not have enough room to extend. The aft fuselage was lower than normal. The aft emergency exit would have been usable for evacuation.

1.5 Personnel information

1.5.1 Captain

Captain:	male, age 41 (born 1953)
Licences:	commercial pilot's licence 1980 airline transport pilot's licence 1990, renewed November 1, 1994, valid until April 30, 1995
Ratings:	instrument rating 1980
Type ratings:	B727-200 B747 DC-9-83 (MD-83)
Last check flight:	November 25-26, 1993
Medical certificate:	class one, issued October 25, 1994 with no restrictions, valid until April 30, 1995
Rest period before the accident flight:	approximately two days

The captain got his basic flight training in 1974-1980 (commercial pilot's licence with multi-engine and instrument ratings) in the Tunisian national aviation school. During this time he flew 280 h.

Flying experience	All types	On type
Last 24 h	4 h 40 min	4 h 40 min
Last 30 days	60 h	60 h
Last 90 days	195 h	195 h
Total experience	9125 h	2300 h

The captain was hired as a copilot by TUNISAIR in 1980. He completed the type training for the B727-200 aircraft as first officer at the company ALIA in Jordania. The captain acted as a copilot in B727-200 in TUNISAIR until 1990 when his total flying experience was 6500 h. He completed the annual recurrent training at the company RAM in Morocco in order to maintain his ratings. In 1984 he completed the type training for the B747 aircraft in the United States and worked for Saudi Arabian Airlines in that aircraft type for four months.

In 1990 he was hired as a captain of MD-83 aircraft by Air Liberté Tunisie. He completed the technical part of the type training and the simulator phase for

the MD-83 aircraft in British Caledonian Flight Training in England during February and March 1990. Thereafter he completed the flight training in Air Liberté Tunisie in Tunisia and got the airline transport pilot's licence and the captain's qualification for the MD-83 aircraft. The annual recurrent training was given by Air Liberté Tunisie.

During the type training in England the instructors have called attention to the captain's cockpit work. The aircraft handling has required a lot of attention and concentration which has resulted in an inadequate control of the situation overall. There are remarks on this from the beginning of the training to the end of it.

1.5.2 First officer

First officer:	male, age 43 (born 1951)
Licences:	commercial pilot's licence 1978, USA
	commercial pilot's licence 1981, Tunisia, issued June 21, 1994, valid until December 31, 1994
Ratings:	instrument rating FAA 1978
	instrument rating Tunisia 1981
	VFR flight instructor 1983
	agricultural flight 1988
Type ratings:	BA-36
	G-164A
	B-200
	DHC-6
	DC-9-83 (MD-83)
Last check flight:	March 1, 1994
Medical certificate:	class one, issued June 21, 1994 with no restrictions, valid until December 31, 1994
Rest period before the accident flight:	approximately two days

The first officer completed the basic flight training and the commercial pilot's course in the United States whichafter he was issued a FAA certificate. Thereafter he completed the theory course in the Tunisian national aviation school and the check flight required by the Tunisian aviation authorities. He was then issued a Tunisian licence. The first officer got additional instrument flight training in the United States in 1981. He was at that time employed by TUNISAIR but did not fly for the company.

Flying experience	All types	On the type
Last 24 h	4 h 40 min	4 h 40 min
Last 30 days	88 h	88 h
Last 90 days	270 h	270 h
Total experience	3103 h	679 h

The first officer completed the flight instructor's examination in the Tunisian national aviation school in 1982-1983 and flew 850 h as a VFR flight instructor. During 1986-1987 the first officer flew ultralight aircraft for 100 h. In 1988 he completed the type training for the PA-36 and the F-164A aircraft and the agricultural flight rating. He flew 400 h as an agricultural pilot. In 1989 he was hired by TUNISAVIA and acted as a first officer in the B-200 and the DHC-6 aircraft for 160 h. In 1990 he worked again as VFR flight instructor in the Tunisian national aviation school and gained 120 h of flight experience.

In 1991 he was hired by the Moroccan company RAM as a VFR and IFR flight instructor. He gained 120 h of flight experience. In 1992 he worked as a DHC-6 first officer in the company TUNISAVIA and flew for 250 h. In 1993 he was hired by Air Liberté Tunisie as an MD-83 first officer. He got the technical part of the type training at the company NATCO in the United States. The simulator training and simulator check flight were performed with an instructor and a check pilot from Air Liberté Tunisie in a NATCO simulator. The first officer completed the flight training and the check flight in Air Liberté Tunisie in Tunisia in March 1994.

1.5.3 Cabin crew

The male purser, position P 11, aged 38 years (born 1955) worked for Air Liberté Tunisie as a cabin crew instructor and on this flight as the chief of the cabin. He had started his career in 1981 in Saudi Arabian Airlines where he had undergone a three month's training for his duties and got the qualification to work as the chief of cabin crew. He had worked for Air Liberté Tunisie since the foundation of the company and his experience in MD-83 was approximately 2500 h. He had experience in five different aircraft types. He had flown with the pilots of the accident aircraft several times before. His last recurrent emergency training had been on March 15-16, 1994. At the time of the accident he occupied the forwardmost cabin crew seat from where he saw to the aft cabin through the aisle. The stewardess, position P 21, occupied the seat on his right side. The purser had had a two days off-duty time before the accident flight.

Steward, position P 12, aged 32 years (born 1962) had the training of dentist. He had completed his cabin crew training arranged by the Tunisian national aviation school. He had worked for Air Liberté Tunisie and in the MD-83 aircraft since the foundation of the company. He had flown with the pilots of the accident aircraft several times before. His last recurrent emergency training prior to the accident had been on January 25-26, 1994. He was seated in the aft cabin next to the aft galley at the time of accident. He had had a two days off-duty time before the accident flight.

Steward , position P 23, aged 27 years (born 1967) had completed his cabin crew training in Tunisia. He had worked for Air Liberté Tunisie and in the MD-83 aircraft since the foundation of the company. During the hearings it was noticed that his knowledge of the English language was poor. His last recurrent emergency training prior to the accident had been on February 22-23, 1994. At the time of the accident he was seated in the aft cabin on the right cabin crew seat. Stewardess, position P14, occupied the seat on his left side. The steward had had a two days off-duty time before the accident flight.

Stewardess, position P 21, aged 25 years (born 1969) had got her cabin crew training in Tunisia and worked for Air Liberté Tunisie and in the MD-83 aircraft since the foundation of the company. She had flown with both pilots before. She was seated in the forward cabin next to the purser. Her last recurrent emergency training prior to the accident had been on 22-23 February 1994. The stewardess had had a two days off-duty time before the accident flight.

Stewardess, position P 14, aged 28 years (born 1966) had got her cabin crew training in Tunisia in Air Liberté Tunisie. She had worked for Air Liberté Tunisie and in the MD-83 aircraft since the foundation of the company. She had flown with both pilots many times before. Her last recurrent emergency training prior to the accident had been on January 25-26, 1994. She occupied the aft cabin door seat from where she saw to the forward cabin through the aisle. She had had a three days off-duty time before the accident flight.

1.6 Aircraft information

The aircraft was a twin-engined commercial jet aircraft with a 169 passenger seat configuration.

Nationality and registration:	French, F-GHED
Owner:	Gie Libellule 1
Operator:	Air Liberté Tunisie
Manufacturer:	McDonnell Douglas Corporation, USA
Type and model:	Douglas DC-9-83 (MD-83)
Serial and fuselage number, year of manufacture:	49576, 1422, 1987
Engines:	
Manufacturer:	Pratt & Whitney Ltd, USA
Type and model:	JT8D-219
Serial number:	left 718074D, right 718079D
Hours since manufacture:	left 16333 h, right 15370 h
Fuel used:	JET A-1

Aircraft maintenance had been performed according to the maintenance program. The last major overhaul (C-check) was performed by Alitalia in Naples, Italy, on January 20, 1994 when the total flight time was 14.259 h. At the time of the accident the total flight time was 16.653 h. According to the loadsheet the takeoff weight was 159.112 lb (72.173 kg). The maximum allowed takeoff weight was 160.500 lb (72.803 kg). The aircraft weight at accident was 125.532 lb (56.941 kg) and the center of gravity was within the certified limits (8,8 % MAC). The certification of airworthiness was valid until January 1, 1995 based on the inspection performed June 17, 1994.

1.7 Meteorological information

A high-pressure area prevailed in Finland. Surface winds were light. The upper level wind direction was 350 degrees and the speed was 10-15 kt below FL 100. Above FL 100 the wind was south-westerly 25-30 kt. The cloud base in Kuopio and Kajaani area was at 1000-1500 ft. There was light icing in clouds. The meteorological measurements at Vehmasmäki radio mast (170 km south of Kajaani) and the data of the DFDR showed that there was no observable WIND SHEAR (a sudden change in the velocity and direction of the wind) which could have had an effect on the flight.

The pilots were given the following weather information in Monastir: terminal area forecasts (TAF) 21-06 UTC for the airports of Helsinki-Vantaa (EFHK), Turku (EFTU) and Tampere-Pirkkala (EFTP), Significant Weather Charts (SWC) for Europe and the upper level wind charts for FL 50, 100, 180, 300, 340 and 390.

Weather in Kajaani (EFKI) local time:

– at 05.50: wind 090 degrees 3 kt, visibility more than 10 km, clouds 6/8 1100 ft, temperature -9 °C, dewpoint -11 °C, QNH 1022 hPa
– at 06.50: wind 110 degrees 3 kt, visibility more than 10 km, clouds 6/8 1100 ft, temperature -9 °C, dewpoint -11 °C, QNH 1023 hPa.

Sunrise at 09.21 local time.

1.8 Aids to navigation

Three approach beacons, VOR/DME and ILS equipment, PAPI glide slope lights and high intensity approach and runway lights were operational at Kajaani airport.

The aircraft had ADF, VOR/DME, ILS and Omega equipment. The crew had Jeppesen Route Manuals in their use.

1.9 Communications

Radio communications relating to the accident have been listened to from the recordings of Tampere ACC, Kajaani AFIS and the CVR.

The captain handled the radio communications while the first officer was acting as the piloting pilot. The first transmission was recorded on the CVR between the ACC and the aircraft at 06.27 when Tampere ATC officer cleared the aircraft to descend to FL 110 at pilot's discretion. The captain acknowledged the clearance.

Tampere ACC passed the aircraft to Rovaniemi ACC frequency at 06.37. Rovaniemi ATC officer cleared the aircraft to descend on altimeter setting QNH 1023 hPa. Kajaani transition level was FL 50. There was no other known traffic below FL 95 at 06.42. The captain acknowledged the clearance but after a moment asked the ATC officer whether the aircraft was cleared to some specific Flight Level. The ATC officer had not cleared the aircraft to any specific

Flight Level but only to descend. After this question, however, Rovaniemi ATC officer cleared the aircraft to descend to 5000 ft on altimeter setting QNH 1023 hPa.

Rovaniemi ACC passed the aircraft to Kajaani AFIS at 06.44. The captain contacted Kajaani AFIS at 06.45. The AFIS officer gave the aircraft traffic and weather information according to the normal procedures. The captain thanked and asked whether RWY 07 was in use which the AFIS officer confirmed. The aircraft passed the outer marker for RWY 07 at 06.54 which the captain reported to the AFIS officer. The AFIS officer reported that the runway was vacated, gave wind direction and said that 100 % runway and approach lights were on. The captain said: ”Thank you very much, runway in sight, cleared to land, thank you.” The AFIS officer answered: ”Confirming.”

At 06.57 after the aircraft had landed and slid off the runway, the AFIS officer asked the crew whether they were ok. The captain answered that they were outside the runway and needed assistance.

The radio communications were clear and common English phraseology was used. There were no language difficulties between the aircraft and the ATC officer nor between the aircraft and the AFIS officer.

1.10 Airport information

The aircraft landed on Kajaani airport RWY 07 the length of which is 2500 m and width 45 m. The runway has an asphalt surface. The coordinates of the airport reference point are 64° 17’ 02” north, 27° 41’ 28” east and the elevation is 483 ft (147 m). The slope of RWY 07 is 0,65 % uphill. The airport maintenance personnel had checked the runway before the arrival of the flight and had noticed that it was clean and dry. The friction coefficients were measured after the accident at 07.31 with Skiddometer equipment. The results were 77/75/75 (touchdown/mid/end).

1.11 Flight recorders

The aircraft had a Digital Flight Data Recorder (DFDR) which recorded 74 parameters (manufacturer Sundstrand, p/n 980-4100-DXUN, s/n 2021). The information was read out by the French accident investigation center (BEA). The recorder had functioned properly and its data was very useful in the investigation of the accident.

The aircraft also had a Cockpit Voice Recorder (CVR) which recorded four parameters on a continuous running 30 minutes tape (manufacturer Sundstrand, p/n 980-6005-076, s/n 11119, model AV557C). The information was read out by the French accident investigation center. The sound quality was good for the radio communications but weak for the cockpit communications, which limited the usage of the recording during the investigation.

1.12 Wreckage and impact information

1.12.1 General description of accident site

The accident aircraft had stopped on the right side of the end of RWY 07 at Kajaani airport. The aircraft had turned 140 degrees to the right from the landing direction and stopped completely outside the runway in the direction of 210 degrees. The tail of the aircraft was abeam the end of the runway and the right wingtip over the runway surface edge. Black tire marks were visible on the runway surface and it was easy to determine the aircraft movement and sliding based on them. Tire marks continued on the grass where the landing gear had sunk into the ground. Before coming to a complete stop the aircraft sank deeper into the ground, the left main gear collapsed into its bay and the aircraft fell onto its left wing. Separated landing gear parts were found on the runway and on the strip areas with metal detectors.

A ditch had been dug in front of the left wing in order to collect the fuel which leaked from the left wing tank. The area under the left wing had been foamed in order to avoid fire. There was a distinct smell of fuel at the site.

The ground outside the runway was flat and obstruction free strip area. The soil was grass covered sand which had a thin layer of snow on it and was frozen to a depth of 10 cm.

1.12.2 Wreckage

The right side of the fuselage and the right wing were intact. The overwing exits were open. The flaps were lowered to 40 degrees and the slats were extended.

The right main gear was down and locked. The wheels of the landing gear had pushed in front of them a lot of sand which had filled the landing gear bay. The inboard tire had bursted and the outboard tire had worn almost through in two locations. The outboard tire was pressurized. The thread of the Apex bolt of the

landing gear torque link had sheared, the bolt had fallen off and the torque link was open. One of the four brakefluid hoses had cut.

The aft stairway had not had enough room to extend completely because the fuselage was lower than normal. The tail cone, which is part of the aft emergency exit, had not been released. The service door between the left wing and the left engine was open and its escape slide had been released and had inflated properly. The overwing exits were open. There were deformations on the left side fuselage skin behind the trailing edge of the wing from the window level down to the wing. The deformations had been caused by the flexure of the fuselage.

Almost the whole left wing was on the ground. The flap hinge supports had broken and the outboard flap had bent upwards. Also the leading edge slats were bent. The cable pulley bracket had torn apart from the wing front spar at the midwing. There was a two centimeter diameter hole in the spar. Fuel had leaked through the hole.

The left main landing gear downlock had broken and the gear had collapsed into the bay and pushed the door in. The door had broken some accessories and structures in the bay. The actuator piston rod of the gear had cut. Both tires had bursted. The thread of the landing gear torque link Apex bolt had sheared, the nut was missing and the torque link was open. The wheel pair had turned 180 degrees. All four brakefluid hoses and the electrical wires of the wheel speed transducers in the wheel axle had been severed.

Nose gear tires had dug into the ground during the side movement to the left. The left tire seemed to be intact but it was unpressurized. The right tire was intact and had normal pressure.

1.12.3 Cockpit

The cockpit switches were in appropriate positions for emergency evacuation except the fire handles which had not been pulled. According to the flap position indicators and the flap/slat lever the flaps were fully extended at 40 degrees. The stabilizer trim was at 8,8 degrees aircraft nose up which is a normal setting for an MD-83 aircraft during final approach and landing with the landing weight in question. The altimeter barometric settings (1023 hPa) and the speed marks ($V_{UP/ret}$ =232 kt, $V_{0°/T.O}$ =181 kt, $V_{15°/T.O}$ =156 kt, $V_{40°/LND}$ =131 kt) were in appropriate positions excluding one speed mark that was missing in the first officer's airspeed indicator in position $V_{UP/ret}$. The autothrottle speed

command bug was set for 141 kt. It was later found out at Finnair Maintenance that VOR/DME Kainuu (114,9 Mhz) was tuned in NAV 1 receiver and ILS RWY 07 (109,9 Mhz) in NAV 2 receiver.

According to the fuel flow indicators 16.991 lb of fuel had been used in the left engine and 17.089 lb in the right engine, a total of 34.080 lb (15.459 kg). This amount corresponds to the calculated burnoff in the computer based flight plans found in the cockpit.

The following documents were found in the cockpit:

On the left side:
- seven Jeppesen manuals with maps required for the flight
- takeoff and landing speed booklet open at approach and landing speeds for an aircraft weight of 126.000 lb which corresponded to the landing weight of the accident aircraft.
- normal check lists
- set of OFPs for the planned flights

On the right side:
- Jeppesen approach chart EFKI ILS 07, page 11-1 (first officer's control column)
- two sets of OFPs for the planned flights
    - weight and balance sheets (one cabin crew member was missing from documents)
- emergency and abnormal check list
- normal check lists
- three Jeppesen manuals with maps required for the flight
- aircraft documents
- performance books A and B

During the flight no notes had been made on the operational computer based flight plans nor on other documents found in the cockpit. For example fuel data, times over route check points, estimates to next waypoints and ATC clearances had not been marked. The takeoff and landing speed booklets were easily readable. The emergency and abnormal check list was issued by the aircraft manufacturer in English. The contents of the normal check list were as recommended by the manufacturer and translated into French. The normal check lists were in photograph album type folders in plastic covers. The font was small and typewritten. In some places the ink had attached to the plastic

folders which together with the small font size made the lists partly unreadable. The performance books A and B contained the data necessary for the takeoff and landing performance calculation, including the correction factors for contaminated runway.

1.12.4 Cabin

The following documents intended for cockpit work were found in the left cabin overhead stowage bin in the forward cabin over seatrow 2:

- Manuel d'exploitation, Generalites - lignes
- Manuel d'exploitation, Utilisation (the first two are Air Liberté Tunisie Flight Operations Manual)
- Minimum Equipment List (MEL)
- CRAC (Compte Rendu Amenagement Cabine)
- Balance charts
- Compte rendu activite
- FCOM (Douglas Aircraft Company)
    - Performance
    - Systems description
    - Operating procedures

These documents were stored in the overhead stowage bin which was also used for the storage of passengers' bags and clothes. There was no special locker or space reserved for these documents.

All hand luggage had been removed before cabin inspection. Therefore it was impossible to find out where the hand luggage had been stowed and whether it had remained at its position. Only a pair of eye glasses and a 5 cubic centimeter bottle of cognac were found.

Seats and seat belts were undamaged except for the armrest of the right aisle seat at row 11 which had bent towards the aisle for approximately 20 degrees. On the left side at row 33 the overhead stowage bin door lock was missing. The locks of other overhead stowage bin doors were operational.

Following deficiencies were found when the emergency and rescue equipment were checked:

- megaphone in the forward cabin was not operational
- batteries were missing from the other forward galley flash light

– portable oxygen bottles were loose from their brackets on the left side of the aft cabin.

On the right side:
– Emergency Locator Transmitter (ELT) was loose from its bracket
– halon fire extinguisher was loose from its bracket
– water extinguisher was loose (there was no bracket)
– oxygen bottles were loose from their bracket
– first aid kit was missing
– a loose crowbar (there was no bracket, according to the representatives of the airline, a crowbar is included to the aircraft equipment; nevertheless it is not mentioned in the cabin crew manual, MANUEL D'EXPLOITATION JUIN 88).

1.12.5 Tire marks on the runway

The MD-83 aircraft has a tricycle landing gear. Each gear has two wheels. The distance from the main gears to the nose gear is 22 m and the main gears are 5 m apart.

Aircraft tire marks were clearly visible on the runway surface. The first touchdown marks, in terms of distance from the threshold, were made by the right main gear tires. The mark of the right main gear left tire was on the runway centerline painting. The marks were clearly visible for 18 m and dim thereafter. The left main gear tire marks begun five meters after the beginning of the right main gear tire marks. They were clearly visible for 18 m and light for 80 m thereafter.

Nose gear tire marks became clearly visible 18 m after the first right main gear tire marks. Both nose wheel tire marks were visible for 10 m. After that only the left nose wheel tire mark was visible as a thin line. Nose wheel tire marks were about 1 m closer to the right than to the left main gear marks.

The following distances have been measured from the first tire marks which were 900 m down the runway from the runway threshold.

The right main gear tire marks continued again after 110 m and the left main gear tiremarks after 130 m from the touchdown marks. The marks of the left wheel pair were first relatively light and straight. They started to shimmy slightly at 190 m. The shimmy increased quickly so that the tires made short black marks after each other. The right main gear marks started to shimmy at

260 m and their appearance was similar to the left marks. At 440 m there were marks of the left main gear spray deflector corner on the runway. The spray deflector is normally 25 cm above the ground.

The first separated landing gear part was on the runway at 470 m. At 490 m there was hydraulic fluid at a distance of four meters on the left main gear marks. The aircraft had been exactly on the runway centerline. At 500 m the shimmy of both wheel pair marks ended. At 550 m there was hydraulic fluid for a distance of 40 m on the left wheel marks and the left brakes were lost. The marks of the right wheel pair were straight and dark due to heavy braking.

At 670 m the left wheel pair had turned 180 degrees in the shock strut for the first time. After this 18 similar turns of 180 degrees had followed after each other. The last turn took place at 950 m where the right tire mark was clearly lighter than the left one. During the left wheel pair turns the right wheel pair had left a dark straight line. During the turns the aircraft had momentarily been on the right side of the runway centerline so that the left wheel pair had been on the centerline. After the turns the movement direction had deviated slightly to the left so that at 1050 m the right wheel pair had crossed the runway centerline.

Nose wheel tire marks appeared again at 1150 m on the right side of the right main gear marks and continued out of the runway. Almost at the same place both right main gear tire marks joined and were dark (the aircraft had turned 90 degrees from the movement direction). The left wheel pair marks were light and the left mark was made by a severely damaged tire. The severely damaged tire was actually the right one because the wheel pair had been stuck in reversed position. The nose gear left the runway at 1450 m and both main gear 70 m after the nose gear at 80 m before the runway end. The left and the right wheel pair had skidded on the same track due to the sideslip of the aircraft.

The trail made by the nose gear continued for 100 m outside the runway. At 10 m before stopping the tires had dug into a depth of 30 cm from where they had risen above ground and thrown sand over a large area. Finally the tires had hit the ground and sunk into it almost completely.

The main gear had made a 50 m long trail in the sand. The depth of the trail was 80 cm at the right main gear. At the end of the sideslip the left main gear downlock had broken and the gear had folded inboard into the well.

Figure 5. Both main landing gear marks seen to the landing direction. The marks of the left main gear shimmy started at 190 m and the right main gear at 260 m from the touchdown.

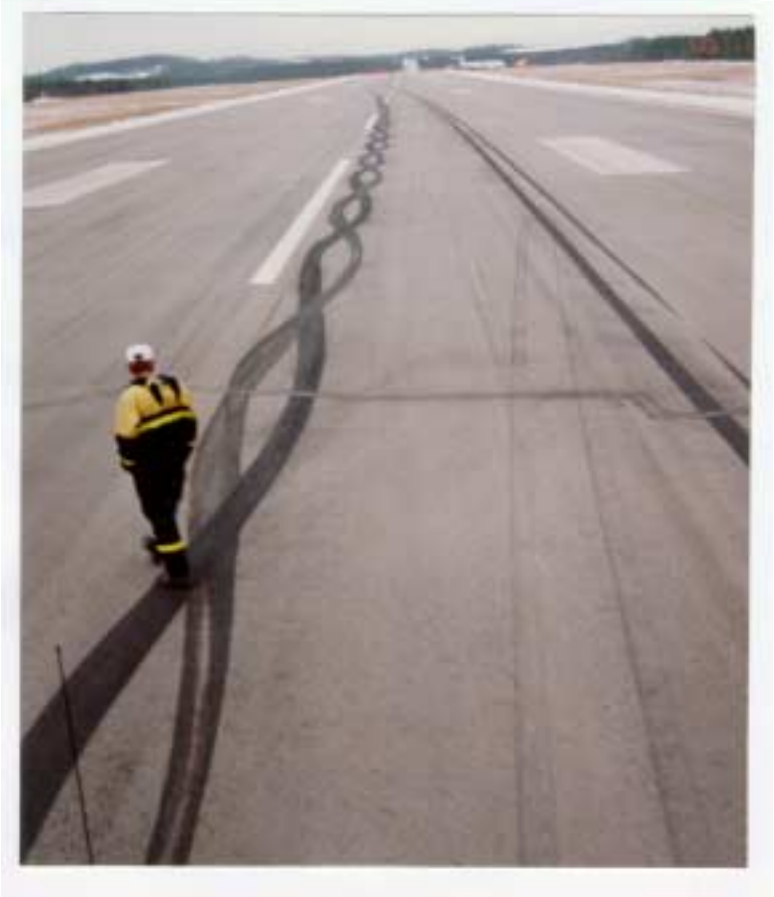


Figure 6. As a result of main landing gear shimmy both main gear torque links broke. The left wheel pair turned 180 degrees in the shock strut for the first time at 670 m from the touchdown. 18 similar turns occurred thereafter.

1.13 Medical information

Ten persons were examined after the accident in a health care center or hospital for various contusions. A slight concussion of the brain was diagnosed for two persons. The other had a slight neck strain as well. Other injuries were neck strain, cut in the forehead, ankle injury during evacuation and for some persons slight bruises around the body. The captain hit his head to the side window in the cockpit. One steward was hit by falling handluggage after an overhead stowage bin door had opened. These injuries did not require medical care.

All crew members were subjected to Alcometer/breathanalyzer test. According to the test results none was found to be under the influence of alcohol. Captain's blood glucose value was normal. His urine sample did not show any signs of narcotics or drugs. First officer's blood glucose value could not be determined reliably because he had had a soft drink before the urine sample was taken. According to the tests of National Public Health Institute (authorized to give statements) the urine sample contained ephedrine and ranitidinine. Ephedrine is listed in the letter number 1758/81 as drugs harmful in traffic ("Liikenteelle haitalliset lääkkeet") issued by the National Board of Health. The first officer stated that he had taken a drug (Actifed) which contains ephedrine. Additionally the first officer's urine sample contained ranitidinine which is a substance taken on gastric and duodenal ulcers. Ranitidinine is not mentioned in the list drugs harmful in traffic. The amount of ephedrine could not be determined from the urine sample. When used in accordance with the prescription, Actifed does not have a negative effect on performance and alertness.

Neither pilot used corrective lenses during the approach and neither had been prescribed them.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 Notifications of the accident

Two Finnair traffic officers were watching the approach of the aircraft in front of the terminal building near the refuelling site. They observed the abnormal landing and touchdown point of the aircraft. After the touchdown and the fol-

lowing loud bang and smoke formation the traffic officers ran to the Finnair office in the terminal building. One officer called the regional emergency center (REC) and reported the accident according to his own statement as follows (translation from Finnish): ”This is from Kajaani airport, send the fire brigade here.” When the REC officer asked what kind of accident was in question, the traffic officer could not answer. When the REC officer asked whether it was an aircraft accident or a danger situation, the traffic officer answered: ”Yes, yes.” The REC officer said that she would send the emergency vehicles. After this first report the REC officer was left with the understanding that this was only an aircraft accident hazard. One Finnair traffic officer stayed at the terminal building in order to open the gate to the airport area for the Kajaani city rescue units and to show it the way to the accident site. The other Finnair traffic officer left for the accident site.

Kajaani AFIS officer was watching the landing aircraft. When she noticed that the landing was not normal she gave an alarm to the airport rescue personnel already before the aircraft had stopped. Alarm was given to the airport fire brigade according to the emergency rescue plan at 06.56.48. Rovaniemi ACC was notified at 06.57.25. The AFIS officer dialed Kajaani REC phonenumber at 06.59.10 in order to report the accident. The phone was answered at 06.59.34. The AFIS officer notified the REC: ”A passenger plane has gone off the runway here.” The REC officer asked about the situation as follows: ”So, it is no longer an aircraft accident hazard, but an accident.” The AFIS officer replied: ”Yes, exactly. It has gone off the runway.” From this report the REC officer got to know that an actual aircraft accident had taken place.

Kajaani REC officer gave the following further reports: police at 07.20, Kainuu central hospital at 07.05, the Finnish defence forces at 07.06, local radio station at 07.20, Finnish broadcasting company at 07.21, county emergency center at 07.22 and county administrative board at 08.15.

1.15.2 Operation of the rescue organization

Kajaani airport rescue unit Palo 2 with a crew of two arrived first at the accident site approximately two minutes after the alarm. It drove to the planned position in front of the aircraft on its left side. The evacuation had started when Palo 2 arrived. The rescue personnel did not have the information about the number of persons on board in the beginning. There were a few persons in the area between the right wingtip and the runway. On the other side of the aircraft there were about 15 persons who were standing at a distance of approximately 25 m from the aircraft fuselage. Evacuation continued through the

left overwing exits and the aft service door on the left side of the aft fuselage. The inflatable slide was used in the evacuation through the aft service door.

Because no fire was observed the monitor (a foaming device) was not used. The areas below the left and right wing and the middle fuselage were foamed with the sidelines (another foaming device). A male crew member pointed out the fuel leak in the left wing to the rescue personnel.

The rescue unit Palo 4 took position directly in front of the fuselage at twelve o'clock position. The fire fighter who acted as the chief of airport rescue unit arrived at the site with Palo 4. Palo 2 and Palo 4 performed the foaming together. In the beginning three members of the fire crew took part in the foaming while the other three assisted in the evacuation. After the foaming was completed all rescue personnel assisted in the evacuation of the passengers.

When Kajaani city rescue units arrived at the accident site at 07.11 the foaming, evacuation and rescue operations were completed. Three slightly injured persons were transported with Kajaani rescue unit ambulances to Kainuu central hospital. The hospital was alarmed at 07.05. In the hospital action was taken according to the alarm instructions in order to prepare for admitting patients.

Buses were requested to the accident site at 07.02 in order to transport passengers to the terminal building. Many passengers walked a part of the distance. They were transported with the service cars of the Civil Aviation Administration, fire trucks and ambulances, a few buses and a police car as well as one small bus.

When Kajaani fire chief arrived at the accident site at 07.26 luggage was being unloaded from the aircraft. The fire chief ordered oil spill control activities to be started. A suction vehicle was requested in order to remove the fuel which had leaked to the ground and to empty the punctured fuel tank. The rescue operations excluding the fuel gathering were completed at 07.30 whichafter the police isolated the area. A detachment from Kainuu brigade arrived in order to assist in the isolation and guarding of the area.

1.15.3 Evacuation of the passengers

The cabin crew spoke English to the passengers. The tour guide acted as an interpreter during the flight and the evacuation. She translated the instructions from the cabin crew to the passengers into Finnish. The guide herself spoke French with the cabin crew. She was a so called flying and hotel guide for the travel agency.

The captain ordered evacuation over the Public Address system (PA) in French when the aircraft had stopped outside the runway. He ordered to evacuate the passengers through the left emergency exits. The first officer came out of the cockpit in the beginning of the evacuation and noticed that the purser was trying to open the left forward door emergency exit. The first officer walked to the aft cabin and told the passengers to remain seated and keep calm. The stewardess seated next to the purser did not do anything at this time because the right forward emergency exit (service door) was her responsibility. After a while the purser asked the stewardess to go and get the travel guide in order to announce instructions in Finnish. The purser went to the right forward emercency exit, removed the slide bar of the semi-automatic evacuation slide from the floor and opened the door. He noticed that there was no fire.

The duty of the steward seated in the aft cabin was to go to the aft galley service door, to open it and to start the evacuation. The opening of the door was delayed because he had to clear hand luggage away from the front of the door. The door could be opened at the second attempt whichafter the slide inflated and the steward started the evacuation.

The steward seated next to the aft galley told he had gone to his assigned station at the overwing emergency exits and opened both on the left side. However, a passenger seated on seat 23 A told he had opened the left overwing exit next to his seat by himself whichafter the steward had climbed to the left wing and opened the other overwing exit from outside. The right overwing exits were opened by other passengers. The stewardess seated in the forward cabin arrived in order to assist in the evacuation at the overwing exits.

The captain came out of the cockpit and tried to help the purser in opening the left forward door. The door could only be opened partly. The purser got the captain's permission to open the aft door. The stewardess seated in the aft cabin guided the passengers first to the aft galley service door according to her duties. When she heard the announcement that the aft door could be opened she opened it. When she noticed that the stairs did not extend enough she closed the door. When the evacuation was completed the first officer returned to the forward cabin where he closed the right forward door.

A deaf-mute passenger got into the forward lavatory during the evacuation. The guardian of the passenger in question and a stewardess together got the lavatory door open and the deaf-mute passenger was evacuated from the aircraft. Finally the rescue personnel carried two physically disabled passengers out of the aircraft.

There were eight emergency exits in the cabin and two in the cockpit. 51 passengers were evacuated through the left overwing exits and 111 through the aft galley service door. Two passengers left the aircraft through the right overwing exits.

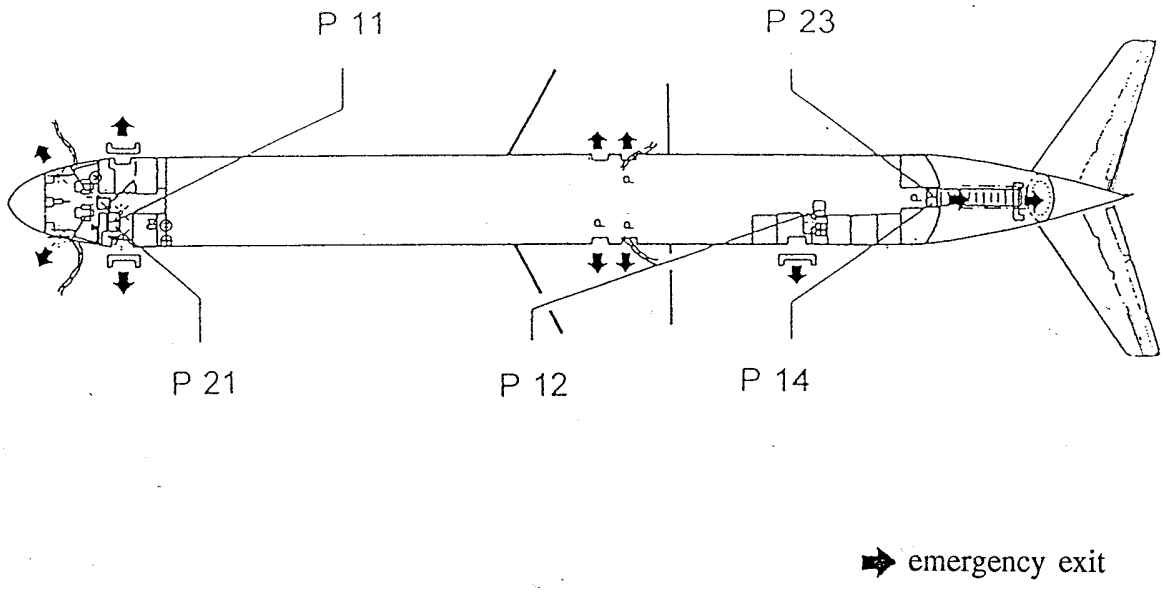


Figure 7. MD-83 emergency exit locations and cabin crew seating (shown with letter P and two digits) during landing. 51 passengers were evacuated through the left overwing exits and 111 through the aft galley service door. Two passengers used the right overwing exits.

1.15.4 Survival aspects

When the aircraft sideslipped off the runway left side first a side force occurred which caused minor injuries to a few persons, mostly impact injuries and bruises. Seat belts and armrests held the passengers in their seats. The seat belt of a passenger seated on the right side of the aisle had not been fastened for landing. As a result a strong force was excerted to the armrest which bent to the aisle. During the landing roll some overhead stowage bin doors opened which allowed some hand luggage to fall down. One bag hit the steward seated next to the aft galley in the head.

Many cabin emergency and rescue equipment were loose or without a bracket. The megaphone in the forward cabin was not operational. The batteries were missing from the other forward galley flash light. These faults had no effect in this case because the emergency lights and the Public Address system were operational. It was dark during the evacuation.

1.15.5 Post-traumatic stress disorder (PTSD) debriefings

After the accident a crisis group working under the public health care held a debriefing session for the passengers of the accident aircraft and the airport personnel in order to avoid post-traumatic stress. The crisis group of Finnair flight department offered a debriefing session for the crew of the accident aircraft in Helsinki but the crew refused the offer.

1.16 Tests and research

1.16.1 General

The aircraft investigation focused mainly on the landing gear structure, the anti-skid and the spoiler systems. Additionally it was confirmed that the left and the right HSI, the ADI and the NAV-receivers had been installed according to the wiring diagram. The last selected ILS and VOR frequencies were found out as well.

Some systems were inspected at the accident site. Inspections were continued later on at the aircraft repair site at Kajaani airport. The removed parts were inspected at Finnair maintenance shop at Helsinki-Vantaa airport and at the factories of Hydro Aire Division and McDonnell Douglas Corporation in the

United States. Inspections in the United States were supervised by the representatives of the NTSB and the FAA.

1.16.2 Landing gear

The following landing gear parts were sent to the NTSB which had them inspected at McDonnell Douglas Corporation:

- both main gear torque link arms, their shimmy dampers and fluid reservoirs
- both torque link arm Apex bolts and nuts, bearing bushings and parts of the nut lock bolts.

Observations:

The lower left torque arm clevis area had torn. The both main gear torque link Apex bolts and nuts had failed in the threads by ductile overload. The damage was caused by the overload from main gear vibration. No material or processing discrepancies were noted in the inspected landing gear parts.

1.16.3 Brakes

The wheelbrakes were inspected at Finnair maintenance shop. In the visual check the brakes were found to be in good condition and their wear corresponded to the amount of landings. The brake bodies had impact marks which originated from the accident. All brakes had more than half of the allowance for wear left. Brakes 1 and 4 were disassembled and inspected in detail. The condition of the brakes did not have an effect on this accident.

Parts of the brake anti-skid system were removed from the aircraft and sent to the NTSB which had them inspected at Hydro Aire Division. The removed parts were

- two brake dual control valves
- four anti-skid dual control valves
- one anti-skid control unit
- four wheel speed transducers.

Observations:

Impurities were observed in the brake dual control valves but they fulfilled the applicable requirements. Small deviations were observed in the linear functioning of the anti-skid dual control valves (mA/hydraulic pressure) compared to the functional values of a new component but they met the requirements set for components in use. The properties of the anti-skid control unit and the wheel speed transducers were within the functional values issued by the manufacturer.

1.16.4 Wheels

Both left main gear wheels (number 1 and 2), the right inboard main gear wheel (number 3) and the left nose gear wheel were removed. The right outboard main gear wheel (number 4) and the right nose gear wheel were not removed and their condition was checked at the accident site. The removed wheels were transported to Finnair maintenance shop for inspection. The roller bearings of all wheels were checked and found functional.

Observations:

– Main gear tire number 1: Dunlop/GB, p/n DR22823, s/n 91044306, 264 landings. The tread of the tire was worn out and no grooves were visible on the tread. The tire had worn clearly more than the economical tire change wear recommended by the manufacturer but the tire was airworthy before the accident. Two tread re-inforcement layers were visible in the skidmark. There was a 60 cm long hole on the brakeside of the tire which had been caused by the torque link and which extended to the tread area. There were three parallel scratches next to the hole. The tire had deflated (not exploded). There were impact marks on the edge of the wheel rim.

– Main gear tire number 2: Bridgestone/JP, p/n APSO1440, s/n Z92WC022, 54 landings. The mean groove depth was 6,3 mm. There was a 10 cm long cut on the brakeside of the tire which had been cut by the torque link arm. The cut extended to the tread shoulder and had punctured the tire. There were no marks caused by locking of the brakes or sideslip but only some longitudinal scratches. The brakeside edge of the wheelrim had impact marks.

– Main gear tire number 3: Goodyear/US, p/n 446K82-2, s/n 21820109, 154 landings. The mean groove depth was 3,4 mm. The tire had an X-shaped bursting mark together with a heavy sideway skidmark. There was also a

circumferential groove just above the wheel flange. The edge of the wheelrim had scratches too. There was a lot of sand between the wheelrim and the tire.

– Main gear tire number 4: Goodyear/US, p/n 446K82-2, s/n 40600331, 89 landings. The wheel was not removed but it was checked at the accident site. The outboard grooves were only slightly visible and their depth was 1 mm at the deepest. Tire pressure was 8 psi. The tire had worn uniformly and on its outboard side on the tread there were skidmarks caused by the last landing. Two fabric layers had worn through on one palm sized skidmark. On another skidmark which was almost as wide as the tread, the tire had almost worn through. Eight fabric layers and approximately 10 lateral scratches were visible.

– Nosewheel tire number 1 (left): Goodyear/US, p/n 266F22-3, s/n 40800029, 52 landings. The mean groove depth was 3,6 mm. The tire was deflated. One-sided wearing was visible on the tread. It had been caused by the turning of the wheel during the sideslip.

– Nosewheel tire number 2 (right): Goodyear/US, p/n 266F22-3, s/n 40800033, 52 landings. The wheel was not removed. The tire was in good condition and had normal pressure. The traces of the tread wear were similar to those in the left tire.

Tire damages and skidmarks were caused by the landing gear vibration, rotation of the left wheel pair in the shock strut, aircraft sideslip on the runway and the loose torque link arms. The brakes did not lock during the landing roll.

1.16.5 Spoilers

The below mentioned spoiler system components were removed from the aircraft. The first component was checked at the manufacturer and the rest at Finnair maintenance shop.

– auto spoiler control unit
– interlock relay
– time delay relay
– auto spoiler actuator

Observations:

The above mentioned components were found to be operational.

1.16.6 Operational check of the spoiler actuator

The following functions of the spoiler actuator were checked:

- arming
- locking mechanism of the manual spoiler deployment
- auto-spoiler actuator
- mechanical operational measurement of the knockdown mechanism commanded by the left throttle lever (mechanism retracts the spoilers when the throttle levers move forward towards the go-around position and is commanded by the left throttle lever).

The operational check was made after the initial repairs during the run-up in Kajaani. It was noted in the measurement that the spoilers remained deployed with a thrust of 1,2 EPR and that they were retracted automatically (commanded by the left throttle) with a thrust setting of 1,4 EPR.

Observations:

The operation of the inspected system was flawless and the operational values were normal for the aircraft type in question. The reference measurements were made with an equivalent MD-83 aircraft from Finnair Oy on part of the spoiler system.

1.16.7 Measurement of the electrical circuits

The below mentioned aircraft systems and their fixed electrical circuits were measured. The following measurement records were made:

1. Electrical circuits of the anti-skid dual control valves and anti-skid control units
2. Anti-skid control units and wheel speed transducers
3. Grounding of the parking brake control circuits and anti-skid dual control valves
4. Auto spoiler control unit and wheel speed transducer wiring
5. Anti-skid system control unit electrical circuit

6. Test circuit of the anti-skid system
7. Electrical circuit of the ground sensing switch commanded by the nose gear ground shift mechanism
8. Electrical circuit of the ground sensing switch commanded by the main gear (weight on wheels)
9. Power supply input circuit of the spoiler control unit
10. Minimum authority switch (controls spoiler operation) commanded by the left throttle and the electrical circuit
11. Left and right NAV display circuits from VHF NAV 1 and VHF NAV 2 receivers to the HSI displays
12. Operation and electrical circuits of the TOGA switches on the throttle levers.

Observations:

All tested circuits and switches were found operational.

1.16.8 The Digital Flight Data Recorder information

The DFDR had a significant role in the investigation. Only the accident flight had been recorded because this was the first flight after DFDR overhaul.

The DFDR was intact and had operated appropriately. With the recorded data it was possible to determine that the flight had been normal until the final approach. The case-relevant data from the initial approach to the complete stop of the aircraft and the shut-down of the engines has been analyzed in order to find out the causes of this accident. The DFDR data is shown in numerical and graphical form. A graph on the most relevant parameters in the final phase of the flight is enclosed (Appendix 2). Some factors contributing to the accident can be found in the graph.

1.16.9 The Cockpit Voice Recorder information

The information of the Cockpit Voice Recorder (CVR) was downloaded and listened to in the French accident investigation center in Paris. The investigation commission used a Tunisian expert who was familiar with the spoken languages (Arabic, French and English). All VHF communications between the air traffic control units and the crew were very clear.

On part of the cockpit monitor microphone the recording was generally of low quality and occasionally so poor that it was not possible to determine even the contents of conversations. Other cockpit sounds were also difficult to hear.

The arming of the spoiler system for landing causes a distinct sound. This sound cannot be heard on the CVR recording. With the same aircraft type but a different CVR type the sound of arming the spoilers can be heard clearly.

The captain's statement "My controls" cannot be heard on the CVR recording. Other normal callouts, conversation, radio altimeter readouts and commands cannot be heard either. The sounds of landing, aircraft systems operation and severe vibration of the aircraft can be heard.

When the aircraft had stopped one of the pilots commanded the shutdown of the engines which can be heard on the CVR recording. When the engines were shut down, the recording ended.

1.16.10 Aerial measurement of the ILS and the PAPI

The Finnish Civil Aviation Administration performed the aerial measurement of the RWY 07 ILS and PAPI (Precision Approach Path Indicator) on November 9, 1994. Both were found to be in normal operational status.

1.17 Organizational and management information

1.17.1 Airline

Air Liberté Tunisie was a charter airline based in Monastir, Tunisia. The airline was founded in March 1990. The main founder was Air Liberté (France) which owned most of the company in its early stages. Air Liberté Tunisie was a subsidiary to Air Liberté (France) at that time. The Tunisian share grew larger later on and a CEO (Chief Executive Officer) of its own was nominated. The airline started flight operations with two MD-83 aircraft registered in France and received later on a third aircraft of the same type.

The Operative and Financial departments worked under the CEO. The Operative department was divided into five offices. The pilots belonged to an office which was led by the chief pilot. The duties of the chief pilot included selection of pilots, training and flight safety. The chief pilot had a deputy. The airline did not have a specific flight safety organization.

The airline had 11 captains and 11 first officers. Most of them had flown previously for TUNISAIR. The airline had four check pilots who had been certified by the Tunisian authorities for the check flights of the airline. The airline leased simulator training time abroad and had its own instructors.

The airline used the Flight Operating Manuals and the normal check lists of Air Liberté (France). The emergency and abnormal check lists were provided by the Douglas aircraft company.

The technical director of the company had the technical responsibility for the aircraft. For example the technical office, quality assurance and line maintenance worked under his supervision. Airline personnel took care of the A checks in Monastir whereas the C and D checks were performed at Alitalia in Italy. The engines were overhauled by Swissair in Switzerland.

1.18 Other information

1.18.1 Aerodrome Flight Information Service

Aerodrome Flight Information Service (AFIS) was provided at the time of the accident. The AFIS is a form of air traffic service provided at airports with low traffic density. It differs from the Air Traffic Control Service in many ways. The AFIS provides the air traffic in the manoeuvring area and in the Flight Information Zone (FIZ) with alerting services and the information necessary for safe and efficient flight. The AFIS does not provide separation but only gives traffic reports using which the pilots themselves are responsible for the avoidance of aircraft collisions.

The AFIS does not issue clearances for the aircraft, only information relevant to the flight, on grounds of which the pilots make the operational decisions by themselves. These decisions shall finally be made by the Pilot-In-Command (PIC) at the ATC airports as well. The difference is that at the AFIS airports the PICs themselves are responsible for the flexible traffic flow. At ATC airports this is left to the ATC officers.

2 ANALYSIS

2.1 The runway requirement

According to the FCOM the runway requirement for landing with the weight and conditions in question was 1410 m. The landing flare (in air) takes 300 m which leaves 1100 m for the landing roll. The reverse thrust is not taken into account when calculating the runway requirement. 40 % of the runway requirement is left unused when the aircraft stops with maximum braking. This 40 % represents a safety margin required by flight regulations. From the figure below it can be seen how the runway requirement is defined.

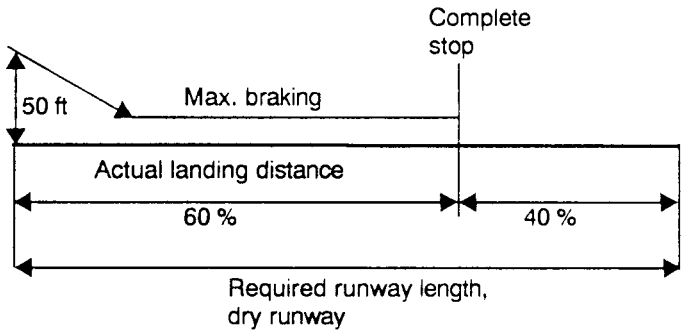


Figure 8. The runway requirement

Had the aircraft overflown the threshold with the right threshold speed of 131 kt and had the touchdown occurred with the normal touchdown speed, the runway requirement would have been 1410 m. The flare and the landing roll would have taken 850 m. In addition to the runway requirement there would have been 1090 m of usable runway. The lenght of Kajaani RWY 07 is 2500 m.

In this case the aircraft touched down 600 m after the normal touchdown point which was 900 m from the threshold. The touchdown speed was 153 kt (overspeed of 26 kt compared to the normal touchdown speed). If the brakes and the spoilers had worked normally the runway requirement would have been 1692 m, of which 1020 m would have been used for the landing roll. In this case there would have been 580 m of runway in addition to the runway requirement.

If the spoilers had not been deployed and the wheel brakes had not been used but the reverse thrust had been applied 10 s after touchdown, maximum continuous thrust obtained three seconds thereafter and maintained until com-

plete stop of the aircraft, the calculated stopping distance would have been approx. 2280 m. The usable runway length would thus not have been sufficient.

2.2 Human factors

2.2.1 General

Various human factors proved to be significant when analyzing the final approach and the unsuccessful landing. Among these were crew background and crew composition, the decision making process of the captain, used flight procedures and learned practices, the alertness of the crew and the company culture.

2.2.2 Errors during the approach and landing

When going through the final phases of the flight the investigation commission paid special attention to the, according to the company pilots, usual practice of the captain taking over the control of the aircraft from the first officer in the final phase of the approach without any preceding briefing. From this change of duties started a sequence of events which led to the situation where a safe landing was no longer possible. The captain, however, clearly stated that he had no intention to discontinue the approach and to make a go-around at any phase of the approach or landing.

During the final phase of the approach the captain took over the control of the aircraft. He stated later on that the reason for the takeover was that the aircraft was not properly on the glide slope but above it. According to the DFDR the aircraft was, however, on the ILS glide slope.

During the approach ILS RWY 07 (landing runway) frequency 109,9 Mhz was tuned into the first officer's NAV receiver (NAV 2). With this setup the first officer had Flight Director (FD) information from the ILS on his ADI but no raw data ILS information. ILS localizer and glide slope raw data information was displayed on his HSI. The captain's NAV receiver (NAV 1) was tuned on VOR/DME Kainuu frequency 114,9 Mhz. With this setup the captain was able to monitor his own ADI for the glide slope and expanded localizer from NAV 2 but he had no ILS Flight Director information when the aircraft was flown manually. During the approach the crew was not able to compare the operation of the aircraft ILS receivers to each other since only the first officer's receiver was tuned on the ILS frequency. According to the commission this kind of operation of the NAV receivers is incorrect even if it is not against the company procedures.

It is possible that the 100 % high intensity approach and runway lights caused an illusion to the captain's height observation. An instructor captain of Air Liberté Tunisie has told the commission that in the company training a warning is given about changing the intensity of the approach and runway lights during the final approach because it might cause an illusion according to which the aircraft is flown above or below the glide slope. Unusually bright lights can cause a visual illusion according to which the aircraft seems to be closer to the RWY than it actually is. This might have appeared as a climb above the glide slope. The runway slope uphill (0,65 %) could have caused a similar illusion. According to the CVR the captain ordered the first officer to descend slightly below the glide slope. The first officer did not act. According to the DFDR the aircraft was on glide slope.

According to the investigation commission 100 % high intensity approach and runway lights were disturbingly bright in the prevailing conditions and the pilots should have asked for the dimming of the lights. The AFIS/ATC officer dims the lights upon pilots' request.

When the captain took the controls, he put his right hand on the throttle levers. According to the DFDR the go-around mode was activated at the height of approximately 120 ft which must indicate that the captain or the first officer pushed at least one of the two TOGA buttons on the thrust levers. The captain told he had no intention to make a go around. No signs of go-around can be seen in the DFDR elevator control data. According to the investigation commission the TOGA button push must have been unintentional or a so called substitution error ie. either pilot has intended to switch off the autothrottle but has selected the TOGA button. The result was in any case a substantial increase in thrust and a climb above the glide slope. The captain steered the aircraft back to the glide slope and reduced the thrust against the autothrottle movement (autothrottle target was the go-around thrust). This led to a situation where the aircraft crossed the threshold at the appropriate height but with a substantial overspeed (24 kt).

It is obvious that the captain did not realize that the autothrottle was still engaged and in go-around mode but concentrated on flying the aircraft towards the runway. Because of the overspeed the reduction of height was not immediately possible. Having flown close to the runway surface for a moment and having held the throttle levers against the movement of the ATS (Auto Throttle System) the captain finally disengaged the ATS. Then he obviously thought that he had set idle thrust as well. This was however not the case because the disengagement of the ATS was not enough but also the throttle levers should have been set to idle. This was not done until four seconds after the touchdown,

probably when the need to apply reverse thrust came up. This was a typical so called omission error ie. the task required (set idle thrust) was considered done already after performing a subtask (disengagement of the ATS).

The nose gear touched down first which is extremely unusual for this aircraft type. The ground spoilers should have deployed at touchdown and remained open. This did not happen during this landing. It is not known whether the ground spoilers were armed. The ground spoiler operation should have been monitored during touchdown and if necessary the ground spoilers should have been deployed manually. This was not done. Brakes were applied immediately after touchdown. The main landing gear started to vibrate severely. According to the aircraft manufacturer's instructions brakes should be applied after the ground spoiler deployment.

The captain thought that he had applied reverse thrust approximately three seconds after touchdown. Reverse thrust was not available at that time because the throttle levers were still on partial thrust. Reverse thrust was actually only applied 10 s after the touchdown when there was 880 m of runway left. It was no longer possible to stop the aircraft on the remaining runway. Only a reverse thrust of 1,2 EPR in the left and 1,3 EPR in the right engine was applied. The maximum continuous reverse thrust would have been 2,05 EPR (MCT). In an extreme situation like this all available reverse thrust should have been used disregarding the thrust limits.

The captain applied pressure to the brake pedals during the whole landing roll. The left brakes were lost at 550 m from touchdown but the pilots did not have any means of knowing this. When the remaining runway was no longer sufficient for stopping the aircraft, the captain decided to steer the aircraft off the runway to the right by applying right rudder. Actually the aircraft turned to the right mostly because only the right main gear brakes were operating. The aircraft turned 140 degrees to the right and sideslipped off the runway.

The severe vibration of the main landing gear probably took a great deal of the pilots' attention. This assumption is supported by the fact that neither pilot could recall the Cockpit Aural Warning System (CAWS) warnings, for example the warning "landing gear - landing gear". Neither pilot noticed the landing gear downlock warning lights nor the anti-skid warning lights.

2.2.3 Lack of monitoring

When going through the errors made during the final approach and landing it can be seen that in many phases the monitoring pilot's (first officer) role would have been central. It is obvious that the piloting pilot (captain) was acting at the upper limits of his capacity and that he had no attention capacity left for example for the observation of flight guidance system modes, thrust setting, speed and height. The piloting pilot made observation and performance errors typical for an overload situation.

The sequence of events began at the faulty go-around mode activation. When the go-around mode is activated unintentionally the monitoring pilot must observe it and call it out clearly. If necessary he must take control of the situation physically. This did not happen in this case. Additionally, the piloting pilot did not get the required, continuous and clear speed and height information from the monitoring pilot. The monitoring pilot did not call out either that the throttle levers were still on partial thrust. He also should have backed up and called out the unusual ground spoiler operation (the spoilers did not deploy) and the flight guidance system mode changes.

The final phases of the final approach were actually in many ways so unstabilized that the criteria for a go-around were clearly met. Under these circumstances the monitoring pilot should have strongly recommended a go-around because the piloting pilot was unable to act as the situation required.

According to the investigation commission, in extreme conditions when the danger of an accident is evident, it is the duty of the monitoring pilot to take over control and to execute the go-around himself, irrespective of his position as captain or first officer.

2.2.4 Why did the monitoring pilot not intervene?

This was the first officer's first flight to Kajaani. He was the piloting pilot. He had had a cold for a couple of days before the flight but he felt fully rested and fit to fly when he checked in for duty and during the flight. During the approach the first officer acted as the piloting pilot in a completely normal manner until the change of duties. According to the investigation commission the sharing of flight duties and the first officer's alertness did not have an effect on the first officer's performance.

The first officer was prepared to land the aircraft himself. The change of duties just prior to landing is a very difficult task if it has not been agreed on beforehand and no training has been received. An unexpected change of duties and the lack of training contributed in this case to the situation in such a way that the first officer was unable to take over the role of the monitoring pilot when the captain took control of the aircraft.

It was the company practice to fly the final approach with a moderate overspeed. The first officer therefore considered an overspeed in excess of 20 kt above the threshold in no way unusual. According to the Air Liberté Tunisie FOM the final approach speed is threshold speed + 5 kt or threshold speed + 5 kt + wind increments. The company had not clearly determined which pilot looks out and which monitors the instruments during the final approach in good weather conditions. In this case both pilots were looking out and the monitoring pilot's duties were not performed.

2.2.5 Crew background

The captain was a former TUNISAIR first officer. He joined Air Liberté Tunisie during its early phases and got the theory and simulator part of the type training for the MD-83 aircraft in 1990 in England (British Caledonian Flight Training). His success in type training was modest especially with regard to cockpit management and leadership. In unexpected situations the captain tended to fall behind. The flight training was given in Tunisia and the captain got the qualification to fly as pilot-in-command in the MD-83 aircraft. Remarks were made on the poor leadership of cockpit work in this training stage as well. After the type training the recurrent training records of Air Liberté Tunisie include no remarks on the captain's performance. The problems during the training make it understandable that the situation which came up during the final approach to Kajaani took the captain to the limits of his capacity. There was a distinct need for a go-around whichafter a new approach should have been made.

The first officer's flying experience was mainly gained in general aviation. He had for example flown light aircraft as a flight instructor. He was hired by TUNISAIR in 1980 but he did not fly there because he did not fulfill the company requirements. He was hired by Air Liberté Tunisie in January 1994. His training success was weak and deficiencies were observed for example in the crew co-operation. His experience in the MD-83 was approximately 680 h which he had flown during the last eight months. He was two years older than the captain. As a result of his training history the first officer's suitability for

the cockpit work of a commercial turbojet aircraft was not ideal. This might partly explain why the first officer had so much difficulty in taking over the monitoring tasks when the captain took the controls.

2.2.6 Airline safety culture

The analysis of flight crew behavior includes the analysis of the airline practices. From this point of view the material at the disposal of the investigation commission has probably been inadequate but some observations could still be made.

Air Liberté Tunisie was a young organization which was founded in 1990. Operative procedures were a combination of various traditions which were themselves of high standard. Most pilots had worked many years for TUNISAIR. Some practices were taken from Air Liberté France. Additionally the aircraft type, MD-83, had brought some North American influence. All this resulted in a great variety of procedures and training. According to the investigation commission the personnel responsible for the flight operations and training took their job seriously and professionally. It is, however, natural that this company did not have the experience of an older and more mature organization.

Air Liberté Tunisie did not have a specific flight safety organization. The operative flight safety matters were the responsibility of the chief pilot. This kind of organization is typical for airlines in this size range: the flight safety matters are taken care of by the pilots nominated to these tasks as a sideline to their flying duties. Air Liberté Tunisie chief pilot told that he took action when faults were detected and made improvements, for example by sending the manufacturer recommendations and guidelines to the pilots (e.g. All Operator Letters). The pilots had been notified of the main landing gear vibration which occurred in this accident.

The recurrent simulator training was given abroad. The company pilots acted as instructors which is a common practice. The company recurrent training included four days of class room teaching whichafter oral questions were made. The theoretical phase was followed by simulator training which included practising a lot of malfunctions. Approximately every third practice was similar to the Line Oriented Flight Training (LOFT) but did not correspond to a normal LOFT due to numerous malfunction practices.

Flight operations were carried out in three languages. Some check lists were in French and some were in English. The native language of the pilots was Ara-

bic. The situation did not make the work in the cockpit easier. The cockpit procedures were still finding their form. Compared to the average European or North American practices it could be seen in the company simulator training that the role of the monitoring pilot was not emphasized.

The cockpit work was quite silent. According to the philosophy stated by the company representatives the main idea was that only deviations from the usual should be reported. This kind of practice is not ideal because the threshold to speak up tends to rise. When the monitoring pilot is expected to call out even the normal situations (altitude, speed, position according to the glideslope etc.) it is easier also for the less experienced pilot to speak up. He then does not have to decide what is normal and what is not. The importance of this is amplified in cultures where the captain's authority is high compared to the first officer. In such a case it is also important that the captain encourages the first officer to speak up his observations. The investigation commission does not know the Tunisian culture well enough to draw conclusions regarding the effect of the national culture in this case. It is, however, obvious that if persons with little experience as airline pilots are hired as first officers the lack of experience must be compensated with firm procedures and training.

2.2.7 Lack of crew resource management

Crew resource management (CRM) is the effective utilization of all available resources by the cockpit crew in order to perform a safe and efficient flight operation. These resources include people (e.g. other crew members, mechanics, air traffic controllers, passengers and even pilots of other aircraft), equipment (e.g. autopilot, navigation and communication equipment, back-up aircraft systems) and other information sources (e.g. established procedures, checklists, aircraft operation manuals, regulations and charts). During the last few decades the need for the CRM has become evident because a high percentage of flight crew errors have been related to difficulties with crew coordination, communication skills, leadership, pilot judgment and decision making.

Air Liberté Tunisie did not give CRM training to their pilots. During the final phases of the final approach the lack of crew resource management was evident. The communication between the pilots was poor, company procedures were not followed, aircraft equipment was not taken full advantage of, leadership, judgment and decision making were impaired and what is most important, the crew co-operation was practically non-existent. A crew resource man-

agement training adapted to the Tunisian culture would probably have prevented at least some of these CRM related deficiencies.

2.2.8 Line-oriented flight training

Line-oriented flight training (LOFT) is a simulator training method which gives crewmembers the opportunity to practice line operations (e.g. maneuvers, operating skills, systems operation and the operator's procedures) with a full crew in a realistic environment. Crewmembers learn to handle a variety of scripted real-time scenarios which include for example routine, abnormal and emergency situations. They also learn and practice cockpit resource management skills, including crew co-ordination, judgment, decision making and communication skills.

The overall objective of LOFT is to improve total flight crew performance in the above mentioned areas. Air Liberté Tunisie had a simulator training which it called LOFT. This training, however, included too many abnormal and emergency situations and lost therefore the basic idea of the LOFT. When abnormal and emergency situations play too large a role in this kind of training, the normal company procedures are not emphasized enough. A good opportunity to improve the general quality of normal operations is lost. This applies directly to this accident. A relatively normal situation got out of hand partly due to the lack of proper training.

2.2.9 Summary of the human factors

Three significant errors were made in the final phase of the flight: the go-around mode was activated with the ATS engaged, idle thrust was not set and ground spoiler deployment was not backed up. The first two errors describe the piloting pilot's work at the upper limits of or above his capacity. Regarding all three errors it must be noted that the monitoring pilot fell behind in the situation. The correction of any of the three errors mentioned would have prevented the accident. A go-around initiated at any moment before the landing gear vibration would have prevented the accident as well.

The operation took place as an individual performance of the piloting pilot, the captain, during which the monitoring pilot did not take care of his duties. This was the case partly because of the first officer's basic aptitude but above all because the first officer was unexpectedly made the monitoring pilot. The first officer had no training for this kind of late change of duties. The procedures and

practices rising from the company culture did not support nor strengthen the performance of the monitoring pilot.

2.3 Technical investigations

2.3.1 Spoiler operation

It is not known whether the ground spoilers were armed for landing. Let us assume that they were armed. The armed spoilers would automatically deploy when commanded either main gear wheel spin-up or ground shift mechanism actuation via nose strut compression. In this instance, armed spoilers should have been deployed when commanded by the nose gear actuated ground shift mechanism. The spoiler handle should have moved toward the spoiler deployed position and then immediately back toward retracted position, because the advanced (to 1,4 EPR) left throttle's spoiler knockdown mechanism would have released the handle from the autopoiler deployment mechanism. The spoilers could have been deployed manually after knock down function. The ground spoilers could also have been deployed manually even if they had not been armed. This was not done.

2.3.2 Landing gear damage

The marks on the runway show that the left main gear started to vibrate severely at a distance of 190 m and the right main gear at a distance of 260 m from touchdown. As a result both main landing gear torque link Apex bolts and nuts failed in their threads by ductile overload. The left main gear wheel pair turned nineteen 180 degrees turns in the shock strut. The first turn cut the brakefluid hoses and the speed transducer wires in the wheel pivot. The left brakes were lost. The right main gear wheels vibrated severely but the wheel pair did not turn in the shock strut. One of the four brakefluid hoses was cut but the brakes remained operational. The anti-skid system boosted the vibration of both main landing gears.

The investigation commission has knowledge of five similar landing gear damage events to the same aircraft type. The first took place already in 1989. In two cases the vibration has led to the damage of the landing gear downlock and the aircraft collapsing onto its wing during the landing roll. Common to these cases has been a high speed at touchdown, the spoilers have remained retracted and the brakes have been applied immediately after touchdown. Because of the high speed and the spoilers remaining retracted, the weight of the aircraft has not shifted to the wheels immediately at touchdown. Together these three factors have caused a severe main landing gear vibration.

The main landing gear of the aircraft type in question is prone to vibration under previously mentioned conditions. The manufacturer has installed a shimmy damper on the main gear torque link apex bolt but it was not designed for the above mentioned critical conditions.

In this case the left main landing gear left tire had worn more than the manufacturer recommended economical change limit would permit but the right tire was almost unworn. According to the experts of the aircraft manufacturer the wear difference between paired tires does not have an effect on the vibration characteristics of the main landing gear.

The aircraft manufacturer has been aware of the main landing gear vibration characteristics and started investigations for its avoidance already years ago. The first Service Bulletin (SB) regarding the main landing gear vibration was issued already in 1991 and it concerned aircraft equipped with autobrake system. This aircraft did not have the autobrake system. In 1995 the manufacturer has issued the following three Service Bulletins: SB A32-275 4 January 1995, SB 32-276 31 March 1995 and SB 32-278 31 March 1995. These have been published after the accident under investigation. After a major modification made according to the SB 32-278 the damping capacity of the shimmy damper (p/n 5923142-5511) should remain unchanged during vibration. The general damper type (p/n 5923142-5505) used in the accident aircraft loses its damping capacity quickly once a severe vibration has started.

In addition to the SBs the manufacturer has published several All Operator Letters (AOL) for aircraft operators for the avoidance of the vibration (the first on January 11, 1990). The last recommendation published before the accident was FO-AOL-9-043, dated September 30, 1994. Its recommendations were:

1. *Ground spoilers should be used for all landings, and should be deployed (manually, if necessary) prior to brake application, runway permitting.*
2. *Fly a speed stabilized approach, using appropriate approach speeds and maximum flaps to reduce landing speeds/distance.*
3. *Avoid landing long to reduce the need for maximum braking.*
4. *Use the thrust reversers in accordance with the Flight Crew Operating Manual (FCOM) to reduce wheel braking energy required during landings and aborted takeoffs.*
5. *Avoid unnecessary heavy braking during the landing, if possible, to further reduce braking loads. When the auto brake system is used, select the MINIMUM or MEDIUM position when possible.*

6. *Autobrakes, if installed, should be armed for takeoff and used per FCOM procudures in the event of a rejected takeoff (RTO). It is important that the crew ensure that the spoilers are deployed during an RTO.*
7. *If a substantial main gear vibration is felt (may appear as a heavy shudder or low frequency vibration) above approximately 50 knots during deceleration, momentarily release the brakes and reapply them smoothly to a lower braking level as soon as the vibration stops. If conditions warrant, however, maximum braking should be utilized.*

In addition, walk around checks should pay particular attention to main gear shimmy damper fluid level, since an improperly serviced damper will significantly affect gear stability under certain landing conditions.

Additionally the manufacturer has performed research and tests to improve the brake anti-skid system and the hydraulic (shimmy) damper to lessen the propability of landing gear instability. The research and tests resulted in the development and release of Service Bulletins A32-275, 32-276 and 32-278.

The United States' Federal Aviation Administration (FAA) and the National Transportation Safety Board (NTSB) have been aware of the MD-80 main landing gear vibration occurrences and have participated in the investigations into these occurrences. Subsequent to this accident the NTSB issued a Safety Recommendation to the FAA to mandate the incorporation of Service Bulletins 32-276 and 32-278. Both these bulletins have been mandated in the United States by the issuance of Airworthiness Directive 96-01-09, effective Feb 26, 1996. The AD specifies that Service Bulletin 32-276 be incorporated within 9 months of the effective date (2/26/96) and Service Bulletin 32-96 be incorporated within 36 months of the effective date.

2.3.3 Jamming of the left forward door

The left forward door opened only 10 cm which made it unusable for the evacuation. The door did not open completely because the guide roller had escaped the bayonnet bracket. The movement of the roller was probably a result of the flexure of the aircraft fuselage when the aircraft sideslipped off the runway. The aircraft manufacturer has published an AOL April 25, 1996 which describes the forward passenger door bayonnet design change. The change should, according to the manufacturer, prevent the door from jamming when the fuselage flexes. According to the manufacturer all new aircraft have been modified accordingly already at the factory production line since summer 1995.

2.4 The rescue and survival aspects

2.4.1 Evacuation

As each emergency situation is unique it is essential that all flight crew members have a thorough and up to date knowledge of the emergency equipment and all relevant emergency procedures as well as their assigned duties in the aircraft concerned. All items in the appropriate passenger evacuation and ground emergencies check list shall be performed. An emergency evacuation shall always be initiated whenever there is a risk of fire and the aircraft is stationary on the ground. When an evacuation order has been announced, the evacuation shall be carried out as quickly as possible using all usable (emergency) exits. The passengers shall be assisted in leaving the aircraft as fast as possible and directed to a place at a safe distance from the aircraft. It is of outmost importance that all handluggage and other personal belongings are left behind in order to leave the aircraft as fast and safely as possible.

In this case the pilots did not complete the appropriate check list ”Cockpit preparation for passenger evacuation” before leaving the cockpit: the fire handles had not been pulled. The captain ordered to evacuate the passengers through the left emergency exits. The evacuation was finally performed through the aft galley service door and overwing exits because the left forward door could not be opened. Also the aft stairs were tried to be utilized but they did not have enough room to extend because the tail of the aircraft was lower than normal. Neither the aft emergency exit nor other emergency exits were tried to be utilized. The passengers opened the right overwing exits by themselves and two passengers went out through them without the guidance of the crew.

The captain did not know about the fuel leak in the left wing fuel tank when he announced the evacuation order. One cabin crew member noticed the fuel leak on the left side of the aircraft very soon after the aircraft had stopped but this did not have an effect on the evacuation. The evacuation to the left side should have been discontinued when the fuel leak was noticed.

The evacuation took a long time, approximately 8 min. Several factors contributed to this: the first officer told the passengers to sit down and keep calm after the evacuation order had been announced, there was no fire, all usable emergency exits were not used and some passengers took their hand luggage with them. The passengers got only minor injuries because of the long evacuation time and the short distance from the emergency exits to the ground. The tour

guide in the aircraft acted as an interpreter when the evacuation instructions were announced. This helped the passengers (all Finnish speaking) to understand the instructions.

A deaf-mute passenger got into the forward lavatory during the evacuation but his guardian and a stewardess got him out. The rescue personnel finally carried two handicapped persons out from the aircraft.

2.4.2 The rescue organization of Kajaani airport

In an aircraft accident the rescue personnel of the airport must act on their own during the first minutes of the rescue operation which are of crucial importance. The units of the Kajaani rescue organization arrived 14 min after the accident. Their role in the rescue would have been important if there had been more injured passengers. In the case of fire a time of 14 min would have been too long. In an aircraft fire the fire fighting activities must be started within three minutes.

According to Finnish Aviation Regulation AGA M3-2 the Kajaani airport rescue crew was three persons during MD-83 operations but it had been added to four by the airport management. Additionally the loading and unloading of aircraft was managed at Kajaani airport by personnel who had been trained for the fire fighting and rescue work. Therefore the total rescue crew was six men.

The readiness of Kajaani airport rescue crew was good since its units arrived at the accident site located 2,5 km from the terminal building already two minutes after the alarm was given. According to the Aviation Regulation AGA M3-2 the personnel taking part in the rescue activities as a sideline to their normal work must always be immediately ready when a commercial airliner arrives or departs so that the response time requirements are met.

When estimating the consequences in case of a fire it can be stated that there was only a small fuel leak in one aircraft wing fuel tank. Because the fire fighting personnel arrived at the accident site quickly its extinguishing capacity would probably have been sufficient to extinguish a starting fire.

In this case the passengers were evacuated to the left side of the aircraft. One cabin crew member noticed the fuel leak on the left wing early during the evacuation. This danger was eliminated by foaming.

This accident proved that the airport rescue units have good chances for success if they are given sufficient operational resources such as the required training and appropriate equipment.

2.5 Air traffic services

2.5.1 Air traffic control

The accident aircraft flew via Jyväskylä towards Kajaani which is situated in uncontrolled airspace. Rovaniemi ATC officer cleared the aircraft to descend on QNH 1023 hPa and gave the traffic report and Kajaani transition level. The crew then asked the ATC officer whether they had been cleared to a specific Flight Level. The ATC officer answered: ”Liberty 930, descend to five thousand feet on QNH 1023.” The ATC officer thus cleared the aircraft to descend into uncontrolled airspace and the clearance was therefore against the procedures.

The ATC officer understood based on the radio communications and his previous experience that the crew did not know the operation in uncontrolled airspace well enough. The ATC officer assumed that there was no other traffic in the uncontrolled airspace into which the aircraft was descending when approaching Kajaani. The ATC officer wanted to make the situation flexible and did not start to instruct the crew about the FIS (Flight Information Services) methods. The ATC officer gave the aircraft a clearance against the procedures but from his point of view an acceptable one regarding the safety of the flight. This clearance had no effect on the accident.

2.5.2 Aerodrome Flight Information Service

Rovaniemi ATC officer passed the aircraft to Kajaani AFIS. Kajaani AFIS officer gave the crew traffic and weather report according to procedures, whichafter the crew asked whether RWY 07 was in use. AFIS officer confirmed. When the aircraft was on final approach, the AFIS officer gave the crew actual weather information, the intensity of approach and runway lights and told the crew runway was vacated. The crew answered: ”Thank you very much, runway in sight, cleared to land, thank you.” The AFIS officer answered: ”Confirming.” The AFIS officer thus confirmed a clearance which she had not given.

AFIS officer cannot give clearances but only information. The AFIS officer understood that the crew of the accident aircraft did not know the AFIS procedures and authorizations well enough. Since there was no other known traffic the AFIS officer considered the clearance against the procedures an unharmful

exception which made the work of AFIS officer and the crew easier. This clearance had no effect on the accident.

2.5.3 Making AFIS known

The Finnish air traffic services have learned during the last few years that the pilots from some charter airlines do not know the procedures of the AFIS nor the operation in uncontrolled airspace. Because of this the Civil Aviation Administration of Finland has translated the aviation regulation OPS M1-19 into English (Sep 1995). These translations have been sent to the Finnish airports which have traffic from the airlines referred to above. The airport personnel has given these translations to the crews of these charter airlines. The idea to translate the regulation came from a North-Finland airport.

Kajaani airport has after the accident individually prepared an information leaflet explaining the AFIS procedures. These leaflets have been given to the flight crews of the above mentioned airlines.

3 FINDINGS AND CONCLUSIONS

3.1 Findings

1. The crew had valid licences and they were qualified for the flight.
2. The airworthiness certificate was valid.
3. No technical malfunction or damage was noted in the aircraft prior to the accident.
4. No notes had been made on the operational flight plans during the flight.
5. One cabin crew member was missing from the aircraft weight and balance calculations.
6. The normal check lists were difficult to read. The investigation commission has learned that the airline has improved their check lists after the accident.
7. The weather was not a contributing factor to this accident.
8. The pilots did not know the operating procedures in uncontrolled airspace nor at AFIS airports well enough.
9. The approach and runway lights were on 100 % intensity during approach and landing. The pilots did not request dimming of the lights.
10. The first officer disengaged the autopilot at a height of approximately 490 ft (AGL).
11. The approach was normal until the final phase of the final approach.
12. The aircraft was tracking the localizer and the glide slope. According to the captain's observation the aircraft was, however, above the glide slope and he therefore ordered the first officer to increase the rate of descend.
13. Because the visibility was good and it was dark, it is possible that the 100 % high intensity approach and runway lights caused a visual illusion according to which the aircraft was above the glide slope. Obviously the captain did not check the position of the aircraft from the glide slope indicator but trusted his visual observations. The approach and runway lights were disturbingly bright in the prevailing conditions.
14. The NAV 2 receiver (first officer's side) was tuned into landing runway ILS frequency and the NAV 1 receiver (captain's side) was tuned into VOR/DME Kainuu. The captain had ILS expanded localizer and glide slope information from NAV 2 on his ADI but no ILS Flight Director information when flying manually. The company FOM had no procedure for the use of NAV equipment in good weather conditions.
15. The first officer who was at this moment flying the aircraft manually obviously monitored the ILS Flight Director on his ADI and ILS localizer and glide slope raw data on his HSI. Because the aircraft was not above the

glide slope according to the flight instrument indications the first officer did not increase the rate of descend in spite of the captain's order.

16. It cannot be heard on the CVR that the first officer would have questioned the captain's order.
17. The captain decided to land the aircraft himself. This change of duties occurred at a height of approximately 150 ft.
18. During the change of duties either pilot inadvertently pushed either TOGA button whichafter the thrust increased to go-around thrust. Neither pilot noticed the flight guidance system mode change from speed mode to go-around mode.
19. The aircraft crossed the runway threshold at an appropriate height but with a 24-knot overspeed compared to the landing speed booklet threshold speed.
20. When the engines reached go-around thrust the captain reduced the thrust to idle but did not disengage the ATS. The thrust started immediately thereafter to increase again towards go-around thrust. The captain did not realize that the ATS was still engaged and in go-around mode.
21. The captain concentrated on flying the aircraft towards the runway despite the overspeed. The ATS was disengaged only three seconds before touchdown. The throttle was not even then retarted to idle nor did the captain notice that the thrust setting was too high for landing.
22. The first officer did not take care of the duties of the monitoring pilot after the change of duties. At this moment he obviously looked out to the runway and did not therefore notice the overspeed nor the high thrust setting. This was the result of the surprising and late change of duties for which the airline had no well established procedure nor the crew appropriate training.
23. The touchdown occurred at a distance of 600 m from the normal touchdown point and with substantial overspeed (approximately 26 kt).
24. The aircraft touched down nose gear first which is extremely unusual for this aircraft type.
25. The ground spoilers did not deploy at touchdown. It is not known with certainty whether the spoilers were armed for landing. The pilots claimed that they had been armed. Due to the high thrust setting (left throttle lever position) the automatic ground spoiler deployment would not have been possible. The first officer did not monitor the spoiler deployment. Spoilers were not deployed manually either.
26. After touchdown the captain applied wheel brakes and thought that he also applied reverse thrust. The reverse thrust was not available because the throttles were not on idle. The spoilers were not deployed and the wings therefore maintained their lift. The aircraft weight did not shift to the wheels. This contributed to the main landing gear vibration.

27. The main gear started to vibrate severely and the main gear torque link Apex bolts and nuts failed in their threads by ductile overload.
28. A go-around and a new approach would have been possible until the main gear vibration started.
29. The captain reduced thrust to idle five seconds after touchdown when the aircraft was vibrating severely. The pilots' observations were very limited due to the severe vibration of the aircraft. The reverse thrust was only applied 10 s after touchdown with a very low thrust setting.
30. The captain told that he had steered the aircraft right out of the runway to the flat and clear strip area because the remaining runway was not sufficient for stopping. This decision was reasonable because the terrain had a slight downhill slope on the runway extension. There were also approach lights and other electrical equipment. Actually the aircraft turned right mainly because only the right main landing gear brakes were effective.
31. Main landing gear vibration can occur on this aircraft type in certain conditions (high groundspeed, ground spoilers retracted, brakes applied immediately after touchdown). The aircraft manufacturer had warned the operators of this danger and given instructions on how to avoid it. Main landing gear vibration and the resulting main gear damages had occurred before this accident.
32. The aircraft manufacturer has further improved the shimmy damper and brake system after the accident.
33. The forward passenger door opening mechanism was jammed because the cam roller escaped the bayonnet track. This was the result of the fuselage flexure which occurred during the sideslip. The door could not be opened for evacuation. The Douglas Aircraft Company has issued April 25, 1996 an All Operator Letter to all DC-9, MD-80 and MD-90 operators regarding forward passenger door bayonet design change.
34. The left wing fuel tank was punctured in the forward wing spar web. 400 litres of fuel leaked into the ground through the hole.
35. The pilots did not complete the check list ”Cockpit preparation for passenger evacuation”: engine fire handles had not been pulled.
36. The captain ordered to evacuate the passengers through the left emergency exits. The captain did not know about the fuel leak in the left wing tank when he gave the evacuation command. The crew noticed the leak during the evacuation but this did not have an effect on the evacuation activities.
37. The evacuation was completed in approximately 8 min.
38. The passengers were allowed to take their handluggage with them during evacuation.

39. Some right side overhead stowage bin doors opened during the landing roll and some handluggage fell down. A lock was missing from one left side overhead stowage bin door.
40. Some items of aircraft emergency equipment were loose from their brackets and some did not have brackets at all. Also some other discrepancies were observed in the emergency equipment.
41. The NTSB has sent, on January 3, 1995 after the accident under investigation, a Safety Recommendation to the FAA suggesting that the FAA should publish its SBs concerning the vibration problem as ADs. The FAA has published two SBs as ADs (SB 32-276, SB 32-278) to be effective February 2, 1996.

3.2 Causes of the accident

The accident was caused by a chain of flight crew errors in the use of the auto throttle system and ground spoilers. The touchdown occurred approximately 600 m further than normal with substantial overspeed. The immediate brake application after touchdown without ground spoiler deployment, the main landing gear vibration characteristics and the overspeed led to the main landing gear vibration and damage during the landing roll. The left main landing gear brakes were lost. Reverse was applied only 10 s after touchdown and with a low thrust setting. As a result it was not possible to stop the aircraft on the remaining runway. The aircraft turned right and sideslipped of the runway mainly because only the right main landing gear brakes were effective.

Factors contributing to the accident were:

1. The 100 % high intensity approach and runway lights which possibly caused a visual illusion to captain's height observation just before he took the controls. According to the captain's statement the aircraft was above the glide slope at that time. The approach and runway lights were disturbingly bright in the prevailing conditions.
2. A change of duties between the piloting pilot and the monitoring pilot during the final phase of the final approach at a height of approximately 150 ft for which the pilots had no training nor the company established procedures.
3. An inadvertent TOGA button push which immediately caused engine thrust to increase towards go-around thrust setting and the flight guidance system mode to change to go-around mode.
4. The first officer did not perform the duties of the monitoring pilot after the change of duties, for example the ground spoiler operation was not monitored nor were the spoilers deployed manually. The flight guidance and auto throttle system mode changes were not observed and called out.
5. In general, the cockpit crew co-operation during the final phase of the final approach and landing was non-existent. The company practices, procedures and training did not support the team work of the cockpit crew.

4 RECOMMENDATIONS

1. The airline shall organize and give Crew Resource Management training for its pilots in order to improve cockpit crew co-operation and resource management using the guidelines set out in ICAO Circular 217-AN132.
2. The airline shall establish procedures also for the good weather approaches.
3. The airline shall modify its procedures so that during final approach both NAV receivers shall be tuned to ILS frequency (if available) for flight guidance, monitoring and cross checking purposes.
4. The airline shall include flight instrument cross-check in its before landing check list.
5. The airline shall establish procedures and give training for the change of duties during the final phase of the final approach, if this practice is common to its operations.
6. The airline shall ensure that its pilots have sufficient knowledge of the operation in uncontrolled airspace and at AFIS airports.
7. The airline shall ensure that its pilots use and fill in the operational flight plans (OFP) during flight according to the company FOM.
8. The airline shall ensure that the emergency equipment fulfill the requirements set by the regulations.
9. The airline shall ensure through training that passengers are evacuated according to the regulations.

Helsinki, Finland, July 10, 1996

Lars Westermarck

Seppo Hämäläinen

Timo Uramaa

Esko Lähteenmäki

Heikki Tenhovuori

Eero Klemetti

Radio communications

930	The accident flight Air Liberté Tunisie 930
ACC TP	Tampere Area Control Centre
ACC RO	Rovaniemi Area Control Centre
AFIS KI	Kajaani Aerodrome Flight Information Service

From	To	Time (local)	Transmission
ACC TP	930	0627	Liberty 930, when ready descend to FL 110
930	ACC TP		Cleared down 110, call you leaving 330, Liberty 930
ACC TP	930		Roger
930	ACC TP		Tampere, Liberty 930 leaving 330 down 110
ACC TP	930		Liberty 930
ACC TP	930	0638	Liberty 930, contact Rovaniemi 124,2 good morning
930	ACC TP		124,2 Liberty 930, good morning sir
930	ACC RO		Good morning Liberty 930
ACC RO	930		Morning Liberty 930, Rovaniemi control, radar contact
930	ACC RO		Thank you
ACC RO	930		Liberty 930, continue descend on Kajaani QNH 1023, transition level 50, no traffic reported below FL 95
930	ACC RO		Roger, we continue our descend to Kajaani, QNH 1023, Liberty 930
930	ACC RO		And confirm, Liberty 930, did you give me a level
ACC RO	930		Liberte 930, descend to five thousand feet on QNG 1023
930	ACC RO		Five thousand copy ok, thank you
ACC RO	930	0645	Liberte 930, contact Kajaani information on 118,1, good morning
930	ACC RO		118,1, good morning, thank you
930	AFIS KI	0645	Kajaani good morning, Liberty 930
AFIS KI	930		Liberty 930, Kajaani AFIS, go ahead
930	AFIS KI		930 descending to five thousand feet, QNH 1023, 25 DME
AFIS KI	930		Liberty 930, no reported traffic, weather in Kajaani: wind 110 degrees 3 knots, visibility more than 10 km, clouds 6 octas 1100 feet, temperature minus 9, dewpoint minus 11, QNH 1023, transition level 50
930	AFIS KI		Thank you, copied ok, runway 07 in use?
AFIS KI	930		Yes, runway 07 in use

930	AFIS KI		Thank you, descending to five thousand
AFIS KI	930		Liberty 930
AFIS KI	930		Liberty 930, for information runway is clear and dry, braking action good
930	AFIS KI		I copied ok, 930, and we leave five thousand down two thousand one hundred
AFIS KI	930		Liberty 930, roger
AFIS KI	930		Liberty 930, handling company would like to know are you going to refuel in Kajaani
930	AFIS KI		Negative, madam
AFIS KI	930		930
930	AFIS KI		Thank you
AFIS KI	930		Liberty 930, what is your distance
930	AFIS KI		Distance 6 miles, 930, and established on localizer
AFIS KI	930		930 and report outer marker inboud
930	AFIS KI		Call you outer marker
930	AFIS KI	0654	Outer marker, Liberty 930
AFIS KI	930		Liberty 930, runway vacated, wind 100 degrees 3 knots, 100 percent high intensity lights on
930	AFIS KI		Thank you very much, runway in sight, cleared to land, thank you
AFIS KI	930		Confirming
AFIS KI	930	0657.12	Liberty 930, are you okay?
930	AFIS KI	0657.32	Kajaani, Liberty 930
AFIS KI	930		Are you okay and on the runway
930	AFIS KI	0658.00	Negative negative, we are outside the runway, we got just when landing tyres broke, we need assistance please
AFIS KI	930		Say again please
930	AFIS KI		We are outside the runway, outside the runway, we got tyres blown
AFIS KI	930		Here is a fire car coming for you
930	AFIS KI		Yes please

MITTAKAAVA 1:4000

0 50 100 200 M

KAJAANISSA 02 PNÄ JOULUKUUTA 1994

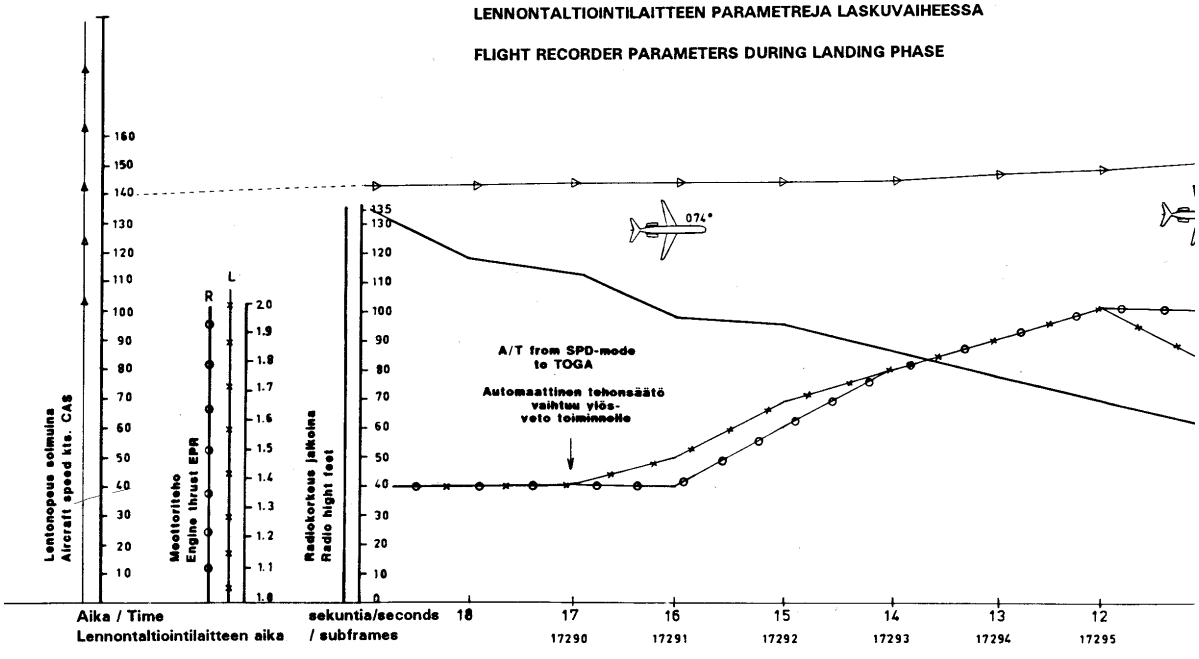
VANHEMPI RIKOSKONSTAAPELI Pentti Kiiponen

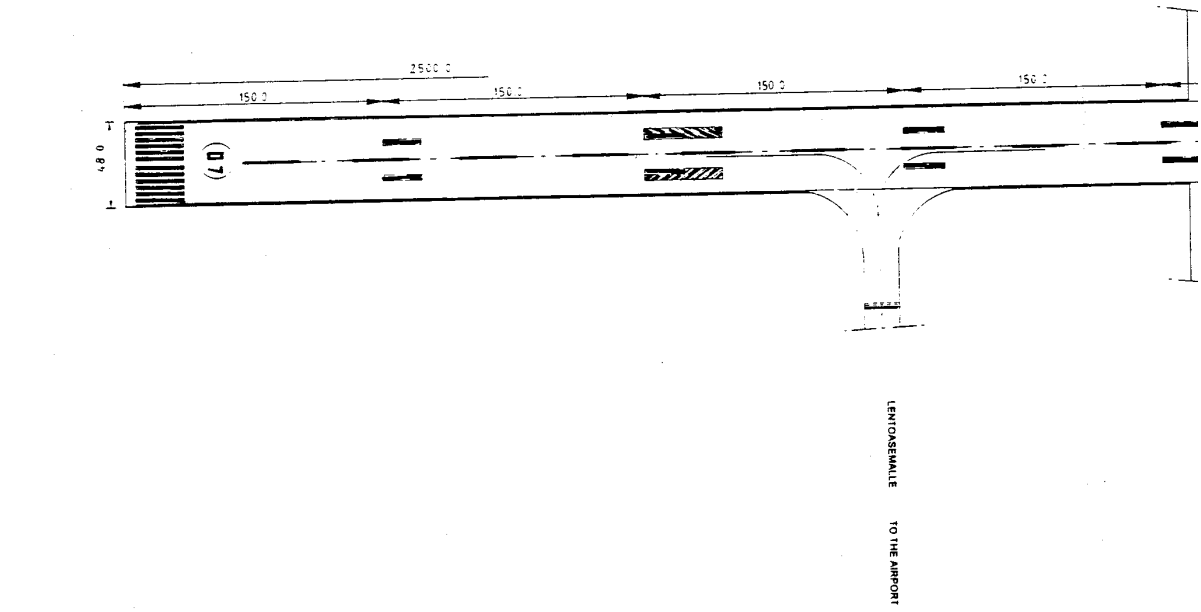
LENTOKONEEN F-GHED:N KIITORADAN PINTAAN JÄTTÄMÄT JÄLJET JA LENTOKONEESTA IRRONNEIDEN OSIEN SIJAINTI

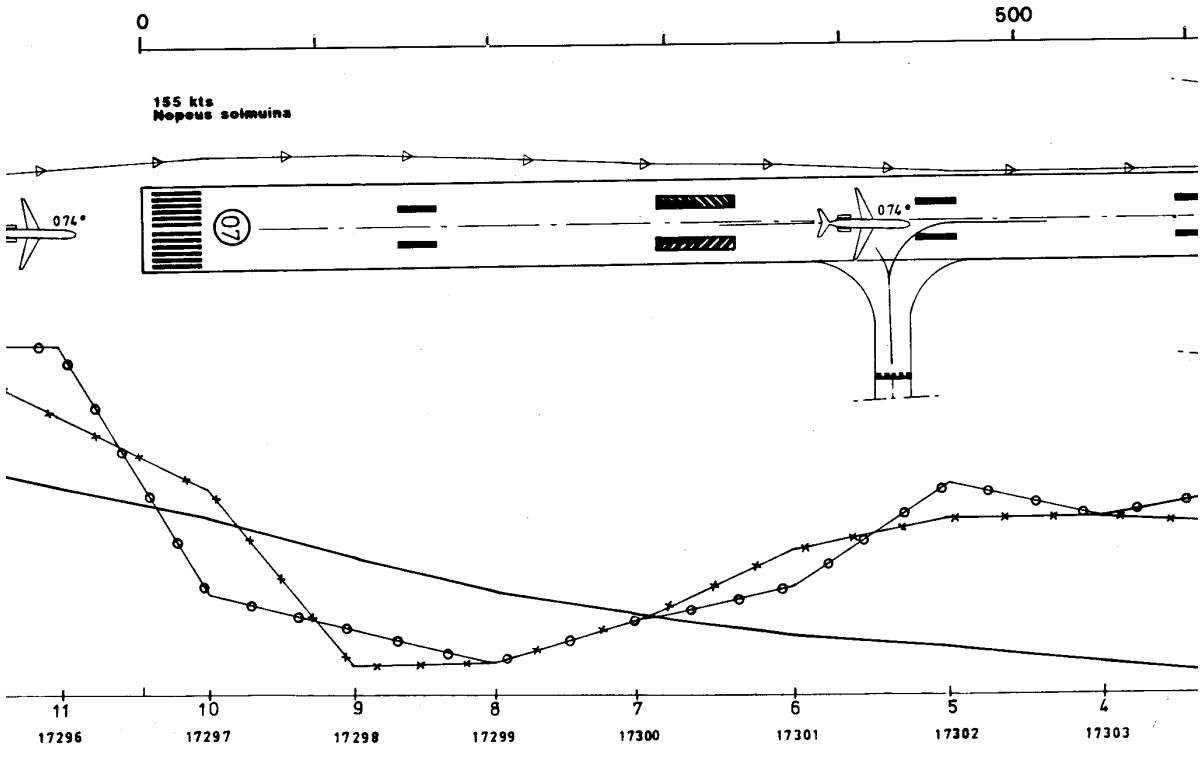
THE TRACKS WHICH THE F-GHED OF THE AIRCRAFT LEFT ON THE SURFACE OF THE RUNWAY AND THE LOCATION OF THE PIECES WHICH CAME LOOSE FROM THE AIRCRAFT

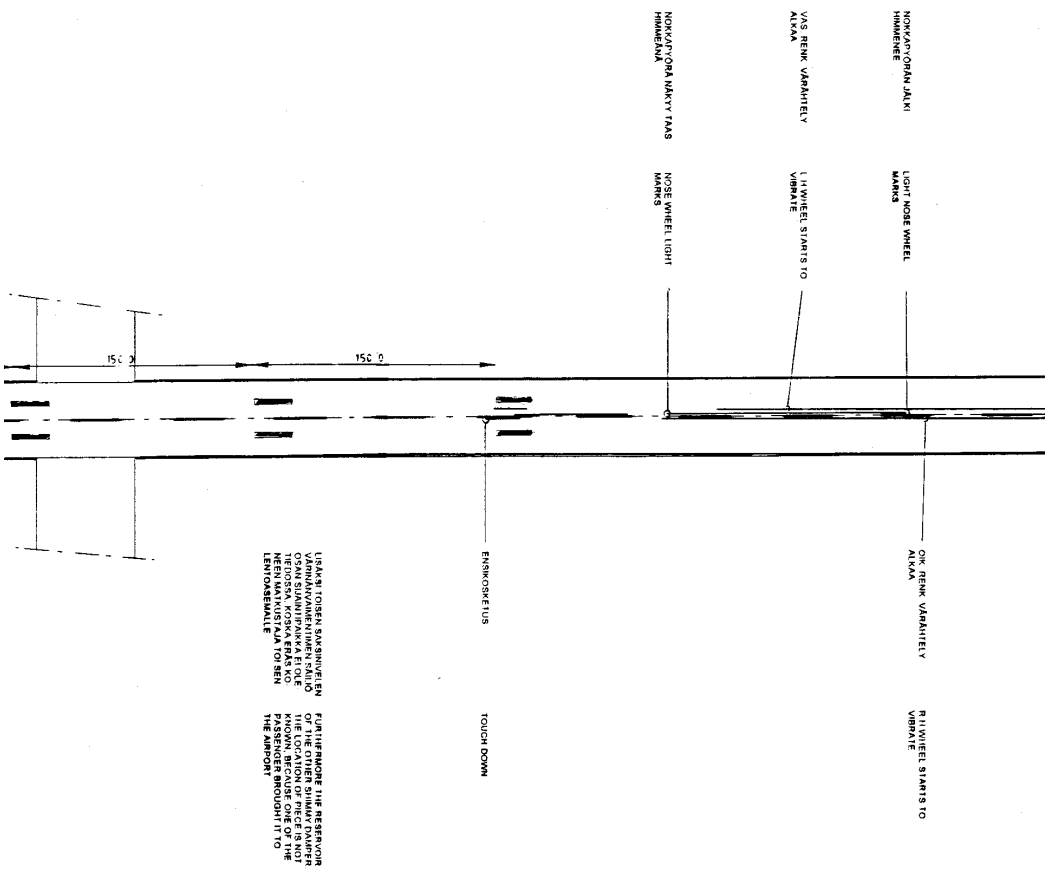
LENNONTALTIOINTILAITTEEN PARAMETREJA LASKUVAIHEESSA

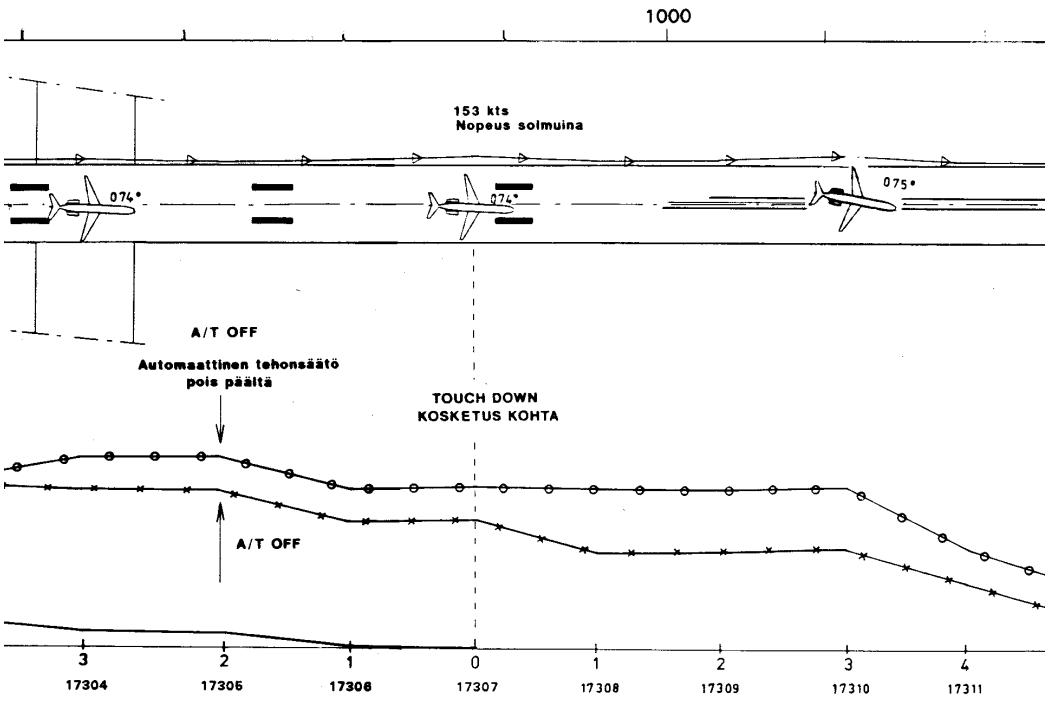
FLIGHT RECORDER PARAMETERS DURING LANDING PHASE

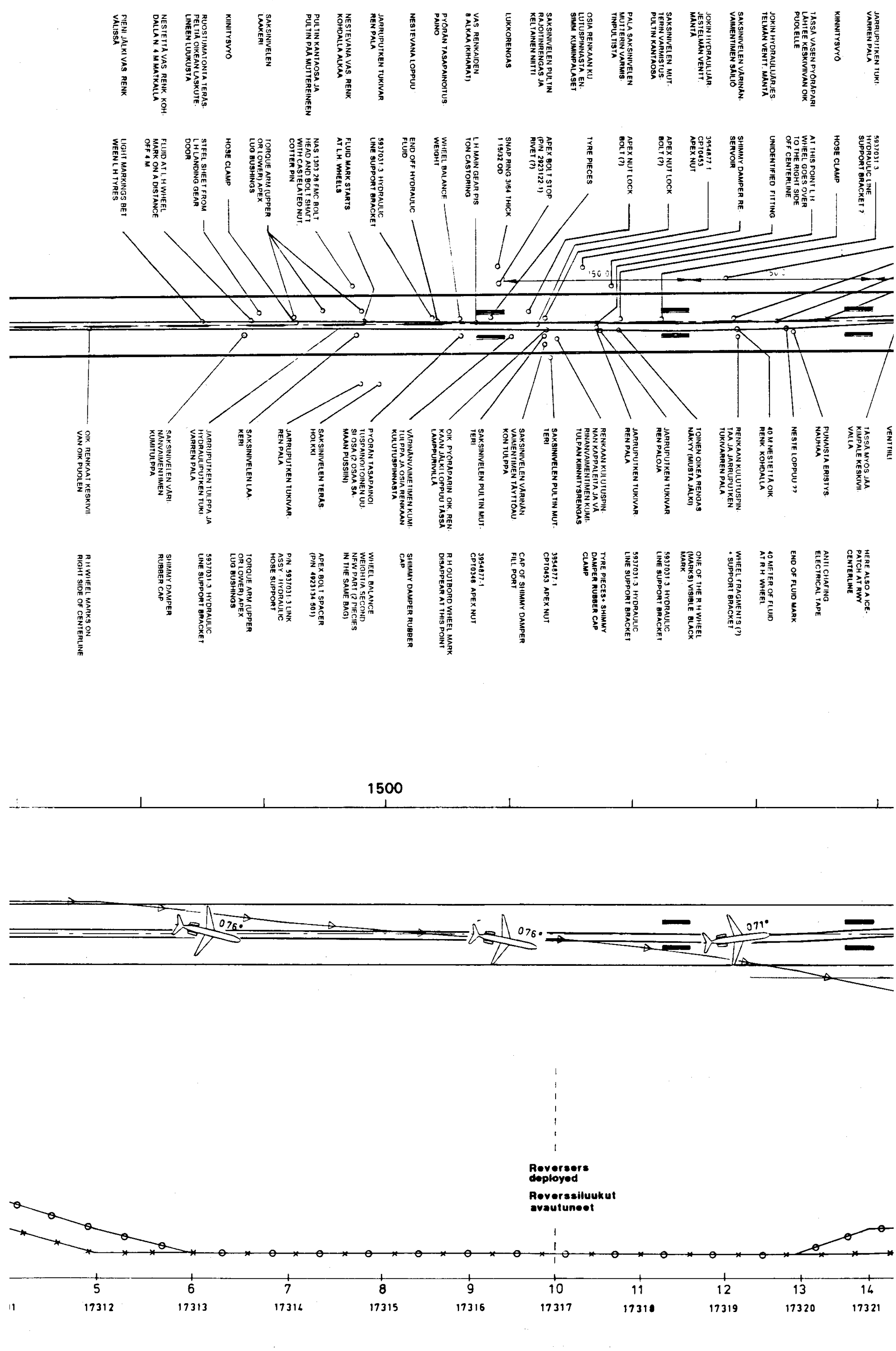



2500 m
150 m
150 m
150 m
150 m
48 m
07
LENTOASEMALLE
TO THE AIRPORT


0
500
155 kts
Nopeus solmuina
074°
074°
07
11
10
9
8
7
6
5
4
17296
17297
17298
17299
17300
17301
17302
17303


NOKKAPYÖRÄ NÄKYY TAAS HIMMENNÄ
NOSE WHEEL LIGHT MARKS
VAS RENK VÄRÄHTELY ALKAA
L H WHEEL STARTS TO VIBRATE
NOKKAPYÖRÄN JÄLKI HIMMENEE
LIGHT NOSE WHEEL MARKS
ENSINKOSKETUS
TOUCH DOWN
OIK RENK VÄRÄHTELY ALKAA
R H WHEEL STARTS TO VIBRATE


1000
153 kts
Nopeus solmuina
074°
074°
075°
A/T OFF
Automaattinen tehonsäätö pois päältä
TOUCH DOWN
KOSKETUS KOHTA
A/T OFF
3
2
1
0
1
2
3
4
17304
17305
17306
17307
17308
17309
17310
17311



JARRUPUTKEN TUKIVARREN PALA
5937031-3 HYDRAULIC LINE SUPPORT BRACKET ?
KIINNITYSVYÖ
HOSE CLAMP
TÄSSÄ VASEN PYÖRÄPARI LÄHTEE KESKIVIIVAN OIK PUOLELLE
AT THIS POINT L H WHEEL GOES OVER TO THE RIGHT SIDE OFF CENTERLINE
JOKIN HYDRAULIJÄRJESTELMÄN VENTT. MÄNTÄ
UNIDENTIFIED FITTING
SAKSINIVELEN VÄRINÄNVAIMENTIMEN SÄILIÖ
SHIMMY DAMPER RESERVOIR
JOKIN HYDRAULIJÄRJESTELMÄN VENTT. MÄNTÄ
3954877-1 CPT0453 APEX NUT
SAKSINIVELEN MUTTERIN VARMISTUSPULTIN KANTAOSA
APEX NUT LOCK BOLT (?)
PALA SAKSINIVELEN MUTTERIN VARMISTINPULTISTA
APEX NUT LOCK BOLT (?)
OSIA RENKAAN KULUTUSPINNASTA ENSIMM. KUMINPALASET
TYRE PIECES
SAKSINIVELEN PULTIN RAJOITINRENGAS JA KELTAINEN NIITTI
APEX BOLT STOP (P/N 2923122-1) RIVET (?)
LUKKORENGAS
SNAP RING 3/64 THICK 1 15/32 OD
VAS. RENKAIDEN 8 ALKAA (KIHARAT)
L H MAIN GEAR PISTON CASTORING
PYÖRÄN TASAPAINOITUSPAINO
WHEEL BALANCE WEIGHT
NESTEVANA LOPPUU
END OFF HYDRAULIC FLUID
JARRUPUTKEN TUKIVARREN PALA
5937031-3 HYDRAULIC LINE SUPPORT BRACKET
NESTEVANA VAS. RENK KOHDALLA ALKAA
FLUID MARK STARTS AT L.H. WHEELS
PULTIN KANTAOSA JA PULTIN PÄÄ MUTTEREINEEN
NAS 1303 28 FMC BOLT HEAD AND BOLT SHAFT WITH CASTELATED NUT, COTTER PIN
SAKSINIVELEN LAAKERI
TORQUE ARM (UPPER OR LOWER) APEX LUG BUSHINGS
KIINITYSVYÖ
HOSE CLAMP
RUOSTUMATONTA TERÄSPELTIÄ OIKEAN LASKUTELINEEN LUUKUSTA
STEEL SHEET FROM L H LANDING GEAR DOOR
NESTETTÄ VAS. RENK KOHDALLA N. 4 M MATKALLA
FLUID AT L H WHEEL MARK ON A DISTANCE OFF 4 M
PIENI JÄLKI VAS. RENK VÄLISSÄ
LIGHT MARKINGS BETWEEN L H TYRES
1500
1500
VENTTIILI
TÄSSÄ MYÖS JÄÄKIMPALE KESKIVIIVALLA
HERE ALSO A ICE-PATCH AT RWY CENTERLINE
PUNAISTA ERISTYSNAUHAA
ANTI CHAFING ELECTRICAL TAPE
NESTE LOPPUU ??
END OF FLUID MARK
40 M NESTETTÄ OIK RENK. KOHDALLA
40 METER OF FLUID AT R H WHEEL
RENKAAN KULUTUSPINTAA JA JARRUPUTKEN TUKIVARREN PALA
WHEEL FRAGMENTS (?) + SUPPORT BRACKET
TOINEN OIKEA RENGAS NÄKYY (MUSTA JÄLKI)
ONE OF THE R H WHEEL (MARKS) VISIBLE BLACK MARK
JARRUPUTKEN TUKIVARREN PALOJA
5937031-3 HYDRAULIC LINE SUPPORT BRACKET
JARRUPUTKEN TUKIVARREN PALA
5937031-3 HYDRAULIC LINE SUPPORT BRACKET
RENKAAN KULUTUSPINNAN KAPPALEITA JA VÄRINÄNVAIMENTIMEN KUMITULPAN KIINNITYSRENGAS
TYRE PIECES+ SHIMMY DAMPER RUBBER CAP CLAMP
SAKSINIVELEN PULTIN MUTTERI
3954877-1 CPT0453 APEX NUT
SAKSINIVELEN VÄRINÄNVAIMENTIMEN TÄYTTÖAUKON TULPPA
CAP OF SHIMMY DAMPER FILL PORT
SAKSINIVELEN PULTIN MUTTERI
3954877-1 CPT0348 APEX NUT
OIK. PYÖRÄPARIN OIK. RENKAAN JÄLKI LOPPUU TÄSSÄ LAMPPURIVILLÄ
R H OUTBORD WHEEL MARK DISAPPEAR AT THIS POINT
VÄRINÄNVAIMETIMEN KUMITULPPA JA OSIA RENKAAN KULUTUSPINNASTA
SHIMMY DAMPER RUBBER CAP
PYÖRÄN TASAPAINOITUSPAINO/TOINEN UUSI OSA (2 OSAA SAMAAN PUSSIIN)
WHEEL BALANCE WEIGHT/A SECOND NEW PART (2 PIECES IN THE SAME BAG)
SAKSINIVELEN TERÄSHOLKKI
APEX BOLT SPACER (P/N 4923134-501)
JARRUPUTKEN TUKIVARREN PALA
P/N 5937031-3 LINK ASSY - HYDRAULIC HOSE SUPPORT
SAKSINIVELEN LAAKERI
TORQUE ARM (UPPER OR LOWER) APEX LUG BUSHINGS
JARRUPUTKEN TULPPA JA HYDRAULIPUTKEN TUKIVARREN PALA
5937031-3 HYDRAULIC LINE SUPPORT BRACKET
SAKSINIVELEN VÄRINÄNVAIMENTIMEN KUMITULPPA
SHIMMY DAMPER RUBBER CAP
OIK. RENKAAT KESKIVIIVAN OIK PUOLEN
R H WHEEL MARKS ON RIGHT SIDE OF CENTERLINE
1500
076°
076°
071°
Reversers deployed
Reverssiluukut avautuneet
5
6
7
8
9
10
11
12
13
14
17312
17313
17314
17315
17316
17317
17318
17319
17320
17321

LIITE 2 / APPENDIX 2