D.G.A.C.

Portugal

McDonnell Douglas Corporation DC-10-30F

MARTINAIR HOLLAND NV

Final Report On The Accident

Occurring at Faro Airport - Portugal

on 21 December 1992

Report nr. 22/Accid/GD1/92

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report is the valid document

IMPORTANT

This translation from Portuguese to English language is provided by the Netherlands Aviation Safety Board for the convenience of the Board and the official investigators. Since no other translation is available, this translation is also provided to the Press and the public.
Neither the Netherlands Aviation Safety Board, nor the Netherlands Government or any official organisation takes any responsibility for the consequence of any action initiated, based on this translation.

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November 1994

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ABBREVIATIONS

AIDS - Airborne Integrated Data System
AOM - Airplane Operations Manual DC-10
ANA - Aeroportos e Navegaçâo Aérea, E.P.
ATC - Air Traffic Control
ATS - Auto-Throttle System
ATS/SC - Auto-Throttle / Speed Computer
BIM - Basic Instructions Manual
CCRL - Centro de Controle Regional de Lisboa
CMD - Command Mode
CTA - Controlador de Tráego Aéreo (Air Traffic Controller)
CVR - Cockpit Voice Recorder
CWS - Control Wheel Steering
DFDR - Digital Flight Data Recorder
FAA - Federal Aviation Administration
F.E. - Flight Engineer (técnico de voo)
FL - Flight Level
F.O. - First Officer (copiloto)
ft - feet
ICAO - International Civil Aviation Organization
INMG - Instituto Nacional de Meteorologia e Geofisica
INM - Instituto Nacional de Meteorologia
IST - Instituto Superior Técnico
kt - knots
MP495 - (MPH495) - Martinair Flight
NAIB - Netherlands Accident Investigation Bureau
NASB - Netherlands Aviation Safety Board
NLR - National Aerospace Laboratory the Netherlands
PF - Pilot Flying
PNF - Pilot Not Flying
PSU - Passenger Service Unit
RA - Radio Altitude
RLD - Department of Civil Aviation - Netherlands
SIO - Sistema Integrado de Observaçâo Meteorológica
UTC - Universal Time Coordinated

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NOTE

The present report expresses the technical conclusions established by the Investigation Commission concerning the circumstances and causes of this accident.

According to Annex 13 of ICAO, the analysis of the events, the conclusions and the recommendations have not been formulated in a manner as to determine faults or to attribute individual or collective responsibilities.

The only objective has been to draw from this accident lessons susceptible to prevention of future accidents.

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SYNOPSIS

Date of the Accident	: 21 December 1992, 07.33.20 UTC
Place of the Accident	: Faro Airport Latitude 37°00'46"N Longitude 07°57'53"W Elevation 7 m (24 ft)
Nature of Flight	: Non Scheduled Passenger Transport
Flightnumber	: MP 495
Owner	: Netherlands Government, Netherlands Air Force
Operator	: Martinair Holland N.V.
Occupants	: Cockpitcrew : 3 Cabincrew : 10 Passengers : 327
Results	: 56 killed, 106 serious injuries, 176 minor or no injuries. Aircraft destroyed Light damage to Runway 11 of Faro Airport

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NOTIFICATION OF THE ACCIDENT TO NATIONAL AND FOREIGN AUTHORITIES

According to Annex 13 of ICAO, on 21 December 1992, approx 12.45 Local Time, Notification of the Accident was transmitted to the following Authorities:

- Netherlands Accident Investigation Bureau (NAIB) - Holland

- National Transportation Safety Board (NTSB) - USA

- Federal Aviation Administration (FAA) - USA

- McDonnell Douglas - USA

- International Civil Aviation Organization (ICAO) - Canada

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ORGANIZATION OF THE INVESTIGATION

According to Annex 13 of ICAO, Portugal, as the State of Occurrence, started the investigation into the Circumstances and Causes of the Accident with Aircraft DC-10-30F, Registration PH-MBN, occurring on 21 December 1992.

In Accordance with the Provisions of Annex 13, Officials of the NAIB - Netherlands Accident Investigation Bureau and NTSB - National Transportation Safety Board, USA, collaborated with this Commission, with the Status of Accredited Representatives.

For the Purpose of the Gathering of Elements, Tests and Research, Specialists of the following Organizations and Companies participated as well:

- Federal Aviation Administration - USA
- McDonnell Douglas - USA
- General Electric - USA
- Rockwell International - USA
- Netherlands National Aerospace Laboratories - Holland
- Instituto Superior Técnico
- Instituto Nacional de Meteorologia

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COMPOSITION OF THE INVESTIGATION COMMISSION

By decision of the Director-General of Civil Aviation, the following Investigation Commission was appointed.

Eng. Luis Alberto Figueira Lima da Silva
Director do Pessoal Aeronautica, functioning as president

Coronel José A. Morais da Silva
Inspector Superior Principal

Eng. José Manuel Salgueiro
Inspector Principal de Aviacao Civil

Joaquim Queirós Neves
Subinspector Principal

Jorge Oliveira
Chefe dos Servicos de Controle de Trafego Aéreo

The Commission was appointed to investigate the Causes of the Accident as well as establish the Conclusions and necessary Recommenations.
By proposal of the President of the Investigation Commission the following DGAC-Technicians were associated:

Eng. Sérgio Renato Marques Carvalho
Inspector Superior de Aviacao Civil
(for the Nav. Aids aspects)

Dr. Pedro Manual Patricio Matos
Inspector de Aviacao Civil
(For the Medical and Pathological Aspects)

Antonio de Sousa Faria E Mello
Subinspector Especialista
(For Flight Operation aspects)

Duarte Nuno Abreu Lima de Araujo
Subinspector Especialista
(For Meteorology and Navigation aspects)

Antonio Maria Domelas Marinho Falcao
Subinspector Especialista Principal
(For Communication aspects)

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By decision of the Director-General of Civil Aviation, on 26 October 1993, Dr. Antonio José Lapido Moreira Rato - Chefe de Divisao da Navegacao Aérea was appointed, to replace Coronel José Morais Da Silva, the reason being the termination of the latter's duties with the DGAC.

Summary of the work of the commission

The Bureau of Prevention and Accident Investigation was notified of the Accident on 21 December 1992 at approx 09.04 Local Time.

The Inquiry Commission travelled to Faro on the very day of the Accident, arriving at 14.30 Local Time at the Accident Site.
Immediately the Airport Authorities were contacted, as well as the Air Traffic Services and Meteorological Services.

The general examination of the Wreckage was started immediately, which was hampered by the bad meteorological conditions.

On that day the DFDR, CVR and AIDS Recorders were recovered.

Photographs were taken of the marks left on the runway by the aircraft, as well as detailed photographs of the cockpit.

Air traffic controllers on duty at the time of the accident, the three cockpit crew of the aircraft and visual witnesses were also interviewed.

On the following day the commission met with members of NAIB, NTSB, Martinair, FAA, General Electric, McDonnell Douglas and ANA, providing the available elements and then working groups were created to proceed with the detailed examination of the wreckage.

On 22 and 23 of December the wreckage examination was continued, and the recorded ATC communications were listened to.

A helicopter flight was made over the accident zone in order to get a video registration.

On the 30 of December the Portuguese Air Force made airphotos of the accident zone.

As it was not possible to decodify in the country the "Digital Flight Data Recorder", as the required equipment was not available, the collaboration of NTSB was requested.

The decodification was performed from 7 January 1993 to 12 February 1993 at NTSB Washington D.C. USA in the presence of a member of this commission.

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The transcription of the recordings in the "Cockpit Voice Recorder" was performed in Holland at KLM in the presence of a member of this commission and a member of Netherlands Accident Investigation Bureau.
This transcription was not performed at DGAC as the aircraft crew used parts of the conversation in Dutch language.

The transcription of the air traffic recordings was performed at DGAC.

Collaboration was requested from NAIB on the investigations related to Martinair flight operations, pilot training, crew medical history and survival inquiry.

On request of the commission NAIB ordered from the Netherlands National Aerospace Laboratory a study on the possibility of existence of a windshear/downburst situation in the Faro airport vicinity.

NTSB was requested information on the operational study and behaviour of the AUTOTHROTTLE SYSTEM, and this study was performed by McDonnell Douglas and Rockwell.

Instituto Superior Tecnico performed the analysis on the fractured components of the main right gear.

Investigations were also conducted in the areas of NavAids, AIP Control organization and meteorological services.

After the conclusion of investigation the commission proceeded with a study and analysis of the gathered elements. Thereafter a Final Report project was eleborated which was discussed and approved by the Commission and collaborators.

The draft final report was sent to NASB on 21 July 1994 and to NTSB on 10 August 1994 for comments.

The comments of NASB, received on 06 September 1994 and of NTSB on 26 October 1994, have been added as appendix to the present report.

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SUMMARY OF THE ACCIDENT

On 21 December, 1992, a DC-10-30F aircraft registration PH-MBN, with 327 Passengers and 13 Crewmembers on Board, executed an approach to Runway 11 at Faro Airport, for a landing.

An active Thunderstorm Formation was approaching the airport.

The aircraft made a hard landing on the left hand side of Runway 11.

The Right Landing Gear fractured, followed by the separation of the Right Wing from the Fuselage, starting a rotation of the aircraft along its longitudinal Axis.

The aircraft slid to the right and off the runway, broke into two main sections and caught fire.

Several passengers and crewmembers were killed.

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1. Factual information

The times mentioned in this report are referring to the ATC communications clock, except when another reference is mentioned. In Annex 5 is a conversion-table of simultaneous hours.

1.1 History of the flight.

The aircraft operated on a non-scheduled public transport flight MP 495 from Amsterdam to Faro.
It took off from Schiphol Airport at 04.52 UTC with ETA Faro at 07.28 UTC.

Cruising level used was Fl. 370 with a TAS of 477 kts, as planned.

The effective duration of the flight (from take-off to touchdown) was 2.41 hours which did not differ significantly from the time previewed in the operational flightplan which was 2.36 hours.

The pilot in command occupied the left seat and the first officer, which performed the function of P.F. the right seat.

Before take-off, available meteo information related to Faro airport, was gathered at Schiphol Meteo Office and the Flight information Office.
The VOLMETS received during flight from Bordeaux and Lisboa did not indicate changes regarding the available information before flight.

The captain examined satellite pictures which showed a low pressure area over the Atlantic, near the South coast of Portugal. The forecast indicated isolated thunderstorms and rainshowers.

On board of the aircraft were three flightcrewmembers, ten cabin crewmembers and 327 passengers.

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The aircraft departure was delayed for about 40 min, due to a deficiency in the reverser of the no 2 engine, which was inhibited by the maintenance team in Amsterdam.

The aircraft was refuelled in Amsterdam and it was determined that the amount of fuel on board was correctly computed for the flight.

It included the trip fuel, alternate and reserve fuel, totalizing 31.000 kg.

After take-off the flight proceeded normally according to flightplan, without incidents.

At 06.56:00 UTC the captain announces "and here are the wipers."

At 06.56:09 UTC the F.E. refers to the computed approach speed: "Speeds ... they are two three seven, on nine five, one six one, fifty land is one three nine. The mentioned speeds coincide with the speed bugs which were found on both airspeed indicators after the accident.

At 06.54:56 UTC. The first officer performs the crew briefing.

At 06.57:50 UTC. The captain recommends to the First Officer a landing "not too soft".
"You have to make it a positive touchdown then".

At 06.58:45 UTC. Lisboa Control Centre instructs MP 495 to proceed direct to Faro.

At 07.00:54 UTC the captain and the copilot were reviewing procedures and facilities for the approach, making reference to the existence of PAPIS, to the nonexistence of approach light system and to the fact that NAV AID VOR, which was to be used, was nog aligned with the runway.

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At 07.02:39 UTC. The F.E. begins performing the descent checklist which is concluded 28 sec. later.

At 07.03:42 MP 495 requests clearance from Lisboa Control Centre to start descent to Faro and Lisboa Control Centre clears MP 495 to descent to Fl250 16 sec. later.

At 07.03:42 UTC MP 495 asks for clearance to descend to Faro from Lisbon Control Center, and CCRL cleared the descent to FL 230, 16 seconds later.

At 07.05:17 The Captain informs the F.O. of the Meteo conditions, transmitted by Lisboa Control Centre to MP 461, at 07.02:47 and mentions the need of 2.000 m visibility for a VOR approach.

From registrations made at 07.04:00, on the aircraft flight log, on top of descent it was verified that fuel remaining was 12 tons.

This commission found that the Aircraftlog was registered at the positions T.O.C. (top of climb)N.T.S. (VOR DME Nantes) and T.O.D. (top of descent).

The crew completed the Landing Data Chart for the approach and landing according to the model in the AOM (annex 3).

At 07.05:53 The captain decides: If it is not possible to land at Faro proceed direct to Lisboa, adding that it would not be a problem.

At 07.07:25. Lisboa Control Centre clears MP 495 to descent to Fl 70, and MP 495 acknowledges three sec. later.

At 07.08:03. The First Officer states that he can not see anything on the radar and a conversation follows between Captain and F.O. on the possibility of radar returns from the right at 10 km distance.

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At 07.09:36. Lisboa Control Centre instructs MP 495 to descent to Fl 070 and to contact Faro on 119.4 MHZ, which MP 495 acknowledges 6 sec. later.

At 07.09:44. MP 495 contacts Faro Approach Control, reporting its position and reporting that it was leaving Fl 240 and descending to Fl 070.

At 07.09:58. Faro Approach Control confirms the clearance of Lisboa Control Centre and provides landing instructions, including Meteo data. This message is acknowledged by MP 495, 41 sec. later.

At 07.14:01. The F.O. mentions that the weather is extremely bad.

At 07.16:23. A cabin crew member asks the crew about the weather conditions at Faro, and the captain answers that the weather is extremely bad.

The whole approach was performed by the F.O. as P.F., according to the procedures of "Manual Crew Coordination" established in the crew briefing, the Captain being P.N.F.

According to crew statements:

During descent and approach, the Captain detects on the weather radar several returns, corresponding to rain showers located West and South of the field. This last one at a distance of more than 50 miles.

During the outbound leg of the procedure he detected a Cb West of the field between 7 and 12 miles DME.

During descent the F.E. noticed a return South of Faro at an estimated distance of 10 miles.

The crew realises from the communication between Faro Approach and flight TP 120 that South of Faro there was what they identified as rainshowers, but according to the captain of TP 120 it was a thunderstorm cloud.

During the whole approach the aircraft experienced light turbulence and occasional moderate turbulence.

By the time when turning final, about 8 miles DME, turbulence of a degree superior to moderate, could have been found and if so, it would be related to the returns detected in the weather radar, west of the field. During final approach light to moderate turbulence was encountered.

The aircraft was flying in and out of clouds and the forward visibility was not good. Continuous rain was experienced in some occasions, namely near the threshold where due to the rain, the visibility was very poor.
Nevertheless, immediately before the threshold, visibility was good.

At 07.19:51. Faro Approach Control informs Flight TAP 120, when clearing it for take-off, that the wind was 150° with 24 knots.

At 07.20:10. Faro Approach Control clears MP 495 to descent to 4000 ft, in order to cross Fl 60 at a distance not less than 10 n.m. DME. MP 495 acknowledges the message 6 sec. later. According to crew statements the aircraft was flying in clear sky at 4000 ft when passing overhead Faro with the airport and MP 461 visible.

At 07.23:42. The F.O. asks: "Slats Take-off". 3 Sec. later, the sound of selection and confirmation by the Captain is recorded.

At 07.24:19. The F.O. asks: "Flaps 15", which was confirmed by the Captain 47 sec. later.

At 07.24:34. Faro approach Control instructs MP 495 to descent to 3000 ft, which MP 495 acknowledges 2 sec. later.

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At 07.24:58. Faro approach Control, when clearing MP 461 for landing, informs that the wind is 150° with 20 knots and that the runway was flooded, and at 07.25:35, the same flight was informed that the wind was from 130° with 18 knots, gusting to 21 knots.

At 07.25:57. MP 495 informs to be overhead and leaving 4000 ft to 3000 ft.

At 07.26:05. Faro Approach Control acknowledges the MP 495 message and clears him to descent to 2000 ft. MP 495 acknowledges this message 7 sec. later.

At 07.28:56. Faro Approach Control instructs MP 495 to report at minimums or runway in sight, informing him about the runway condition: Runway surface condition are flooded. MP 495 acknowledges this message 9 sec. later.

At 07.29:37. The landing gear was selected down at a distance of about 7 n.m. DME Faro VOR (VFA).

At 07.30:01. The F.O. asks for Flaps 35.

At 07.30:18. The autopilot was changed from Altitude hold to Vertical speed. The F.O. requests Flaps 50 °, confirmed by the Captain 4 sec. later, and then the aircraft was configured for the landing.

At 07.30:41, at 1830 ft the flaps were extended to a position of 52°.

At 07.30:47. The Captain transmits to the crew the windinformation derived from the Area INS. "Wind is coming from the right, thirty knots, drift twelve degrees, so you make it one two three or so."

At 07.31:00 UTC. At 1200 ft and approximately 4 miles out, according to the captain's statement the runway was perfectly visible.

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At 07.31:01. The F.O. request the start of the landing checklist which was completed 28 sec. later.

The descent was performed with the F.O. as P.F. with the autopilot in command. At an approximately radar altitude of 560 ft the autopilot switched from CMD to CWS. This last action, according to the CVR being initiated by the F.O.

Later, at about 80 ft radio altitude, the CWS was switched off and the aircraft control was manual, probably due to opposite actions on the control wheel by the captain and the copilot.

One of the autopilots remained disconnected during the whole procedure, according to the AOM procedure.

At 07.31:17. The F.E. during the checklist, announces "spoilers" and 6 sec. later these were armed.

At 07.31:37. Approach Control requests from MP 495 information about its actual position. MP 495 informs 3 sec. later that it is 4 miles out.

At 07.31:58. At an altitude of 995 ft and a speed of 140 knots, an oscillation starts with values of vertical G between + 0.75 G and + 1.25 G.

At 07.32:04. Windshield wiper operation starts.

At 07.32:08. MP 495 reports on final.

At 07.32:10. With the aircraft at 815 ft (797 radar altitude) a fluctuation starts in the flight parameters.

At 07.32:11. Approach Control asks MP 495 if he has the runway lights in sight, which was confirmed by MP 495 3 seconds later.

At 07.32:14. MP 495 reports lights in sight.

At 07.32:15. Approach Control clears MP 495 for runway 11, and the information that the wind is 150° with 15 knots, gusting to 20 knots.
MP 495 acknowledges the message 8 sec. later.

At 07.32:15. The start of synchronized oscillations of N1, between 55 and 105%.

At 07.32:23 UTC. The copilot selected the A.P. to CWS at an altitude of about 580 (RA) when an increase of oscillations in the flight parameters was verified. The switching of the A.P. to CWS took place two seconds later (07.32:25).

At 07.32:25. Approach Control asks MP 495 whether the lights were too bright. MP 495 answered three sec. later that they were allright and they should be kept as they were.
There were no further communications from and to MP 495 until the end of the flight.

At 07.32:30 UTC. The F.E. points out the skipping of the 500 ft call, but four seconds later the standard crew coordination procedure associated with this call would be completed through the confirmation by both pilots and F.E. that clearance to land had been received.

The applicable checklists at this flight fase, (approach and landing), were performed satisfactory. As a whole, it was found that the crew coordination procedures were performed in a satisfactory way.

At 07.32:34. The F.O. warned: "PAPI" which was confirmed by the captain 1 sec. later.

At 07.32:50. The Captain warns about the airspeed: "Speed a bit low, speed is

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low". And confirms 4 sec. later: "Speed is O.K."

At 07.33:00. The F.O. asks for windshield anti-ice, stating "Windshield anti-ice. I don't see anything".

At 07.33:03. The F.E. gives the following warning: "You're at fast", meaning that the wipers had been selected to high speed.

At 07.33.05. The Captain warns: "A bit low, bit low, bit low" and acknowledgement by the F.O. is obtained 2 sec. later.

At 07.33:07. At 150 ft radar altitude, autothrottle applied power up to 102 %. The aircraft leveled off and the airspeed stabilized.

During final, the Captain, at about 200 ft, noticed lightning to the South.

At 07.33:10. The captain warns: wind of 190° with 20 kts. The autopilot changes from CWS to manual.

At 07.33:12. The C.A.S. starts decreasing in a continuous way and it falls below the reference speed at 07.33:15. The throttles were reduced to approximately 40%, the aircraft pitch attitude was maintained. A rudder deflection was registered reaching a maximum deflection of - 22.5°. The rotation along the longitudinal axis (roll) reaches 1.76° (right wing up).

At 07.33:15. The aircraft was at a radio altitude of 70.6 ft with the left wing down, and correction was applied for right wing down.

At 07.33:18. The radar altimeter audio starts, indicating passing 50 ft.

At 07.33:19. The Captain warns "Throttles" and the sound of the throttle levers advancing follows.

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At 07.33:20. The aircraft contacts the runway and 2 sec after the aural warning for landing gear not down and locked sounds.

One second after contact with the runway the indicated airspeed shows 126 kts, a roll excursion of + 5.62° left wing up and a pitch attitude of + 8.790° nose up. A vertical acceleration of 1.9533 G. was registered and the magnetic heading was 116,72°.

About 3 to 4 sec. before contacting the runway the Captain took action, pulling the elevator to pitch up, almost at the same time when there was an increase in the engine power by the captains initiative.

Three sec. later spoilers no 3 an 5 extended and the aircraft had a bank of +25.318° (left wing up).

At 07.33:28. Roll angle reached +96.33°, with a pitch of - 6.390° nose down, heading was 172.62°.

The first contact with the runway was made by the right main landing gear, on the left hand side of runway 11.

The bogie of the right undercarriage, due to the hard landing, fractured as well as the various structural components of the retraction mechanism.

After the collapse of the right landing gear, the right engine and right wingtip contacted the runway. The right wing suffered total rupture between the fuselage and the right engine.

The aircraft slid along the runway for about 30 meters and gradually moved to the right, supported by the center landing gear.

The rolling movement on the longitudinal axis to the right continued increasing during the trajectory until the aircraft was upside down, as confirmed by the damage to the right horizontal stabilizer, which was fractured near the root, the vertical fin, which fractured near the nacelle of the engine no 2, engine no 2 intake showed signs on the upper side to have been in contact with the runway, as well as the upper skin of the forward fuselage section.

After the rupture of the right wing, fire developed and enveloped the fuselage from the right to the left.
The right wing followed a trajectory next to the aircraft up to the area it came to rest.

The aircraft left the runway at the right hand side with an track of about 120°, in an inverted position.

The presence of ground and vegetation on the upper side of the cockpit confirms the position of the aircraft when it left the runway.

When leaving the runway and entering the runway edge, with soft and flooded ground due to the torrential rain that fell on Faro airport, the aircraft rolled left and the left wing bottomside dug into the ground, desintegrated partially and the fuselage broke into three sections.
It came to rest with the rear section in a normal position and the front section on the left side with the windows and doors contacted the ground.
The fuel flowing from the tanks caused explosions followed by fire, causing the destruction of the rear fuselage up to the rear pressure bulkhead.

The forward part of the fuselage was not affected by the fire.

The accident occurred at 07.33:20 UT, in dusk light conditions.

The Faro airport location is 37.00.46 N. 007.57.53 W and elevation 24 ft.

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1.2 PERSONAL DAMAGE

Injuries	Crew	Passengers	Others	Total
Fatal	2	54	0	56
Serious	2	104	0	106
Minor/Nil	9	169	0	178
Total	13	327	0	340

1.3. DAMAGE TO THE AIRCRAFT

The aircraft was totally destroyed by the forces originating from the Impact and the Fire.

1.4. OTHER DAMAGE

Damage to the Runway Surface caused by the sliding of the aircraft.

Destruction of three Runway Edge Lights (no. 49, 50 and 51) on the Right Hand side of Runway 11.

In the zone of Aircraft Immobilization, Light Damage to the Runway Edge of the Right Hand Side of Runway 11.

1.5. PERSONNEL INFORMATION

1.5.1. Information on the Crew

1.5.1.1 Captain

Age : 56 years (DEC 92)

Licence : Airline Pilot Licence B1 no. 67-0026,
valid until 1 February 1993

Medical : 14 Juli 92 (with extension)

Flying experience (hours):

Total:	14.441
Day :	4.110 (Pilot in Command)
Night:	1.878 (Pilot in Command)
Instruments:	Approx 90% of total hours
As Captain:	5.988

Experience on DC-10

First Officer:	257
Captain:	1.240

Recent experience (as of OCT 92)
Number of flights to Faro in 1992: 5

Aeronautical carreer

- 4 years as Navy pilot (FEB 62 - FEB 66)
- 18 months as pilot with Schreiner Airways (F.O. DC-7)
- Joined Martinair in JAN 68
- Training Captain CV640 (DEC 68)
- First Officer DC-8 (DEC 70)
- First Officer DC-10 (NOV 73)
- Captain DC-9 (MAR 75)
- Instructor DC-9 (FEB 78)
- Captain A-310 (MAY 84)
- Instructor A-310 (MAY 84)
- Deputy Chief Pilot A-310 (MAR 86 - NOV 87)
- Captain DC-10 (MAR 88)
- Instructor DC-10 (JAN 89)

1.5.1.2 First Officer

Age : 31 years (DEC 92)

Licence : Pilot Licence B3 no. 88-0073,
valid until 1 July 1993, including ratings for
instrumentflight and R.T.

Medical : 24 June 92

Flying experience (hours):
Total: 2.288:05
Day : 1.362:35
Night: 925:30
Instruments: 2.035:40
Captain (Single-engine): 219.35

Experience on DC-10 (First Officer):
Total: 1.787:50
Day : 917:50

Night: 870:00
Pilot Flying: 860:45
Simulator : 123:35

Recent experience (as of OCT 92)
General : 119:31
Pilot Flying: 75:35
Manual landings: 9
Automatic landings: 3
Number if flights to Faro in 92: 0
(one in 1990)

AERONAUTICAL CARREER:

- Followed the Flying Course at Zestienhoven Airport to obtain the A2-PPL/Cessna 150/Cessna 172 (SEP 82 to APR 83)
- Obtained the A1-PPL/Cessna 172 (DEC 86)
- Followed the Professional Flying Course to obtain the B3-CPL and Instrument Rating, as well as preparing for the theoretical examination for B1-ATPL at the RLS-National Flying Training School/BE33 (129.20); C-500 (67.20) (MAR 87 to MAY 88)
- Business Aviation Pilot (SAS Teuge/C172 (41:40); C182 (07.25) (JUN 88 to OCT 88)
- Pilot at MVVL/First Officer C550 (135.25) (OCT 88 to APR 89)
- Entered Martinair Holland, initial training as First Officer on DC-10 (APR 89)
- First Commercial Flight as First Officer on DC-10 (AUG 89)

1.5.1.3 Flight Engineer

Age : 29 years (DEC 92)

Licence : Flight Engineer Licence 92-0001,
valid until 1 May 1993, with RT Rating

Medical : 31 March 92

Flying experience (hours):

Total: 7.540
Pilot: 5.840
Second OFF DC-10: 352
F/E DC-10: 1.348
Recent experience: 135.31
(Since OCT 89)

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AVIATION CARREER:

- Obtained CPL Aircraft Licence and IR-rating at the Mount Royal Canadian College - Canada
- Worked as Pilot for Oil and Charter Companies (BE90; HS 748)
- Second Officer Canadian Airlines (1988)
- Flight Engineer Swissair (SEP 89 to SEP 91)
- Second Officer Canadian Airlines (OCT 91)
- Flight Engineer DC-10 with Martinair (FEB 92)
- Flight Engineer with Martinair (FEB 92)

1.5.1.4 Proficiency Checks and Line Training

In the years 1990, 1991 and 1992 prof checks were conducted (Annex 2) and no deviation was observed in relation to the prescribed on pharagraph 1,1,3-03 of the Martinair BIM.

From the records on the prof checks the flight crew members were submitted to in the referred years no comments or failures were found worth mentioning.

The flight crewmembers were submitted to refreshment training in flight safety in the 4th of December 1991 (Captain) and 2nd of December 1992 (Copilot). The flight engineer was not submitted to any refreshment in this area due to the fact that his initial training was done on a very recent date (MAR 92).

1.5.1.5 Previous Accidents and Incidents

1.5.1.5.1 Captain

Through all his career he was involved only in two incidents.

1.5.1.5.2 Copilot

Does not have any previous accidents or incidents reported.

1.5.1.5.3 Flightengineer

He was involved, as pilot, in some previous accidents.

1.5.2 INFORMATION ON AIR TRAFFIC CONTROLLERS

At the day of the accident a shift was rostered composed by 1 Air Traffic Controller Operational Supervisor and 4 Air Traffic Controllers, one being an Instructor and one stagiary for the Airport qualification license.

In case of conflicting text, the Portuguese
report is the valid document

During the descent and approach of the aircraft to Faro there was on duty and present in the tower, the Air Traffic Controller/Operational Supervisor, one Air Traffic Controller/Instructor in the Airport position and on Air Traffic Controller in the Approach position.

1.5.2.1 Occupation of work stations at the moment of accident

1.5.2.1.1 Shift Supervisor

Nationaliteit: Portugese
Sex: Male
License: CTA/1, issued at 18 JUN 76, valid until 19 NOV 93

Qualifications:
- Faro Airport Control 28 FEB 77
- Faro Approach Control 18 APR 78

Last medical exam: Class 3, issued DGAC 20 NOV 92

Education and Professional Experience:

1975 - started duties at the Faro tower were he remained until the date of the accident.
He passed the following courses for general qualification at ANA

- Relaçoes Humanas 2
- Organizaçao Empresarial 1
- Chefias Directas
- Estatistica 1
- Formaçao em Treino Operacional
- Informática 1
- ATC 08 (refrescamento)
- Planeamento 1
- Qualidade 2
- Direito Aeronáutico

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Work and resttime from 14 to 21 DEC 92

DAY	IN	OUT
14	rest	rest
15	14:00	22:00
16	08:00	14:00
17	14:00	22:00
18	rest	rest
19	rest	rest
20	14:00	22:00
21	08:00	14:00

Times in position

The average time in position per shift was 4 hours.

In case of conflicting text, the Portuguese
report is the valid document

1.5.2.1.2 Approach Position

Nationality: Portuguese
Sex: Male
Licence: CTA/1 issued at 15 MAR 84, valid to 15 NOV 94
Qualifications:
- Faro Airport Control 09 JAN 89
- Faro Approach Control 16 NOV 92

Last medical exam: Class 3, DGAC 16 NOV 92

Training and professional experience

1988 - started his duties at Faro Tower
Frequented the following training courses at ANA
- ATC 2/3 course (Airport/Approach)
- ATC 5 course (Area)

Working schedule from 14 to 21 DEC 92

DAY	ON DUTY	OFF DUTY
14	Rest	Rest
15	14:00	22:00
16	08:00	14:00
17	00:00	08:00
18	Rest	Rest
19	Rest	Rest
20	14:00	22:00
21	08:00	14:00

Time at position
The average time at position was 4 hours.

In case of conflicting text, the Portuguese
report is the valid document

1.5.2.1.3 Airport Position

Nationality: Portuguese
Sex: Male
Licence: CTA/1, issued 29 FEB 80, valid through 20 OCT 93
Qualifications:
- Faro Airport Control 23 MAY 86
- Faro Approach Control 23 MAY 86

Last medical exam: Class 3, DGAC 10 NOV 92

Training and professional experience

1986 - started his duties at Faro Tower
Frequented the following training courses at ANA
- Airport Control qualification
- CTA's training (Instructor)
- Basic Management Course

Working schedule from 14 to 21 DEC 92

DAY	ON DUTY	OFF DUTY
14	Rest	Rest
15	14:00	22:00
16	08:00	14:00
17	14:00	22:00
18	Rest	Rest
19	Rest	Rest
20	14:00	22:00
21	08:00	14:00

1.6 INFORMATION ON THE AIRCRAFT

1.6.1

- Aircraft: McDonnell Douglas DC-10-30F
- Serial number: 46924
- Year of fabrication: 1975
- Valid Certificate of Airworthiness, issued on 26 NOV 75 by RLD
- Registration: PH-MBN
- Owner: State of the Netherlands, Royal Dutch Airforce
- Operator: Martinair Holland N.V.
- Valid Certificate of Registration, issued on 26 NOV 75 by RLD
- Type Certification: Model DC-10-30F, approved by FAA on 30 MAR 93, serial number 46924, with a maximum take-off weight of 565.000 lbs
- Certification base: FAR 25 of 1 FEB 65, including amendments 1 to 22
- Airworthiness Standards: Transport Category Airplanes and FAR 25.471, Amendment 25-23

Aircraft times:

Total hours: 61.543
Total landings: 14.615

Last inspection:

A-Inspection by KLM on 24 NOV 92, at 61.258 aircraft hours.

Airworthiness Directives:

Alle the applicable ADs were introduced up to the date of the accident.

1.6.2 ENGINES

1.6.2.1 General Electric CF6-50C S/N 530405

Year of manufacture: 1988
Installed in position: 1
Time : 13 093 H T.T. and 2892 total cycles
- Last inspection: A Inspection in 24 Nov. 92, at KLM
- Time after installation: 1 576 H and 297 cycles

Airworthiness Directives:

All the applicable ADs were introduced up to the date of the accident.

1.6.2.2 General Electric CF6-50C S/N 455466

Year of manufacture: 1974
Installed in postition: 2
Time: 59 627 H T.T. and 14907 total cycles
- Last inspection: A Inspection in 24 Nov. 92, at KLM
- Time after installation: 666 H and 128 cycles

Airworthiness Directives:

All the applicable ADs were introduced up to the date of the accident.

1.6.2.3 General Electric CF6-50C S/N 455200

Year of manufacture: 1972
Installed in position: 3
Time: 61 802 H T.T. and 16052 cycles
- Last inspection: A in 24 Nov. 92, at KLM
- Time after installation: 4 116 H and 780 cycles

1.6.2.4 APU - Airresearch TSCP 700-4

1.6.3 PENDING DEFICIENCIES

The technical log was recovered on site and the inputs from 05 Dec. 92 up to the date of the accident were verified.
Additionally the Operator supplied the list of pending deficiencies since 10 Nov. 92 up to the date of the accident.

The items pending at the date of the accident did not affect the aircraft airworthiness.

However, dispatching the aircraft from Amsterdam with #2 Engine reverse unserviceable, violated the dispositions stated in the AOM (dispatch Deficiency Guide) which made landings in Amsterdam mandatory with 3 operating reverses.

1.6.4 RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT LIST

Navigation:

- 2 VHF/NAV BENDIX RVA 33A
- 3 VHF COLLINS 618M-2-B1-3
- 2 HF COLLINS G18T-2
- 3 INS LITTON 58
- 2 WEATHER RADAR BENDIX RDR-1F
- 2 AUTO THROTTLE/SPEED CONTROL SPERRY
- 2 AUTO PILOT BENDIX PB 100

- 2 FMS COLLINS ANS 70
- 2 ADF COLLINS S1Y7
- 2 TRANSPONDER COLLINS 621A-3
- G.P.W.S. SUNDSTRAND MK1
- 2 DME COLLINS 860E-3
- 1 TCAS HONEYWELL 4066010-902
- 2 RADIO ALTIMETER COLLINS 860F-1

The present list was made by Martinair at 11 Jan. 93.

In case of conflicting text, the Portuguese
report is the valid document

1.6.5 WEIGHT AND BALANCE

On board were 13 crew members and 327 passengers for a total of 334 available passengers seats. The computed weight and balance stated in the loadsheet which was recovered from the aircraft, showed the following figures:

Take off weight:	: 180.474 kg (256.300 lb)
C.G.	: Take off 16.8 % MAC
	: Landing 13.6 % MAC

The computation of weight and balance performed by this Commission, confirmed that the figures stated in the loadsheet were within the limits prescribed in the AOM. This commission detected that the weight and balance automatic system was unserviceable.

1.6.6 History of the Righthand Maingear

Identification:

Manufacturer:	Mc Donnel Douglas
Partnumber:	ARG 7993-5510-(KSSU)7847500
Serial number:	-(KSSU)3032

Times of the gear:

Total time:	75.774 hours
Total cycles:	20.105 cycles
Time after general revision:	20.807 hours
Cycles after general revision:	4.296 cycles
Date of general revision:	Dec. 87, Revima-France
Time after installation:	20.807 hours
Date of installation:	5 Jan. 88

Airworthiness Directives

All applicable Airworthiness Directives were carried out prior to the accident.

1.7 METEOROLOGICAL INFORMATION

1.7.1 Climatic Characteristics

The climatic elements relative to Faro Airport in the month December are as follows:

Temperature:

Maximum	170°
Minimum	8.6°
Average Atmospheric Pressure	1020.6 hPa

1.7.2 Meteorological Conditions

1.7.2.1 Meteorological information gathered by the crew at Amsterdam

The Meteorogical information delivered to the crew at Amsterdam was not recovered from the aircraft wreckage.
A copy of the Faro Airport meteorological information, available at the date of the accident in the Amsterdam Airport Meteo Centre was requested from NAIB.

The Meteorlogist on duty at Amsterdam Meteo Centre in the early hours of 21 DEC 92, when confronted with a photo of the captain admitted that the same had not been present at the centre. As the F.E. declared that he had not gone to the Meteo Centre, and only two crew members of Martinair had been at the centre on that dawn, the same could only have been the captain and copilot of flight MP 495, as declared by themselves. As far as flight planning and meteo condition at Faro is concerned, regarding refueling and choice of alternates the captain declared:

- the fuel uplift requested at departure was dictated by reasons of ATC and change of alternate due to meteo conditions and the transport of PAX, more favorable from Lisbon than Sevile;
- taking into account the time of departure of flight MP 495 from AMS (04:52 UTC) it is forseeable that the following meteo info concerning Faro was supplied.

METAR FARO 04:00 UTC

Wind	: 140°/13 Kts
Visibility	: more than 10 km
Clouds	: 2/8 Stratocumulus 2000 ft
	: 3/8 Altocuumulus 10.000 ft
	: 1/8 Cumulonimbus 2500 ft
Temperature	: 15°C

In case of conflicting text, the Portuguese
report is the valid document

Dewpoint	: 14°C
QNH	: 1014.0 hPa

TAF FARO 04/13 UTC

Wind	: 150°/15 Kts
Visibility	: more than 10 km
Clouds	: 3/8 Stratus 500 ft
	: 4/8 Cumulus 1200 ft
	: 5/8 Stratocumulus 2000 ft

TEMPORARY

Visibilty	: 8000 m
During light to moderate rain	: 5/8 Stratus 400 ft
	: 5/8 Cumulus 1200 ft

INTERMITTENT

Visibility	: more than 10 km
Moderate thunderstorm clouds	: 218 cumulonimbus 1800 ft

In case of conflicting text, the Portuguese
report is the valid document

1.7.2.2 Faro Meteorological Situation

The Meteorological Institute reports the following:

Weather conditions in the South of mainland Portugal and their development between 18 UTC on 20 December 1992 and 12 UTC on 21 December 1992

The weather in mainland Portugal, and particularly leeward of the Algarve, where Faro Airport is situated, was conditioned by an almoste stationary depression, concentrated at 18 UTC on 20 December at 37N 13W and at 12 UTC on 21 December at 36N 11W, whose center of pressure increased from 1001hPa at 18 UTC on 20th to 1007 hPa at 12 UTC on 21st; the greatest variation occurred between 18 UTC on 20th and 00 UTC on 21st, at which time there was a pressure of 1005 hPa at the centre.

This depression increased with altitude with a practically vertical axis, combining ascending vertical movements with maximum intensity south of Sagres, whose intensity increased with altitude.

Consequently, at 00 UTC on 21st, at 1000 hPa, the estimated ascending vertical velocity was 6,5 cm per second, and at 500 hPa 11.3 cm per second, the corresponding values at 12 UTC being 2 cm per second and 9 cm per second, respectively.

In the south-west of the Iberian Peninsula, the relative humidity in the lower troposphere was higher than 70%, reaching a maximum of 90 % of 850 hPa, near Sines, at 00 UTC (Annexes A - C).

An analysis of the vertical soundings of the atmosphere in Lisbon and Gibraltar (00 and 12 UTC on 21st) (Annex D) shows that the mass of sea polar air carried in the circulation of the above depression was very humid and unstable, virtually throughout the troposphere.

On the south-eastern edge of the depression, systematic bands of convergence arose, shown on the satellite pictures (Annex E) by the associated clouds of great vertical deminsions (cumulonimbus).

These bands, moving towards the north-east, subsequently reached mainland Portugal, particularly the south and the Algarve.

Weather conditions in the Faro region

An analysis of the synoptic observations made at Faro Airport, Faro and Sagres (Table I and Appendix) and the METEOSAT and NOAA satellite pictures shows that the weather conditions in the Faro region during the period of analysis were as follows:

In case of conflicting text, the Portuguese
report is the valid document

The sky was very cloudy or overcast, with a predominance of vertical cumulo-nimbus clouds associated with bands of convergence, causing rain, heavy showers at times and thunderstorms.

However, during the period between 03:50 UTC and 06:00 UTC on 21st, there was decline (both in quantity and intensity) in vertical clouds in the region, corresponding to the interval between the passing of two consecutive convergence bands.

At 07:30 UTC, clouds of greater vertical dimensions approached Faro and by 08:00 they were clearly over the region. This band of convergence was still affecting the region at 12 UTC on the 21st.

Visibility in the area was generally moderate (6-9 km), falling to 2-4 km during the periods of heaviest rainfall, particularly the strongest or even violent showers during the night and early morning.

The wind was south-easterly and south-south-easterly (140-180°) with average intensities of 10-17 kt, occasionally exceeding 20-25 kt as the cumulonimbus clouds passed. With this situation, the local wind varied considerably, with gusts in the airport region that could have exceeded temporary intensities of 35-40 kt.

Along with the above cloud bands crossing Faro, there were periods of heavy rainfall at times, the heaviest being between 18 UTC on 20th and 00:20 UTC on 21st, between 06:00 UTC and 11:20 UTC on 21st and also between 14:50 UTC on 21st and 02:15 UTC on 22 December. In fact, the amounts of rainfall noted in subsequent 6-hour periods (Tables II-A and II-B) after 18 UTC on 20th were 10 mm, 18 mm, 4 mm and 26 mm. It should be pointed out, however, that during the night and early morning, there were periods of very intense rainfall (conventional station rain gauge at the Faro Airport station for 20-21 December 1992 - Annex F) associated with the cumulonimbus clouds forming the cloud bands, with the following showers being recorded in paricular:

- Between 23:15 UTC on 20th and 00:10 UTC on 21st: 10,6 mm
- Between 07:20 UTC and 07:40 UTC on 21st: 8,6 mm

The associated average rainfall intensities are 33,5 mm per hour and 25,8 mm per hour respectively, although during the period between 07:27 UTC and 07:37 UTC the average rainfall intensity reached values of around 60-65 mm per hour, which means that a <u>violent storm</u> arose.

1.7.2.3 Meteorological Information provided by Faro Approach Control to flight MP 495

At 070958 UTC.

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report is the valid document

Wind	150°/18 Kts
Visibility	2500 m
Present Wheather	thunderstorms
Clouds	3/8 500 ft 7/8 2300 ft 1/8 CB 2500 ft
Temperature	16°C
Barometric pressure	(QNH) 1013.0 hPa

At 0732:15 UTC

Wind	150°/15 Kts Max 20 Kts

1.7.2.4 Meteorological Information produced by the Inquiry Commission

SPECI LPFR 210739

Wind	170°/23 Max 34 Kts
Visibility	5000 m
Present weather	light or moderate thunderstorm without hail but with rain
Clouds:	3/8 STRATUS 300 ft 7/8 STRATOCUMULUS 2300 ft 2/8 CUMULONIMBUS 2000 ft
Temperature	13° C
Dew point	12° C
Barometric pressure	1014

Information on wind registered in "secundary page" of SIO

LPFR 07:40 meteorology time, 07:41:30 standard UTC time - information filed on paper and registered by the printer of the integrated observation system every 10 min. after the round hour.

Wind	170°/24 Kt Max 220/35 (the wind direction is expressed in magnetic degrees)

The detailed analysis of the observation results by the SIO installed on runway 11 shows that at 07.32:30 UTC a rotation in wind started (20°+ 20°+ 10° in a period of one minute) and an increase of average intensity (from 20 to 27 Kt in a period of 2 minutes) and then between 07.32:30 and 07.33:00 UTC, a gust of 35 Kt with a magnetic direction of 220° occurred.

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SIGMET transmitted by Lisbon Airport Aeronautical Meteorologic Center

At 04:45 SIGMET NR1 was transmitted, valid between 06:00 and 12:00 UTC with a forecast of moderate clear air turbulence, locally severe above FL 340, thunderstorms and strong icing conditions Lisbon FIR. Pointing at Annex 13 of ICAO it is emphazised that the phenomena of windshear is normally associated with thunderstorms.

1.7.3 Responsibility of the delivery of Meteorological Information

The decreto-Lei n. °633/46 establishes that "the delivery of informations, forecasts, and warnings of meteorologic character to public and privaat entities is of exclusive competence of the Instituto Nacional de Meteorologia e Geofisica".

The AIP-PORTUGAL informs that the Meteorological Authority is the Institute Nacional de Meteorologia e Geofisica and that it is responsible for the Meteorological survey in the regions: Lisbon FIR/UIR and Santa Maria oceanic FIR.

To provide aviation with a quality service a close coordination is essential between the meteorologic authority and the Air Traffic Service. This coordination must be established at National level by agreement, preferably by written agreement amongst these authorities, in a way that the services and responsibilities of each one is assigned without any ambiguities. This agreement must cover, amongst others:

a) delivery to Air Traffic Services organisations:
   1) displays; or
   2) surface wind, RVR, atmospheric pressure measure instruments, or
   3) integrated automatic systems

b) the usage by Air Traffic Services Personnel of the information provided by these displays/instruments

The commission discoverd the non-existence of this agreement.

1.7.4 Faro Airport Meteorological Centre

1.7.4.1 Faro Meteorological Services Facilities

According to AIP-Portugal the following meteorological equipment are present:

ANEMOMETER	RUNWAY 29
RVR METER	RUNWAY 29
CLOUDBASE METER	RUNWAY 29

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report is the valid document

1.7.4.2 At the date of the accident the Faro Airport Meteorological Centre had the following equipment installed:

	1. Anemometer with mechanical recorder
Runway 29:	1. RVR meter 1 Telepsicometer 1 Anemometer 1 Cloudbase meter
Runway 11:	1 RVR meter 1 Cloudbase meter 1 Anemometer
Control Tower:	2 Digital wind displays 2 RVR displays 2 SIO main page displays
Faro Airport Meteorological Centre	SIO Computerised central unit Graphic recorder of wind (direction and itensity), pressure, temperature, dew point and rainfall parameters for runway 29.

1.7.4.3 Faro Airport Meteorological data gathering Integrated System (SIO)

The SIO installation at Faro Airport is a computerised system that performs, diplays and records in real time, the surface meteorological observations, gathered through a group of meteorological sensors and visual observations periodically performed by Meteorologist observers from the Meteorological Intitute.

1.7.4.3.1 System Architecture

The system consist of a central station which commands the system through a control programm allowing also the manual input of complentary information. The central station processes and executes the data received from the sensors and manual input.

The SIO records every 30 seconds the meteorological information delivered to the control tower display in the form of a "main page".

The recorded meteorological information assigned to the permanent file is printed every 10 minutes after the hour, being the secondary page of SIO.

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The SIO recorder clock is independent of the Air Traffic Communications recorder clock and its settings can only be performed by the Air Traffic Controllers at duty at the Control Tower.

The sensors installed in the vicinity of the thresholds of the runaways 11 and 29 send the gathered informtion to the central station and to the displays at the control tower through digital and analogical dat channels.

The displays installed in the Airport control Tower, at the positions Airport Control and Approach Control, provide individual informtion of wind, RVR, and global information of SIO "main page".

The display of the individual wind information set has the following selectors and indicators:

Selectors	1) Runway	11 and 29
	2) Indication	Instantaneous wind, average wind (2 minutes) and average wind (10 minutes)
	3) Brightness with four positions	
Indicators	1) Status, power and warning	
	2) Wind measure - analogical display for wind	

direction which shows the instantaneous wind direction or the average wind direction, according to selecion, the top values in the selected period, and three digital displays for wind intensity which shows: the instantaneous or average wind according to selection, the minimum wind in the selected period and the maximum wind in the selected period.

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This display does not give a clear indication of which runway the values refer to.

The RVR displays show the information, 150 to 3000 m in digital quick reading.

The global display of the main SIO page shows the following information:

MET-REPORT LPFR 07H30
140/20 KT VIS 10 KM
Recent thunderstorms
3 ST 0500 FT 7 SC 2300 FT
1 CB 2500 FT
T 16 DP 14
QNH 1013 QFE 1012
QFE-RWY11 1012 QFE-RWY29 1013

TL: 0050

LPFR 92-DEC-21 07:31:30

	RWY 29	MID	RWY 11
RVR	>2000		AAAAA
WND	160 18 25		160 21 35
CBH	002000 FT		AAAAAA
QFE	1013,1		1012,9
WSW			00008
		QNH	1013,7
		T	+15,3
		DP	+14,1

WIND INFORMATION

The wind information is received through two parallel lines which send the samples every second, straight to the displays in the Control Tower and Central Station.

WIND DIRECTION

The direction used for sensor calibration is Magnetic North.

PERFORMED MEASUREMENTS
Instanteneous wind
With the selector in the position "Instantaneous", the display shows the instantaneous wind and the limit values of changes in direction and intensity in the last 5 seconds. These informations are updated every second.

AVERAGE WIND (2 minutes)

With the selector in the position "2 minutes" the display shows the average wind, from a floating average in scale, of a 10 seconds period sample in direction and intensity in the last two minutes and the peak values of wind direction and intensity in the last two minutes.

AVERAGE WIND (10 minutes)

With the selector in the position "10 minutes" the display shows the resulting average wind from a floating average in scale of an every 10 seconds sampling of winddirection and intensity in the last 10 minutes.

WINDSHEAR INFORMATION

The system computes the vectorial difference between the winds measured at runway 11 and 29 and displays that difference in the SIO main page. Every time the computed difference reaches a predetermined value - at Faro Airport 15 kts - a windshear warning is generated.

Deficiencies of SIO operation
It was verified by this Commission that, on the accident date:

- There was a difference of one minute thirty seconds between the simultaneous times of the ATC system clock and the SIO clock.

- There were no written procedures for time setting of the standard clock and SIO clock.

- The setting of the standard clock for the ATC system communications, which sends the time directly to the approach section clock is done, as routine, on Mondays, comparing with the BBC time information.

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report is the valid document

- There was no written report of errors on the standard clock at the time of reset.

- The SIO record as far as wind is concerned only includes direction and intensity of the average wind 2 minutes period and the intensity of maximum wind in the last 2 minutes.

- The average wind is the result of a scaled average of directions and intensities of the wind registered in the referring period and not a vectorial average of these winds.

- There was no record of wind direction variations nor instantaneous wind and minimum wind.

- The variations in wind direction are referring to the last two minutes, when they should refer to the last ten minutes.

- As the meteorlogical information is provided every 10 seconds, but only recorded every 30 seconds, not all the information provided to aircraft are recorded in the SIO.

- The runway 11 sensors are located on the right side of the runway, 17 m high, close to a ditch 7 m deep, between the sensor and the runway.

- There was no check and calibration programme to assure the precision and reliability of the system components and consequent good quality of data supplied to the users.

- The DGAC, since the introduction of the SIO, did not perform any inspection to the Faro Airport Air Traffic Services.

1.7.4.4 Wind on runway 11

The wind information provided to aircraft between 07.00:00 and 07.34:30 UTC on the 21 DEC 92, gathered from the transcription of ATS system communications was as follows:

Standard time	Working position	Wind provided (°M/kt)
07:04:27	Approach Control	150/15
07:05:34	Approach Control	150/16 max 18
07:09:58	Approach Control	150/18
07:18..	Approach Airport	140/23
07:19:51	Approach Control	150/24
07:24:58	Approach Control	150/20
07:26:20	Approach Control	130/18 max 21
07:32:15	Approach Control	150/15 max 20

Information on average wind (2 min) registered at SIO for runway 11 and 29, was as follows:

Hora da meteorologia (h:min:s)	Vento médio (2 minutos)					
	Pista 11			Pista 29		
	Dir. (° M)	Int. (kt)	Máx. (kt)	Dir. (° M)	Int. (kt)	Máx. (kt)
07:00:00	130	10	27	140	13	24
07:00:30	130	9	27	140	14	24
07:01:00	130	9	27	140	14	24
07:01:30	140	9	27	140	15	24
07:02:00	140	10	27	140	16	23
07:02:30	150	12	27	140	16	23
07:03:00	150	13	27	150	16	23
07:03:30	150	15	27	150	15	23
07:04:00	150	15	27	150	15	21
07:04:30	160	15	27	150	16	21
07:05:00	150	15	27	150	17	21
07:05:30	150	14	27	150	17	21
07:06:00	150	14	27	150	17	21
07:06:30	150	14	27	150	16	21
07:07:00	150	14	27	150	17	21
07:07:30	140	14	23	150	17	21
07:08:00	140	14	20	150	19	27
07:08:30	140	14	20	150	20	27
07:09:00	140	16	24	150	21	27
07:09:30	140	18	24	150	23	27
07:10:00	140	19	24	150	22	27
07:10:30	140	21	26	150	22	27
07:11:00	140	21	26	150	20	27
07:11:30	140	21	26	150	19	27
07:12:00	140	22	26	150	20	27
07:12:30	140	20	26	150	20	27
07:13:00	140	19	26	150	21	27
07:13:30	140	20	27	150	22	27
07:14:00	140	20	27	150	20	27
07:14:30	140	21	27	150	19	27
07:15:00	140	22	27	150	17	27
07:15:30	140	22	27	150	16	27
07:16:00	140	21	27	150	15	27
07:16:30	140	21	27	150	15	27
07:17:00	140	21	27	150	16	27
07:17:30	140	21	27	150	18	27
07:18:00	140	20	27	150	20	27
07:18:30	140	20	27	150	22	28
07:19:00	140	20	27	150	23	28
07:19:30	140	19	27	150	23	28
07:20:00	140	19	27	150	23	28
07:20:30	140	18	27	150	21	28
07:21:00	140	18	27	150	20	28
07:21:30	140	29	27	150	20	28
07:22:00	130	20	27	150	20	28
07:22:30	130	20	27	150	20	28
07:23:00	130	19	27	150	20	28
07:23:30	130	19	27	150	19	28
07:24:00	130	18	25	150	18	28
07:24:30	130	18	25	150	18	28
07:25:00	130	18	25	150	17	28
07:25:30	130	17	25	150	18	28
07:26:00	130	17	25	150	17	28
07:26:30	130	17	25	150	17	28
07:27:00	130	17	25	150	17	28
07:27:30	130	17	25	150	17	28
07:28:00	130	17	24	150	18	28
07:28:30	130	17	24	150	19	26
07:29:00	140	18	24	150	20	26
07:29:30	140	19	26	150	20	25
07:30:00	140	20	26	150	19	25
07:30:30	140	21	26	150	19	25
07:31:00	140	20	26	150	18	25
07:31:30	160	21	35	160	18	25
07:32:00	180	22	35	170	20	29
07:32:30	190	24	35	180	22	29
07:33:00	190	27	35	200	24	32
07:33:30	180	26	35	200	27	34
07:34:00	170	25	35	200	29	34
07:34:30	170	25	35	200	29	34

It was established by this commission that, on the accident date:

- Approach Control provided to the aircraft the instantaneous wind measured by the sensors of runway 29. Fact that leads to the discrepancy between the winds which were registered on runway 11 and the winds given to the aircraft.

  The SIO registration pointed out:

a) On runway 11 between 07.32:30 UTC and 07.33:00 UTC, a 35 kt intensity gust and magnetic direction 220° occurred. This wind gust was not transmitted to MP 495.

b) On runway 29 between 07.34:30 UTC and 07.35:00 UTC, a 34 kts intensity gust and magnetic direction 230° occurred.

- The wind gust information should have been transmitted according with procedures stated on DOC 4444 Rac/501/12.

- The Air Traffic Controller on duty at approach control position, declared not to have been aware of any wind gust during short final of flight MP 495, which confirms that the wind provided referred to runway 29

- There were no procedures published by the Meteorological Institute or by ANA regarding the usage of SIO information by the Air Traffic Services.

- The Control Tower had two separate displays for wind, one in the position Airport Control and another in the Approach Control being far from each other.
  The displays show the wind for runway 11 or 29, according tot the selection made.
  The selector is a rotating switch, which rotates 30° between the reference marks for runways 11 and 29.
  The displays do not show any other information that clearly could determine which runway was selected.

- In the SIO records the information regarding selection of runway by the controller was not recorded.

- The wind information provided by the Air Traffic Services is updated every 10 seconds but is only recorded every 30 seconds.

- The recording of wind only shows the direction and intensity of average wind, period 2 minutes, and the intensity of the maximum wind in the last 2 minutes.

- An interruption in the gathering of RVR information on runway 11 and cloudbase information on the threshold of runway 11, starting respectively at 22:40 and 22:50 UTC of 20 DEC 94 was recorded. AT 08:54 UTC of 21 DEC 94 the system was still unserviceable.

In case of conflicting text, the Portuguese
report is the valid document

- Wind changes, instantaneous wind and all figures regarding the information at minute plus ten, twenty, forty and fifty seconds were not recorded.

1.7.4.5 Information on Windshear

The windshear information available in the mainpage of the SIO, displayed in the Airport Control Tower, was not transmitted to the aircraft.

The system triggered the windshear warning between 07:34:00 and 07:35:30 UTC. This commission detected that there are no studies in the Meteorologic Institute on situation of windshear at Faro Airport, nor written procedures on the use of the available information in SIO by the Air Traffic Control.

1.7.4.6 Meteorological Phenomenon Manga de Vento (Windsock)

The commission detected that at approximately 400 meters from the accident place, on the righthand side of runway 11, the airport fence was destroyed and twisted to the North, at a length of around 10 meters and the greenhouses located tot the righthand side of the runway were partially destroyed. A rural worker who was nearby the destroyed fence stated that approximately 20 minutes after the accident he felt a strong wind which he associated with a meteorological phenomenon that occurs often in that part of Algarve designated "wind sock" which shows its effects in a narrow stripe on the ground.
In the aerial photo survey performed after the accident the presence of similar damage to greenhouses on the lefthand side of runway 11 was observed.

Statements of other rural workers pointed these destructions to the phenomenon "wind sock" as well.

The SIO recording, which only records the figures of the round minute and 30 seconds, recorded between 07:33:00 and 08:10:00 UTC the following values of maximum wind.

a) Runway 11 - Sensors located a few meters away from the destroyed fence.

1) From 0732:30 UTC till 0743:00 UTC 35 kt
2) From 0743:00 UTC till 0743:30 UTC 32 kt
3) From 0743:30 UTC till 0746:00 UTC 30 kt
4) From 0746:00 UTC till 0746:30 UTC 28 kt
5) From 0746:30 UTC till 0807:30 UTC between 27 and 22 kt
6) From 0807:30 UTC till 0808:30 UTC a system failure occurred
7) From 0808:30 UTC till 0810:30 UTC 27 kt

b) Runway 29

1) From 0732:30 UTC till 0733:00 UTC 25 kt
2) From 0733:00 UTC till 0734:00 UTC 29 kt
3) From 0734:00 UTC till 0734:30 UTC 32 kt

In case of conflicting text, the Portuguese
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4) From 0734:30 UTC till 0744:30 UTC 34 kt
5) From 0744:30 UTC till 0745:00 UTC 33 kt
6) From 0745:00 UTC till 0746:00 UTC 31 kt
7) From 0746:00 UTC till 0807:30 UTC between 26 and 27 kt
8) From 0807:30 UTC till 0808:30 UTC a system failure occurred
9) From 0808:30 UTC till 0810:00 UTC 26 kt

This commission detected the nonexistence, at the date of the accident, of any publication on the phenomenon "wind sock."

1.8 NAVIGATIONAL AIDS

1.8.1 Introduction

Faro Airport was equipped with the following Radio Navigation Aids:
NDB FAR, FREQ. 332 Khz (370026N-0075529W) VOR/DME VFA A9W and V7D (370043n-0075826W)

1.8.2. Functioning of the Radio Aids Equipment

The functioning of the Radio Aids System was analyzed, according to periodical checks reports, in flight by the Portugese Air Force, respectively before and after the accident with aircraft PH-MBN.

1.8.2.1. NDB System (FAR)

The periodic inflight check report, performed on 23 MAR 92, classifies the Radio Aid NDB for "unrestricted" use.

In the check performed on 14 JAN 93, after the accident with aircraft PH-MBN. The report shows the following remarks:

"Only number one transmitter was checked due to this being the one in operation on the accident date".

"Indent frequency TX1 1010 Khz".

The recording of the observed checks are satisfactory, and this radio aid station remained "Unrestricted".

The ANA maintenance occurrence report did not show any remarks.

1.8.2.2 VOR/DME System (VFA)

The periodic inflight check report, performed on 16 NOV 92 classifies the radio aid VOR "VFA" for "Unrestricted" usage.

In case of conflicting text, the Portuguese
report is the valid document

The check report is considered satisfactory, and, on this date, there were no remarks nor discrepancies.

In the special check performed on 14 JAN 93, after the accident with aircraft PH-MBN, the report shows the following remarks.
Special check performed after the accident, number two transmitter, aid found with normal operation values.

On radial 021 scalloping values were detected above the ones found on the certification check, as well as in the sector 040 to 050. These high values. although within tolerance, could have been caused by the presence of the aircraft wreckage close to the VOR/DME station.

Aterwards, on the periodic check performed in 16 NOV 93, the observed values were satisfactory and no remarks or comments were noted.

The VOR/DME (VFA) equipment keeps the "Unrestricted" classification.

The ANA maintenance occurrence report did not show any remarks.

1.9. COMMUNICATIONS

In the analysis of the Faro Airport Maintenance report sheet regarding the month December 1992, it was noticed that in the period between 22 15 h 20 DEC 92 and 11:15 h UTC 21 DEC 92 there were no anomalies nor discrepancies in funtioning of the transmitters/receivers COM/VHF that could have interfered with the communications with the aircraft.

The aircraft was equipped with three transmitters/receivers VHF, collins model 618M and two transmitters/receivers HF, collins model 618T-2.

The onboard VHF equipment was apparently in normal working order, and no problem was noted in the message receiving by the aircraft or the aeronautical station.

The DGAC performed the analysis of the communications recordings and transcriptions on the following frequencies:

a) 118.200 Mhz Control Tower Faro
b) 119.400 Mhz Approach Faro
c) 159.750 Mhz Emergency Channel

In annex 6 the transcript of the communications is attached, of the frequencies mentioned in b) en c).

In case of conflicting text, the Portuguese
report is the valid document

1.10 INFORMATION ON THE AIRPORT

1.10.1 General Information

The airport infrastructure services at Faro and the area navigation infrastructure are provided by Empresa Publica de Aeroportos e Navegacao Aerea (ANA, EP) and are its responsibility.

The Aeronautical Information Service is also provided by the same organization by delegation to DGAC, being the Portuguese State still responsible for the provided information.

In AIP - Portugal which is published by "Serviços de Informaçâo Aéronautica - ANA EP" by delegation of DGAC, the practices and procedures applicable to the national territory are published.

1.10.2 Faro Airport

Reference point

Coordinates:	37°00'46"N 07°57'53"W

Location of the Airport in relation to the town (Alto de Faro)

- Distance	4 km
- True Azimuth	262°
Elevation	7 m/24 ft
Magnetic deviation	06° (JAN 90)

Verification points:

Altimeter	: Exit Runway 29 - 18 ft : Exit Runway 11 - 24 ft

Runways

11/29

True Direction	: 100/280
Length	: 2.490 m
Width	: 45 m
Landing Zone	: 268 m
Length of hardened area	: 2.520 m
Width	: 150 m

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Runway Load Factor	: PCN 80 /F/A/W/T
Runway pavement	: Asphalt

Markings

Runway 11/29	: Runway identification marks, exit's, runway distance remaining, touchdown zone, lateral runway limits
Taxi-ways	: Markings for exits, taxi routes, holding zones at intersections, identification of taxi-ways and holding area's to runway.
Obstacles	: Marking of all obstacles

Equipment

Auxiliary emergency power	: Auxiliary electrical power is assured according to the requirements of Annex 14

Radio navigation Service

Radio Aids	: VOR/DME NDB

Taxi ways

Width	: 23 m
Compactation	: PCN/90/F/A/W/T
Pavement	: Asphalt

Visual Nav Aids

Reference Visual Aids:	Airport beacon unserviceable due to work in progress in the control tower airport, identification mark Faro

Indicators and signal devices

For landing	: Iluminated wind sock (runway 29)
For Communication	: There is no signal area

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Lighting

Approach runway 11/29: PAPIS with windbars on both runways

Runway 11/29	: Edge, touch down zone, centerline lights with colour codes all of variable intensity
Obstacles	: Lights on all obstacles
Taxy ways	: Centerline green lights of variable intensity

1.10.2.1 Operation of lights

Lighting of runway 11 was in perfect working condition at the time of the accident.

Runway 11 PAPI was subjected to an inflight inspection performed on the 14 JAN 1993 by DGAC and the report mentions "no malfunction has been detected which could jeopardize the operational condition of the aid."

1.10.2.2. Within AOP-1 frame from EUR air navigation plan the operational requirements for Faro airport are mentioned, all of them considered satisfactory.

The commission verified that in AIP-Portugal, AGA 2-1-3, dated 09/12/91 section 35 - Ajudas Luminosal, subsection "Approach Lights" runways 11/29 states PAPI 3, whilst PAPI is not a approach light.

1.10.2.3 Airport Control Tower

Airport control service is installed on a floor separated in half by a wall. Airport control cannot see the aircraft flying in quadrants NE and NNE.

1.11 FLIGHT AND COMMUNICATION RECORDERS

The aircraft was equipped with a CVR - Cockpit Voice Recorder SUN-STRAND, P/N 980-6005-060, S/N 6047, a DFDR - Digital Flight Data Recorder SUNDSTRAND, P/N 981-6009-014, S/N 3765, and a AIDS - Aircraft Integrated Data System, P/N 981-6102-001.

The CVR and DFDR were found in the aircraft wreckage in the tail right side, with the covers showing signs of exposion to fire.

The AIDS was removed intact from the electronics bay in the lower side of the cockpit.

1.11.1 <u>Reconstruction of conversation and aural warnings in the cockpit through the CVR</u>

The unit was transported to the installations of KLM in Amsterdam where it was opened and photographed on 28 DEC 92.
The unit showed exterior signs of exposion to fire, but, after being open it was verified to be in good order.
Approximately 10 cm, of the tape was destroyed.
The recording finished when the aircraft landed at Faro.

Copies of the tape were produced, one was sent to NAIB and the original plus two copies were sent to Portugal, care of DGAC/GPI.
The recording was not affected by the accident and was in good conditions, however the legibility of the recording was bad due to a strong background noise which severely affected the reading, therefore it was necessary to request the help of NTSB which used a digital filtering technique to remove noises.
The transcription is attached in Annex 8.

The timings of communications ATS in the CVR and subsequent correlation of recordings CVR ATS made it possible to verify the working speed of the CVR and to establish a reference for determination of noises recorded on the CVR.

It was possible to reconstruct the development of the last flight phase, using the recordings of DFDR, AIDS and Radar.

In case of conflicting text, the Portuguese
report is the valid document

1.11.2 Reconstruction of flight through the parameters registered on the DFDR

The unit was recovered from the wreckage and transported by a member of this commission to the NTSB-H.Q. in Washington D.C., being decodified as from 07 JAN 1993 in the presence of the above mentioned commissionmember.

The unit showed exterior signs of exposion to fire. It was photographed and opened.
The vicaloy tape showed discoloration and contamination, mainly in the area's with the registration of the last minutes before the accident.

The damage to the tape made it necessary to use an NTSB developped technique (bit dump) in order to make the reading possible.

1½ minute prior to landing the aircraft was at 995 ft pressure altitude with a magnetic heading of 125° and an IAS of 140 knots.

At 07.32.10 UTC pressure altitude was 815 ft, the vertical accelleration values started fluctuating between 0.75 G's and 1.25 G's and at 07.32.17 the N1 values on the three engines started a synchronized fluctuation between 55% and 105% and kept fluctuating up to landing.

At 07.33.12 UTC, at a radar altitude of 104.3 ft, a movement of the rudder to the left started, with a maximum value of -22.5°, with a roll angle of -1.76° left wing down.

At 07.33.15 UTC, at a radar altitude of 70.6 ft, the inboard left aileron showed a deflection that reached -11.612°, while the right outboard aileron showed a deflection of +7.11°, both deflections indicating a right wing down command.

At 07.33.20 UTC contact with the runway was registered.
Recordings show an altitude of 1.2 ft, an IAS of 126 knots, magn. heading 116.72°, +8.79° pitch up, +5.62° roll left wing up and vertical accelleration of 1.9533 G.

The elevator deflection parameters show its maximum value at the point of contact with the runway, and the maximum pitch of +9.4°, 1 second after contact with the runway.

Autopilot no. 1 (Captain) remained off during the descent phase.

Autopilot no. 2 (Copilot) was on in mode Command at 07.26.43 UTC (beginning of the FDR recording), until 07.32.25 UTC.

During this period the autopilot was selected to HDG.SEL in mode Roll.

Between 07.26.43 and 07.26.49 UTC it was selected to mode ALT. CAP.

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Between 07.26.50 and 07.39.18 UTC the Command Altitude Hold was selected. Thereafter it was changed to Vert. Speed until the end of the flight.

The auto throttle speed command was engaged during the last 6 minutes of flight. Pitch until 07.30.34 show small oscillations around 3° nose-up.

From 07.31.22 UTC until approx 07.32.10 UTC small oscillations shows around a central value of 4° nose-up.

In a last phase, after 07.32.10 UTC, high pitch oscillations between 0° and 8° nose-up started, which were not damped, with increasing turbulence in between.

The roll attitude behaviour emphasizes a decrease in stability in the last part of the approach, mainly as from 07.33.20.

As far as rate of descent is concerned, as from 07.31.51 UTC very wide oscillations started in values between +130 ft/min and -1300 ft/min.

As the time of touchdown the descent rate was above 900 ft/min.

The groundspeed did not show any abnormalities, being only worth mentioning that around 07.31.31 UTC there was a decrease in groundspeed, returning to the normal values afterwards.

The vertical approach profile referred to the parameters barometric altitude, radar altitude and radar altitude registration showed an oscillating character with a level off at 400 ft around 07.32.10.

There is no recording on descrepancies between the values given by the barometric altimeter and the radar altimeter.

The evolution of values of magnetic heading and track does not shown any abnormality, taking into consideration the present wind conditions, the fact the final approach VOR radial (111°M) and the circumstance of an overshooting on baseleg as shown on the radar recording.
The crab angle after 07.32.10 starts significant oscillations and at 07.33.17 reached 9°.

It was found that the N1 and N2 behaviour matched the power lever position.

It was observed that until 07.32.00 the RPM were kept in limits, but thereafter remarkable oscillations started as a result of ATS response to pitch oscillations.

Around 07.33.10 UTC the engines accelerated to the maximum registered in this phase of the flight (102% N1), decreasing rapidly to flight idle (40% N1).

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From the actuation of the power levers in this phase it was noticed that power was completely reduced at 150 ft radar altitude above the runway, thereafter it was slightly increased and reduced again.

The recorded evolution in vertical accelleration shows the turbulent character of the approach and also can reflect the pitch oscillations noticed in the final phase of the approach, as well as the resulting sinking when the power was reduced to idle at 150 ft RA.

The extreme values of vertical accelleration are comprised between a maximum of 1.29 and a minimum of .8 G and these values are within the aircraft operation limits.

1.11.3 Correlation between CVR and DFDR recordings

In the segment from descent to the point of impact on Runway 11 there are no significant discrepancies between DFDR and reports and warnings.
In Annex 8 the report and warnings on the CVR during the last phase of flight are presented.

1.11.4 Correlation of the recordings of ATC communications and CVR recordings

The comparison of transcriptions of the ATC and CVR recordings showed a difference in the times simultaneous, initial and final.

It was necessary to make an adjustment of the times and a correction table is shown in Annex 5.

The times in this report are the adjusted times.

As reference the moment of the first impact of the aircraft wheels on the runway was taken, which was at 07.33.20 adjusted time.

1.11.5 Reconstruction of the flight through the recorderd parameters in the AIDS

The unit was recovered from the wreckage without external damage and transported to the KLM quarters where the reading and registration of parameters was performed.
The gathered information was in good conditions, finishing at an altitude of 47 ft RA, as there was no more information due to damage in the tape, probably caused by impact forces.
The AIDS recordings combined with DFDR recordings allowed to establish the flight profile in the last phase of flight and can be found in Annex 9.

In case of conflicting text, the Portuguese
report is the valid document

1.12 INFORMATION ON IMPACT AND WRECKAGE

1.12.1 Impact

The aircraft performed the landing on the left hand side of Runway 11, with a crab-angle of 7° to the right and a roll angle of 5.62° left wing up.

The aircraft wreckage was spread over the runway and on the left and righthand side in an area of around 184.800 square meters.

On the runway at the touch down zone, traces of continuous sliding could be seen with an increase in the width of the marks, of the tires of the right main gear and lighter slidemarks of the tires of the main center gear, in an extension of approx 30 m.

After the tiremarks on the runway, a parabolic impact zone could be seen, approx 15 m wide, due to the impact and sliding of engine no. 3, on the runway.

The inboard right wing flap was found on the intersection of taxiway D, with the left side of the runway.

Still on the left hand side of the runway and a few meters ahead of the right hand flap a wide and deep cut could be seen, produced by the rim of the center main gear no. 2 wheel.

This cut could be seen along the runway turning progressively to the right hand side and stopping close to the centerline.

In the 942 zone of Runway 11 and from the centerline, crazes could be seen, indicating the final trajectory of the aircraft up to the final stopping point outside the runway with an angle of 120° to the right.

In the track of the aircraft several components were found which are listed in the wreckage distribution chart in Annex 11.

1.12.2 Fuselage

The fuselage, on the immobilization zone, was broken into two main parts.
The forward part, not consumed by fire, between station 239 and 1039, showed substantial damage on the right hand side and a cut on the left hand side at station 475.
This fuselage part was oriented at 274° West and the distance between the radome and the runway centerline was 115 m.
The aft part of the fuselage between stations 1039 and 2007 was consumed by fire which started after the aircraft came to a stop. This part was oriented at 230° West at the distance between the tailcone and the runway centerline of 82 m.

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The cockpit showed substantial damage on the right hand side with multiple fractures and skin deformation which provoked the opening of the right lateral window.

Signs of sliding also on the runway surface, could be seen and also runway edge mud, confirmed by the presence inside the cockpit of a high quantity of mud, water and vegetation.

The outboard panels of the fixed and sliding windows show damage that confirm sliding.

Inside the cockpit the instrument panels and systems show fractures at the attachment points and were partially covered with mud.

1.12.3 Tailsection/Flight controls

The horizontal tailplane and right elevator were broken from the fuselage into parts, which could be found a few meters of the aft fuselage.
The fractures show that the break off was caused by bending upwards in a vertical direction towards the vertical stabilizer.
These parts were partially consumed by fire.
The vertical fin and rudder were broken from the fuselage at station 312.8 and fractured in several pieces.
The fracture close to the separation zone show that the break off was caused by bending forces to the left of the aircraft.

1.12.4 WINGS

Right hand wing

The right hand wing was separated from the fuselage and some meters away from the attachment point, partially consumed by fire, between the trailing edge station XORS 455 and XC 118.
By the trail on the runway and the edge it was confirmed that the wing separation happened still on the runway, following the trajectory close to the remaining of the aircraft, up to the point of immobilization.

The inboard flap and vane were missing, They were found on the intersection of the runway with taxiway D.

Slats no. 1 and 3, spoiler no. 1 and inboard aileron were destroyed by fire.

Engine no. 3 was connected to the wing by the pylon and showed important deformation caused by sliding on the ground.

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Left hand wing
The wing was connected to the fuselage showing several fractures caused by stress and explosion. The wing tip top skin showed marks of sliding on the ground. The wing was sectioned at station XORS 623.

The inboard flap, vane, spoiler no. 1 and aileron were attached to the wing structure.
The remaining control area's were spread on the point of immobilization of the aircraft.
The wingtip was at around 70 m from the runway centerline.

The inboard flap was extended and at the end of its travel at 50°.

In case of conflicting text, the Portuguese
report is the valid document

1.12.5 Cabin interior

1.12.5.1 Forward cabin

All the forward cabin up to station 1039 (row 16) which corresponds to the fuselage section which, do to the favourable wind direction, was not touched by fire, shows massive deformation consistent with the sliding on the right hand side and ceiling, in the soft soil of the runway edge, and mud, sand and light vegetation entered this area.

The fuselage walls deformation in an inward direction, caused the general release of ceiling panels and the attachment points, air conditioning ducts and cables, with the isolating materials being exposed, on the right hand side the lateral supports failed as well as window frames, P.S.U.'s and luggage bins.

It is worth mentioning that the majority of the bins remained attached to the fixing points, which indicates that the release/destruction of the bins was a consequence of the fuselage deformation and not of the excessive weight combined with great decelleration in the longitudinal sense.

On the left hand side there was less destruction and it could be verified that panels, bins and P.S.U.'s, although deformed, remained in place.
In spite of the extensive damage sustained by the fuselage, there was no major structural deformation of the cabin floor, including the rails which fix the seats to the bulkheads. The after impact state of the remaining cabin interior as passenger seats, jump seats, galleys, lockers and bulkheads, was very much affected by the rescue services, while evacuating wounded passengers and trapped passengers.

These services, strange to the airport, used hydraulic scissors to remove ten seats in rows 1 and 2, and 16 seats between rows 8 and 10. Also a shovel was used to remove wreckage from inside the cabin between rows 11 and 17.

Therefore only a small section of the cabin, between rows 3 and 7, can be considered relatively preserved. (There was no rows 5,6, and 13, neither centra' aisle of row 7.)

In this section the attachement points and structure of these seatgroups do not show deformations that can point to great decelleration, at least in the longitudinal sense, and all seats on the right windows side, showed the same type of deformation at head-rest level, which confirmed the "falling" of the lateral cabin wall.

1.12.5.2 Central and aft cabin

As the central and aft fuselage as from row 17, was destroyed by impact or by the explosions and subsequent fire, it was not possible to examine the wreckage to assess the post-impact state of its equipment.

From the wreckage which could be found on the ground was recovered seat groups of rows 16 and 22, and group H, G. and K of row 26. (taking as credible the handwritten indication of the number of rows RH or LH, that could be found in the canvas in the base of the seat bottom of each group of 2 or 3 seats.)

These seats, many of which were destroyed by fire, showed great structural deformation but it was not possible in the majority of the cases to separate theresult of impact from the action of the mechanical means used to remove wreckage.

The seats of rows 23 to 41, as well as the remaining cabin equipment of this section, were consumed by the fire which destroyed this part of the fuselage.

It is worth mentioning however that a portion which was not burned, of the cabin floor, made of composite material, could be seen in an almost vertical position, leaning to the right and aft fuselage, close to the wing flap.
This floor portion, of approx. 8 m2, which was still connected to the fuselage interior, showed the stringers of the seat groups floor support, which were cut and the floor, leaning to the fuselage, showed therefore an explosion in the interior of the central section.

1.12.6 Passengers and cargo doors and slides

1.12.6.1 Left hand doors and slides

Crew and forward passengers door (11)

It showed evidence of being forced by the rescue teams. The escape slide had a cut.

Intermediate passenger door (12)

The door was closed and deformed. Escape slide intact.

Central passenger door (13)

Was ejected from the aircraft and showed cuts in the structure. It was found at around 5m from engine nr.3. The girtbar was buried in the ground. Escape slide was not found.

Aft passenger door (14)

Was destroyed, still connected to the rail, but in an inverted position. Escape slide was released, not inflated and destroyed.

Upper cargo compartment door.

Showed indication of being sawed with mechanical saw by the rescue team.

1.12.6.2 Right hand doors and slides

Crew and Passengers forward door (21)

Was deformed but intact. Escape slide intact.

Intermediate passenger door(22)\

Was separate from the aircraft and deformed. Escape slide was intact.

Aft passenger door (24)

Was not found and it is presumed that it was destroyed in the fire that started after the aircraft came to rest. Escape slide destroyed.

1.12.7 Engines

Engine # 1.

The engine was found, separated from the wing by fracture of the pylon thrust fittings and pylon aft bulkhead, and was located in the area of immobilization on the right hand side of the fuselage and close to the zone of separation of the two fuselage sections.

The nose cowl was separated from the engine at a short distance.

The blades of the fan first stage and the spinner were in their correct postition.

The fanblades showed light damage to the leading edges provoked by the ingestion of foreign objects.

The painted tips of the fanblades showed damage by foreign object ingestion.

No significant signs of ingestion could be found through the fan duct.

The fan reverser was stowed.

The fan carter and the inverter were partially burned.

There was no sign of contact between the underside of the engine and the runway.

The exhaust core nozzle and the aft center body showed deformations on the right side consistent with the impact with the fuselage forward cargo compartiment.

In the aft part of the engine no significant damage could be found up to the fourth stage of the low pressure turbine.

In the air/oil exchanger there were no signs of bird ingestion.

No signs could be found in carters and cowlings that could indicate ejection of rotating engine components.

The master chip detector was inspected and no metallic chips, which could produce damage to the engine, were found.

There were no signs of engine fire.

Engine # 2.

The engine was in its normal position on the aircraft, in the tailcone.

There were no indications on the cowlings and carters of perforation by ejected rotating components.

The aft fuselage part including the engine area were subjected to the fire effects which consumed the center and aft fuselage. However, the engine cowlings were easily opened, showing that the engine did not have exterior structural damage.

The first stage fanblades showed slight damage to the leading edges. Inside the air inlet duct there was a great quantity of grass and debris.

It was verified that the reverser was stowed and inhibited.

No signs of internal fire could be found.

The master magnetic chip detector was inspected and no presence of metal chips, that could indicate internal damage to the engine, could be found.

Engine # 3.

The engine was connected to the wing by the pylon. The pylon was deformed with the engine leaning to the left. The cowling was touching the ground in the area between 7 and 10 o'clock. (Seen from backwards to forward).

The nosecowl was separated from the engine and partially destroyed.

The spinner cone showed a spiral deep cut of approx. half circumference.

One fanblade showed light damage made by a hard object, on the leading edge.

The fanblades showed radially typical lines of water drops.

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All fanblades were present.

There was quite some rubbing in the fan duct on the upper quadrant.

The engine underside showed evidence of hard contact with the runway.

In the air/oil exchanger no signs of bird ingestion could be found.

There were no signs of engine fire.

The access to the turbine was limited, however no significant damage could be found.

The horizontal drive shaft was found at approximately 120 m from the engine and separated at the broken section.

The cover of the lower radial driveshaft was found at approx 95 m from the engine.

The generator and CSD were found, connected to the gear box and at approx. 80 m from the engine, showing deep marks of sliding on the runway.

The pneumatic starter was found at approx. 80 from the engine and to the left of the gearbox.

The engine oil tank was found at approx. 75 m from the engine.

The transfer gearbox showed evidence of hard contact with the runway and sliding.

The fan aft starter case was deformed and fractured, circumferentially.

The reverser was stowed and showed marks of the shovel used in the rescue operation.

The access to the turbine was limited, however no damage was found.

The engine cowlings were dislocated and the compressor rear frame could be sean.

No sign of damage could be found on the engine cone stationary structure.

The exhaust nozzle, exhaust cone and center body were in the correct position, showing damage all around circumferentially.

The master chip detector was inspected and no metal chips could be found, which could indicate possible internal damage to the engine.

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The commission established that the engines operated at high RPM and were delivering power at the moment of impact.

APU

The turbine carter showed deformations. There were no signs of fire in the APU.

1.12.8 Landing gear

Right main gear

The truck beam was fractured, separated in two from the group of axels of the forward and aft wheels. The truck beam trim cilinder was fractured at the shock strut fixing terminal.

The front link Ext. was fractured at the fixing terminal.

The front link Int. was deformed.

The rear brace compensating link Ext. was fractured on the body and aft fixing terminal.

The link assy-upper lock was fractured on the upper and lower downlock.

The lower sidebrace was fractured close to the aft attachment terminal.

The upper side brace was fractured close to the aft attachment terminal.

The fixed brace showed fractures close to the aft and forward fixing terminals.

The retract cilinder showed fractures close to the point of attachment of the retracting tack.

Support right hand. This connecting support to the fixed arm showed a fracture located in the left lower side of the support.

The wing fitting showed a fracture on the retracting jack fixing point.

All gear components were found attached to the right wing or in its vicinity, except the truck beam which separated from the gear assembly and was found at approx. 10 m to the left of the immobilization place.

The gear tires showed the following condition:

- Wheel 3 tire - with pressure, and cuts in the surface.
- Wheel 4 tire - no pressure, and cuts in the surface.
- Wheel 7 tire - with pressure, no damage.
- Wheel 8 tire - with pressure, and right hand side with cuts and torn.

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The brake assemblies showed the following:

- Wheel 3 - locked
- Wheel 4 - locked
- Wheel 7 - locked
- Wheel 8 - unlocked

LEFT MAIN GEAR

The gear was intact and in the position down and locked. It was verified that the tires were damaged by the fire.

MAIN CENTER GEAR

The gear was in the position down and locked but totally destroyed by fire. The right hand wheel showed damage to the right rim, resulting from the scraping through the runway which make the tire separate, which was found close to the runway centerline.

NOSE GEAR

There was no damage and it was down and locked.

1.12.9 Instruments and controls

In the cockpit area the panels and instruments showed light damage and it was possible to make the following read-outs:

1.12.9.1 Fuel quantity ganges

Tank 1	999.50 kg
Tank 2	839.00 kg
Tank 3	999.50 kg
Aux tank	999.50 kg
TOTAL:	3837.00 KG

The commission determined that this values of fuel quantity were not representative of the remaining fuel on board at the time of the accident.

1.12.9.2 Altimeters

1 -QNH	1013 Hpa
2 - QNH	1013 Hpa
EMERG.QNH	1009 Hpa

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1.12.9.3 Oil quantity indicators

Engine 1	No indication
Engine 2	"
Engine 3	"
APU	"

1.12.9.4 Oil temperature indicators

Engine 1	50 °
Engine 2	50 °
Engine 3	50 °

1.12.9.5 N1 Indicators

Engine 1	No indication
Engine 2	"
Engine 3	"

1.12.9.6 N2 indicators

Engine 1	No indication
Engine 2	"
Engine 3	"

1.12.9.7 EGT indicators

Engine 1	No indication
Engine 2	"
Engine 3	"

1.12.9.8 Fire Control handles

Engine 1	OFF
Engine 2	ON
Engine 3	OFF
APU	ON

1.12.9.9 Fuel shut off handles

Engine 1	OFF
Engine 2	OFF
Engine 3	ON

1.12.9.10 **Bugspeed**

Captain Air Speed Indicator	139 Kts
First Officer Air Speed Indicator	139 Kts

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1.13. Medical and Pathological information

1.13.1 Injuries to occupants

The aircraft transported 340 occupants of which 13 were crewmembers.

The accident provoked fatal injuries to 56 occupants (2 cabin crew members and 54 passengers).
Of these, 45 deaths by total or partial carbonization (70% - 90%) 9 deaths by cranial-encephalic traumatism, one death by traumatism and/or carbonization and one death by asphyxiation.

The autopsies of the victims revealed a large number of total carbonization, the bodies being bloodless and total exposing of body organs, compatible to the exposion to very high temperatures.

1.13.2 Crew

The crew of the accident aircraft was composed of ten cabin crew elements and three technical crew: Captain, First Officer and Flight Engineer.

The lack of an implemented scheme at national level for the gathering of organic liquids for biochemical examination and toxicology in aeronautical accidents made this to be performed outside the express orientation of the inquiry commission. For this reason there was no gathering of samples of blood and urine in adequate quantity for the determination of presence of drugs that could have interfered with performance.

Only an alcohol test was done on all crew members with negative results on every case.

It is worth mentioning, following the information from the laboratory, that the gathering of samples was performed without application of the legal requirements (sealing and double gathering).

The analysis of the last 72 hours of the technical crew was requested and it did not show any significant abnormalities of behaviour or evidence of overwork or jetlag.

However it was not possible to find in detail the private activities of the crew in this period, i.e. rest hours before reporting before duty.

The register of the medical examinations of the three cockpit crew revealed that all had valid medical certificates, being on the last inspection considered fit without restrictions.

There is no evidence in the previous history or actual patology, nor clinical or laboratorial abnormalities, subseptable to influence the accident, i.e. history of any type of regular medication by any of the three cockpit crew members.

In the captain's clinical process there was a hypothysis of demyelinative in the Central Nervous system, following a history of Scotoma (Visual Field Defect).

An Extensive neurological assesment was carried out, and chronic pathologic ailment of the central nervous system was excluded.

After an interruption of 6 months of flying, the Captain returned to this functions in July 1990 and nothing abnormal could be found there after.

All crew members were checked by neurologists and no alterations were found, being considered fit to return to duty.

No psychological tests were performed.

1.13.3 Air Traffic Controllers

At the moment of the accident four controllers were on duty, with three of them working.
All the controllers had valid Class 3 medical certificates, being considered fit without restrictions on the last medical examination.

As there is no precise requirement on the gathering of samples on the controllers in this type of situation, no gathering of blood or urine for toxical/biochemical evaluation and research on prohibited substances or products was made, therefore, no information is available.

Interviews with each of the controllers were not done in due time, with focus namely on the activities of the last 48 hours - 72 hours before the accident. Written statements were gathered by the very controllers only on procedures in the context of the accident.

ANA/EP was requested the results of the initial psychological tests of the controllers, in order to detect indications of lower performance or aspects that could influence the operation.

Without objective elements for analysis on the controllers it was found insufficient the available information to establish a link between any eventual operational instability and the psyco/physical balance at the moment of the accident.

1.14 FIRE

The fire was originated in the right wing, right after the collapse of the main right landing gear. Visual witnesses, present on both side of the runway threshold, stated that the saw right after touchdown, a"ball of fire" enveloping the center section followed by the developping, on both sides of the fuselage, at window height, a horizontal flame that followed the aircraft in the roll-out.

The majority of the passengers seated on the right hand side of the aft section of the cabin refer they observed sparks on the right wing, immediately followed by fire "that immediately advanced in their direction", penetrating the cabin section over the wing.

Some passengers seated in places on rows J and K, refer they observed the right wing "came up as a big wall" which matches the longitudinal rotation of the fuselage to the right, simultaneously with the fracture of the right wing close to the root.

At the time of the aircraft immobilization or immediately before one or two subsequent big explosions took place in the fuselage center section. (Overwing emergency exit section).

The fuselage was completely separated into two parts, and the forward part (from noise to station 1039) being untouched by fire. On the aft part fire was due to the rupture of the integral tanks.

The airport rescue services, which meanwhile arrived at the site, fought the main fire focus with watery foam with AFFF particles, and simultaneously covered the victims who were evacuating, via the aft left door (14), with foam.

After the first three minutes of the intervention by the airport firemen the fire was almost controlled, although the positioning of the vehicles was very deficient and the efficiency of the mixture AFFF was reduced by dilution with heavy rain at that time. (annex 14)

After the evacuation of the last survivors and two cabin crew via exit 14, a strong explosion (07.37) re-ignited the fire at the time that the firetenders, after the first intervention, started refilling.

The fire was extinguished with the help of exterior rescue but still re-ignited (09.03) in the luggage compartment which provoked the total destruction of the aft fuselage.

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1.15. SURVIVAL FACTORS

1.15.1 Survivability

The aircraft had a cabin version with 41 rows and a total of 334 seats. There were 327 passengers on board aged between 3 months and 74 years.

The crew consisted of 13 persons, three cockpitcrew and 10 cabincrew.

After the impact the fuselage broke in two distinct parts that according to the structural damage, determined four different zones of injury in the cabin.

The forward section consisting of rows 1 to 10 and the cockpit that corresponds to part of the aircraft which did not catch fire after the impact was immobilized with the left side lying on the ground. In this section were seated 56 passengers, four cabin crew and three cockpit crew.

They all left the aircraft through ruptures in the fuselage, either by themselves or with the help of other passengers.

The two left exits in this zone, 11 and 12, were inoperative because they were in contact with the ground, not permitting its utilization.

The other two, 21 and 22, were not used because they were difficult to reach since they were practically vertical above.

Among the 56 passengers there were no fatalities. There was one serious burned and one mild burn victim, 16 seriously injured (fractures, different internal injuries) and 23 minor injuries (bruises).

The captain and one of the cabin crew sustained minor injuries. The copilot and another cabin crew serious injuries.

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In a second section, Forward intermediate, seatrow 11 to 19, there were 73 passengers and two cabin crew.

In this zone was the tranversial rupture that completely broke the aft part of the aircraft from the front part.

The passengers situated in that area left exclusively by the holes in the fuselage, either by themselves or being ejected or assisted out.

This situation existed in 20 - 25% of the cases.

From the above passengers there were 6 fatalities, two mild burned, 26 serious injuries (mainly with fractures) and 28 minor injuries.

One of the cabin crew suffered minor injuries.

This section was the one sustaining more serious injuries of traumatic origin, probably in direct association with the rupture of the fuselage, the observed mortality essentially being due to cranial or spinal injuries.

The section referred to as AFT intermediate included rows 20 to 29.

There were seated 92 passengers and 2 cabin crew.

This section, located over the integral fuel tanks, was severely damaged by fire, that penetrated the cabin at the moment of impact and propagated into its interior transversally from right to left.

Survivability in this zone was very much affected by the explosion of fuel tanks and subsequent fire, being admissable that there was some kind of previous partial incapacity (loss of conscinousness, fractures) from the fatalities, in a way that they did not have the chance to evacuate in time.

We had 48 fatalities among the passengers and also the two cabin crew in this section.

This number corresponds to 89% of the fatalities. Of these, the majority met death by carbonization and some by cranial traumaties.

Although it was not possible to determine in the majority of the cases evidence of post-impact survivability, this is admissable, although not quantifiable, due to the documented evidence of elevated levels of carboxihemoglobin.

From the other passengers in this section 37 (84% of the survivors) suffered serious injury or burns, having left the aircraft in the majority by holes in the fuselage or through the cabin floor or being assisted by other people to the

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outside (52%).

The two passengers in seats 24A and 24B left the aircraft using emergency exit 13, which door had been projected out at the time of impact.

Both suffered extensive and serious burns.

Survivors from rows 28 and 29 left the aircraft via exit 14, also with serious burns.

In the aft section of the aircraft, rows 30 to 41, there were 106 passengers and two cabincrew.

This section corresponds to the zone which proved more structurally resistant to the impact.

It was possible to perform evacuation through the two rear exits during about 3½ mins, before a big explosion occurred and this part was thereafter totally consumed by fire.

The survivalrate in this zone was 100%, with relatively low morbidity in relation to the other sections.

The left exit (14) opened by structural deformation before the aircraft had stopped and the slide deployed, but did not inflate.

83% of the passengers and the two cabin crew from this zone used this exit, being covered in majority by foam of the firemen.

The right exit (24) was opened by the assigned cabin crew member with partial inflation of the slide which was almost immediately consumed by fire.

The other 17% of the passengers used this exit, right in the beginning of the evacuation.

Its use was afterward suspended by the cabin crew due to the presence of fire outside. It was registred in this area 20 serious injuries and/or burns and 48 minor injuries, with the rest of the occupants being uninjured.

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1.15.2 Fire Fighting and Rescue

At the time of the accident and according to landing and take-off routine, two vehicles were on standby for prevention and assistance for the movements. The vehicle first intervention - OSKOSH T-15 nr. 05 - had on board a team-chief and a fireman. The second intervention vehicle - OSKOSH T-12 nr. 01 - was crewed by two fireman.

The remaining members of the shift, the Shift Chief, a teamchief and a fireman were waiting for sunrise to perform the routine equipment daily inspection. The rescue service chief was in his office.

At 07.32.00 UTC (approx) the crew of the first intervention vehicle, positioned with the engine running in the external park of the firebrigade building, observed the approach, apparently normal, of Flight MP495, when they saw an explosion followed by flames that envelopped the aircraft.

The vehicle immediately departed, switching on the lights and sirens.

The second intervention vehicle, parked on the same place, took off immediately afterwards, simultaneously with the Faro control tower aural alarm.

Shortly afterwards the vehicles Protector C-2 nr. 3, driven by a fireman and the Shift Chief operating the cannon, the Command and Rescue vehicle, driven by the rescue services chief and finally, the vehicle OSKOSH T-12 nr. 2, crewed only by the teamchief, left the building.

From the recordings on the emergency channel and statements from the rescue people and other witnesses, as well as the timing made over the same routes and with the same vehicles, the rescue service intervention chronogram was as follows: (annex 14)

At 07.33.22 UTC.
Accident

At 07.33.31 UTC.
Faro Control Tower transmits by radio the accident waring.

At 07.34.45 UTC (approx).
Vehicle T-15 in standby starts driving to the accident place before the alarm was given, positioned itself close to the aircraft tail left side and starts fire-fighting.

At 07.35.15 UTC (approx).
Vehicle T-12 in standby arrives at the place and positions itself close to the tail section, longitudinally in relation to the fuselage.

At 07.35.18 UTC.

The rescue services Chiefs arrives at the place, staying at the right hand side of the wreckage. As the flames were diminishing in intensity, he saw figures coming out of the aft section of the aircraft and starts rescue operation.

At 07.35.45 UTC (approx).
The Vehicle Protector leaving the runway edge, tried to reach the southern side by the left side of the wreckage, close to the drain channel.
When it crossed the muddy ground, trying to find the best position in relation to the wind direction, it became stuck, allowing however a good cover of foam to the survivors, some of them with the closing-in of flames, as well as to the firemen who were trying to remove from the danger area those that could not do it by their own means.

At 07.36.00 UTC (approx).
A follow-me car driven by an airport operations officer and with the airport rescue post nurse on board arrived at the accident and were immediately integrated into the rescue operations in course.

At 07.36.30 UTC (approx).
Vehicle T-12 nr. 2 with only one crew, after looking for the best possible position, taking into account the muddy tail, positions itself close to the aircraft tail on the left hand side.

At 07.37.09 UTC.
The fire apparently becomes under control, but is re-ignited by a violent explosion located, according to reports of some witnesses, in the middle of the wreckage, and according to others, from under the no. 2 engine.
Together with the explosion, an intense flame spread horizontally up to the middle of the fuselage.

At 07.37.15 UTC (approx).
Vehicle T-15 ran out of water. The driver drove to the well to refill.
The cannon operator remained at the accident place working on the rescue.

At 07.37.37 UTC.
The rescue chief reports by radio that he has all firefighting vehicles excpet T-15.

At 07.38.00 UTC (approx).
Vehicle Protector which was stuck, runs out of water.
The cannon operator integrates himself in the rescue operation and the driver proceeded to vehicle T-15 which was manoeuvring to leave the place, in order to help refilling.

At 07.38.45 UTC (approx).
Vehicle T-12 nr. 1 runs out of water. The cannon operator joins the rescue operation and the driver receives instructions to go back to the building in de command vehicle to pick up the Mercedes vehicle equipped with chemical

powder.

At 07.41.29 UTC.
The rescue chief requests by radio transport vehicles and ambulances to evacuate the victims.

At 07.42.00 UTC (approx).
Vehicle T-12 nr. 2 runs out of water and leaves the place to refill.

At 07.45.00 UTC (approx).
Support vehicle Mercedes nr. 4 arrives at the accident place with 1500 kg of chemical powder.
The fireman driving it receives instructions to go back to vehicle T-12 nr. 1 and the rescue chief tries to manoeuvre this mentioned vehicle to the place left vacant by the first intervention vehicle T-15.
This was not possible due to the risk of overrunning victims which still were in the muddy area.

At 07.46.40 UTC.
The rescue services chief asks again for vehicles to transport the victims.

At 07.49.30 UTC (approx)
The second intervention vehicle T-12 nr. 1 with two crew members leaves the place in order to refill. This was delayed by the fact that vehicle nr. 2 was still refilling.

At 07.50.30 UTC (approx).
Vehicle T-15 returns to the accident place after refilling and gets stuck, when it tried to get in a wind-favourable position on the right hand side of the wreckage.

At 07.51.11 UTC.
The first ambulance arrives followed, 5 min. 46 sec. later, by three more.

At 07.58.47 UTC.
An airportbus arrives through the Southern side vis the old fence route and starts picking up passengers from the forward cabin, which was not affected by fire.

At 07.59.44 UTC.
Several Transit Vehicles from the airport start picking up lightly injured passengers.

At 08.00.39 UTC.
The Faro municipal fireman arrived at the accident site.

At 08.04.59 UTC.

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Another ambulance arrived.

At 08.05.01 UTC.
Vehicle T-12 nr. 2, already refilled, receives instructions to position itself to the southern side of the wreckage using the VOR road but became immobilized due to a flat tire caused by wreckage.

At 08.08.27 UTC.
An unsuccesful try to unstuck vehicle T-15 was made.

At 08.10.33 UTC.
Another ambulance arrived.

08.11.35 UTC.
Vehicle T-12 nr. 1 returns, refilled with water, after trying to reach the southern side via the VOR road unsuccesfully due to the obstruction by vehicle nr. 2.

At 08.14.54 UTC.
A sufficient number of ambulances had arrived at the accident place allowing there after a constant flow of evacuating victims.

At 09.03.03 UTC.
The fire re-ignited in the aft cargo compartment.
This fire was extinguished with the collaboration of the municipal fireman and other brigades.

In the first 10 minutes of actuation the airport rescue services and by order of intervention, the following was consumed:

Vehicle	Water (Liters)	AFFF (Liters)	Time of Action
OSKOSH T-15.05	6.000	375	1 min. 30
OSKOSH T-12.01	12.000	750	2 min. 15
Protector C2.03	6.000	375	1 min. 15
OSKOSH T-12.02	12.000	750	2 min. 15
TOTAL	36.000	2.250	7 min. 15

1.15.3 RESCUE AND EVACUATION

1.15.3.1 External conditions

The accident occurred inside the airport perimeter.

The aircraft came to a stop at approx 1100 m of the threshold of Runway 11

and approx 100 m to the right of the centerline.
The place of the accident was of easy access although on the day of the accident the soil, where the aircraft came to a stop, was flooded.

Faro district hospital, equipped with a heli-port, is located in town 8 km from the airport, by first class roads.

It was possible to create an area specially reserved for the rescue vehicles by closing off the route at 7 locations.

1.15.3.2 Alarm phase

The accident happened at 07.33.22 UTC and was witnessed simultanously by the firemen who crewed the vehicles and by the controllers on duty.

At 07.33.31 UTC.
The message "Emergency" was spread by the control tower via Emergency Channel nr. 1.

At 07.34.10 UTC.
This message was reconfirmed to the Aeronautical Operations Services although, with the wrong information that the "Columbus" which was awaiting clearance for line up and take-off, had caught fire.

The Lisbon control center was warned simultaneously due to the fact that at the moment of the accident, communications were in progress between Faro Tower en Lisbon Control Center.

The 115 - National Institute for Medical Emergency (INEM/PSP) registered the warning of the control tower at 07.35 UTC with the information: "Serious accident at airport".
The warning was re-transmitted to:
- Faro municipal firebrigade (B.M.F.)
- Faro district hospital
- Republican National Quard (G.N.R.) and Traffic Brigade (B.T.)
- Firebrigade inspectorate
- Portugese Red Cross
- Faro Harbour Authority
- Public Security Police (P.S.P.)

Up on receiving the warning from "115" the Faro municipal firebrigade sent to the airport its ambulances, which were outside the building, transmitting around 07.37 UTC identical comment to all vehicles inside the building.
The fire alarm was sounded and at 07.40 UTC the Faro volunteer firemen were informed of the accident, as well as the operational control center, in order to activate all other fire brigades in Algarve.

The Faro district hospital cleared the emergency entrance area and called the medical and paramedical personell on leave.

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G.N.R. together with B.T. proceeded to block the crossroads creating a clear way, reserved for the rescue means.
This operation took place outside the town boundaries and at 07.45 UTC. traffic was already rerouted.
The operational control center alerted by "115" or by Faro municipal fire brigade, according to the respective reports, mobilized the rescue entities in Algarve combining approx 36 ambulances, which arrived in great numbers to the accident place at 08.14 UTC.
The Red Cross received the warning through the operational control center at 07.45 UTC sending to the airport medical and paramedical personell in three ambulances and three transport vehicles.
The Faro Harbour Authority did not take part as it was found not necessary.
According to a report from B.M.F., the Faro Municipal Civil Protection was called up at 08.12 UTC, and coordinated at the accident place the corporations involved in the search and removal of bodies.

The PSP Faro district Command marked the itineraries inside the Faro town boundaries and at 07.50.00 UTC had under control the access route to the hospital.
The PSP division on duty at the airport was re-enforced in order to control emergency entrances and several supports.

1.15.3.3 <u>First Phase of Rescue operations</u>

At 07.35 UTC the airport rescue chief requested the enforcement of the emergency plan, requesting at 07.36 UTC to send ambulances.
Meanwhile two vehicles from the Airport Operation Service with the Airport Health Service nurse on board, arrived at the accident place.

At 07.37 UTC, as a violent explosion took place, panic was spread among the victims which started running in the direction of the terminal due to the fact that at that time it was the most illuminated place at the airport.
The Team Chief and an clement from the airport operation service picked up some wounded victims which looked seriously wounded and drove them to the arrival lounge.
T.A.P. ground personnel, customs and border police who waited at the terminal the disembarking of passengers of a T.A.P. aircraft which had just parked, took the wounded to the rescue post in the terminal.
The nurse on duty had not been warned of the accident.

At 07.41 UTC the rescue chief asked for buses to transport victims which were spread as well as ambulances.

At 07.46 UTC the tower transmits to the rescue services information regarding number of passengers on board.

At 07.52 UTC a vehicle from S.O.A. (Airport Operational Service) sends an ambulance to the domestic flight lounge.
Another ambulance waited for directions at the gate.

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At 07.55 UTC the rescue chief informs that the airport ambulance, driven by a firemen on leave, was gathering wounded and this, concerned about the scattered passengers in the mud, asked for buses.

At 07.59 UTC answering the demand of the rescue chief an ANA-bus informed it was on its way to collect victims.

At 08.02 UTC, after repeated demands from a firemen team chief, who was trying to group, in the southern side, the victims of the forward aircraft section, the ANA-bus arrived there via the old fence route and collected victims.

At 08.09 UTC. Stretchers were requested at the "meeting point" and coordination informed that as soon as ambulances arrived they would be routed to that point.

At the same time the rescue post meanwhile re-enforced by the presence of a medical doctor from Faro hospital, who was casually passing by the airport, and a Red Cross nurse, proceeded with the evacuation of the first assisted victims. For the more serious cases ambulances were used, sent by SOA, and for the light cases tourist busses which were parked outside.

At 08.10 UTC the coordination vehicle reported the arrival of one more ambulance followed by two more, and as from 08.14 UTC a constant flow of ambulances allowed as from that moment the quick evacuation of all wounded. The separation of cases was performed by Faro district hospital, Urgencies Department.

At 08.20 UTC the rescue post was still assisting passengers and asked the fire brigade for wooden splints.

At 09.00 UTC the doctor and nurse present at the the rescue post went to the accident place where they met a medical team from Faro hospital and it was verified that all victims had been evacuated.

1.15.3.4 <u>Subsequent operations</u>

At 08.00 UTC the Faro municipal firemen arrived and afterwards several other volonteer firebrigades arrived and started looking for victims trapped inside the non-burned section of the fuselage.

At 08.58 UTC a vehicle was requested with bags for dead bodies and medical gloves, which arrived at 09.08 UTC.

At 09.28 UTC instructions were given to relaod Foam agent into the firebrigade intervention vehicles in order to assist the Portugese Airforce aircraft, asked for evacuation support.

At 09.30 UTC was proceeded with the gathering of dead bodies and their transport to the rescue service head quaters.

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This operation was much hampered by the fact that the bags available at the airport were not suited for deformed bodies, and Red Cross bags were used. This operation was accompagnied by police authorities which gathered personal belongings.

At 09.31 UTC the Rescue chief informed that they did not have yet accurate information on the number of deceased at the accident place.
The company representative sent two employes to Faro hospital, where comparing the passenger list received from Amsterdam, and the hospital list, it was possible to establish at around 15.00 UTC, a provisional list of deceased and missing passengers.

At 09.34 UTC the rescue chief, suspecting the excistence of bodies trapped underneath the wreckage, asked fro the shovel to which arrived at 10.10 UTC.

At 09.30 UTC the rescue chief expressed his concern about the large number of people around the accident site which was hampering the rescue operation in course.

At 09.46 UTC the operation for the gathering of dead bodies continued and 40 to 50 stretchers were requested to the southern side of the wreckage.

At 10.07 UTC one C-130 of P.A.F. arrived with 60 stretchers.

At 10.09 UTC control tower was asked a forecast of the number of wounded to be evacuated to Lisbon.
The rescue chief informed he had no figures for that purpose.

At 10.16 UTC several P.A.F. helicopters arrived and some flew to Faro hospital, while others remained on the airport.

1.15.3.5 Operational conclusion

Approx at 14.00 UTC the operation for search and gathering of dead bodies was finished, although later on one body was reported missing.
This body, which was half-buried under neath the wreckage, was only located and removed 47 hours later with the help of a specialised member of the Dutch Police.
Approx at 17.00 UTC military vehicles transported the dead bodies to the mortuarium of Faro hospital.

The airport was reopened at 18.00 UTC.

1.15.3.6 Hospital action

The medical and paramedical Faro hospital personnel reported at the hospital after having been recalled by the hospital or by being informed through radio-news.

The hospital direction was informed on the situation by a doctor who reported at the airport rescue post, and being informed on the great number of available ambulances, decided to concentrate this means in the Urgency Department, to face the foreseen avalanche of victims.
However, he sent in ambulances from the Red Cross and the fire brigade a medical team, combining specialists in general chirurgy, ortopedy, medicine, neurologists, and two nurses.

At 09.00 UTC the medical team noticed that all victims had been evacuated and proceeded to the rescue post where it callaborated, assisting the wounded.

The Faro hospital, coordinated by "115 - INEM" rased the aeronautical means supplied by the P.A.F. to proceed with air evacuation.

Through wounded lists it collaborated on the identification of survivors.

Together with Red Cross personnel it assisted rendering medical assistance at the hotels, where the victims not admitted into hospital, were staying.

1.15.4 Faro airport emergency plan

According to the ICAO recommendations this airport has an emergency plan which first version was produced in March 1980.

This version had attached a distribution list on which DGAC was mentioned.
It was not verified that this plan had been formally approved (by DGAC).

Tests were performed which made the update of the referred plan and in July 1990 there was a major change to the plan, which was followed by a second re-issue in July 1992, as an answer to the changes in the requirements which the annual exercises dictated.
The last great exervise was performed at 22 November 1991.

Although in the section "Introduction" of this plan is stated "The Faro airport Emergency plan pretends:
(.........) to try and improve the efficiency level (.........) programming exercises and emergency situations in order to permit the concerned aeronautical authority to assess the credibility and efficiency of the plan, (...........)", it was not confirmed that DGAC behaved as a observing authority in the referred exercises.

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1.16 TEST AND RESEARCH

1.16.1 Examination of the Right Main Gear

The examination of the Right Main Gear was performed at the place of the accident by a member of this commission and later on, on the second phase the Instituto Superior Técnico de Lisboa performed the study and analysis of the cause of the fracture of the components of the right main gear, with the presence of a specialist of McDonnell Douglas as technical adviser of NTSB.

The examination of the fractured areas showed that the gear parts and the associated mechanisms were, at the time of the accident, without fatigue defects or defects of any other type and had no previous fatigue damage.

The rupture happened exclusively due to the impact on landing which produced the overload which induced in the components and critical zones instantaneous levels of tension which exceeded the material static limit resistance.

The report on the fracture study is presented in annex 10.

1.16.2 Study on functioning of the Autothrottle speed control

1.16.2.1 Description

The system autothrottle speed control combines three basic operation functions:
- Speed control guidance
- Autothrottle control
- Stall warning

These three functions use several common sensors and dedicated computers which are channeled to a single AT/SC COMPUTER.

The AT/SC is a double system, each system is completely independent with separate computers, power sources, indicators and inputs.

1.16.2.2 Operation

Speed control
In the mode "speed control" the speed is programmed as a function of a certain pre selected speed (selected speed) or as function of a given reference speed at a certain AOA (Angle of Attack speed reference), which is computed with a certain safety margin above stalling speed.

Therefore the system can be used in all phases of flight.

If it is intended to operate with a given maximum rate of climb as for instance during take off or missed approach the reference speed is in function of AOA.

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This speed determines the pitch command to be followed by the aircraft up to the moment on which the acceleration allows the retraction of the gear, flaps or slats.
The selected speed determines the speed control which can be read on the indicator SLOW-FAST during cruise including changing of altitudes, holding and approach.

Auto Throttle
The auto throttle system automatically adjusts the engine power settings for a maximum N1 when an optimal rate of climb is required or to maintain a selected speed during all phases of flight.
(Altitude chances, holding patterns and approach patterns).

One or both ATS can be engaged during take off, climb out, go-around or cruise.

Additionally, during CAT III landings both ATS can be engaged to prevent an operational failure and an auto throttle retard between flare and touch down.

On any condition the N1 limit becomes the maximum authority for the range of the auto throttle lever.

The minimum authority is limited by switches in the lower throttle quadrant.

The lower authority limit, during flight, prevents the throttles from going to idle RPM.

Stall Warning
The stall warning computations are continously sent to each of the AT/SC computers.
The circuits receive the information taking into account the wing configuration and the AOA.
When the aircraft approaches a stall situation, a signal is sent to the control columns and activates the shakers.
Both control columns will shake when one or both AT/SC detects pre-stall (approximately 5% above 1 "g" stall).
Simultaneously, if the outboard slat are retracted, will deploy to an angle of 13.7° to avoid stall.
The stall warning circuits of the AT/SC computer will be activated two seconds after nose wheel lift off which is ground sensing relays open plus 5 seconds.
The warning is given 5% above 1 "g" stall speed. The same way, in a clean wing configuration the outboard slats will deploy automatically.

1.16.2.3 Investigation on the ATS/SC state of functioning

The aircraft DC-10 registration PH-MBN was equipped with an ATS/Auto Pilot system.
During the approach until the ground impact and according to the DFDR and

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AIDS records, the system AT/SC was selected to speed control.
The autopilot system switched from AP-ON to CWS-ON at 0731.56 UTC (DFDR time) and at 0732.44 UTC (DFDR time) to CWS-OFF and the ATS/SC was kept in SC mode.

The investigation on the ATS functioning was directed to the functioning during the final phase of flight at 0731.41 UTC (DFDR time) when the ATS did not react to a reduction of airspeed below reference speed.

The investigation process was initated by sending the AUTOTHROTTLE ATS DUPLEX SERVO which was removed from the aircraft to Honeywell for functioning analysis.

The Honeywell inspection report was satisfactory except for tachometer no. 2 associated with servomotor no. 2, of which a connection was broken.

As the throttles were closed when the airspeed came below reference speed it was requested from Douglas a report on possible influence of this failure on the normal system operation.

It has no been possible to obtain a definitive conclusion referring to the exact moment at which the ATS should have increased the engines power.

According to the information received from Douglas the malfunction did not affect the normal operation of the ATS double servo command.

In order to confirm the ATS operational state, from Douglas it was requested information on the parameters which affect the ATS functioning during situations of turbulence and windshear.

1.16.2.4 Actuation of AT/SC during final approach and landing phases.

According to the aircraft manufacturers information during an approach in turbulence with the auto throttle in speed mode the CAS will be slightly above the pre-selected speed (approximately 5 knots).

The analysis of the DFDR, AIDS and CVR informations determined that the approach until 600 RA, at which the auto pilot was selected to CWS and fluctuations of the flight parameters was noticed, was normal.

The aircraft performed a VOR/DME procedure for Runway 11 of Faro Airport without significant deviations as could be observed on the register of flight profile (AIDS) and radar register.

The descent was performed with the auto pilot engaged in CMD, and at around 560 RA was selected to CWS. At around 80 RA the CWS mode was switched off and the aircraft control reverted to manual.

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The two autothrottles stayed engaged throughout the whole procedure, according to the AOM.

It was stablished that as far as the flight control automatic systems were concerned the following procedures were executed:

- AOM paragraph 3.3.5-08 on which during Non Precision Approach, the auto pilot switch from CMD to CWS must be performed at an altitude not below 500 feet HAT.

- BIM paragraphs 3.4.3-01, 3.4.3-02 and 3.1.7 on which the auto pilot and auto throttle must be ON, as much as possible, during approach even in turbulence and windshear conditions.

- AOM paragraph 3.3.1-04 on which the auto pilot and auto throttle shall be used as much as possible, and during manual flight, the auto pilot in CWS and both auto throttles ON.

- AOM paragraph 3.3.5-04 on which the primary way to execute an approach, regardless of the meteo conditions, is with auto pilot and auto throttle ON.

Until the auto pilot was switched from CMD to CWS the approach was stable. Thereafter it became unstable and an increase in the flight controls movement was noticed, as well as variations in the engines power settings.

Calibrated air speed (CAS)

From the analysis of CAS registeration it was noticed that Vref 139 Kts was respected the majority of the time up to 0733.15 UTC, except during a momentary decrease registered at 0732.51 UTC.

As from 0733.15 UTC up to the end of the registration a constant and excessive increase of CAS was verified.

From the cockpit examination it was noticed that the introduced bugspeed in the auto throttle window coincided exactly with Vref 139 kts.
The CAS was generally with oscillations around 144 kts which is related to the fact that with ATS in SPEED MODE, the increase in the power levers is faster than decrease, in response to a deviation in relation to a preselected speed. These characteristic of ATS introduces systematically a correction to wind gusts up to a maximum of five knots above the selected speed.

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1.16.3 Engines examination

The engine examination was executed at the accident place by a member of this commission and a General Electric specialist, who was present there as NTSB tecnical assistent.

It was verified in all engines that the blades of the fan first stage had light damage by the ingestion of foreign objects.

Engine #3 showed the worst external damage due to the fact it had been in contact with the runway and the ground until the point of immobilization.

The inquiry commission established that the engines were running at high RPM and delivering power up to the moment of impact with the runway.
There were no signs of fire in any engine before impact.

1.16.4 Investigation on the existence of windshear conditions.

The Dutch National Aerospace laboratory was requested to conduct an investigation on the existence of windshear conditions in the proximity of Faro Airport during the approach phase to runway 11 by flight MP 495. The results of this investigation can be found on reports CR93080 C "windshear analysis using flight data from the DC-10 crash at Faro Airport" and CR94238C "Analysis of additional flight data of the DC-10 accident at Faro Airport". (Annex 4)

From the study it was concluded:

1. The meteorologic conditions at Faro Airport presented turbulence conditions.

2. The aircraft crossed a downburst during the final approach phase from which it came out at 700 ft. without negative effects except the beginning of theoscillations in the flight parameters.

3. At around 1 km from the runway threshold the aircraft crossed two more microbursts qualified as small. The last microburst created variations in headwind and tailwind in an intensity that could have triggered the windshear warning system if the aircraft would have been equiped with such device.

4. The windshear reached values which could have passed momentarily the aircraft performance limits.

5. The power levers response in the last 10 seconds was normal. It is presumed that they were retarded to idle although the ATS was ON.

6. From the additional study of the behaviour of the ATS it was concluded:

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6.1 The longitudinal pitch instability in speed and power setting started when the autopilot was still engaged in vertical speed mode and it was triggered by the vertical upburst associated with the first downburst. The longitudinal stability deteriorated in the flight phase with the CWS engaged.

6.2 The functioning of the ATS was normal as far as speed control was concerned. The ATS gust trim worked normally. From the analysis it can be concluded that on the final approach phase, the pilot flying (PF), probably reduced the power levers, more than likely induced by an initial reduction of power by the ATS. Also the fact that from there onwards the power levers were kept on the position Flight Idle could possibly have been due to copilots action.

6.3 Just before landing the cross wind was above the prescribed aircraft limits.

6.4. The switching from CWS mode to normal flight just before landing must have contributed for the abrupt flare followed by the hard landing due to the fact that the landing technique with CWS on is significantly different from manual landing. The switching from CWS to manual was provoked by the PNF command of right wing up which was counteracted by the PF.

6.5 There were indications of delay of the functioning of the ATS dynamic system which could have contributed to the longitudinal dynamic instability.

6.6 The wind information from the on board Area Nav was affected in the crosswind readout due to slideslip which was considerable during the approach phase.

1.17 ADDITIONAL INFORMATION.

1.17.1 Information on Martinair.

1.17.1.1 General considerations.

Martinair had an operator certificate issued by the Dutch Rijksluchtvaartdienst and it's main base is Amsterdam Airport in Holland.

The company is authorized to operate non scheduled passenger and cargo flights in the conditions established in the Basic Instructions Martinair Flight Operations Manual, Route Operations Manual, Operational Instructions and Dutch official regulations. The crew training is done by KLM in a RLD approved programme.

The Dutch RLD, responsible for the inspection of Martinair, is located at Hoofddorp in Holland.

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1.17.1.2 Operational procedures.

The company has a flight operations manual (BIM) and a DC-10 aircraft operations manual where the company operational procedures are stated.

The following procedures are emphasized as they concern the investigation:

1.17.1.3 Martinair Flight Operations Manual (BIM).

On section 1 it is interesting to emphasize paragraph 1.2.5-03 which establishes as mandatory for the Captain to be briefed on meteorology before each flight.

1.2.3-03 <u>Company aspects</u>

In addition to the legal aspects the captain shall:
- Receive a meteorological briefing before each flight.
- Give loading instructions when required.
- Ensure an ATC flight plan is properly made and submitted at least 30 minutes before scheduled departure time.
- Ensure all necessary flight safety equipment is on board.
- Ensure all necessary navigation material is on board.
- Check the flight order and receive a briefing from "Afdeling Logistiek" on the flight, to avoid misunderstandings or mistakes.
- Ensure a flight safety briefing is given.
- Exercise supervision on the correct wear of uniform and a correct appearance of all crew members.
- Check all available latest information (e.g. "Opdrachten en Mededelingen aan bemanningsleden", navigational changes, NOTAM'S, amendements to manuals, etc.) before each flight.
- State work periods for each flight crew member, when additional crew members form part of the oprating crew.
- Ensure all passengers and dead load are on board, when a departure is planned well in advance of the scheduled departure time.
- Adhere to flight techniques and operating procedures as laid down in the respective aircraft operating manuals.
- Continuously check that the progress of the flight is according to flight plan and take those actions necessary, when not in accordance.
- Check in time, weather conditions at destination and alternates.
- Give route and progress information to the passengers.
- Be responsible for the welfare of the passengers and shall instruct his crew members accordingly.
- Brief the cabin crew via the cabin supervisor before and during the flight on any pertinent aspects of interest to the cabin crew.
- Inform before arrival the company at Schiphol or the handeling companies at other stations equipped with a company frequency about ETA, technical conditions of the aircraft (Schiphol coded), particulars about passengers or cargo, requests for special attention or equipment, etc..
- Check that all parts of the "Journaal" are completed and signed after arrival.

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- Ensure that Martinair or the appropriate handling company knows where the crew stays and can be reached, in case of a "night" stop.

And paragraph 1.2.1-01 section which establishes that the captain may delegate his duties but he remains responsible.

On section 2 paragraph 2.1.1 reffering to Flight Plan.

2.1.1 Flight plan

The law requires that a flight shall not be commenced unless the captain has satisfied himself that:
- the aircraft is airworthy,
- the instruments, equipement and documents, as prescribed in the aircraft operations manual and in BIM 1.4 and 1.5 for the particular aircraft and type of operation to be undertaken, are on board and in good order,
- the aircraft maintenance log, technical flight report or aircraft technical report and the maintenance release certificate are completed and signed,
- all available information appropriate to the intended operation, including all available current weather reports and forecasts, indicate that the flight can be completed as planned,
- the load to be carried is distributed and secured in accordance with pertinent instructions and safety regulations,
- the flight can be conducted safety in accordance with the operating limitations as laid down in this manual and the aircraft operations manual,
- the operational flight plan has been completed in accordance with BIM 2.1.2

To indicate that the flight will not be commenced unless the items mentioned above have been checked, the captain is required by law to sign the following statement printed on the flight plan:

"I certify compliance with BIM 2.1.1."

Paragraph 2.4.1-02 C concerning the company policy for refueling:

c. Trip fuel

Fuel required to fly from the aerodrome of departure to the planned destination, based on "Planned Operating Conditions". This amount shall include fuel for take-off, climb, cruise, descent, approach and landing.

On section 3 paragraph 3.4.1 where it's defined the company policy for CREW COORDINATION.

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"During critical phases of the flight, however, there may not be time to wait for response and the only alternative will be to take immediate control of the aircraft. If this action is considerd necessary, the captain shall fully take-over control while calling out "My Controls". Changes in e.g. power settings, flight instrument set-up, configuration, shall not be made without informing the PF, as this may lead to uncoordinated actions.

Paragraph 3.4.3-01 and 3.4.3.-02 concerning the operation of the autopilot and ATS.

3.4.3 AUTOMATIC FLIGHT

01 General

To minimize cockpit workload and thus to increase the safety level, optimum use of the autopilot and its submodes and autothrottle as far as permitted per Aircraft Operations Manual, is strongly recommended during the whole flight regime.
The following general regulations apply:

- The autopilot shall be regarded as the primary means of aircraft control during turbulence.
- Below 2500 ft above terrain the PF shall have his thumb near the disconnect button in order to be able to disconnect immediately when necessary.
- At least one pilot shall always be in a position to take over manually at any time and without delay in case of a malfunction, therefore at least one pilot shall be seated with his seat belts fastened at all times during flight.
- The aircraft shall be properly trimmed for the intended configuration and speed before the autopilot is switched on; it shall remain trimmed during the next operation, for which purpose the trim indicators shall be checked regularly.
- Apart from standard crew coordination procedures, the pilot (PF) will ask the co-pilot (PNF) for settings and selections of instruments and systems during manual flying, while keeping the co-pilot (PNF) informed about these actions or mode changes.
- During approach, all control actions shall be followed with hands and feet on the controls by the PF, in order to resume manual control immediately after a disconnect.
- When conducting an automatic approach/landing the vital function of both pilots is to monitor instruments and annunciators, and to be alert to take over immediately when circumstances dictate so.

02 Use of autopilot and autothrottle

- Compared with the manual approach/landig technique, us of the autopilot/autothrottle has the following advantages:
. speed and ILS beams can be flown with a higher accuracy,
. lower cockpit workload, permetting better monitoring,
. in marginal weather conditions a better decision making process is obtained.

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- Maximum use of autopilot and autothrottle is required for ILS approaches provided that:
. the performance to the relevant airborne and ground systems is satisfatory,
. the localizer can be intercepted at an adequate distance from the runway,
. no restrictions to autopilot use are indicated on the approach chart.

- It should be realized that in weather conditions of CAT I or better an number of factors such as:
. protection area not assured to be clear,
. close sequencing of aircraft,
. switch over time of ground aids,
. quality of ILS signals.

may influence performance of aircraft autoland system in a negative way. Therefore it is essential that the pilot flying is perpared to take immediate action in case of a significant deviation from the desired flight path and, if necessary, make a (Auto) GO-around.

Paragraph 3.1.1-06 concerning crew coordination procedures.

3.1.1-06 Crew co-operation and monitoring

If a captain is not satisfied with the manner in which a pilot under his command handles the flight, verbal instructions will normally be sufficient to remedy the situation.
During critical phases of the flight, however, there may not be time to wait for reponse and the only alternative will be to take immediate control of the aircraft. If this action is considered necessary, the captain shall fully take-over control while calling out "My Controls".

Paragraph 3.1.7 which establishes the rules and recommendations for operation in WINDSHEAR.

3.1.7 -Approach

If a wind shear in the approach area is expected or known to exist:
. use speed increment as indicated in the AOM,
. consider the use of a reduced landing flap setting, runway length permitting,
. use autopilot and autothrottle, if possible,
. monitor Inertial/Omega data, IAS, rate of descent, pitch and power, closely for early shear recognition.

Do not make large power reductions until beginning of the flare.

Delay approach or divert if severe thunderstorms are present in the approach area.

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Reporting

If a wind shear has been encountered, this should be reported immediately to ATC.
Reports should include altitude and amount of shear.

On section 4 it is interesting to emphasize paragraph 4.1.2 which establishes the standard weight for passengers and crew.

4.1.2 STANDARD WEIGHTS FOR PASSENGERS AND CREW

With regard to seat allocation and aircraft loading the following categories of passengers can be specified:

. Adults: A passenger is considerd an adult as from the 12th birthday.
. Children: A passenger is considered a child as from the 2nd up to the 12th birthday.
. Infants: A passenger is considered an infant up to the 2nd birthday.
The following standard passenger weights shall be used for payload calculations and loadsheet preparation.
These weights are in accordance with the new JAA/RLD regulations.

The standard weights to be used depend on the numer of seats installed in the aircraft. However, the following weights apply for Martinair aircraft independent of the actual cabin configuration.

- 747, DC-10, 767 and A310 on holiday flights:
  adults (male or female): 76 kg

- 747, DC-10, 767 and A310 on all flights except holiday flights:
  adults (male or female): 84 kg

1.17.1.4 DC-10 Aircraft Operation Manual

On section 3 it is interesting to emphasize paragraph 3.1.17 which establishes the procedures of operation with an engine reverse unserviceable.

- Thrust Reversers. On fan thrust reverser may be unserviceable provided:

. Aircraft shall not depart a station where repair or replacement can be made.
. The unserviceable fan thrust reverser is secured and stowed according to MAI78-00-01
. When dispatching from a wet or contaminated runway, the thrust used for take-off shall not be less than full A rating
. Asymmetric thrust reverser configuration does not seriously affect directional control due to the runway conditions at destination and/or alternate airports
Anti-skid system is in Phase IVi configuration

Paragraph 3.3.1-04 and 3.3.4-05 which establishes the use of the automatic flight systems

3.3.1-04 USE OF AUTOMATIC FLIGHT GUIDANCE AND CONTROL SYSTEMS

Full use should be made of the autopilot and autothrottle whenever possible. Operate with an autopilot in CMD and both autothrottles ON. During manual flight, operate with CWS engaged and both autothrottles ON, except if otherwise dictated per procedure. When the aural warning starts, approaching a desired ALT or FL LVL, check that the correct speed is set in the ATS speed readout.

3.3.5-04 CREW CO-ORDINATION AND MONITORING

Use of Auto Flight System

The primary method of executing an approach, regardless of weather conditions, is by means of the autopilot(s) and autothrottles. To avoid inadvertent autopilot disconnection by overpowering, hold the controls lightly.

Divisions of duties

During every approach and landing, monitoring of instruments is essential. At the same time, in a see to land operation, looking out is necessary. None of the following instructions relieves the crew of the duty to scan for conflichting traffic, weather conditions permitting.

Paragraph 3.3.5-05 which establishes the procedures related to ARRIVAL AND CREW BRIEFING.

3.3.5-05 ARRIVAL CREW BRIEFING

The PF shall give the arrival crew briefing preferably before starting the descent. It shall be completed or confirmed in response to the applicable item on the approach checklist.
The crew briefing shall at least cover the following procedures.
- Any deviation from the standard AOM procedures.
- Applicable minimum altitudes.
- Type of approach/landing and landing flapsetting to be used.
- Approach profile, descent limit and, for non-precision approaches, rate of descent and MAP.
- Missed Approach Procedure.
- Runway condition and landing distance (if marginal).
- Taxi-in route.
- Set-up of NAV-equipment.
- Operational impact of local situation, weather and aircraft deficiencies, if not yet covered.

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Paragraph 3.3.5-08 which establishes the procedures for NON PRECISION APPROACHES.

3.3.5-08 <u>NON-PRECISION APPROACHES</u>

<u>General</u>

Non-Precision Instrument Approaches are approaches without electronic glide slope guidance. When an ILS facility is used for an non-precision approach, set the G.SLOPE switch to OVRD before entering the warning envelope to avoid nuisance warnings. For approach stabilization apply only slight variations on the target rate of descent.

- It is strongly recommended to use the AP in CMD until the runway/approach lights can be used as reference for line-up and glide path.
  The minimum height to change from CMD to CWS is 500 ft HAT.
  The minimum height to change from CMD to OFF is 150 ft HAT.
- Start descent 0.5 NM before, and timing at point "D".
- The PNF occasionally goes head up, and goes fully head up after his call "APPROACHING MINIMUMS".

Paragraph 3.7.1-06 which establishes the cross wind component limitations.

06 <u>MAXIMUM WIND COMPONENTS</u> (including gusts)

- Take-off and Landing:
  . Crosswind . . 30 kt
  . Tailwind . . . 30 kt

- Autoland:
  . Headwind . . . 25 kt
  . Crosswind . . 15 kt
  . Tailwind . . . 10 kt

For restrictions due to runway conditions and weather minima refer to AOM 3.7.3 - weather Limitations. These restrictions are always overriding.

On section 6 it must be emphasized.

Paragraph 6.4.2. establishes the ACTUAL LANDING DISTANCE for GOOD, MEDIUM and POOR braking conditions.

Paragraph 6.4.3-01 establishes the approach and landing speeds.

On section 7 it must be emphasized.

Paragraph 7.1.1 which establishes the company procedure for the computation of LONG RANGE CRUISE POWER.

Paragraph 7.2.1-02 establishes the company operational directives regarding STANDARD FUEL ALLOWANCES.

1.17.2 Information on Air Traffic Control

1.17.2.1 General

The Faro Airspace organisation comprises the Faro terminal area and Faro control zone. The identification, limit and ATS, are the following:

FARO TERMINAL AREA

Lateral Limits:	340.ON 00732.OW, 35NM DME ARC centered in VOR/-DME VFA (370043N 0075826W) clockwise to 373545N 0075600W - 3724.ON 00752.OW - 3725.ON 00726.OW - Portugal/Spain border - 3707.5N 00723.3W - 3650.ON 00723.OW - to the origin excluding Faro CTR inside these limits.
Upper Limit:	FL 115
Lower Limit:	300 m GND/MSC
Air Space Classification :	C
Unit:	Faro approach

FARO CONTROL ZONE

Lateral Limits:	5 NM radius circle centered in the Airfield reference point (ARP 370046N 0075753W)
Upper Limit:	2.000 ft (600 m)
Lower:	GND
Air Space Classification:	C
Unit:	Faro approach and tower

Air Traffic Control, Flight Information and Alert are provided H24.

Air Traffic Services are provided by two units:

- Airport Control
- Approach Control

Communications are the following:

- AIR/GROUD

Airport Control Service	118.20 Mhz
Approach Control Service	119.40 Mhz
Emergency	121.50 Mhz
- Ground mobile Service	159.75 Mhz

- Direct telephone line with Lisbon Control Center

- Internal PBX telephone net, and direct external telephone net

- AFTN telex connected to Lisbon Central for the reception and emission of ATS messages

All the communication devices have automatic recorders except the internal and external telephones.
The control tables for AIRPORT and APPROACH are equiped in each position with a digital clock, a wind indicator WAD 21M, a visual display for the SIO, a RVR indicator, main transmitters control, telephone with direct line to Lisbon ACC and internal and external line telephone.
In the central part there is AFTN telex and flight progress stripe printing and messages.
The control desk has also two 720 channel emergency transmitters/receivers and a transmitter/receiver for ground communications.
On the opposite side of the table there is a panel with the control for runway lights and the emergency and prevention controls.

1.17.2.2 Operational Procedures

Meteorological Information

The Faro meteorological Centre supplies to the tower, through monitors in the positions Airport and Approach, the integrated information of RVR, wind (Instataneous or average wind of two minutes period or ten minutes period; minimum wind and maximum wind), cloudbase, altimeter settings (QNH and QFE) temperature and dew point.
A monitor in each position displays the wind indications (maximum speed, minimum speed, average or instantaneous speed, direction and change).

Aeronautical Information

The Airport Control Tower receives NOTAMs referrent to the airport, navaids and visual aids conditions connected with the procedures for ground circulation, take off, approach and landing in the areas it assures services to Air Traffic Control.

Coordinating procedures

There are no written procedures for coordination between Tower and Approach.

Communication of aircraft movement to the Airport Operation Service

The Airport Controle Tower supplies, through a digital system to the Airport Operation Service the required information of arriving and departing aircraft.

Alteration of the Action state of the Rescue Services

The alteration of the action state of the rescue services is, in principal, provoked by the Airport Control Tower through a light and sound system installed for that purpose, or through telephones or UHF intercoms.

Rescue service is in a state of readiness every time aircraft are in the approach or ready for take off and up to the moment that the last aircraft in the approach lands, parks and stops the engines. The activation or deactivation of readiness is the control responsibility.

Manuals

There is no Airport and Approach Manual.
The local information required for the performing of duties in Airport and Approach Control can be found in several service instruction papers.

1.17.2.3 Significant Occurrences on the Air Traffic Control Services, during the final phase of flight MP 495

Communications from Approach related with the separation of aircraft MP 461 and MP 495 in relation to TP 120.

UTC	From	ATC/CVR Report
07:09:40	MP495	APPROACH MARTINAIR FOUR NINE FIVE GOOD MORNING SEVENTY FIVE DME AND OUT OF TWO FOUR ZERO FOR LEVEL SEVEN ZERO
07:09:58	APP	MARTINAIR FOUR NINE FIVE GOOD MORNING CONTINUE AS CLEARED REPORT APPROACHING FLIGHT LEVEL SEVEN ZERO YOU ARE PRE-SENTLY NUMBER TWO NO DELAY EXPECTED RUNWAY ONE ONE...
07:12:33	TP120	UH TO HOLDING POINT RUNWAY ONE ONE VIA PAPA READY TO COPY
07:12:38	APP	CLEAR TO LISBON DIRECT CAPARICA FLIGHT LEVEL ONE SIX ZERO THE SQUAWK ALPHA THREE THREE SIX
07:12:46	TP120	PORTUGAL ONE TWO ZERO CLEAR TO LISBON DIRECT CAPARICA FLIGHT LEVEL ONE SIX ZERO AND SQWACK THREE THREE SIX ZERO
07:12:55	APP	READ BACK CORRECT
07:13:23	APP	MARTINAIR FOUR SIX ONE CONFIRM PASSING ALTITUDE AND DISTANCE
07:13:26	MP461	OUT OF EIGHT FIVE FOR FOUR THOUSAND FEET PRESENTLY OUT OF TWO ZERO NAUTI-CAL MILES
07:13:34	APP	ROGER
07:14:36	MP461	MARTINAIR FOUR SIX ONE UH COULD WE UH PROCEED UH APPROXIMATELY FIVE MILES OVER LEFT TO AVOID (BUILD UP)
07:14:47	APP	AFFIM CONFIRM YOU'RE FLYING UH DOWN THE UH INS TO FIVE MILES FINAL
07:14:56	MP461	UH NEGATIVE PROCEEDING FIVE MILES LEFT TRACK TO AVOID BUILD UP
07:15:01	APP	OK SO REPORT PASSING ABEAM OVERHEAD FOR A VOR DME PROCEDURE

07:15:07	MP461	UH WE'LL PROCEED OVERHEAD WHEN WER ARE CLEAR AND WE HAVE PRESENT OUT OF SIX ZERO FOR LEVEL UH CORRECTION FOR FOUR THOUSAND FEET AND WE ARE ONE FOUR NAUTICAL MILES OUT
07:15:20	APP	ROGER OUTBOUND TWO SIXTY NINE CALL YOU OVERHEAD MARTINAIR FOUR SIX ONE
07:15:26	MP461	ROGER OUTBOUND TWO SIXTY NINE CALL YOU OVERHEAD MARTINAIR FOUR SIX ONE
07:16:48	APP	TONE TWO ZERO LINE UP IS APPROVED
07:16:49	TP120	ONE TWO ZERO CLEAR TO LINE UP RUNWAY ONE ONE
07:18:15	APP	MARTINAIR FOUR SIX ONE CONFIRM DISTANCE
07:18:19	MP461	UH APPROACHING OVERHEAD TWO AND HALF MILES OUT FOUR THOUSAND FEET
07:18:23	APP	ROGER CLEAR FOR A VOR DME APPROACH RUNWAY ONE ONE TWO SIX NINE OUTBOUND REPORT LEAVING FOUR THOUSAND
07:18:32	MP461	ROGER I'LL CAL YOU LEAVING FOR THOUSAND AND OUTBOUND TWO SIX NINE
07:18:39	APP	MARTINAIR FOUR NINE FIVE CONFIRM DISTAN-CE TO RUN
07:18:42	MP495	DISTANCE TO RUN IS TWO SIX ANS WE ARE OUT OF NINE ZERO FOR SEVEN ZERO
07:19:03	TP120	FARO PORTUGAL ONE TWO ZERO READY FOR GO RUNWAY ONE ONE OF POSSIBLE REQUEST LEFT TURN OUT AFTER TWO THOUSAND FEET
07:19:11	APP	OK BE ADVISED WE HAVE A DC TEN COMING FROM UH NORTHEAST DESCENDING TO SEVEN ZERO
07:19:24	TP120	COPIED CONFIRM WE ARE CLEAR FOR TAKE OFF
07:19:27	APP	JUST A SECOND MARTINAIR FOUR SIX ONE CONFIRM PASSING OVERHEAD
07:19:29	MP461	AFFIRMATIVE AND LEAVING FOUR THOUSAND FEET TO TWO THOUSAND
07:19:33	APP	CONFIRM UH JOINING TWO SIX NINE RADIAL

07:18:36	MP461	AFFIRMATIVE MARTINAIR FOUR SIX ONE
07:19:40	APP	PORTUGAL ONE TWO ZERO I SUGGEST TO AVOID RESTRICTIONS A RIGHT TURN TO BE OVERHEAD ABOVE SIX ZERO
07:19:47	TP120	UH ROGER RIGHT TURN PORTUGAL ONE TWO ZERO
07:19:41	APP	THE WIND TWO SORRY ONE FIVE ZERO TWO FOUR KNOTS CLEAR FOR TAKE OFF RUNWAY ONE ONE RICHT TURN TO BE OVERHEAD ABO-VE SIX ZERO
07:20:03	TP120	ROGER RIGHT TURN TO BE OVERHEAD ABOVE SIX ZERO CLEAR FOR TAKE OFF RUNWAY ONE ONE PORTUGAL ONE TWO ZERO
07:20:10	APP	MARTINAIR FOUR NINE FIVE DESCEND TO FOUR THOUSAND FEET TO BE BELOW SIX ZERO AT LEAST TEN DME
07:20:15	MP495	ROGER BELOW SIX ZERO AT TEN DME DOWN FOUR THOUSAND FEET
07:21:05	MP495	FOUR NINE FIVE IS OUT OF SIX ZERO
07:21:09	APP	FOUR NINE FIVE ROGER NEXT REPORT PASSING OVERHEAD TURNING OUTBOUND RADIAL TWO SIX NINER FOR FURTHER CLEARANCE
07:21:17	MP495	WILL CALL MARTINAIR FOUR NINE FIVE
07:22:05	APP	PORTUGAL ONE TWO ZERO AIRBORN AT TWO ONE REPORT PASSING OVERHEAD
07:22:11	TP120	ONE TWO ZERO WILCO
07:22:16	MP495	MARTINAIR FOUR NINE FIVE MAINTAINING FOUR THOUSAND
07:22:20	APP	FOUR NINE FIVE CONFIRM DISTANCE
07:22:22	MP495	ONE ONE
07:22:24	APP	ROGER NEXT REPORT OVERHEAD
07:22:28	MP495	WILCO FOUR NINE FIVE
07:23:17	MP495	APPROACH FROM FOUR NINE FIVE THE DEPAR-TING TRAFFIC IS OUT OF FOUR THOUSAND NOW
07:23:23	APP	ONE TWO ZERO CONFIRM PASSING ALTITUDE

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07:23:26	TP120	WE ARE EIGHT ZERO JUST ON THE MIDDLE OF A THUNDERSTORM
07:23:38	TP230	THIS IS WHY I ASKED A LEFT TURN OUT THANK YOU ONE TWO FIVE FIVE FIVE ONE TWO ZERO
07:24:34	APP	MARTINAIR FOUR NINE FIVE ONCE PASSING OVERHEAD JOIN OUTBOUND RADIAL TWO SIX NINE INITIAL DESCENT TO THREE THOUSAND FEET
07:24:42	MP495	WHEN OVERHEAD AT TWO SIX NINE RADIAL AND DOWN THREE THOUSAND
07:25:57	MP495	FOUR NINE FIVE IS OVERHEAD LEAVING FOUR THOUSAND FOR THREE THOUSAND

1.17.2.4 Air Traffic Controllers Tranining

The instruction and training of Air Traffic Controllers was performed on ANA,EP information center were the approved courses are given under the supervision of DGAC.

Before the creation of ANA,EP the instruction and training of Air Traffic Controllers was done by the DGAC through ICAO requirements.

Control and Airport Basic Course

The candidates for the Air Traffic Controller License receive a training on theorectical and practical knowlegde based on the instruction manual -Doc. 7192-AN/857, Part D-2 and "Standard Training Syllabus" -052 Airport Control.

The theorectical knowledge is complimented with practicall knowledge on simulator for Airport Control for the Air Traffic Control License. At the end of each course the result of each student is subjected to the approval of a jury created for this purpose. This approval is based on written oral and practical tests.

After succeeding on the written oral and practical tests the student is moved to the Airport Control Tower as a stagiary supervised by a qualified Air Traffic Controller.

As soon as he is considered ready by the Supervising Controller the stagiary will still be subject to an assesment jury were he will have to demonstrate to fullfill the rules established on ICAO Annex 1.

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Approach Control Qualification

The candidates for the initiation and qualification in approach control receive theoretical and practical knowledge according to the instruction manual - Doc. 7192-AN/857, Part D-2 and "Standard Training Syllabus Approach" (Terminal), complemented by the subjects in "Standard Training Syllabus" - Regional Control.

Instructors

DGAC accepts and approves the programm for instructors and supervisors training who will be responsible for the ANA,EP controller candidates preparation.

Proficiency

For the revalidation of a DGAC Air Traffic Control License, it is presented to the Aeronautica Personel Direction a Profcheck form on which the chief of the unit where the controller performs his duties states if he has or if he has not recent experience and if he is able to perform the duties inherent to his license. When the Air Traffic Controller fails the check he stops performing the privilages of his license. The return to duty is conditioned by the fullfillment of a stage periode under the supervision of a qualified Air Traffic Controller on his unit and the achievement of a profcheck pass.

1.17.3 Flight plan information

Operational flight plan.

The operational flight plan for flight MP 495 is computorized (Annex 1).

Nothing wrong was detected as far as the flight plan is concerned.

1.17.4 Landing Data Chart

According to the wind information from the Approach Control to flight MP 495 and the wind information through the aircraft inertial system as observed on the CVR register, the crew completed the Landing Data Chart according to the AOM established procedures.

From the Landing Data Chart it was detected that the values for estimated landing weight and actual landing weight were correct if compared with the operational flight plan and remaining fuel on the aircraft flight log.

As far as "bugspeed" is concerned, taking into account the wind received from approach control, the selection of Vref 139 Kts was correct.

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According to captain's statement the introduced speed in "speed window" of ATS would have been 144 kts (Vref+5). The commission established that, after the accident the introduced speed in "speed window" was 139 kts.

The company policy states the preferential use of the landing configuration whith 50 flaps and this was the crew selection.

Taking into account the gust wind transmitted by approach control to the crew, it was not mandatory to insert the AOM stated wind correction.

According to the information presented to the crew the calculated actual landing distance was correct.

In POOR braking conditions the landing distance exceeds the landing distance available (LDA). And even for MEDIUM braking conditions the computed and written value is only slightly short of LDA.

Taking into account the actual Faro conditions at the time of the accident, this commission calculated the real distances for MEDIUM and POOR braking conditions according to the AOM procedures.

The result values for MEDIUM and POOR exceeds the LDA.

From the values written on the landing data form it must be emphasized that the wind value is close to the one stated on 04:00 METAR and 04:00 /13:00 TAF.

The written values are correct in face of the operational flight plan figures and "fuel remaining" figures in the aircraft flight log.

1.17.5 Radar register

The MP 495 radar position registrations were received from the Lisbon radar recording.

It was possible to determine the aircraft trajectory inside the Lisbon FIR up to the point of impact on the runway.

The commission verified that there were no significant differences in position and altitude in relation to the DFDR and AIDS recordings.

From the recordings it was determined that the aircraft, at time of contact with the runway, had a 1000 ft/min rate of descent.

The commission determined that this value exceeds the DC-10 operational limitations which, for maximum landing weight, is 600 ft/min

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2. ANALYSIS

2.1. GENERAL CONSIDERATIONS

The crew was correctly certificated according to the Dutch regulations, and no physical or psychological conditions were found that could have affected the operation of the aircraft.

The aircraft was airworthy, according to the regulations of the state of registry. No evidence was found concerning any mechanical failure, occurring before the impact, that could be contributary to the risk for the safety of the aircraft.

The commission concluded that the aircraft operated normally and that the flight was conducted according to planning and according to the commands of the crew.

The existing meteo conditions had an important contribution to the accident, taking in account the turbulence associated to windshear-phenomena that the aircraft was subjected to during final approach and landing.
According to the established facts the commission addressed the analysis to the crew procedures, ATC procedures, Meteo factors and the survivability of the occupants.

2.2. CREW PROCEDURES

2.2.1 Flight preperations

As far as meteorology is concerned, the crew visited the meteo center at Amsterdam Airport and according to a statement of the captain it showed the existence of a low pressure area over the sea, close to the southern coast of Portugal, and isolated thunderstorms and showers were forecast. The pressure was 1013 Hpa and temperature 15 C.

It is common practise to admit the possibility of existence of windshear phenomena if thunderstorms are present closer than 15 n.m. from the airport, as it is referred in the Martinair Flight Crew reference guide 5.1.2.

2.2.2 Take-off, climb, cruise and descent

These phases of the flight went on an routinely manner, no abnormalities were registered during these phases, which could have contributed to the accident.

2.2.3 Approach

The longitudinal instability which was registered during the final phase of the approach may have induced the pilot to manually reduce the power, in order to bring the aircraft back to the glide path or with the objective of stopping the sequence of oscillation which probably resultated from an interaction between the operation of the automatic systems, namely the ATS and the operation of the controls by the pilot.
The instability may have originated still in that phase of the approach, in which the aircraft was flying with the autopilot engaged in command, by an updraft associated with the first of the downdrafts which the aircraft crossed.

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As a result of the change to the function CWS these oscillations were aggravated.

Although the Faro Approach Controller had not communicated to the aircraft on the probability of the occurrence of the windshear-phenomena, neither had the previous aircraft reported this type of phenomena, it's thought that the captain, as an experienced professional, could be aware of the possibility of occurrence of this type of phenomena in the meteorogical conditions present in the Faro Airport area.

Assuming a situation of windshear, and applying the procedures laid down in the AOM (aircraft operating manual), the landing distance for average conditions, would have an increase of 300 m, which, when added to the figures entered on the landing chart, for the same conditions, would have exceeded the landing distance available with 255 m.

The wind information provided by the Aera Nav INS, 10 seconds prior to landing, was superior to the last information provided by the Approach controller.

The cross wind component resulting from the wind provided by the Approach controller was 14 knots and the one resulting from the Area Nav was 20 knots, and recording to the AOM the information supplied by approach control prevails over the information supplied by Area Nav.

According to the AOM procedures the cross wind component should not exceed 15 knots under braking conditions Medium and 5 knots under braking conditions Poor.

The use of flaps selection of 35°, as recommended in company procedures, for situations of wind shear conditions, instead of the 50° selection which was used, would have caused an increase in landing distance.

The crew did not use operational procedures which took into account the occurrence of windshear.

According to company procedures, the decision rests with the captain, and the computation of the actual landing distance is not obligatory.

The aircraft was informed by Faro Approach control that the runway was flooded. This information was provided four minutes before landing.

If this information provided was correctly interpreted, the landing distance resulting from the application of the AOM procedures, would be substantially increased, exceeding the landing distance available.

It was established that the AOM, to describe the runway condition, did not make use of the ICAO phraseology.

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The company operations manual (BIM) strongly recommends that in cases when an approach is not stabilized at 500 ft (H.A.T.) or below that level, the approach should be abandoned (a missed approach should be executed).

The instability started when the aircraft was at a radar-altitude of 750 ft, and continued during the remaining of the approach.

The BIM does not contain any objective parameters when an approach is not stabilized, in particular during non precision approaches.

Nevertheless it can be asked, why the captain did not consider the approach as unstable when the rate of descent below 500 ft suffered variations between + 100 ft/min to 1300 ft/min as well as his passivity throughout the whole approach.

It was established that the descent rate, about 1000 ft per minute, exceeded the operational limits of the aircraft, which, according to the AOM, and considering maximum landing weight, should be 600 ft/min.

The reduced C.A.S. during the final phase of the approach was a contributing factor to the descent rate which was registered, as it was not counteracted by an increase in A.O.A. which would have decreased the sink rate.
The increase of A.O.A. under these circumstances could have brought the aircraft in a situation close to the stall.
According to the commission, the most important reason for the occurrence of the high sink rate was the fact that the throttles were reduced to idle at a radar altitude of about 150 ft, when under normal circumstances the autothrottle should only initiate the retard mode at a radar altitude of 50 ft.

Since the hypothesis of a malfunction of the ATS is excluded, it is considered probable that an action of the crew took place in this respect.

The aircraft, according to the NLR report, when overflying the runway threshold, encountered a crosswind component of 40 knots, and a tailwind component of 10 knots, which exceeded the wind calculated by NLR, 210°M with 41 knots, is confirmed by the wind registered by the SIO (Meteo Observer Integrated System) at this same time at runway 11, 220°M with 35 knots.

The concern of the crew to prevent an excessive airspeed, confirmed by the conversation recorded on the CVR, considering the limitations of the landing distance available, and considering the longitudinal instability registered during the last part of the approach, can be the reason why the power was prematurely reduced to idle.

The information transmitted by Approach Control when correctly interpreted, would determine the braking conditions as poor, which then would exceed the landing distance available and the consequent reduction of crosswind limit.

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The pilot flying could have been the victim of an optical illusion caused by a refraction error resulting from the shower situation which the aircraft crossed; and creating a perception of a false horizon, lower than the true one.

The wing surface contamination by the rain could have been a contributing factor to the accident, as it would detrimentally affect the coëfficent of lift.

The degree of reduction of this coëfficient has not been quantified.

One can wonder to what extend the captain could have been psychologically motivated to conclude the flight as planned.

It would not have been easy for the captain to take the decision to divert to the alternate, bearing in mind that some minutes before an aircraft of the same operator had landed and no problem was reported.

This commission is convinced that the captain was aware of the existence of water on the runway, since he instructed the copilot to make a touchdown that would prevent aquaplaning.

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2.2.4 Operation of Autopilot and ATS

It was established that the longitudinal instability affecting the parameters: pitch attitude, speed and power, started with the auto pilot still engaged in command, in the mode Vertical Speed, and it was originally initiated, probably in an updraft associated with a microburst, which caused the auto pilot to lower the aircraft nose with the objective of maintaining the preset vertical speed.

The behaviour of the ATS was normal, both concerning maintaining airspeed and introduction of automatic gust compensation and it is believed that an intervention by the pilot, in the sense of manually retarding the power to idle, at about 150 ft radio-altitude, took place.

The action of the pilot manually retarding the power, could have resulted from an initial reduction of the ATS, and which the pilot possibly may have complemented.

There are indications of lagging of the ATS which could have contributed to the instability of the apporoach.

The CWS function was switched off at 80 ft radio-altitude, while it should be switched off not lower than 150 ft AAL, by crew action.

It was established that the switch over from CWS to OFF was not a result of a decision by the crew and probably resulted by opposed aileron activation by the copilot (P.F.) and the captain (P.N.F.), when the last one tried to bank the aircraft to the right, and was counteracted by the first.

According to the B.I.M. and according to the DC-10 AOM, the use of the automatic flight control systems, ATS and CWS, is mandatory during approach, including when windshear conditions are present.
The use of ATS and CWS can have made the intensity of the turbulence, which the aircraft encountered during approach, less apparent to the pilot.

The intervention of the captain (P.N.F.) in the sense of increasing power, was late, and consequently was not timely to stop the excessive descent rate.

2.3. AIR TRAFFIC CONTROL PROCEDURES

The crew of flight MP495 received information concerning the runway condition as "Flooded", provided at 07.28:56 UTC, by Approach Control, and the phraseology used was in accordance with the rules of ICAO.

The supplied meteorological information is analysed in paragraph 2.5.

The ATC service provided to the flight, TP120, MP461 and MP495 showed various deficiencies, two of which are serious:

- Answering with O.K. to an information from TP120, that
  it was ready to take-off, which O.K. if it were to be accepted, would have

created a collision risk with MP461. This O.K. was not accepted by TP120 who requested confirmation for take-off.

- The request made by TP120 made the controller reconsider the clearance already give and ensure that the MP461 would no longer be conflicting traffic to the take-off of TP120.

- The passage of TP120 at 4000 ft took place about 1 minute after it's take-off to the east, and at that time the MP495 was equally at 4000 ft, about 3 minutes North East of the airport.

2.4. TRAINING AND CREW QUALIFICATION

The crew was correctly qualified for the flight, and was in possession of valid and appropriate licences and medical licences.

Instruction and training of the crew was performed according to the Martinair procedures, approved by the Netherlands Civil Aviation (RLD).

Analysing the proficiency checks made in 1990/1991 and 1992, no faults were found or any significant comment worth mentioning.
In the copilot route training register, performed at the end of 1988, comments are made regarding flare and landing manoeuvres. Since then no further comments were registered. Therefore this commission considered these inputs meaningless.

The two pilots of flight MP495 were submitted to training for operation in adverse meteorological conditions including windshear and microburst.

2.5. METEOROLOGICAL FACTORS

2.5.1. The S.I.O. which manages the meteo information, gathered by sensors, and provides these, in real time, to the tower for information to the flights, was analysed by the commission, which found deficiencies in the system conception, relating to the registration of all the necessary information for a later analysis, in case of the occurrence of an accident or incident.

Therefore, the commission found that meteo information, gathered and displayed every ten seconds, only is registered every thirty seconds, and the instantaneous wind is not registered, and also not variations in wind direction, according to ICAO recommendations Annex 11, and the World Meteo Organization.

The SIO clock showed a difference of 1 min 30 sec in relation to the ATC clock. The commission found no written procedures concerning clock synchronizating and also no procedures concerning recording of observed errors.

This situation made the commission develop a study of correlation of time bases of SIO and ATC.

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It was found by the commission that the departments responsible for providing meteo information, the INMG and ANA, did neither publish regulations and procedures for the operation of the SIO, nor a calibration programme, that would guarantee the good quality of the furnished information, taking into account the recommendations of WMO and ICAO (Annex 3).

The agreement concerning the meteo services which was established by INMG and ANA on 28 May 1992, is lacking in these matters.

The sensors installed at runway 11 are 7 meters above the recommended maximum level, and near a hole 7 meters deep.

One can ask whether the location of the sensors of runway 11 could have contributed to the providing of wrong information by the SIO.

The approach controller supplied the aircraft with instantaneous winds instead of average winds of 2 min. period.

The commission proceeded to the study of the winds, furnished to flight MP495, and concluded that the winds were instanteneous and could not be taken from the sensors at runway 11 but were taken from sensors of runway 29.

The ATC controller in the approach control position did not transmit to flight MP495 the variations of the wind on runway 11, that was 220° with 35 knots, occurring between 07.32:30 to 07.33:00, because of the fact that the runway selector of the tower wind display was selected for runway 29.

On runway 29, only one gust of 230 °with 34 kts was registered between 07.34:30 and 07.35:00.

The ergonomy of the equipment is favourable to the occurrence of this type of mistakes.
It was found in ICAO documents Annex 3 and Annex 11 and more in depth in doc. ICAO Doc. 9377 that when more than one sensor is used, in order to obtain representative observation of certain parameters, (some anemometers) the appropriate department of ATC service must be provided with an indicator per sensor and each indicator must have a label that clearly identifies the sensor. This condition was not fullfilled in Faro tower.

The Meteo phenomena Manga de Vento (wind sock) registered in the Faro area is frequent in that region and can be associated with windshear phenomena.

The NLR study showed evidence that flight MP495 crossed a micro burst situation.

The commission considers that the INMG should proceed with a study of these phenomena in the Faro Airport area and publish this information.

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The DGAC, as the organizational and Inspection authority, must have inspected the fullfilment of the regulations and procedures which are internationaly established in order to assure of the quality of the service furnished by ATC.

2.6. Survivability of the occupants

2.6.1. General aspects

The rate of survivability of this accident was conditioned by several factors, concerning characteristics and circumstances of the accident itself and also the subsequent events.
So, it is presumed by the type of injuries found, and the aircraft data on impact, that the accident would be generally survivable (low inertial forces) with a limited area of increased mortality and/or morbidity, corresponding to the main rupture of the fuselage.

Analysing the causes of the fatalities with 80 % of the cases by serious burns or total carbonization, allows us to conclude that the survivability was severely conditioned by post-impact fire.

From the statements of the survivors we can also derive that the ruptures in the fuselage allowed the evacuation of many passengers and crew members (i.e. the cockpitcrew) in area's where the exits were inoperative of had difficult accessability, this being a vital aspect in the intermediate parts of the aircraft where afterwards the fuel tank explosion occurred.
The adequate and timely spraying of water and foam by the firemen in the aft part of the aircraft, near exit 14, stopping the propagation of fire in this zone, led to the adequate conduction of the evacuation by the cabincrew in directing the survivors, allowing the evacuation by this door of the passengers seated in the intermediate and aft part of the aircraft (30% of the occupants)

Fortutious circumstances of door 13, having been ejected during impact, allowed its use by the two only survivors in row 24, with serious burns and probably no possibility to manage a different way of escape.

2.6.2. Types of injuries

With the objective of better correlating injuries sustained by the occupants and the conditioning factors, we related the types of injuries found with the localization within the aircraft, the structural changers (cabin interior) and the accident evolution and actions of rescue and evacuation.
With this idea in mind, a selection of serious injured persons was undertaken for different locations in the plane, and the types found compared with the types observed in the fatalities.
Following the survivors statements it was possible to establish that immediately after first impact, fire penetrated the cabin transversally from right to left, near the right wing, causing severe burns to the occupants seated there.
All survivors between row 22 and 30, with two exceptions, had different degrees of burns, varying between 4 and 56% of body surface area. A finding which is in agreement with the type of injuries found with the fatalities.
Only passengers in seat 26 J and 29 E had traumatic injuries beside thermal injury.
It was also in rows 26 and 27 that two traumatic deaths were found (among the 4 in this area), eventually caused by loosened objects in the cabin interior or structural deformation of the fuselage.

The analysis of impact effects in the cabin interior suggests that the seats did not sustain important changes apart from those referred to in the separate chapter (deformation), namely fragmentation or release from the seatrails, with the exception of the seats in rows 14 to 17, localized in the area of fuselage rupture.
Also the safety belts seem to have resisted the impact well, as the majority of the survivors declared to have them fastened at the moment of immobilization of the aircraft.
This fact allowed that, with the exception of the center parts of the aircraft, a very low level of passenger incapacity was observed, allowing their evacuation in a very short time.
Unable to completely confirm the rate of post-impact survival, the presence of some cases of elevated carboxihemoglobin in the fatalities, suggests that some of them (an undetermined number) would have died by the effect of fire and not of direct traumaties.

It is also admissible that for undetermined reasons these passengers could have had some form of partial incapacity (lower limb fractures, loss of consciousness) not allowing their timely evacuation, i.e. before the fuel tank exploded.
Following the survivors statements in this section we could find that stowage bins and some chairs loosened with the impact, and also that there was significant deformation of the cabin floor and ceiling, eventually determining passengers incapacity, and that some of them did not recall how they left the aircraft, being assisted out or projected out.
Facts that feed the previous hypotheses:
After the gear fracture and before the immobilization of the aircraft, between rows 14 and 17 the main rupture of the fuselage occurred, with a great number of passengers being ejected to outside (25%). From the 6 fatalities in this zone (rows 10 to 19) only 2 were not due to cranial or spinal injuries. One was due to suffocation suggesting that the survivability in this section was not conditioned by fire.

The types of injuries present (spinal fractures) with passengers seated in 10 G, 19 G and 21 F and several fractures of 18 B and severe thoracic trauma in 16A) as well as several survivor statements are consistent with the presence of a highly traumatic section with survivability conditioned by the type and severity of the sustained injuries.

2.6.3. Conclusions

Correlation of available elements (type of injury, evacuation, cabin interior) was curtailed in this analysis because the aft cabin was consumed by fire, not permitting a more detailed examination of the wreckage.

Summarizing, we can conclude that the main factor conditioning survivability in this accident - basically survivable - seems to have been, as it is frequently documented in other accidents, the post-impact fire evolution. Without its propagation and the fuel tank explosion it is admissible that part of the fatalities would have survived the traumatic injuries sustained, although it is not possible

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to quantify this additional rate of survival.

It was not possible also to determine to what extent some of the bins and seats, having loosened, could have influenced the possibility of timely evacuation of passengers in this section.

Deaths caused by trauma can be considered natural consequences of the accident, not seemingly influenced by subsequent factors, namely the way how immediate assistance was rendered to the wounded.

Evacuation, although chaotic in general, took place quickly and was efficient in the aft part of the aircraft, where the cabin crew managed to conduct part of the survivors to exit 14.
Spraying by the fireman with foam directed to the rear part of the fuselage stopped the propagation of flames, allowing the evacuation of a great number of survivors in reasonable safety conditions (the vast majority of the passengers from row 28 to 41).

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2.7 FIRE FIGHTING

2.7.1 General considerations

On International Airports the rescue services use a fire fighting technique based on the first intervention vehicles speed to performe a first attack before the arival of the second intervention vehicles of bigger capacity. The main task of the fast intervention vehicles is to extinguish the initial fires, protecting the way of the passengers already evacuating the aircraft. When the second intervention vehicles arrive to the place, at least one of them must be positioned close to the nose or tail of the aircraft in a way to cover longitudinaly the hull or the side more affected by the fire.

The remaining vehicles of first or second intervention must be available where more appropriated to the accident circumstances, taking always into account the main task of assuring the passengers protection by keeping clear the evacuation routes.

In this accident the commission verified that the task was totally fulfilled even during adverse meteorologic conditions.

However, amongst the fatal victims, two presented high values of carboxihemoglobine which indicates their survival after impact. The fire was not extinquished in time due to difficult positioning, movement and reloading of the vehicles and to the heavy rain which reduced the efficiency of the extinquishing product.

2.7.2 Response time

The readiness and consequent response time were adequate and the operational objectives were achieved in time as well as in foam quantity according to the ICAO recommendations. It must be emphasized that the operational objectives are defined for optimal pavement and visibiliy conditions which was not the case at the time of the accident.

The access from the fire brigade quarters to the runway is a not paved way only 3.5 m wide and was muddy and slippery due to deficient conditions of area drainage.

2.7.3 Positioning and fire fighting

The aft section of the furselage came to a stop not far from the runway centerline (tailcone at 82 m).

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The safety strip along the runway was compact over a distance of 75 m from the centerline, according to ICAO recommendations, to the reference code of Faro Airport.

The drivers of firetenders T15 and the two T12's were aware of the flooding of the terrain and they moved only to around 10 m past the compact and drained strip.

The position of these vehicles close to the aircraft tail, although upwind and far from the wings and centersection, where the fuel tanks are located, contributed to the high passengers survival rate in the aft fuselage.

The operators of the three vehicles spread foam in concentrated jets following a congitudinal direction in relation to the aft fuselage, trying to reach with headwind, at a distance of around 30 m, the center of the wreckage.

Little efficiency of the extinguishing product was detected, due to the reduction in viscosity of the product in heavy rain conditions.

The Protectors vehicle which tried to position itself closer to the main focus of fire (center fuselage section) and simultaneaously to a more favourably wind position, became stuck when trying to avoid a draining channel which was located 50 m East of the fuselage.

The cannon operator opted to eject the foam in a dispersed jet, covering the left wing and all the left center and aft fuselage, protecting survivors and firemen.

It was verified that all vehicles on the second trip, trying a more adequate position in relation to the wind and closer to the aircraft fuel tanks, became stuck on the flooded ground on the security strip, except vehicle no 2 (which managed to get through), due to the lack of emergency alternate accesspath, as recommended by ICAO.

2.7.3. Refilling

The water refilling operation was so slow to the three vehicles, that independantly of all the reposition difficulties, it was verified that at the moment of return to the fire place there was very little they could do to help in the fire fighing and rescue.

It was verified that the delay on refilling was due to the fact that there was no fast coupling to the hose from the refilling well to the vehicle tank, which make the driver come out of the cabin, switch on the submersed pump, climb on the vehicle tank and staying there until the end of the refilling.

It was verified that two vehicles remained close to the refilling well, not being able to be refilled simultaneously, because the submersed pumps did not have capacity for this type of situation. The existing pumps have a flow of 750 liter per minute, insufficient to refill in adequate time, two vehicles with a unit capacity of 12.000 liters.

2.8 EMERGENCY PLAN

2.8.1 General

If the ambient conditions, specially adverse at the time of the accident, are taken into account, it can be concluded that the actioning of operation and posterior development of the emergency plan, were satisfactory, being verified by not only a fast intervention in fire fighting, as well as by the concentration, in approx. 45 min, of a significant number of human and material resources for the operation, rescue and evacuation to the hospital.

However, due to difficulties in communication and shortcomings in the very emergency plan, an emergency operational center was never created, generating, as can be seen in the following paragraphs, inefficiencies in actions of direction, coordination and support to the several involved parties.

2.8.2 Emergency plan execution

The operation plan Identification corresponds to the situation "Accident or Immiment Accident with Aircraft", in the airport area or vicinity, was correctly executed, with the first actioning and development of the first phase of the plan taking place without remarks. Therefore, in the beginning of the emergency, the disciplined actuation of Rescue Services and S.O.A. coordination garanteed a certain order in the beginning of the operation.

Afterwards the plan foresees that the members of the emergency operation center are informed and that they progressively take over the direction and coordination of operations.

However, although sectorial reports state that its members were warned, in practice it was verified that the emergency operation center never worked as an supporting team, coordinating and directing the action of the several involved parties. Its actuation as can be noticed in the recording of the emergency channel, was always noticed to be uncoordinated and without any discipline of communications.

The mobile command post functioned at least for half an hour, in the person of the rescue department Chief. Afterwards, for lack of support from the emergency operation center, several officials of the control tower, S.O.A., municipal firemen, control tower chief, airport director and subdirector showed up in the mobile center. This situation transferred to the rescue department chief the coordination of several tasks, detrimental to the execution of other tasks that were specified to him in the operations plan.
In this case are transfer of the mobile illumination towers and support vehicles to the first aid post. The last ambulance should have taken the nurse on duy at

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the airport first aid, to the accident place.
According to the plan, the rescue chief is also responsable for the constitution of a "Victim gathering post", in a tent.
None of these activities was completed in due time, being virtually impossible to gather the passengers due to the panic generated by fuel explosions, which make the majority of survivors to abandon the accident site by their own means, transferring wrongly to the airport first aid the first medical support to the victims.

Although the non-implementation of a selection zone to separate by victims priority, was not significant in this very accident survival rate, another accident with other repercussions and type of injury, namely traumatic wounds or severe haemorrage, would more than likely negatively influence the survival rate.

Taking the above into account, it is considered very necessary that new methology must be tested in future sectorial exercises, for the constitution and functioning of emergency operational centers, simulating not only this operations plan, but others, in which the use of external means can make the coordination fundamental for the mobilization and actuation of all involved parties. Particularly a communications routine must be established, activated as soon as the type of emergency is declared and identified.

In another way, in case of accidents with a wide-body aircraft, the impossibility is obvious for the rescue services with the present number of persons in each shift, to be able to fullfill their duties in this operations plan in time, to which can be added the above-mentioned difficulties for water refill.

2.8.3 Considerations on the Emergency Plan

2.8.3.1. General Considerations

The emergency plan for Faro airport was elaborated, based on a conceptual common model according to recommendations for contingency plans, as well as ICAO directives.
Although globally the plan which is in force, follows the existing recommendations and combines the several foreseen operational plans, there are some area's where it must be improved and completed.

In an analysis to the point described in ICAO airport emergency planning DOC 9137/AN/898-part 7, some discrepancies and shortcomings were detected, in relation to the ICAO recommendations, which could have contributed to the non-execution of certain procedures in the emergency plan and in some cases to the below standard efficiency as would be expected.

Although these shortcommings had little influence on the operations final result at Faro, it can be presumed that with other accidents, with different contditions, type of accident and type of injuries, time of accident, the efficiency could have been much worse.

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2.8.3.2. Specific aspects to be evaluated

Training of AID and Rescue teams

Taking into account that in the majority of cases, members of these teams (firemen, airport personnel) are the first to arrive at the accident place and for a quite some time they can be the only ones present, it is fundamental that they are able to perform the primary objectives which is the immediate rescue of gravely injured, otherwise these can quickly become fatalities.
Therefore, as there is no permanent medical doctor at the airport, there must be at least two elements per shift, identified and trained in cardiopulmonar resuscitation and first aid, in order to perform this if need be.

The specific training must be repeated regularly, for proficiency maintenance, and there must be a list with the individuals that are adequate trained.

Medical support services (3.6 and 3.7 of Doc.9137/AN 898)

As there is no fixed medical doctor at the airport and the creation of a medical team is the responsibility of FARO H.D., it is necessary and, following the recommendations in the ICAO manual, to define in the plan names and functions of medical doctors and nurses, involved in all hospitals, that can supply support, specifically and differentiated, namely on area's of neurochirurgy, burnings and toraxic chirurgy.

Since, there is not, as would be desirable, a list of medical doctors and replacements to be immediately moved to the accident place to coordinate selection of wounded and transport to the hospital. This list must appoint the responsible/coordinator medical doctor who may also be appointed Transport Officer. He shall be responsible for all contacts between accident site and involved hospitals.

The plan must also have a list of appointed hospitals with identification of capacity, location and access, which are mandatory by ICAO.

The involved hospitals specially "Hospital Distrital de Faro", must have a contingency plan for the mobilization of medical teams as fast as possible.

Transport means (3.11 Doc.9137/898)

In order to quickly mobilize transport means for victims as well as for the members of the several aid and rescue teams, it is recommended to define in the plan the existent means through a list. The plan must include specifically all the equipment (buses, ambulances, firetenders), maintenance and support vehicles) available and by whom lies the responsibility for driving, to avoid delays in the actions.

Relations with Civil Protection (3.13 Doc.9137/AN/898

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Taking into account that the foreseen emergencies in the existent plan can imply (or normally imply) the mobilization of means and the involvement of the local Civil Protection, the cooperation ways and preplanning must be integrated and specified in the plan, according to the existing ICAO recommendations.

Other General aspects of preplanning (3.14,3.18 and 3.19 Doc.9137/AN/898

All the agreements on mutual help with entities that can eventually be involved in the operation, specifically fire brigades, police, security services and medical services, must have written agreements according to the manual. For adequate management of relations between the media and the involved parties there must be a preappointed information officer who can filter the information to be provided, avoiding hastily declarations which will hamper the investigation in course.
Finally it is advisable that in the area a mental support center exists for the psychological support to post-traumatic shock situations of the victims, families or personnel involved in the emergency.

Available equipment for emergency operation (9.3 and 9.5 Doc.9137)

As there was no selection center for victims it was not necessary to make a list in terms of seriousness of sustained injuries.

The ICAO manual recommends in this matter that the victims must be defined with coloured stripes, simple and fast application, standardized according to the recommendations there must be four colours: Red for first priority; Yellow for second; Green for third and black for deceased.

In this area of immediate resue of the first priority victims in a situation of immiment life risk, there always must be an ambulance with paramedics, adapted to emergency situations, able for cardiopulmunar resuscitation, temporary ventilation, where the seriously wounded can be stabilized until they are transferred to an adequate hospital.

Medical equipment requested for continuous availability at the airport

The available medical equipment list must be included in the emergency plan in force, and it depends on the type of airport and type of airplanes operating. Therefore, in an airport like Faro, with the operation of wide-body aircraft, what is suggested on list 3-1, appendix 3 of the manual, should be available.

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From the above equipment list it must be emphasized:

- 100 stretchers
- 10 matresses for coumn fracture immobilization
- 50 inflatable splints
- 50 first aid boxes
- 20 rescussitation kits
- 2 to 3 electrocardiagraphs and ventilators
- 300 - 500 plastic bags for deceased

All this equipment must be regularly renovated and replaced in case of use, and this must be the responsability of the airport rescue or medical center.

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3. CONCLUSIONS

3.1. ESTABLISHED FACTS

- The aircraft was in a airworthy condition and was properly certified for the flight concerned.
- The weight and balance was within the approved limits.
- There were no indications of faults on the aircraft or its systems that could either have contributed to the degradation of safety, nor could have increased the workload on the crew during the last phase of the flight.
- The inoperative items at departure from Amsterdam, did not affect the aircraft operation.
- The crew was properly licenced, qualified and certified for the operation of the aircraft.
- The Air Traffic Controllers were properly licenced and qualified.
- The crew and the airtraffic controllers were working within the limits of the prescribed working and resttime regulations.
- The meteo conditions at Faro airport area at dawn and in the morning were influenced by a depression centered at the accident time at about 250 n.m. E.S.E. of Faro airport with a pressure of 1006 hPa in the center. The depression extended at altitude with an axis practically vertical, bringing into circulation a mass of very humid and unstable maritime air, with an instability which extended practically until the troposphere. In the South-East border of the depression were developing organized lanes of convergence with bank of clouds in which Cb were embedded, with great vertical development that gradually reached the Faro airport region.

  The forward part of one of these lanes arrived at the Faro airport about 07.30 UTC and at 12.00 UTC still affected the region.

  As a consequence strong thunderstorms and heavy rainshowers developped with very significant local wind variations, with gusts developing that in the airport region reached a velocity of 40 kts.

  The average wind came from South-East and S.S.E. with an average force of 10-17 knots, that, occasionally, with the passing Cb could have surpassed 20 to 25 knots.

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The surface visibility was 6 to 9 km, being reduced to 2 - 4 km during the periods of intense rainfall.

The forecast for Faro airport for the period 04.00 - 13.00 UTC gave a surface wind of 150°, 15 knots, visibility more than 10 km, 3/8 stratus at 500 ft, 4/8 cumulus 1200 ft, 5/8 stratocumulus 2500 ft, temporary visibility 6000 m, light rainshowers or light or moderate thunderstorms, with rain but no hail, intermittent vis more than 10 km, moderate thunderstorm and 2/8 Cb at 1800 ft.

At 04.45 UTC the meteo center of Lisbon airport sent a sigmet valid between 06.00 - 12.00 UTC in which was warned for clear air turbulence, moderate and locally severe, above FL 340 and thunderstorms and ice formation in Lisbon FIR. This sigmet was not transmitted to the aircraft.

At 07.09:58 UTC Faro Approach Control gave the following meteo information to flight MP495: Wind 150° 18 kt, vis. 2500 m, present time thunderstorms, clouds 3/8 at 500 ft, 7/8 at 2300 ft, 1/8 Cb at 2500 ft, Temp. 16°, QNH 1013.

The aircraft in the final phase of the approach crossed a turbulence area associated with microburst and downburst phenomena, that initiated a longitudinal instability of the aircraft.

The use of the automatic flight control systems (ATS+CWS), could have degraded the crew's perception of the turbulence and the instability of the approach.

The aircraft was informed by Approach Control that the runway was flooded. The crew did not associate the term flooded with bad braking conditions (Poor), due to a lack of update of the ICAO phraseology in the Aircraft Operating Manual and Crew Training Manual.

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At 07.32:15 UTC Faro Approach Control transmitted the last wind information. Wind 150° - 15 kts, max. 20 kts.

Faro Approach Control transmitted to the aircraft the instantaneous wind instead of the 2 minute average wind and the wind from runway 29 instead of runway 11.

Faro Approach Control did not transmit to the aircraft the wind information on runway 11 that reached 220° with 35 kts between 07.32:40 and 07.33:30 UTC.

At 07.33:20 the accident occurred.

At 07.35:30 UTC. The SIO registered a warning for windshear.

About 08.00 UTC farmworkers gave indications that in the airport zone a very strong wind developed along a narrow lane that passed the beginning of runway 11 from South to North, that destroyed some greenhouses South and North of runway 11, and destroyed part of the airport fence, near the sensors of runway 11. The farmworkers attributed this destruction to a local phenomenon which is locally named Manga de Vento (wind sock) and which would have been of sufficient intensity to affect the operations of landing and take-off at Faro airport.

The crew did not integrate informations concerning the instability and the momentarily visibility degradation in the final phase of the approach, and having wrongly interpreted the communication of the runway condition (Flooded), did not take the decision to abandon the approach.

At 80 ft RA the autopilot disengaged the CWS mode, apparently not intentionally. There are no clear indications that the crew became aware that the warning light for this condition was lit.

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The function CWS of the autopilot was switched off at (RA) 80 ft, apparantly not intentionally, while it should have been done by crew decision at a height not below 150 ft above the runway threshold.

At 150 ft (RA) power has been reduced to flight idle through ATS and kept at flight idle, probably by copilots action. Under normal conditions the ATS retard mode starts at 50 ft (RA).

The premature power reduction and the sudden wind variation probably increased the rate of descent, which reached values exceeding the operational limits of the aircraft.
According to the values registered in the SIO, there has not been a significant variation of wind speed and direction in the last 20 seconds.

The captain's intervention during the whole approach seems to have been too passive, and concerning the last power increase, it came too late.

The fracture of the right main landing gear was due to the combination of the high rate of descent and the drift correction taking place at the moment of contact with the runway.

The wind sensors from runway 11 are placed 17 m above runway level, next to a hole 7 m deep, located between the sensor and the runway.
The average wind is determined by a scaled average of wind direction and intensity of the wind during the given period and not by a vectorial average.

The meteo clock of SIO showed a lag of one minute and 30 secs relative to the reference ATC clock.

There are no written procedures for time setting of the SIO clock.

SIO registration does not include all meteo information displayed in the control tower positions.

There is no written agreement between INMG and ANA about the way of processing the information supplied by SIO.

The definitions concerning the calibration of the meteo sensors are interpreted in a different way by ANA and by INMG.

On the control tower there are no individual displays for each of the zones covered by each pair of sensors.

The wind displays do not have a clear indication of the area from which the information comes.

There are no written procedures concerning the checks to be carried out by ATC personnel prior to start of their work, neither concerning their tour of duty, in order to assure the correction of available information.

There are no written Air Traffic Service procedures to minimise the possibility of human error.

It has not been evident that DGAC had inspected the ATC Service at Faro airport, according to paragraph 0, of article 3rd, of law decree 242/79.

The action of the fire fighting personnel at the airport was hampered by the access conditions to the place of the accident.

The fire was started by the rupture of the integral tanks of the right wing, after the impact with the runway.

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The survivability was conditioned by the fire which broke out and propagated after the impact.

The accident was generally survivable.

The action of the fire fighting personnel had a significant contribution to the survivability of the passengers of the aft section, keeping open the escape routes.

The emergency plan was activated correctly but its further development was affected by insufficient coordinating instructions.

The medical equipment at Faro airport at the time of the accident was inadequate in certain aspects.

3.2. CAUSES

The commission of inquiry determined that the probable causes for the accident were:

- The high rate of descent in the final phase of the approach and the landing made on the right landing gear, which exceeded the structural limitations of the aircraft.
- The crosswind, which exceeded the aircraft limits and which occurred in the final phase of the approach and during landing.

The combination of both factors determined stresses which exceeded the structural limitations of the aricraft.

Contributing factors to the accident were:

- The instability of the approach.
- The premature power reduction, and the sustaining of this condition, probably due to crew action.
- The incorrect wind information delivered by Approach Control.
- The absence of an approach light system.

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- The incorrect evaluation by the crew of the runway conditions.
- CWS mode being switched off at approx. 80 ft RA, causing the aircraft to be in manual control in a critical phase of the landing.
- The delayed action of the crew in increasing power.
- The degradation of the lift coëfficient due to the heavy showers.

4. RECOMMENDATIONS

The commission recommends:

4.1. That the actual procedures concerning the operation of ATS and CWS, during the approach and landing phase, especially during adverse meteorlogical conditions, be reviewed.

4.2. Martinair shall review their BIM in order to:

4.2.1. Review the procedures concerning landings and take-offs in order to stipulate if, and under which conditions, these manoeuveres could performed by the copilot, whenever the meteo conditions are adverse and/or the operational parameters are marginal.

4.2.2. Review the Operational procedures concerning the operation of engine nr. 2 thrust reverser, in order to define a clear procedure on this matter.

4.3 That Martinair reassess the training of crews concerning windshear, especially concerning the recognition of the possibility and existence of this phenomenon.

4.4. That ANA/EP installs in Faro airport an approach light system in order to improve pilot perception under conditions of reduced visibility, of the deviation relative to the runway center line.

4.5. That ANA/EP publishes processing procedures for air traffic control of information supplied by SIO.

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4.6. That all meteo information, displayed in the control tower, be registered and filed for accident and incident investigation.

4.7. That ANA/EP establishes a set of operational practices in order to minimise human error.

4.8. To install in the control tower, wind displays according to international recommendations.

4.9. That the wind sensors of runway 11 be installed correctly according to international regulations.

4.10. That the average wind available at SIO be changed to vectorial average.

4.11. That the former INMG, now ING, studies and makes known the meteorological phenomenon, locally known as Manga de Vento (wind sock).

4.12. That written agreements are made between Meteo authority and the ATC authority, defining the services to be provided and the responsibility of each authority in the area of aeronautical meteorology.

4.13. That ANA/EP:

4.13.1 Improves the emergency accesspath from the fire brigade building to the runway, and creates alternative accesses and improves the drainage of the terrain of the safety strips.

4.13.2 Changes the water refill system for the fire fighting vehicles.

4.13.3 Reviews and adapt the emergency plans of national airports according to ICAO recommendations.

4.14. That conditions be created in order to realise inspections of the Air Traffic Control Services by ANA/EP.

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APPENDIX

COMMENTS:

- NETHERLANDS AVIATION SAFETY BUREAU (NASB)
- NATIONAL TRANSPORTATION SAFETY BOARD (NTSB)

Comments of the Kingdom of the Netherlands, by the Aviation Safety Board, on the Final Report of the Portuguese Government, concerning the Aircraft Accident with Martinair Flight MP495, a DC-10-30CF, on December 21th, 1992 at Faro Airport, Portugal.

General

The Aviation Safety Board is of the opinion that the Portuguese report, in general, correctly reflects the course of events leading to the accident.
The Board agrees with the factual information and generally agrees with the analysis and the conclusions drawn from it.

The Board is of the opinion that the analysis of several aspects in the course of events should be expanded, in order to be able to accurately determine the probable causes of the accident and the contributing factors, for the purpose of learning the lessons and taking accident prevention measures.

In the following paragraphs the Board offers its views on the Analysis in the Portuguese report, concerning the Weather Aspects, the execution of the Approach and Landing, the Autothrottle System, the phraseology "Flooded", the Conclusions and Causes, and the Recommendations.

The Amended Conclusions, Causes and Recommendations with the changes, made by the Board are attached.

Weather aspects

The Board is of the opinion that the crew of MP495 has been fully aware about the prevailing weather at Faro Airport, with the exception of the extreme conditions at the time of the accident.

Prior to the flight the Captain and First Officer (F.O.) were informed at the Schiphol Meteorological Office, about the weather enroute and at Faro. They were shown a satellite picture indicating a depression South-West of Portugal and isolated thunderstorms in the Faro region.
Enroute they received weather information from Bordeaux and Lisbon and during the Approach, Faro ATC informed them on the actual weather at Faro Airport.
During the progress of the flight the reported weather did not change. The weather conditions mentioned in the forecast prior to the flight until the final part of the approach remained generally the same, with a reported wind of 150° with a speed of 15 knots, with gusts up to 20 knots only reported at the last moment.
The crew was aware of the presence of isolated thunderstorms and while in the initial approach phase they verified the position of the thunderstorms on their weather radar. According to their statements the closest echo was to the West of the airport, between 7 and 12 n.m. and some further activity far to the South, at least 50 n.m away.
The presence of the thunderstorm West of the field at about 8 n.m DME was also evident from the increased turbulence encountered at that position, as recorded on the DFDR, and the crew's report of rainintensity and turbulence.
During their arrival overhead Faro the crew's impression of the weather was not changed by the appearance of the weather. When flying overhead Faro at 4000 ft. they were flying in the clear and could see the runway and some time later, the approaching Martinair MP461.

From the forecast and the prevailing weather the crew of MP495 did not expect the existence of windshear phenomena. In this context it should be remarked that the Portuguese AIP does not contain any warning for specific weather phenomena at Faro Airport.
Consequently, according to AOM procedures, the crew briefing incorporated a standard 50° flap landing, anticipating a wet runway. The Actual Landing Distance as calculated by the crew according to company regulations, was within the Available Landing Distance. With the reported wind: 150°, 15-20 knots, the crosswind component was within the limit of 30 knots for braking action "Good" and also within the limit of 15 knots for braking action "Medium".

The Captain, knowing the runway was wet, instructed the F.O. to make a positive touchdown, which is standard operating procedure to avoid aquaplaning.

The reported visibility in the approach was above 2000 m which is the minimum required visibility for a VOR approach.
The Captain stated that he had the runway in sight from about 1200 ft, which equals about 3-4 n.m. distance to the runway. Notwithstanding the varying rainintensity during final approach he could constantly see the runway lights and the Papi.
At around 250 ft the F.O. lost view on the runway lights due to the rain on his windshield. The Flight Engineer switched the windshield wipers to high, telling the F.O.: "You are at fast". This action obviously restored visibility as, according to the CVR, there was no further comment by either pilot.

During the final approach the Captain monitored windreadings of the Area NAV.
This action is not required in the AOM procedures.
Furthermore, the AOM states that due to the inaccuracy of the Area NAV windreadings, the calculations of maximum allowable windcomponents for landing should be based on the tower reported surface wind.

The reported weather at Faro was not of exceptional concern to the crew, since, with the precautions they had taken in view of the wet runway, all conditions were within the operational limits of the aircraft.

They did discuss the missed-approach procedure, which is standard operating procedure. The Captain decided that in that case they would proceed directly to Lisbon. This decision was based on the better means of transport for the passengers available at Lisbon, in relation to Seville, which was the first nominated alternate.

The change of the weather occurred rather abrupt, at the moment that the aircraft was on short final at about 150 ft. With the - unexpected - arrival of a spearhead of an active frontal system from the South, winddirection and speed changed from the reported 150° - 15 knots, max. 20 knots, to a wind of 220° knots, with 35-40 knots. The aircraft entered a heavy rainshower, as observed by a crew at the holding position.

The calculations of the NLR showed three area's of downburst/microburst activity along the aircraft approach path.
The first one, a downburst, which the aircraft crossed at about 700 ft, has been discussed in the Portuguese report.
The two others were microbursts, classified as small. The aircraft flew through the second one while descending from 600 ft to 300 ft. This microburst could have had an influence on the instability of the approach. The position of the third microburst was approx 1 km in front of the runway, with the aircraft descending from 200 ft to 110 ft. This microburst, according to the calculations made by NLR, caused headwind to tailwind changes of a magnitude which would have triggered a windshear alert system, if such a system had been installed in the aircraft. The NLR study also showed that the experienced windshear occasionally was beyond the aircraft performance limits, and that one such occasion took place when the aircraft was at about 150 ft altitude.

The Phraseology "Flooded"

During the final approach of MP461 and of MP495 the ATC controller reported: "The runway conditions are flooded".
According to the ICAO document Doc 4444 (PANS-RAC), the ATC Controller, when informing the crew of the presence of water on the runway , can amongst others use the word "Flooded", indicating that: "extensive standing water is visible". This word should, if possible, be accompanied by a figure indicating water depth. The word "Flooded" however did not trigger the crew's mind, and its significance was not realized by the crew.
According to the statement of the Captain he took it to mean that the runway was wet. In the AOM no reference is given to the word "Flooded".

The AOM states that braking action is "Medium" with "Moderate to heavy rain on a clear runway" and "Poor" with "standing water".
If the crew had understood the meaning of the word "Flooded", they would have

considered the braking action as "Poor".
However, in view of the prevailing weather, with heavy rain at times, they applied the AOM tables for braking action "Medium".

Approach and Landing

As has been discussed before, the crew, in view of the prevailing weather conditions, prepared for a 50° flap landing, on a wet runway. According to AOM procedures, the approach was flown with one autopilot and two autothrottle systems engaged.
In the crewbriefing the F.O. had indicated a "Manual Crew Coordination Procedure", in which the F.O. would fly the aircraft and the Captain would monitor and look outside for visual cues.

During the crew briefing the F.E. had mentioned the various airspeeds to be maintained in the approach.
The reference speed Vref was mentioned as 139 knots. After the accident the value in the ATS Speed Window was found to be 139 knots.
According to AOM procedures a Wind Correction Factor with a minimum of 5 knots should be added to this value, and this value (144 knots) should be inserted into the ATS Speed Window. The Captain was positive in his statement that he indeed had inserted 144 knots. His statement is confirmed by the DFDR registrations of CAS and Speed Error, indicating an average speed of 142 knots.

During the approach increasing oscillations took place in pitch, airspeed and engine power.
The Board agrees with the view in the Portuguese report concerning the initiation of the oscillations, which was most probably due to the effects of the first downdraft which the aircraft passed through.
The oscillations may have increased due to the influence of the second and third microburst along the aircraft approach path, as well as to the interaction of Autothrottle response and pilot control input.
These oscillations became quite large, but at no time did the values exceed the parameters

mentioned in the AOM regarding speed, bank and position relative to the runway.
Only when the preset limits of the Ground Proximity Warning System are exceeded, the rate of descent during an approach is considered excessive, and in that case an autoprint of the AIDS will take place.
Such an autoprint did not occur, as evident from the AIDS registration.

It should be considered that the registrations of the DFDR concerning the Altitude Rate (Rate of descent) are not dampened. The registrations show the calculated rate of descent per minute at any moment, while actually the aircraft, due to its inertia, does not follow these excursions.
The flightpath of the aircraft is more related to the indications of the IVSI (Instantaneous Vertical Speed Indicator) which indications are not registered in the DFDR or AIDS.

According to the crew statements the aircraft was correctly in the slot for landing, down to an altitude of 200 ft. The PAPI indication showed the aircraft to be on the correct glidepath, with some minor corrections.

The problems started at around 150 ft where the ATS increased thrust to 102%, the aircraft temporarily levelled off and the speed increased.
To all probability the aircraft encountered the third microburst which was calculated by NLR to be present there. Immediately thereafter engine thrust reduced to flight idle.
The Board agrees with the Portuguese report that in all probability this thrust reduction was initiated by the ATS, with a follow-through by the F.O.
Engine thrust remained at flight idle. Although a malfunction of the ATS can not be sustained, the influence of the ATS computer logic is insufficiently known to determine whether the ATS should have reacted or not.
The Board agrees that to all probability an action of the F.O. resulted in the sustained flight idle thrust.
From approx. 150 ft to touchdown several occurrences took place.

- A bank to the left developed when the F.O. applied left rudder to decrab the aircraft. Both pilots took opposite corrective control wheel action simultaneously most probably causing the autopilot CWS mode to disengage;

- Airspeed dropped fast to below reference speed, as a consequence of the thrust reduction and the developing tailwind;
- A high rate of descent started, at approx. 80 ft radio altitude.

With the wings level again the aircraft was displaced rapidly to the left side of the runway, obviously by the abrupt change in winddirection and speed.

The Captain, startled by the sinking feeling, reacted by opening the throttles. Due to the rapidly developing situation his corrective actions (Opening the throttles and increasing pitch) were commenced when the aircraft had passed through 50 ft altitude, and consequently were too late to prevent a hard landing.

Disengagement of the autopilot CWS mode could have resulted in less pitch increase than could be expected from the control wheel input, as the crew was not aware that the CWS mode had disengaged. The reason that the crew was not aware of the disengagement could have resulted from the fact that the aircraft was in the final stage of the landing and the attention of the crew was focused on outside references and therefore missed the Autopilot red flashing warning light.

Obviously the crew tried to correct the situation and to bring the aircraft back to the runway centerline.
The aircraft touched down on the right hand main gear first, with a rolling motion to the right, a crabangle of about 11°, and a high rate of descent.
Touchdown was on the far left side of the runway.

The failure of the right main gear truck beam was to all probability caused by the high torsional forces imposed on this truck beam by the combination of a large crabangle, a high rate of descent and touchdown on the aft right hand wheel first.

It should be mentioned that the registrations of the DFDR after touchdown are to be treated with caution, as their accuracy could be impaired. However, the Board fully agrees with the description of the movements of the aircraft after the impact.

THE FOLLOWING PARAGRAPHS ARE A REPRINT FROM THE PORTUGUESE REPORT, WITH THE CHANGES OF THE AVIATION SAFETY BOARD ADDED IN SHADED TEXT.

3. CONCLUSIONS

3.1. ESTABLISHED FACTS

- The aircraft was in a airworthy condition and was correctly certified for the flight.
- The weight and balance was within the approved limits.
- There were no indications of faults on the aircraft or its systems that could have contributed to the degradation of safety nor could have increased the workload on the crew during the final phase of the flight.
- The inoperative items at departure from Amsterdam, did not affect the aircraft operation.
- The crew was correctly licensed, qualified and certified for the operation of the aircraft.
- The crew and the airtraffic controllers were working within the limits of the prescribed working and resttime regulations.
- The meteo conditions at Faro airport area were influenced by a depression centred at the accident time South-West of Portugal with a pressure of 1006 hPa in the center. The depression extended at altitude with an axis practically vertical, bringing into circulation a mass of very humid and unstable maritime air, with an instability which extended practically until the troposphere. In the South-East border of the depression were developping organized lanes of convergence with bank of clouds in which Cb were embedded, with great vertical development that gradually reached the Faro region.

- The forward part of one of these lanes arrived at the Faro airport about

07.30 UTC and at 12.00 UTC still affected the region.
As a consequence strong thunderstorms and heavy rainshowers developed with very significant local wind variations, with gusts developping that in the airport region reached a velocity of 40 kts.
The average wind came from South-East and S.S.E. with an average force of 10-17 knots, that, occasionally, with the passing Cb could surpass 20 to 25 knots.
The surface visibility was 6 to 9 km, being reduced to
2 - 4 km during the periods of intense rainfall.

- The forecast for Faro airport for the period 04.00 - 13.00 UTC gave a surface wind of 150°, 15 knots, visibility more than 10 km, 3/8 stratus at 500 ft, 4/8 cumulus, 1200 ft, 5/8 stratocumulus 2500 ft, temporary visibility 6000 m, some moderate showers and some lightning, small or moderate small hail, intermittent vis more than 10 km, moderate thunderstorm and 2/8 Cb at 1800 ft.

- At 04.45 UTC the meteo center of Lisbon airport sent a sigmet valid between 06.00 - 12.00 UTC in which was warned for clear air turbulence, moderate and locally severe, above FL 340 and thunderstorms and ice formation in Lisbon FIR.

- At 07.09:58 UTC Faro Approach Control gave the following meteo information to flight MP495: Wind 150° 18 kt, vis. 2500 m, present time thunderstorms, clouds 3/8 at 500 ft, 7/8 at 2300 ft, 1/8 Cb at 2500 ft, Temp. 16°, QNH 1013.

- The aircraft in the final phase of the approach passed a turbulence area associated with windshear and downburst phenomena, that initiated a longitudinal instability of the aircraft.

- The crew was less aware of the turbulence intensity and its consequences on the aircraft stability, due to the influence of the operation of the automatic flight control systems (ATS and CWS).

- The aircraft was informed by Approach Control that the runway was flooded and the crew did not consider this information when determining braking action.

- At 07.32:15 UTC Approach Control transmitted the last wind information. Wind 150° - 15 kts, max. 20 kts.

- Approach Control transmitted to the aircraft the instantaneous wind from runway 29 instead of runway 11. In view of the fast changing weather, in the last phase of the approach, the Board considers that this omission had no bearing on the accident, since, even if the correct selection for runway 11 had been made, the warning of the ATC controller would to all probability have come too late to be effective.

- AT 07.33:20 UTC the Accident Occurred.

- At 07.35:30 UTC. The SIO registration gave a warning for windshear.

- Approach Control did not transmit to the aircraft the wind information on runway 11 that reached 220° with 35 kts between 07.32:40 and 07.33:30 UTC.

- About 08.00 UTC farmworkers gave indications that in the airport zone a very strong wind developed along a narrow lane that passed the beginning of runway 11 from South to North, that destroyed some plastic greenhouses South and North of runway 11, and destroyed part of the airport fence, near the sensors of runway 11, which locally is named Manga de Vento (wind sleeve) and was of sufficient intensity to affect the operations of landing and take-off at Faro airport.

- The instability and the momentary visibility degradation in the final approach were not of such a magnitude that the crew should have made the decision to discontinue the approach.

- At 150 ft the power was reduced to flight idle. In all probability this power reduction was initiated by the ATS with a follow through by the F.O. Also the sustained flight idle thrust condition was most probably a result of action of the F.O. Normally, the ATS Retard Mode starts at 50 ft RA.

- The autopilot CWS mode disengaged at R.A. 80 ft, apparently non-intentional. There is no evidence that the crew noticed the resulting "autopilot red light" flashing signal.

- The sudden windvariation in direction and intensity during the last phase of the final approach created a cross-wind component which exceeded the aircraft limits in the AOM.

- Due to the premature large and sustained power reduction and the sudden windshift (tailwind component) in the final approach phase the aircraft attained a rate of descent of about 1000 ft/min.

- The crew intervention for power increase of the engines was too late to stop the high rate of descent.

- The fracture of the right landing gear was caused by the combination of the touchdown on the right hand aft wheel, the crabangle and the high rate of descent.

- The wind sensors from runway 11 are installed 17 m above runway level, near a hole 7 m deep, located between the sensor and the runway.
  The meteo clock of SIO showed a lag of one minute and 30 sec relative to

the reference ATC clock.

- There were no written procedures for time synchronization.

- SIO registration did not include all meteo information displayed in the tower control positions.

- There are no written agreements between INMG and ANA about the way of working of the SIO.

- There are no defined responsibilities about the calibration of the meteo sensors.

- On the tower there are no individual displays for each separate sensor.

- The visual displays do not have a clear indication of the zone of runway they represent.

- There are no written procedures concerning the checks to be carried out by ATC personnel prior to start of their work.

- There are no published Air Traffic Service procedures to decrease the possibility of human error.

- It was not evident that DGAC had inspected the ATC Service at Faro airport.

- The action of the fire fighting personnel was hampered by the difficult terrain at the place of the accident.

- The fire was started by the rupture of the integral tanks of the right wing, after the impact with the runway.

- The survivability was conditioned by the fire which broke out and propagated after the impact.

- The accident was generally survivable.

- The action of the fire fighting personnel had a significant contribution to the survivability of the aft section, keeping open the escape routes.

- The emergency plan was activated correctly but development of the plan was affected by insufficient coordinating instructions.

- The medical equipment at Faro airport was in certain areas insufficient.

3.2. CAUSES

The commission of inquiry determined that the accident was initiated by:

- a sudden and unexpected windvariation in direction and speed (windshear) in the final stage of the approach.

Subsequently a high rate of descent and an extreme lateral displacement developed, causing a hard landing on the righthand maingear, which in combination with a considerable crabangle exceeded the aircraft structural limitations.

Contributing factors to the accident were:

- From the forecast and the prevailing weather the crew of MP 495 did not expect the existence of windshear phenomena.
- The premature large power reduction and sustained flight idle thrust, most probable due to crew action.
- CWS mode being disengaged at 80 ft RA causing the aircraft to be in manual control at a critical stage in the landing phase.

4. RECOMMENDATIONS

The commission recommends:

4.1. Civil Aviation Authorities to review current procedures regarding the use of ATS and CWS during approach and landing especially in extreme weather conditions.

4.2. Martinair to review the BIM in order to:

4.2.1. Review the procedures concerning landings and /or take-offs in order that when the meteo conditions are bad or the operational parameters are marginal, whether the manoeuvres should be performed by the Captain or not.

4.2.2. Review the operational procedures concerning the use of no. 2 engine thrust-reverser.

4.3. That ANA installs in Faro airport an approach light system in order to improve pilot perception under conditions of reduced visibility, of the deviation relative to the runway center line, as a contribution to the PAPI's.

4.4. That ANA publishes procedures for SIO operation.

4.5. That all meteo information, displayed in the control tower, is registered for accident and incident investigation.

4.6. That ANA publishes Air Traffic Control Service operational procedures.

4.7. To install in the control tower, wind displays according to international recommendations.

4.8. That the wind sensors of runway 11 are installed correctly according to international regulations.

4.9. That the average wind available at SIO be changed to vectorial average.

4.10. That the former INMG, now ING, establishes a study about the phenomena Manga de Vento (wind sleeve) and when applicable, amend the relevant AIP information.

4.11. That written agreements are made between Meteo authority and the ATC authority, defining the tasks and responsibility of each authority in the area of aeronautical meteorology.

4.12. That ANA:

4.12.1 Improves the emergency accesspath from the fire brigade building to the runway. Develops alternate accesspath and improve the drainage of the terrain along the runway.

4.12.2 Improves the water refill system of the fire fighting vehicles.

4.12.3 Reviews and corrects the emergency plans of national airports according to ICAO recommendations.

4.13. That conditions be created in order to realise inspections of the Air Traffic Control Services by ANA.

National Transportation Safety Board

Washington, D.C. 20594

October 26, 1994

Mr. Luis Alberto Figueira Lima Da Silva
Investigator-in-Charge, Avn Inspection Div.
Directorate of Civil Aviation
Rua B Edificio G
1700 Aeroporto
Lisboa, PORTUGAL

Dear Luis Alberto Figueira Lima Da,

Thank you for the opportunity to comment on the confidential draft report concerning the landing accident at Faro, Portugal involving a Martinair DC-10-30 on December 21, 1992.

It appears that the airplane and autoflight systems worked properly. Information from the quick access recorder indicates that the speed error (which is one of the parameters controlling the autothrottle computer and translates how hard the computer wants to push the throttles forward) suddenly increases when the throttles were reduced to idle at 150 feet radio altitude, rather than at 50 feet when the normal autothrottle retard mode would have been in effect. The report contradicts itself when on page B-5 it indicates the above information, but later, on the last sentence on page D-3, it states "The power was reduced at 150 ft instead of at 50 ft by autothrottle action." Consideration might be given to changing the latter sentence to indicate manual intervention by the crew.

Martinair's Flight Crew Operating Manual (FCOM) dated March 1, 1989 states on page 05-60-09 of Volume II, approach precautions for windshear procedures. It appears from the report that the following procedures were not followed:

Achieve a stabilized approach no later than 1000 feet AGL

Avoid large thrust reductions or trim changes in response to sudden airspeed increases as these may be followed by airspeed decreases.

Consider using the recommended flap setting. (Recommended landing flap setting is minimum flap setting authorized for normal landing configuration.)

Use the autopilot and autothrottles for the approach to provide more monitoring and recognition time. If using the autothrottles, manually back-up the throttles to prevent excessive power reduction during an increasing performance shear.

During the approach, use of flaps 50, the low airspeed, and throttle movement to idle, minimized the flight crew's options for recovery and increased the recovery time required. Once the autopilot was disengaged, CWS with ATS remained; functions which were inappropriately used by the flightcrew.

If the commission feels that windshear was present during the approach then consideration should be given to recommending implementation or review of crew training for windshear recovery.

Sincerely,

Alfred W. Dickinson
U.S. Accredited Rep