ACCIDENT REPORT

ACCIDENT

occurred to the aircraft

ATR72-212A (ATR 72-500)

registration marks YR-ATS

Rome Fiumicino airport

February 02nd 2013

NOTE : This is an English unofficial translation by

INDEX

INDEX **2**

THE OBJECTIVE OF THE SAFETY OCCURENCE INVESTIGATION **4**

GLOSSARY **5**

FOREWORD **8**

CHAPTER I - INFORMATION FACTS **9**

1 GENERAL **9**

1.1. HISTORY OF THE FLIGHT **9**

1.2. INJURIES TO PEOPLE **11**

1.3. DAMAGE TO THE AIRCRAFT **11**

1.4. OTHER DAMAGES **11**

1.5. PERSONNEL INFORMATION **11**

1.5.1. Cockpit Crew 11

1.5.2. Cabin crew 13

1.6. THE AIRCRAFT **14**

1.6.1. General Information 14

1.6.2. Specific Information 15

1.6.3 Additional Information 16

1.7. METEOROLOGICAL INFORMATION **18**

1.8. AIDS TO NAVIGATION **24**

1.8.1. Aids to Navigation and Landing 24

1.8.2. Available on-board systems 24

1.8.3. Other information 25

1.9. COMMUNICATIONS **25**

1.9.1. Mobile services 25

1.9.2. Fixed-base services 25

1.9.3. Communications' transcriptions 25

1.10. AIRPORT INFORMATION **26**

1.11. FLIGHT RECORDERS **27**

1.11.1. General 27

1.11.2. State of the findings 27

1.11.3. Data extracted from the FDR 28

1.11.4. Transcription of the CVR 30

1.12. INFORMATION ABOUT THE WRECK AND THE PLACE OF IMPACT **31**

1.12.1. Location of the Accident 31

1.12.2. Ground traces and distribution of the debris 31

1.12.3. Examination of the wreck 34

1.12.4. Impact's dynamic 36

1.12.5. Failures associated with the event 36

1.13. Medical and pathological information **37**

1.14. FIRE **37**
1.15. SURVIVAL **37**
1.15.1. Evacuation of the aircraft 37
1.15.2. Search and rescue operations 38
1.17. ORGANIZATIONAL AND MANAGEMENT INFORMATION **42**
1.17.1. Aircraft operator's YR-ATS 42
1.18. ADDITIONAL INFORMATION **42**
1.18.1. Testimonials 42
1.18.2. Operator's manuals 44
1.18.3. Regulations on rescue and firefighting 45
1.18.4. The "Manuale Rosso" of Rome Fiumicino's airport 47

CHAPTER II ANALYSIS **49**

2 GENERAL **49**
2.1. HUMAN FACTOR **49**
2.2. TECHNICAL FACTOR **50**
2.3. ENVIRONMENTAL FACTOR **50**
2.4. CONDUCT OF THE FLIGHT **51**
2.5. SEARCH AND RESCUE OPERATIONS **52**

CHAPTER III CONCLUSIONS **54**

3 GENERAL **54**
3.1. FACTS **54**
3.2. CAUSES **56**

CHAPTER IV SAFETY RECOMMENDATIONS **57**

4 RECOMMENDATIONS **57**

APPENDIX **59**

THE OBJECTIVE OF THE SAFETY OCCURENCE INVESTIGATION

The *Agenzia Nazionale per la Sicurezza del Volo* (ANSV), established by the Legislative Decree on the 25th of February 1999 - n. 66, is identified as the investigation authority for the civil aviation safety of the Italian State, according to art. 4 of the EU Regulation n. 996/2010 of the European Parliament and of the Council of the 20th October of 2010**.**
ANSV conducts, independently, the safety investigation processes.

Every accident and every serious inconvenience involving a civil aircraft undergoes a safety investigation in accordance with the combined provisions of the paragraphs 1 and 4 of the Art. 5, coming from the EU Regulation n. 996/2010.

As for safety occurrence investigation, a set of operations including the collection and the analysis of data coming from every relative source, the elaboration of conclusions, including the determination of the cause and /or the contributing factors is meant. Moreover, when appropriate, the making of safety recommendations is also a part of the investigation.

The sole objective of the safety occurrence investigation is to prevent future accidents and inconveniencies and not to attribute the blame or the responsibility to someone (art. 1, paragraph 1, EU Regulation no. 996/2010). As a direct result, this investigation is conducted independently and separately from any judicial inquiries which are responsible for the appropriate apportion of the blame or responsibility.

The safety occurrence investigation is conducted in accordance with the provisions of the Annex 13 to the Convention base on the International Civil Aviation *(signed at Chicago on December 7, 1944, and which was approved and implemented in Italy by the Legislative Decree of the 6th March, 1948- n. 616 , ratified by law on the 17th April of 1956, n. 561)* and the EU Regulation n. 996/2010.

Each safety investigation shall be concluded with a written report according to the type and seriousness of the accident or serious incident. It may contain, where appropriate, safety recommendations, which consist of a proposal drawn up for the pure purpose of prevention.

A safety recommendation does not constitute, by itself, a presumption of blame or the responsibility for either an accident, incident or serious incident (art. 17, paragraph 3, EU Regulation no. 996/2010).

The report guaranties the anonymity of those who were involved in the accident or the serious incident (art. 16, paragraph 2, EU Regulation no. 996/2010).

GLOSSARY

(A): Airplane.

ADF: Automatic Direction Finder.

AFM: Airplane Flight Manual.

AGL: Above Ground Level.

AIP: Aeronautical Information Publication.

AIRMET: information concerning the en route weather phenomena which may affect the safety at low altitude.

AMO: Approved Maintenance Organization.

ANSV: The corresponding NTSB in Italy.

AOA: Angle of Attack.

AOC: Air Operator Certificate.

AP: Autopilot.

APP: Either Approach control office or Approach control or Approach control service.

ATIS: Automatic Terminal Information Service.

ATPL: Airline Transport Pilot License.

ATS: Air Traffic Services.

BEA: French investigation authority for civil aviation security.

BKN: broken, abbreviation used in weather reports to indicate cloud coverage with slashes (5/8 to 7/8 coverage).

CHECK LIST: List of pre-checks.

BRIEFING: Description of preventive maneuvers and procedures.

CAMO: Continuing Airworthiness Management Organization.

CAT I, CAT II, and CAT III: categories of instrument approach.

CIAS: Civil Aviation Safety Investigation and Analysis Center.

CLA: Condition Lever Angle.

CM 1/2: Crew Member 1, Crew Member 2.

CMG: Crew Must Go, crew that have to go to another airport in order to report for duty.

CPL: Commercial Pilot License.

CRM: Crew Resource Management. It is defined as the effective usage by the flight crew, of all available resources in order to ensure efficient and safe flight operations.

CVR: Cockpit Voice Recorder.

COMPLACENCY: Underestimation due to great experience and routine gained.

CRC: Continuous Repetitive Chime.

DME: Distance Measuring Equipment.

EGPWS: Enhanced Ground Proximity Warning System.

ELT: Emergency Locator Transmitter.

ENAC: Italian National Civil Aviation Agency.

ENAV SPA: National Provider Company for Navigation Services.

FCOM: Flight Crew Operating Manual.

FDR: Flight Data Recorder.

FIR: Flight Information Region.

FL: Flight Level.

FT: foot, 1 ft = 0, 3048 meters.

HPA: hectopascal, pressure unit equal to approximately one thousandth of atmosphere.

IAS: Indicated Air Speed.

ICAO/OACI: International Civil Aviation Organization.

IFR: Instrument Flight Rules.

ILS: Instrument Landing System.

IR: Instrument Rating.

KIAS: IAS expressed in knots (kt).

KT: knot unit to measure speed, nautical mile (1852 meters) per hour.

LDA: Landing Distance Available.

ME: Multi Engine.

MEP: Multi Engine Piston.

METAR: Aviation routine weather report.

MHZ: megahertz.

MLAT: Multilateration.

MTOM: Maximum Take Off Mass.

NDB: Non-Directional radio Beacon.

NLG: Nose Landing Gear.

NM: nautical miles, (1 nm = 1852 meters).

NOSIG: No Significant Changes.

OM: Operations Manual.

OVC: overcast, abbreviation used in weather reports to indicate cloud coverage (measured in 8/8).

PF: Pilot Flying.

PIC: Pilot in Command.

PIREP: Pilot Report.

PUM: Pitch Uncoupling Mechanism.

P/N: Part Number.

PNF: Pilot Not Flying, Pilot that monitors and helps PF.

QFU: Magnetic orientation of the runway.

QNH: Setting the QNH in order to read down the airport altitude.

RCAA: Romanian Civil Aviation Authority.

RESA: Runway End Safety Area.

RWY: Runway.

SEP: Single Engine Piston.

SITUATIONAL AWARENESS: Defines the perception of the environmental elements in a given interval of space and time, the understanding of their meaning and the projection of their status in the near future.

SMR: Surface Movement Radar.

TAF: Aerodrome Forecast.

TAS: True Air Speed.

TCAS: Traffic Collision Avoidance System, on board avionic system that warns the crew about situations that might lead to collisions with other airplanes

DEW POINT: Meteorological term for defining the reference temperature at which the air mass condensates.

RUNWAY THR: Beginning of the Runway.

TRE: Type Rating Examiner.

TRI: Type Rating Instructor.

TSB: Transportation Safety Board (of Canada).

TWR: Aerodrome Control Tower.

TWY: Taxiway.

UMA: Italian acronym for Airport weather office.

UTC: Universal Time Coordinated.

VAPP: Approach speed.

VFR: Visual Flight Rules.

VHF: Very High Frequency (from 30 to 300 MHz).

VMC: Visual Meteorological Conditions.

VNL: limitation to the medical certificate: the person concerned must have corrective glasses for near vision while having a spare pair of glasses.

VOLMET: Acronym of the French language " vol météo" (meteorological information for aircraft in flight), is a network of radio stations broadcasting weather reports on VHF.

VOR: VHF Omni-directional radio Range.

VVF: Italian acronym for Firefighters.

FOREWORD

The accident occurred on Feb. 2, 2013, at 19:32 'UTC (20:32 local time), at Fiumicino's airport in Rome and affected the aircraft of type ATR 72-212A with identification marks: **YR-ATS**.

The aircraft, operating the flight AZ1670 from Pisa (LIRP) to Roma Fiumicino (LIRF) with 4 crew members and 46 passengers on board, after trying to land at the runway 16L, stopped at a distance of about 1800 m from the runway threshold, on the grassy strip located on the right side of its track , close to the intersection called "DE".

The aircraft reported extensive damage to the structure, while some of the occupants were transferred to the medical facilities outside the airport.

ANSV was informed of the accident by ENAV SPA immediately after the occurrence.

ANSV made its first operational site visit of after one hour from the event.

ANSV has sent the requested notification of the event, according to the international regulations (Annex 13 to the Convention on International Civil Aviation), to the Romanian investigative authority (CIAS), to the French investigation authority (BEA) and to the Canadian investigation authority (TSB), who proceeded in order to accredit their representatives in the investigation conducted by ANSV.

On the accident the Court has opened its own investigation, placing the seizure of the aircraft wreckage and all the related equipments and documentation of interest.

All times quoted in this inquiry report, unless otherwise specified, are expressed in UTC, which, at the date of the event, local time corresponded to one hour less.

CHAPTER I - INFORMATION FACTS

1 GENERAL

The following content includes the objective evidence collected during the safety occurrence investigation.

1.1. HISTORY OF THE FLIGHT

On the 2nd of February, 2013, at 18.44'33", the aircraft ATR72-212A with identification marks: YR-ATS operating the flight AZ1670 from Pisa to Rome, took off from the airport of Pisa (LIRP) with 4 crew members and 46 passengers on board.

From the ground traces and by additional evidence acquired, it seems that the aircraft touched the runway at the airport of Fiumicino at 19:32'03", close to the center line of runway 16L, at a distance of about 560 m from the threshold. After the first contact with the runway, the aircraft would attempt three more times the very same, during which the nose gear and later the main landing gear collapsed.

After the last contact (4th and last one) with the runway, the aircraft would permanently be supported by the fuselage, crawling for approximately 400m before stopping completely.

Throughout the swiping the aircraft's trajectory was leaning to the right, only to stop on the grass, at about 30m from the edge of the runway, near the intersection called "DE". During the course of the sweep, the aircraft was leaning to the right by performing a rotation of about 170° on its vertical axis, stopping with the prow nose oriented at 330° magnetic degrees.

As soon as the aircraft stopped, the two flight attendants, assisted by the crew members of another company on board as CMG, took care of the process of the evacuation of passengers, who, after exiting the aircraft fuselage, waited for the authorities to come and help. The first emergency vehicles of firefighters came to the scene after 10 minutes and due to the absence of a possible fire condition, they positioned themselves around the aircraft ready for intervention. The doctor, who arrived at the scene at the same time of the Police Department, would provide for the immediate relief of the wounded ones while carrying out the process of the nursing *triage* in order to encode the rescue urgency.

The **ANSV** made its first operational site visit about one hour from the event. The aircraft removal operations began around 13:00 of the 3rd of February. The 16L-34R runway was reopened to traffic at 15:43 of the very same day.

Picture 1: the ATR 72 YR-ATS after the accident

Pictures 2 and 3: the ATR 72 YR-ATS after the accident

1.2. INJURIES TO PEOPLE

Injuries	Crew	Passengers	Total people onboard	Other
Fatal				
Serious				
Minor	2	5		not applicable
None	2	41		not applicable
Total	4	46	50	

1.3. DAMAGE TO THE AIRCRAFT

The aircraft was affected by a failure of the front and the main gear, damage to the right propeller and a permanent deformation of the fuselage in such a way that reparability and reconditioning would not be possible.

1.4. OTHER DAMAGES

Damage to external third parties had not been identified.

1.5. PERSONNEL INFORMATION

1.5.1. Cockpit Crew

Captain

General: male, 58 years old, Romanian nationality

License: ATPL (A) valid

Operating Qualifications: ATR 42/72; IR (A); CAT II LVTO 150m; TRI (A)-ATR 42/72.

Authorizations: TRE (A) ATR 72/42 expiring on 3.3.2015; special authorization nr. ASAT-FCL-1-0029/E07 “In Flight Airplane Technical Acceptance” ATR 42/72 expiring on 15.2.2013.

Other skills: English radiotelephony.

English proficiency level: level 4 ICAO.

Medical check: valid first class, with a VNL limitation.

Captain’s total flight experience: check following table.

	Total flight hours	Type of A/C	Flight hours CM1	Flight hours CM2
Total flight hours	18.552 h 00'	3.351h00' ATR72 6.256h00' ATR42		
Last 24 hrs	5h30'	5h30'	5h30'	
Last 7 days	19h40'	19h40'	19h40'	
Last 30 days	56h08'	56h08'	56h08'	
From 14th of December	82h51'	82h51'	82h08'	00h43'

The captain had been, from 1996 to 2000, the ATR chief Pilot to another airline company.

The captain started his flight activity with the airline involved in the event on the 14th of December 2012 and from the 30th of December 2012 until the 2nd of February 2013 (date of the accident) was assigned as CM1 exclusively on the route Pisa-Rome Fiumicino, for a total of 64 round-trip flights.

The day of the accident, the captain flew the first sector departing from Pisa at 10.45' landing at Fiumicino at 11.55' ; the second sector departing from Fiumicino at 16.40' and arriving in Pisa at 17.45 and one last sector (which resulted in the accident) departing from Pisa at 18.44' and landing in Fiumicino at 19.32'.

First officer

General: female, 25 years old, Romanian nationality.

License: valid CPL (A).

Operating Qualifications: ATR 42/72; SEP (land); MEP (land), IR (A).

English proficiency level: 5 ICAO.

Medical check: valid first class

Flight experience of the first officer: check next table.

	Total flight hours	Type of A/C	Flight hours CM1	Flight hours CM2
Total flight hours	624 h 00’	14h59’ (36h SIM)		14h59’
Last 24 hrs	5h30’	5h30’		5h30’
Last 7 days	13h59’	13h59’		13h59’
Last 30 days	14h59’	14h59’		15h59’
From 14th of December	14h09’	14h59’		14h59’

The first officer had obtained the rating to operate the ATR 42/72 aircraft on November 20, 2012 and began her flight activity with the airline involved in the event on December 15th 2012, with a first flight of 1h 10'. After training with the simulator for about 36h, the first officer was subsequently employed by the company on an ongoing basis as CM2 starting from January 29th 2013 on the Pisa-Rome Fiumicino route, totaling 13 round-trip flights, including that one of the accident, for a total of 14h 59' of flight time on the ATR 72. On the day of the accident, the first officer had flown her first sector starting from Pisa at 10:45'and landing at Fiumicino’s airport at 11:55'; a second sector departing from Fiumicino at 16:40' and landing in Pisa at 17:45' and a last one, which ended with the accident, taking off from Pisa at 18:44' and landing at Fiumicino’s airport at 19:32'. From the documentation gathered, it appears that for the first officer, the qualification acquired for the ATR 42/72 was the first one for such a type of aircraft, and that she had gained much of her experience by flying gliders and ultra light aircrafts, totaling 350h flight hours on a total of 624h.

1.5.2. Cabin crew

Chief Purser

General: female, age 36 years, Romanian nationality.

Aeronautical titles: Cabin Crew License.

Medical check: second class medical examination, valid.

On duty flight attendant

General: female, age 33 years, Romanian nationality.

Aeronautical titles: Cabin Crew License.

Medical check: second class medical examination, valid.

1.6. THE AIRCRAFT

1.6.1. General Information

The aircraft ATR 72-212A, marketed under the name ATR 72-500, is an metal made airplane with high-wing, having a MTOM of 22,800kg equipped with two turboprop Pratt & Whitney Canada PW127F type engines. The external dimensions are as follows: 27,05 m of wingspan, 27,166 m of length and 7,65 m in height. It has a pressurized cabin with seats arranged in pairs placed in two rows, for a total of 70 passenger seats and two crew-seats, one of which is anchored to the front luggage hold bulkhead and the other one, to the rear luggage hold bulkhead next to the lavatory door. The cabin has a total of four doors arranged on the left and right side of the fuselage, in correspondence of the first and last places of the two rows of seats. All doors are usable as emergency exits, where the two front doors, as they do not have access ladders, are used exclusively for emergency exits while, the two rear ones are normally used for the cabin access: the door on the left side of the fuselage, as equipped with ladders, is used as the main access for the crew members and the passengers, while the one on the right side, with no ladder, is normally used as a service door.

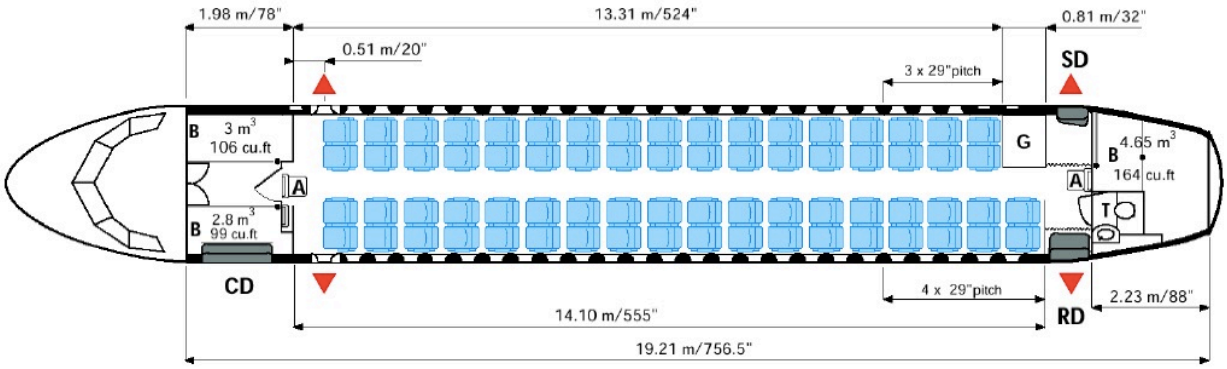


Figure 1: aircraft configuration as shown by the OM.

1.6.2. Specific Information

Aircraft

Manufacturer: ATR-GIE Avion de Transport Regional.

Model: ATR 72-212A (marketed as ATR 72-500).

Built Number: 533.

Year built: 1997.

Brands and registration numbers: YR-ATS, previously registered with N533AT marks on the 4th of December 2008.

Registration certificate: No. 740 issued by the RCAA.
Owner: Kirk Aviation A / S (Denmark).
Operator: S.C. Carpatair S.A.

Certificate of Airworthiness: n. 416 issued on December the 22nd of 2012 from RCAA.

Revision airworthiness certificate: n. 78 issued on December the 22nd of 2012 from RCAA, still valid.

Total hours: 24.088h.
Period since last inspection, check C: 179H from the 18th of December 2012.
Period since last inspection, daily check: 9H from the 1st of February 2013.

Technical documentation's compliance in legislation/directives: **Yes**.

Engines

Manufacturer: Pratt & Whitney Canada.
Model: PW127F.

Engine position	Part number	Serial number	Total hours (TSN)	Hours since last revision (TSO)
1	3047600	PCE-AK0010	21.821	180
2	3047600	PCE-127111	27.690	1275

Propellers

Manufacturer: Hamilton Standard.
Model/Type: 568F.

Propeller position	Part number	Serial number	Installation date	Total hours (TSN)	Hours since last revision (TSO)
1	H5568F	20081016		7049	176
2	H5568F	143		18746	158

1.6.3 Additional Information

Weight and Balance

Based on what is written on the loadsheet (load file), the aircraft at the time of takeoff from Pisa, had a mass of 19,745 kg, with the center of gravity (CG) positioned at 27.6% of the wing mean aerodynamic chord (MAC), while during the landing phase at Rome Fiumicino, assuming a fuel consumption of 700kg, a mass of 19,045kg was estimated, with the CG positioned to 27.2% of the MAC.

From the loadsheet chart of the Weight and Balance Manual, as shown in figure 2, it is shown that the positions of the center of gravity of the aircraft during the take-off and during the landing were within the acceptable limits.

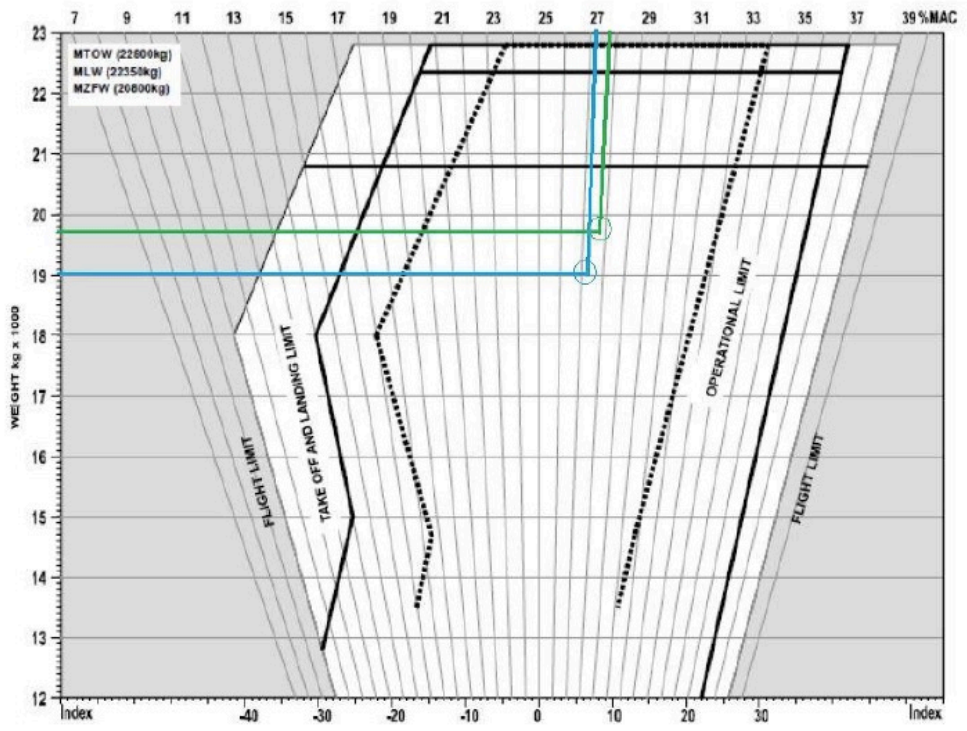
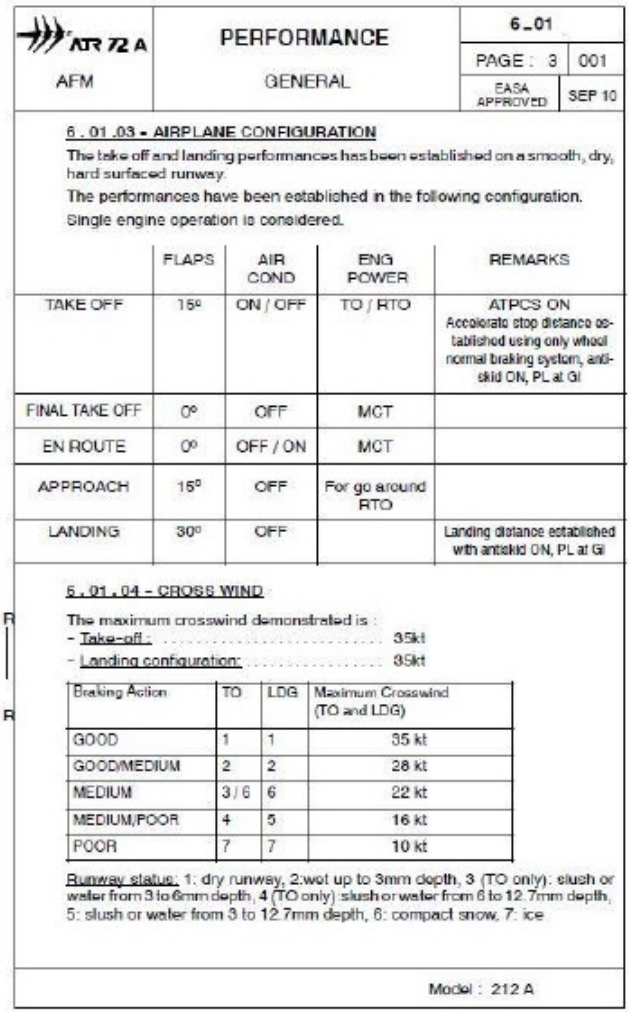


Figure 2: loadsheet of the weight and balance chart (take-off: green line, blue line: landing)

Aircraft wind limitations

The aircraft wind limitations indicated in the AFM, the FCOM and in the OM of the company, are shown in the pictures below (pictures 3, 3a and 3b).



ATR 72 A — AFM | PERFORMANCE — GENERAL | 6_01 | PAGE : 3 | 001 | EASA APPROVED | SEP 10

6 . 01 .03 - AIRPLANE CONFIGURATION

The take off and landing performances has been established on a smooth, dry, hard surfaced runway.

The performances have been established in the following configuration.

Single engine operation is considered.

	FLAPS	AIR COND	ENG POWER	REMARKS
TAKE OFF	15°	ON / OFF	TO / RTO	ATPCS ON Accelerate stop distance established using only wheel normal braking system, anti-skid ON, PL at GI
FINAL TAKE OFF	0°	OFF	MCT	
EN ROUTE	0°	OFF / ON	MCT	
APPROACH	15°	OFF	For go around RTO	
LANDING	30°	OFF		Landing distance established with antiskid ON, PL at GI

6 . 01 . 04 - CROSS WIND

The maximum crosswind demonstrated is :

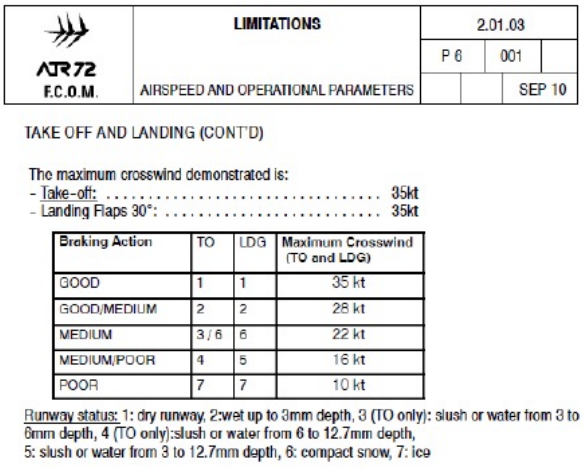
- Take-off : 35kt
- Landing configuration: 35kt

Braking Action	TO	LDG	Maximum Crosswind (TO and LDG)
GOOD	1	1	35 kt
GOOD/MEDIUM	2	2	28 kt
MEDIUM	3 / 6	6	22 kt
MEDIUM/POOR	4	5	16 kt
POOR	7	7	10 kt

Runway status: 1: dry runway, 2:wet up to 3mm depth, 3 (TO only): slush or water from 3 to 6mm depth, 4 (TO only) :slush or water from 6 to 12.7mm depth, 5: slush or water from 3 to 12.7mm depth, 6: compact snow, 7: ice

Model : 212 A

Figure 3: Aircraft wind limitations (from the AFM)



ATR72 F.C.O.M. | LIMITATIONS | AIRSPEED AND OPERATIONAL PARAMETERS | 2.01.03 | P 6 | 001 | SEP 10

TAKE OFF AND LANDING (CONT'D)

The maximum crosswind demonstrated is:

- Take-off: 35kt
- Landing Flaps 30°: 35kt

Braking Action	TO	LDG	Maximum Crosswind (TO and LDG)
GOOD	1	1	35 kt
GOOD/MEDIUM	2	2	28 kt
MEDIUM	3 / 6	6	22 kt
MEDIUM/POOR	4	5	16 kt
POOR	7	7	10 kt

Runway status: 1: dry runway, 2:wet up to 3mm depth, 3 (TO only): slush or water from 3 to 6mm depth, 4 (TO only):slush or water from 6 to 12.7mm depth,
5: slush or water from 3 to 12.7mm depth, 6: compact snow, 7: ice

Figure 3a: Aircraft wind limitations (from the FCOM)

Friction coefficient	Braking action	Equivalent rwy. condition	Max. crosswind
0.4 or above	Good	1	30KTS
0.39-0.36	Good/ Medium	1	30KTS
0.35-0.30	Medium	2/3	20KTS
0.29-0.25	Medium/Poor	2/3	15KTS
0.25	Poor	3/4	5KTS
Below 0.25	Unreliable	4/5	No T/O or Landing

Equivalent runway condition:
1 - Dry, damp or wet runway (less than 3 mm water depth).
2 - Rwy covered with slush.
3 - Rwy covered with dry snow.
4 - Rwy covered with wet snow or standing water with risk of hydroplaning.
5 - Icy runway or high risk of hydroplaning.

Figure 3b: Aircraft wind limitations (from the OM of the company)

As specified to the ANSV by the ATR manufacturer, the value of 35 knots mentioned in the AFM and in the FCOM represents the *maximum demonstrated crosswind*, which also includes the possible gust value. In this regard, the ATR manufacturer, on request of the ANSV, explained that «when ATC announces a gust of 37 kt, it is out of demonstrated condition. ».

1.7. METEOROLOGICAL INFORMATION

The analysis at 500hPa and 850hPa of 18:00' UTC (Figure 4) shows a low pressure area which is over the Italian peninsula with the low-pressure center located over the central regions while associated with strong westerly winds.

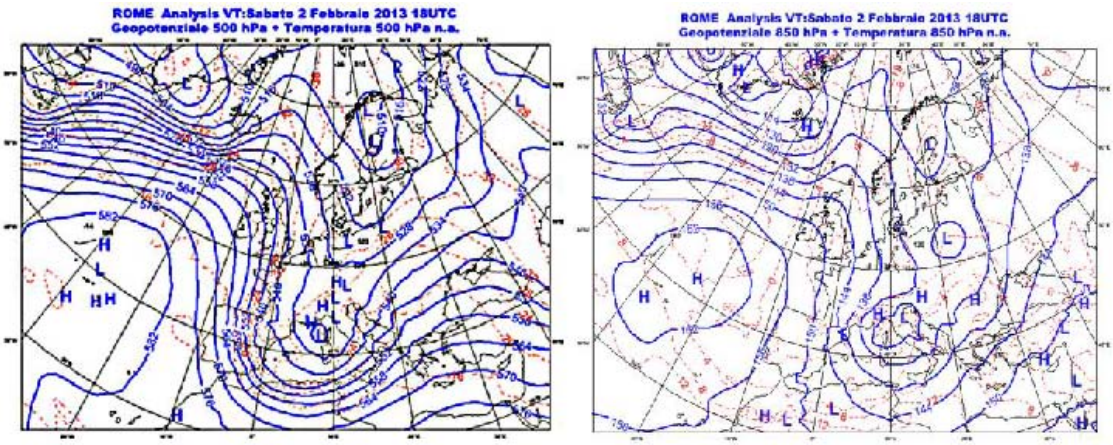


Figure 4: The analysis at 18:00 UTC.

As seen from the satellite image in *figure 5*, the low pressure area was also associated to a moderately cloudy unstable system that would move eastward with the top of the clouds at about 26,000 feet at a temperature of -43°C, as reported in the nephanalysis in figure 6.

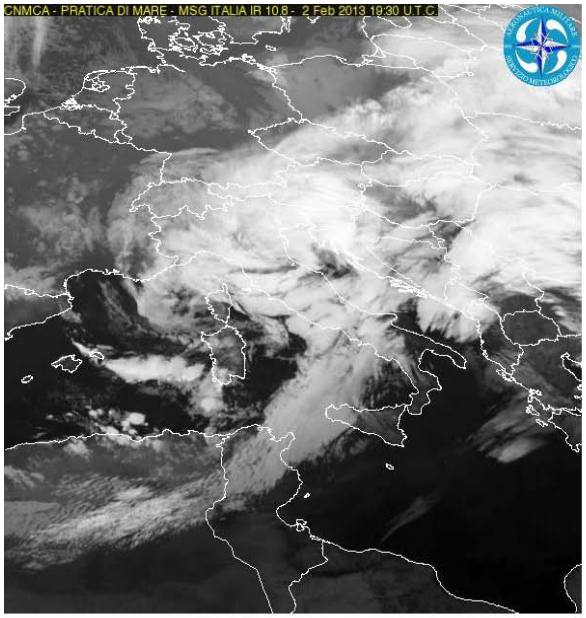


Figura 5: sistema nuvoloso da satellite.

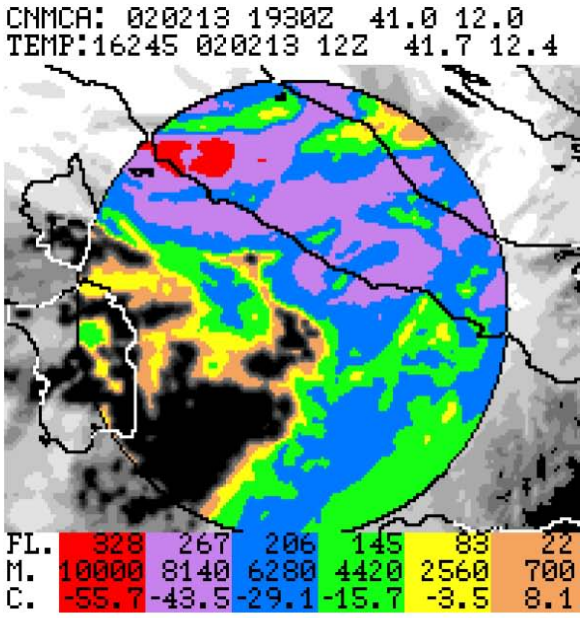


Figura 6: nefoanalisi.

The chart of the *Italian significant weather* (from *ground* until 10,000 feet), referring to 18:00' UTC of *02/02/2013*, shows the presence, on the Tyrrhenian coast of central Italy (zone 2), of a cloud coverage ranging from BKN*(5–7 oktas)* to an OVC (8 oktas) in heaps, stratocumulus, altocumulus and altostratus (medium-low clouds) based at 2,000 feet and the presence of an isolated cumulonimbus calvus based at 1,500 feet, with a forecast of thunderstorms, rain showers, cloud tops and severe turbulence, as it is shown in figure 7 .

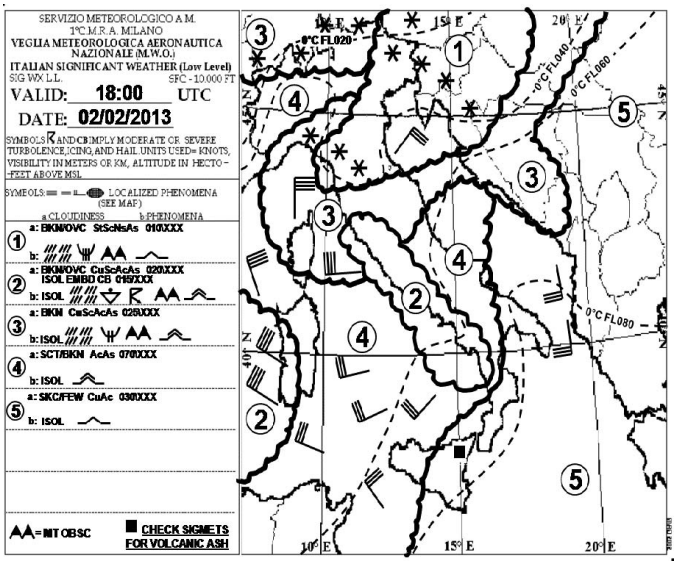


Figure 7: The chart of the *Italian significant weather*.

AIRMET

The AIRMET safety messages valid for the time period ranging from 15:30' to 23.30' UTC, given below, would predict (for the data of interest) for the FIR of Rome, a wind of 30/40 knots and a moderate turbulence above FL *050.*

LIRR AIRMET 04 VALID 021530/021930 LIMM.
LIRR ROME FIR MOD TURB FCST WHOLE FIR ABV FL050 STNR NC.
LIRR ROME FIR SFC WSPD 30/40 KT FCST WHOLE FIR STNR NC.
LIRR AIRMET 05 VALID 021930/022330 LIMM.
LIRR ROME FIR MOD TURB FCST WHOLE FIR ABV FL050 STNR NC.
LIRR ROME FIR SFC WSPD 30/40 KT FCST WHOLE FIR STNR NC.

TAF

The TAF issued at *11:00'* UTC, valid for the time period ranging from *12:00'* UTC of *02.02.2013* to *I8:00'* UTC of *03.02.2013*, which is reported below, would provide (for the data of interest) the following: a wind coming from 190 degrees at a speed of 16 knots and wind gusts up to 28 knots; expected horizontal visibility of 8 km, a cloud coverage of 3 to 4/8 with the base at 2,000 feet and a second cloudy layer from 5 to 7/8 with the base at 6,000 feet.

TAF LIRF 021100Z 0212/0318 19016G28KT 8000 SCT020 BKN060 WEATHER 0212/0215 4000 SHRA BKN014 BECMG 0214/0216 25018G28KT WEATHER 0215/0218 3000 TSRA SCT012CB BKN014 BECMG 0222/0224 14010KT WEATHER 0300/0305 RA BKN014 BECMG 0302/0304 05012KT SCT030=

The TAF issued at 17:00' UTC, valid for the time period ranging from 18:00' UTC of 02.02.2013 to 24:00' UTC of 03.02.2013 which is reported below, would provide (for the data of interest), the following: a wind coming from 250 degrees at a speed of 22 knots and wind gusts up to 32 knots; expected horizontal visibility of 8 km, a cloud coverage of 3 to 4/8 with the base at 2,000 feet and a second cloudy layer from 5 to 7/8 with the base at 6,000 feet.

TAF LIRF 021700Z 0218/0324 25022G32KT 8000 SCT020 BKN060 WEATHER 0218/0224 4000 SHRA BKN014 BECMG 0223/0302 07012KT BECMG 0304/0306 01020KT=

Airport alert

The following airport alert would predict, for the time period ranging from 15:00' to 19.00' UTC, winds of 20 knots which could reach speeds of 30.

WOIY60 LIRF 021440
LIRF AD WRNG 04 VALID 021500/021900
SFC WSPD 20KT MAX 30KT
ISSUED BY PREVI LIRFYMYX=

METAR

The METAR data related to the time slot ranging from 18:20' to 19:20' UTC is shown below. In particular, from the METAR of 19:20' UTC is shown that: a weather situation which was characterized by wind coming from 250 degrees with an intensity of 28 knots and gusts up to 41 knots, horizontal visibility over 10 km, cloud coverage of 3-4/8 based at 2,300 feet, a second cloud layer at 4,000 feet, ground temperature of 11°C and the dewpoint temperature of 04°C (relative humidity 64%); QNH 992. The *wind shear* on runway 16L that is shown, is starting from 18:20' UTC. The first report of a *wind shear* at 200 feet was made at 18:17' UTC from an aircraft landing on runway 16L.

METAR LIRF 021820Z 24030KT 9999 FEW023 SCT040 11/04 Q0991 WS RWY 16L NOSIG=
METAR LIRF 021850Z 24024KT 9999 FEW023 SCT040 11/04 Q0992 WS RWY 16L NOSIG=
METAR LIRF 021850Z 24024KT 9999 FEW023 SCT040 11/04 Q0992 WS RWY 16L NOSIG RMK VIS MIN 9999NW=
METAR LIRF 021920Z 25028G41KT 9999 SCT023 SCT040 11/04 Q0992 WS RWY 16L NOSIG=

It should be noted, however, that the meteorological data reported in METAR reports represent the synthesis of a greater number of data detected instantly and with a higher temporal frequency than the one of the most significant meteorological station for the area to which the METARs refer.

Figure 8: Depicturing the runways of Rome Fiumicino.

Other information

At the airport of Rome Fiumicino six weather stations can be identified: five located, respectively, in the vicinity of the runway 16L threshold, in the 16R threshold, in the 34L threshold, in the 25 threshold and in the 16C threshold (when active); the sixth, called “MET GARDEN”, is located approximately at the half of the 25/07 runway. Data obtained from the latter station is processed by the METARs of Fiumicino airport, as the station itself is in a central position considering the airport position. For this reason the weather conditions at certain times in each single runway threshold, considering the fact that they are about 4000 away from the central weather station, may present some discrepancies from those published by the METARs.

As a result, in order to define more precisely the actual weather conditions found on runway 16L at the time of the accident (and in particular, their variability in the time ranging from 19:30' to 19:33') the intensity values and the direction detected every five seconds by each weather station have been reported in Table 1.

WIND DATA

Date	Time	Met. Gard.		16L		16R		34L		34R	
		Dir.°	*Speed kt*	*Dir.°*	*Speed kt*	*Dir.°*	*Speed kt*	*Dir.°*	*Speed kt*	*Dir.°*	*Speed kt*
02/02/2013	19.30.00	255	23,71	252	22,94	240	23,33	232	13,80	248	24,10
02/02/2013	19.30.05	255	21,97	240	18,47	243	24,69	243	20,02	255	22,55
02/02/2013	19.30.10	255	26,05	245	20,02	251	22,94	219	21,58	253	22,94
02/02/2013	19.30.15	255	21,77	250	21,38	235	21,58	248	23,33	255	27,60
02/02/2013	19.30.20	253	28,77	245	17,88	234	19,05	245	27,41	251	33,82
02/02/2013	19.30.25	256	25,66	238	18,47	236	17,69	246	25,27	252	24,69
02/02/2013	19.30.30	254	24,30	251	16,33	237	18,66	249	25,08	263	25,27
02/02/2013	19.30.35	255	25,46	248	17,69	250	20,22	238	26,05	252	21,97
02/02/2013	19.30.40	249	20,22	238	15,75	237	23,13	236	26,05	256	26,83
02/02/2013	19.30.45	248	20,41	234	17,69	238	28,57	246	24,69	252	25,85
02/02/2013	19.30.50	252	22,35	255	19,63	246	30,71	246	24,88	258	22,74
02/02/2013	19.30.55	251	20,41	256	19,24	243	24,10	243	23,13	253	23,71
02/02/2013	19.31.00	262	20,60	258	20,80	240	21,58	242	17,88	252	23,71
02/02/2013	19.31.05	251	21,38	244	21,19	237	24,49	246	23,33	255	21,58
02/02/2013	19.31.10	253	20,22	242	19,05	235	27,99	235	22,74	266	23,91
02/02/2013	19.31.15	251	21,97	242	17,11	240	24,30	231	21,58	258	25,27
02/02/2013	19.31.20	249	22,94	236	17,88	247	22,74	238	28,19	265	20,80
02/02/2013	19.31.25	256	19,83	255	16,52	233	29,55	234	22,94	257	25,27
02/02/2013	19.31.30	246	23,33	242	15,94	235	27,41	231	21,58	248	23,33
02/02/2013	19.31.35	248	18,27	237	16,33	239	25,85	228	23,33	254	24,49
02/02/2013	19.31.40	254	21,58	239	14,77	241	22,55	233	21,38	249	23,33
02/02/2013	19.31.45	238	20,99	243	14,97	241	22,55	241	24,49	251	22,74
02/02/2013	19.31.50	248	21,38	240	16,13	238	23,91	235	23,13	263	26,44
02/02/2013	19.31.55	240	27,99	242	14,38	235	23,33	229	22,16	247	25,46
02/02/2013	19.32.00	244	29,16	245	17,30	238	22,35	242	19,24	258	26,05
02/02/2013	19.32.05	246	29,94	235	16,52	238	21,38	245	23,52	258	26,83
02/02/2013	19.32.10	247	24,69	243	19,05	236	18,27	245	26,63	253	27,80
02/02/2013	19.32.15	244	27,80	249	19,83	240	18,66	244	28,38	254	24,10
02/02/2013	19.32.20	247	24,88	245	20,99	246	20,80	246	25,46	256	26,44
02/02/2013	19.32.25	247	23,33	230	19,83	242	17,30	236	23,91	258	26,05
02/02/2013	19.32.30	242	22,16	245	20,60	242	17,30	246	27,41	251	25,46
02/02/2013	19.32.35	245	24,69	244	24,49	242	18,27	240	25,46	250	28,77
02/02/2013	19.32.40	245	23,91	238	22,55	238	15,94	237	27,02	257	24,88
02/02/2013	19.32.45	264	22,74	247	24,30	243	15,75	244	27,02	253	24,30
02/02/2013	19.32.50	241	25,85	250	23,33	246	15,16	241	29,55	257	27,60
02/02/2013	19.32.55	250	28,38	256	21,19	223	12,83	243	26,83	256	23,13
02/02/2013	19.33.00	255	24,10	254	20,41	237	12,83	245	26,83	252	23,52

Table 1: Wind direction and intensity on individual titles (UTC time).

The time slots are also highlighted with different colors concerning the various stages of the event ended with the accident, which is the terminal phase of the ILS procedure (yellow), the final phase of the approach of the runway (pink), the first contact with the threshold (red) and the phase following the first contact with the threshold (blue). It is noticeable the difference in values especially the one of the wind intensity on the same runway 16L-34R, denoting, in fact, a major wind gust situation.

As shown in figure 9, the same values are also presented in a graphical form, for the purpose of a more immediate display of the speed and the direction occurring in the course of each individual phase.

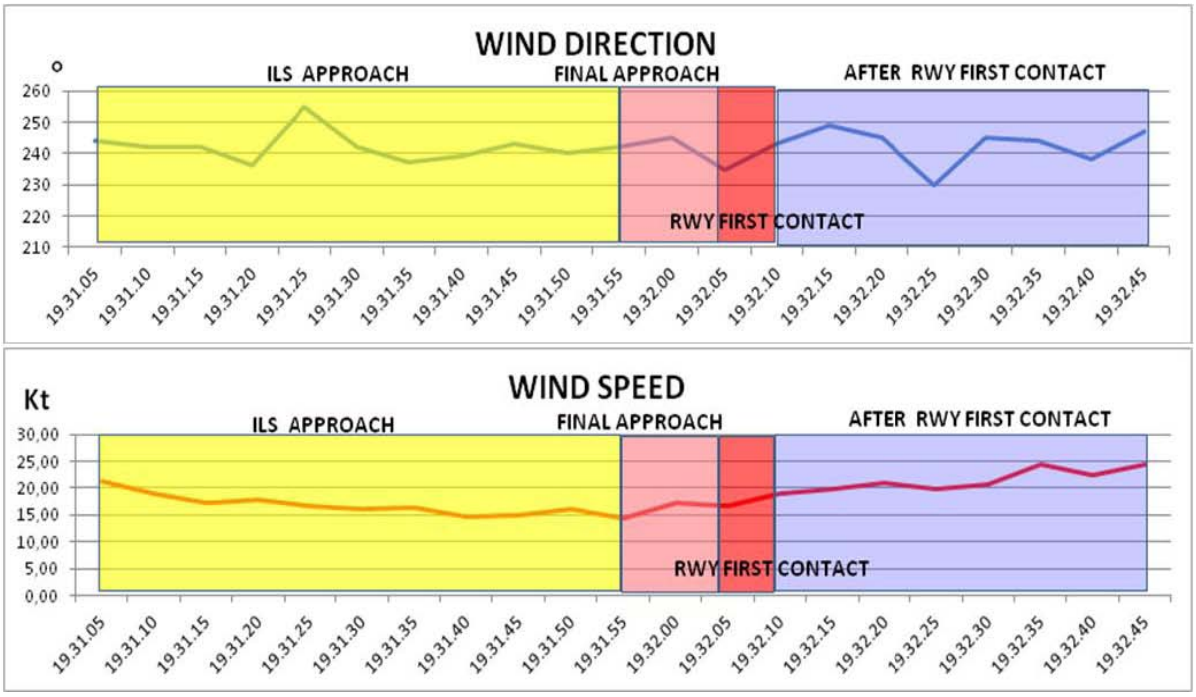


Figure 9: graphical representation of the changes in the wind on the runway 16L.

For all the phases of the accident, maximum variations of the wind direction of around 20 degrees were detected, with a variation from 245 degrees to 235 degrees during the five seconds before the first contact with the threshold and a variation from 235 degrees to 243 degrees during the next five seconds.

As for the intensity of the wind, there is a constant reduction of the speed during the part of the ILS approach, from which a maximum of about 21.19 knots at the time 19:31'05" goes to a minimum of 14.38 knots at the time 19:31'35", only to go up to 16.52 knots over the next 10 seconds before the first contact with the runway.

During this contact and during the course of the next thirty seconds, the speed of the wind had a gradual and steady increase, which from 16.52 knots at 19:32'05 " reached a maximum of 24.49 knots at the time 19.32'35 ".

During the descent phase, the following ATIS message could be heard from the crew: «This is Fiumicino ATIS, information for arrival QUEBEC at 1850, runway in use 16L category one, transition level 80, wind 240 degrees 22 knots, maximum 38 knots, random 14 knots, visibility more than 10 km, clouds few 2300 feet, scattered 4000 feet, temperature 11 degrees, dew point 05 degrees, QNH 0992 hectopascal, QFE 0992 hectopascal, light windshear reported at 200 feet in approach, you have received information QUEBEC».

At 19:30'50" the Rome Fiumicino TWR, after giving the clearance to land, would provide for the crew of the YR-ATS, the direction and the intensity of the wind: blowing from 250 degrees with an intensity of 22 knots and with gusts up to 37 knots. By listening to the CVR it is shown that the TWR, tended to highlight the value of these gusts, as they were of a significant value, to any aircraft landing.

1.8. AIDS TO NAVIGATION

This section shows the most interesting information regarding the assistance available for the air navigation and the state of its efficiency.

1.8.1. Aids to Navigation and Landing

On the day of accident, at the Rome Fiumicino airport were available the following radio aids to the air navigation: NDB, VOR-DME, ILS RWY 16L CAT 1, the airport control service with the aid of a radar, surveillance service with 2 SMR supplemented by a Multilateration Mode S system (MLAT).

1.8.2. Available on-board systems

On the aircraft were installed three VHF Comm. systems. Transceivers; two ELT systems, two ADF Receiver systems, two VOR / ILS Receiver systems, two DME systems, two Marker Beacon Receiver systems, a TCAS-RA system; a WXR radar system, a EGPWS system and one autopilot.

1.8.3. Other information

The accident occurred during the execution of a flight conducted according to the IFR rules, with the approach procedure called *Precision Approach* mode (ILS CAT1) RWY 16L, during the final stage of contact with the runway 16L of Rome Fiumicino's airport.

1.9. COMMUNICATIONS

This section shows the most interesting information regarding the means available for communications and the relative state of its efficiency.

1.9.1. Mobile services

The aircraft had always maintained the expected radio contacts with the relevant ATS Units. More specifically, the aircraft established its first radio contact with TWR of Fiumicino at 19:28'51" on the frequency 127,625 MHz, keeping that contact until 19:30'50", at which time the aircraft was cleared to land.

At 19:32'03" the aircraft touched for the first time the runway 16L.

From 19.32'25" the TWR was trying to establish further radio contact with the aircraft, without any success.

1.9.2. Fixed-base services

Irrelevant.

1.9.3. Communications' transcriptions

For the purposes of the safety occurrence investigation, the ANSV examined the recordings and the transcripts of the communications between the aircraft registered as YR-ATS operating the flight AZ1670 APP and the Rome/Fiumicino TWR; the results were of a good utility as they were beneficial for the defining of the environmental context in which the accident happened.

1.10. AIRPORT INFORMATION

The international airport of Rome Fiumicino as reported by AIP Italia is located approximately 19 NM west-south-easts from Rome and has an elevation of 13 feet. The administrative authorities of the Airport and the Civil Aviation Authority (ENAC) - Administration airport system Lazio; the airport is operated by ADR SPA; the ATS service provider is the ENAV SPA.

The airport has 4 asphalt runways with the following features.

- Designation 07/25 (magnetic orientation 068°/248°): length 3307 m, width 45 m.

- Designation 16C/34C (magnetic orientation 161°/341°): length 3602 m, width 45 m.

- Designation 16L/34R (magnetic orientation 161°/341°): length 3902 m, width 60 m.

- Designation 16R/34L (magnetic orientation 161°/341°): length 3902 m, width 60 m.

The following table provides further information on the runway 16L/43R, which, at the time of the accident, resulted as “DRY” (dry).

- Runway 16L: LDA 3902 m, RESA 90x120 m, 13.5 ft of elevation of the runway threshold.

- Runway 34R: LDA 3902 m, RESA 90x120 m, 4.9 ft of elevation of the runway threshold.

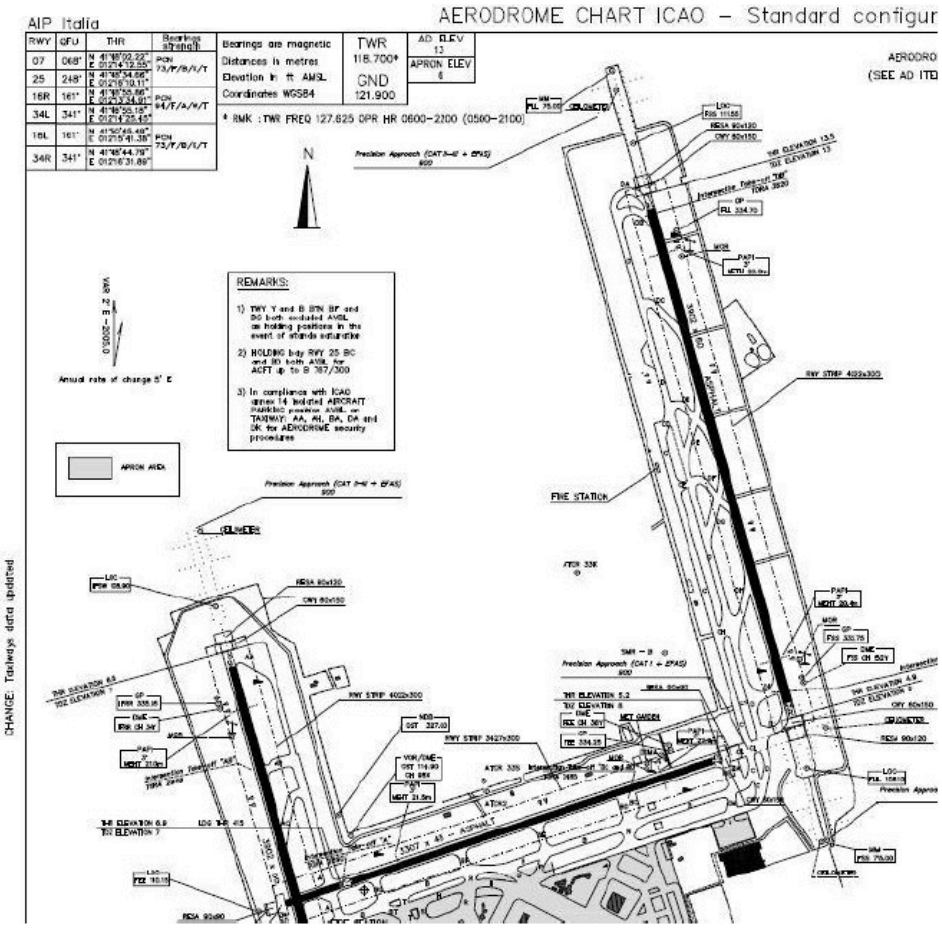


Figure 10: ICAO chart of Rome Fiumicino’s Airport (AIP Italy); on the right, the runway 16L/34R

1.11. FLIGHT RECORDERS

This section shows the most interesting information about the recordings on board.

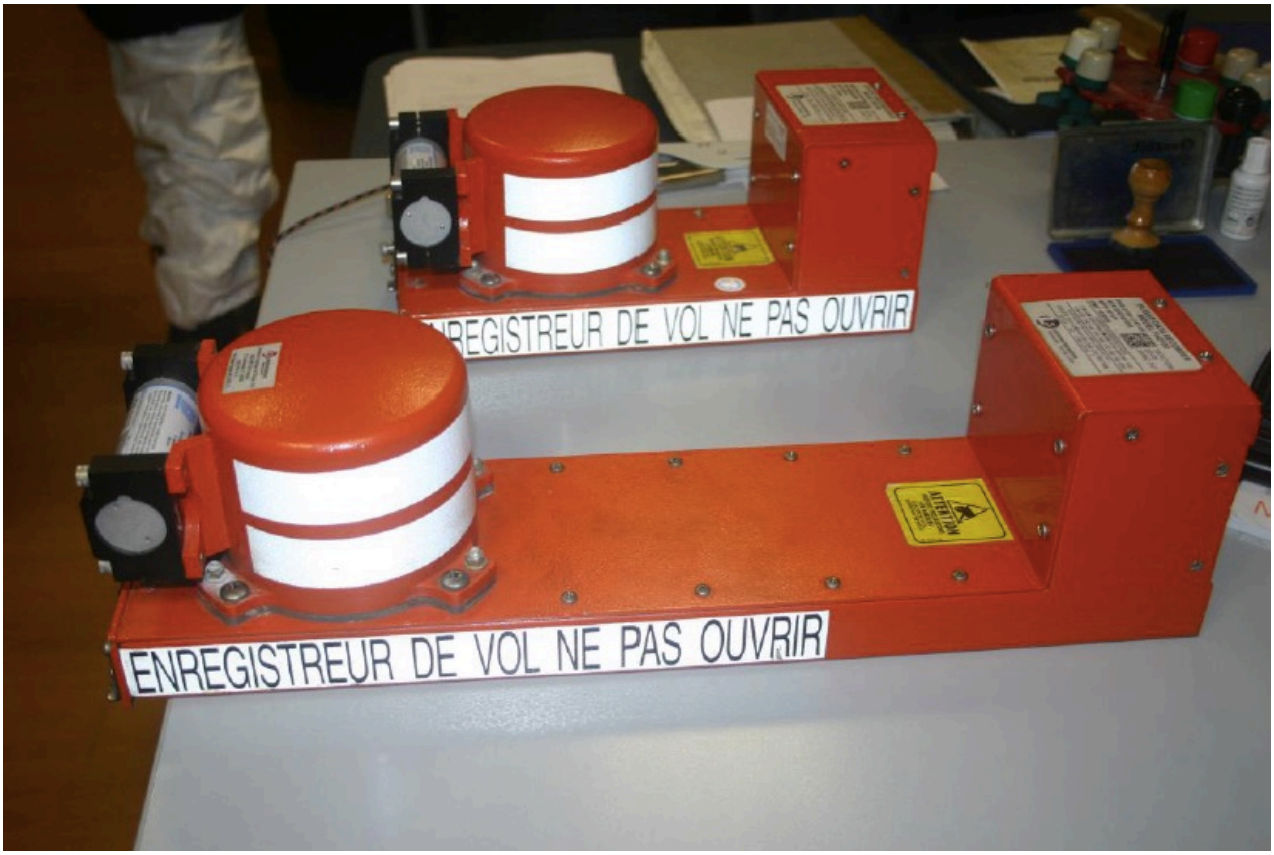
1.11.1. General

The flight recorders (FDR and CVR) were removed from the aircraft and impounded by the court. These are the following devices:

- FDR, L3 brand, model FA 2100, P/N 2100-4043-00, S/N 000 347 000;

- CVR, L3 brand, model FA 2100, P/N 2100-1020-02, S/N 000 306 298.

The extraction of data took place in February the 5th of 2013, inside the ANSV laboratories, attended by the technical consultant of the judicial authority.



Picture 4: Aircraft flight recorders of the YR-ATS.

1.11.2. State of the findings

The devices were brought inside the ANSV laboratories from the technical consultant of the judicial authorities, who attended the essential extraction of the data. Before proceeding with the operations, it was verified that the equipment delivered by the technical consultant was the same

one that was on board of the ATR 72-212A YR-ATS at the time of the accident. The verification was carried out by the comparison of the data of the devices delivered with the data gathered by photos from the ANSV staff at the event site. The verification confirmed that the device was the same as the one on board. These last results are intact and the extraction of data was successful.

1.11.3. Data extracted from the FDR

The data extracted from the devices had shown the following:

Until the disengagement of the AP, the flight and the descent parameters were set according to the profile of the instrumental procedure; a stable speed of about 130 KIAS, with small variations of about 10 KIAS can be observed.

At the time of the first contact with the runway, as it is depicted in *Figure 11* below, the “snapshot” of the selected parameters of interest shows: the AP was not inserted (as expected by the OM of the company to the "minimum" of the instrumental procedure), that the pitch had an angle of -2.6 degrees, the speed was of 125 KIAS and that no evidence of opposites *inputs* by the two crew members was found. The above data indicates that the aircraft touched the runway during a controlled approach.

From the analysis of the parameters after the first contact with the runway (*Figure 11*) and after the first bounce (*Figure 12*) emerged that on the *pitch axis effort*, was set up an opposite input from the two pilots: the PF (Captain) had an input to "pitch down" (*pitch axis effort 1*), while the PNF (copilot) had an input to "pitch up" (pitch axis effort 2).

The above-mentioned situation might have caused the activation of the PUM, a device which, by detecting opposing forces on the respective flight controls, unlocks in fact their interconnection in order to avoid the impairment of the aircraft controllability in case of an eventual blocking of only one *control column*.

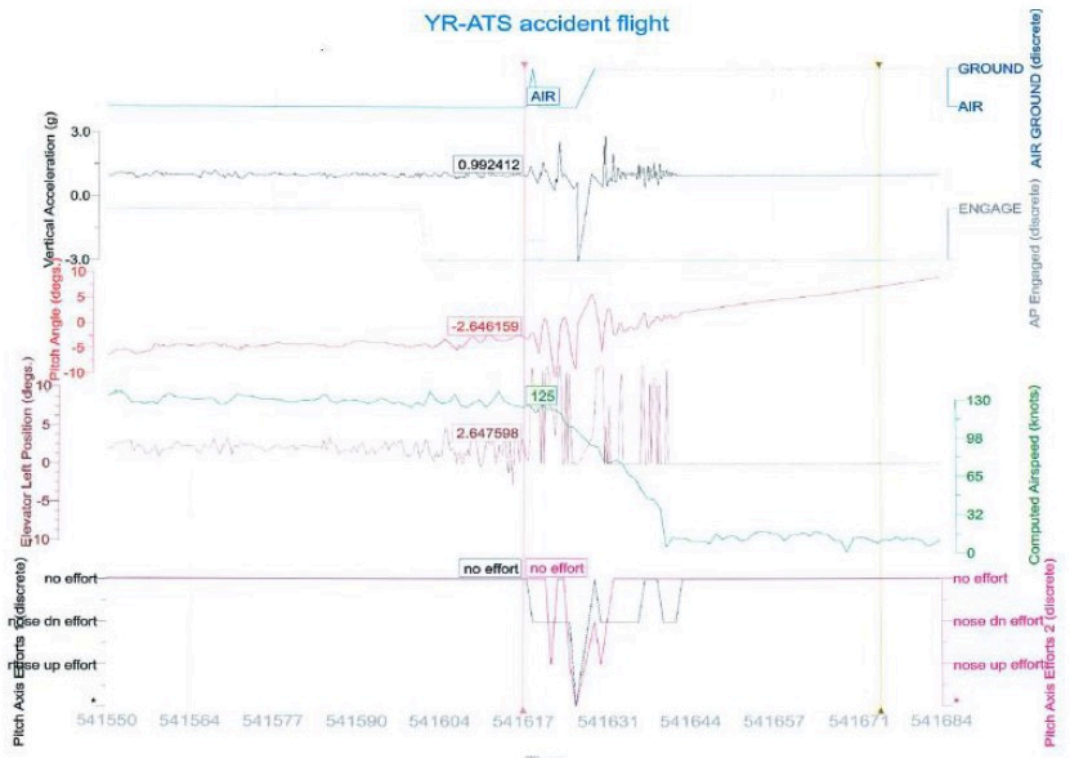


Figure 11: FDR parameters at the first contact with the runway.

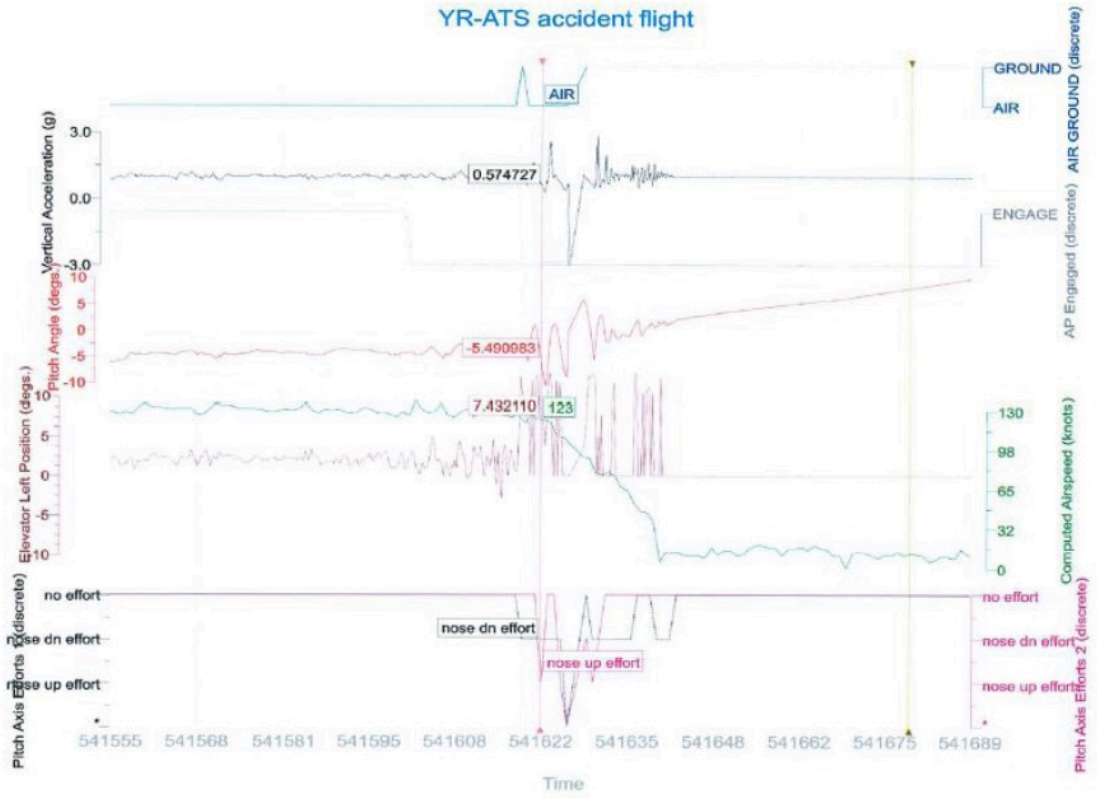


Figure 12: FDR parameters after the first contact with the runway.

The observation of all the other parameters recorded by the FDR showed neither peculiarities nor anomalies.

1.11.4. Transcription of the CVR

The analysis of the CVR was carried out by listening to the last 30 minutes of the flight, focusing mainly on the conversations between the captain and the first officer.

In this regard, the aspects of greatest interest were the following:

- At 19:07'27", at an altitude of about 13,000 feet, the captain asked to begin the checklist related to the part of the “DESCENT”; the first officer then, would successfully perform the checks. With the phrase “landing briefing” the Captain confirmed that it had been done, though, from the communications recorded by the CVR, nothing confirmed this.
- Throughout the duration of the flight, and in particular while being under 10,000 feet as well as during the approach, the remaining communications between the crew members resulted done in compliant with the OM of the Company.
- At 19:29'04" the TWR of Rome Fiumicino communicated a wind coming from 260 degrees, with an intensity of 24 knots and gusts up to 37 knots.
- At 19:29'44" the PF (Captain) extended the flaps at 30°.
- At 19:29'52" the captain announced that he wanted to keep the speed up to 130 KIAS, receiving a confirmation by the first officer; the Captain asked again if the value of the speed was fine and first officer confirmed again.
- At 19:30'38", after passing 1,000 feet AGL, the Captain announced that he wanted to continue with a speed of 130 KIAS for the final approach and the first officer confirmed.
- At 19:30'50" the TWR of Rome Fiumicino cleared the landing of the aircraft marked as YR-ATS in the runway 16L while communicating the direction of wind (250 degrees) and the relative intensity (22 knots with gusts up to 37 nodes).
- At 19:31'26" the Captain also asked the first officer to get her hands on the controls in order to "follow him" for the touchdown.
- At 19:32'10" the Captain exclaimed («hop, hop, hop») immediately after the aircraft touched the runway; then the noises of the impacts with the runway as well as the CRC aural warning can be heard.
- At 19:32'25" the TWR of Rome Fiumicino contacted the aircraft operating the flight AZ1670 to know if there had been any problem without getting a response.

- At 19:33'19" the Captain ordered, several times, the evacuation of the aircraft via the onboard intercom system, which, unable to transmit, communications with both inside the aircraft and the TWR were not successful.

As follows, the voices of the flight attendants in the background leading the evacuation can be heard.

1.12. INFORMATION ABOUT THE WRECK AND THE PLACE OF IMPACT

This section reports information acquired from the examination of the wreck and the accident's location.

1.12.1. Location of the Accident

Runway 16L of the airport of Fiumicino, Rome: the aircraft, after landing, start sliding sideways only to stop at a distance of about 1,800 meters from the runway threshold, on the grassy strip located on the right side of the runway , close to the "DE" intersection.

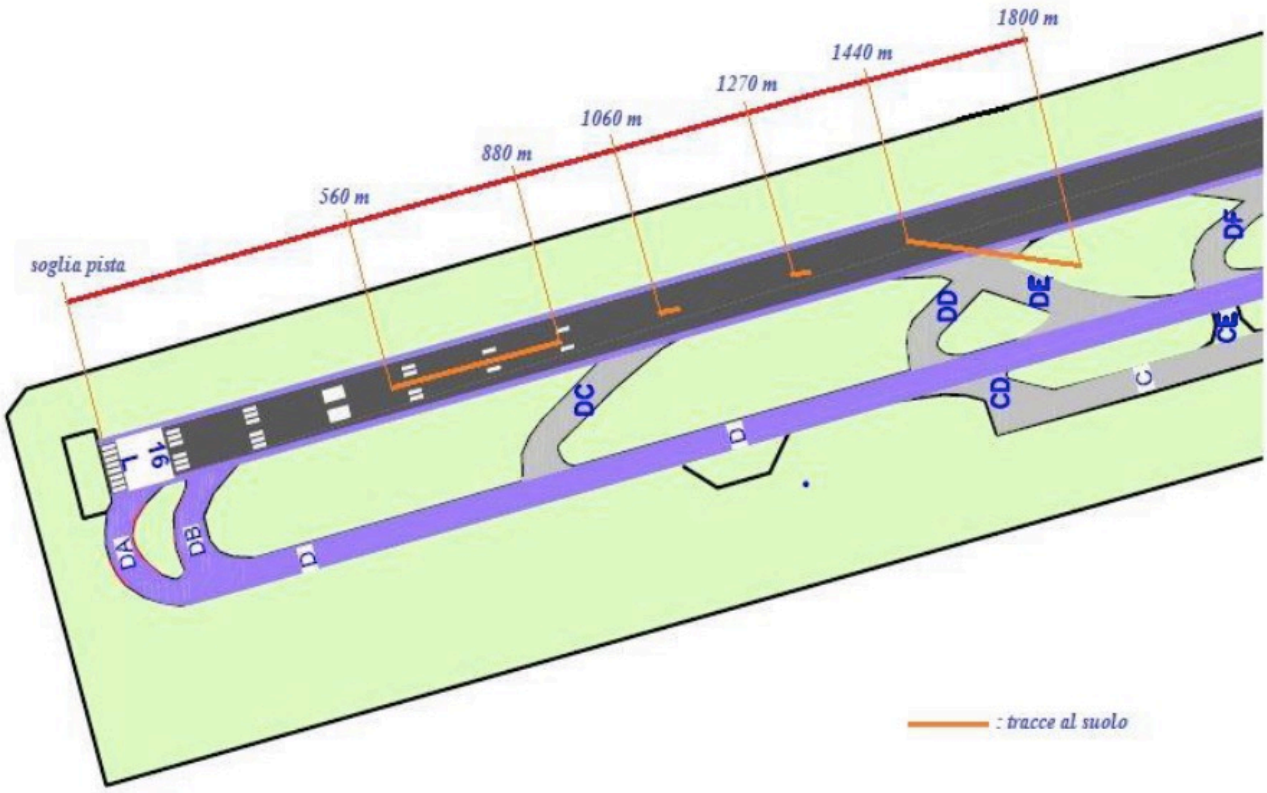
1.12.2. Ground traces and distribution of the debris

Ground traces on the runway left by the contact of the tires and the underside of the aircraft structure were detected.

The first marks of the contact of tires were detected at a distance of about 560 m from the runway threshold, followed by other obvious signs of heavy contact of the nose gear and its doors after a distance of 320 m.

The next signs of contact have been found at, approximately, 180 m, 210 m and 170 m; at this point the evidence on the ground showed the ground traces of the fuselage until its exit from the runway for about 400 m. There was not any kind of dispersion of the wrecks.

Figure 13: Contacts tracks and their respective coordinates on the runway



Picture 5: Ground tracks on the runway left by the front gear.

Picture 5 : Trails on the runway left by the nose gear

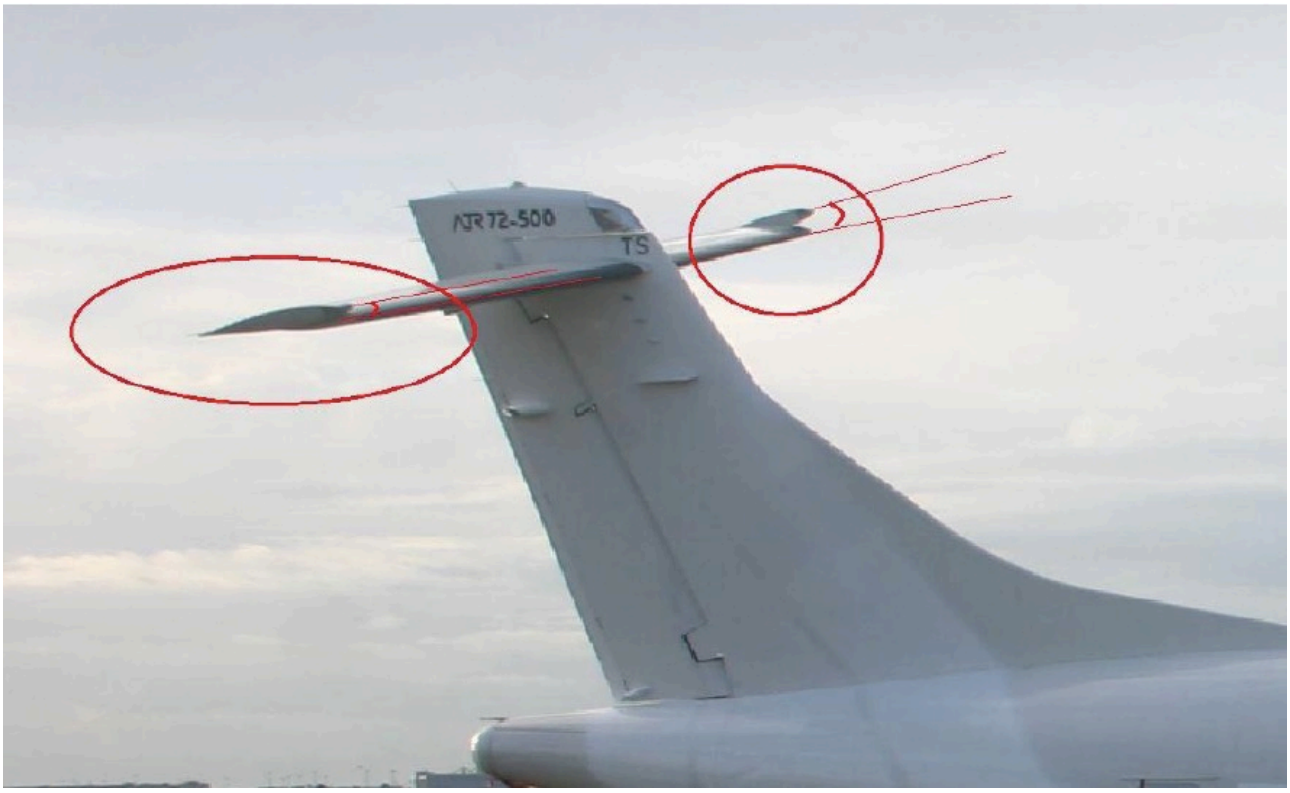
Picture 6: Damage to the aircraft

1.12.3. Examination of the wreck

The aircraft wreckage appeared significantly damaged.

The fuselage appeared lying on the ground with the front landing gear retracted while the main one was retracted partially and greatly damaged. The fuselage appeared, however, substantially intact and accessible.

The tail and the wing panels with the relative movable surfaces were substantially intact, except from the tip of the right wing which had touched the ground and as a result was damaged. In particular, the stabilizers appeared not “coordinated”, or with different angles when confronted with the fixed-base parts (*picture 7*).



Picture 7: Empennage (tail assembly)

Flaps were extended at 30° as it had already been verified from the FDR and the CVR.

The cockpit appeared in a good condition and accessible; in the anemometers on the instrument panel (captain and co-pilot’s side) the *speed* bug of the VAPP was set to 130 KIAS.

***Picture 8**: speed bug* of the VAPP (captain's side)

***Picture 9**: speed bug* of the VAPP (co-pilot's side)

The two twin-engine turboprop's (power plants) appeared intact, with the exception of the right side propeller engine, which had suffered damage at the top of the blades from the contact with the ground.The front emergency exits were open, with missing doors; the rear passengers' exit at the right side appeared open and that one of the left side, open with the scale extracted.

The morning of the 3rd of February, the ANSV staff, returned to the crash site for further operational inspection, acknowledged that, after the first inspection, the livery of the Italian carrier for which the flight had been operating, had been removed from the aircraft leaving out only the identification marks and the flag of nationality.

Picture 10: The wreckage of the aircraft the day after the accident with removed liveries.

1.12.4. Impact's dynamic

From the ground traces and by additional evidence acquired it is shown that the aircraft touched the runway 16L in the vicinity of the center line, at a distance of about 560 m from the runway threshold. After the first contact with the runway, the aircraft made 3 more of them, during which the nose landing gear and later, the right main landing gear, collapsed. After the last contact with the runway, the aircraft has its fuselage on the ground, crawling for 400 m before stopping while performing a rotation of about 170° around its vertical axis, stopping with the nose oriented to 330° of the magnetic field.

1.12.5. Failures associated with the event

During the second touchdown with the runway, the engines flamed out, as shown from the data extracted from the FDR that indicated a sudden decrease of the propeller revs (NP) and of the exhaust gas temperature (ITT). Within examinations and along with the presence of the aircraft manufacturer, it had been detected that the shutdown was caused by a damaged mechanical linkage of the engine control levers (in particular the ones of the CLA) which were damaged from the collapsing of the front landing gear. As a result, this circumstance made the above-mentioned levers useless, with the consequent engines shut down.

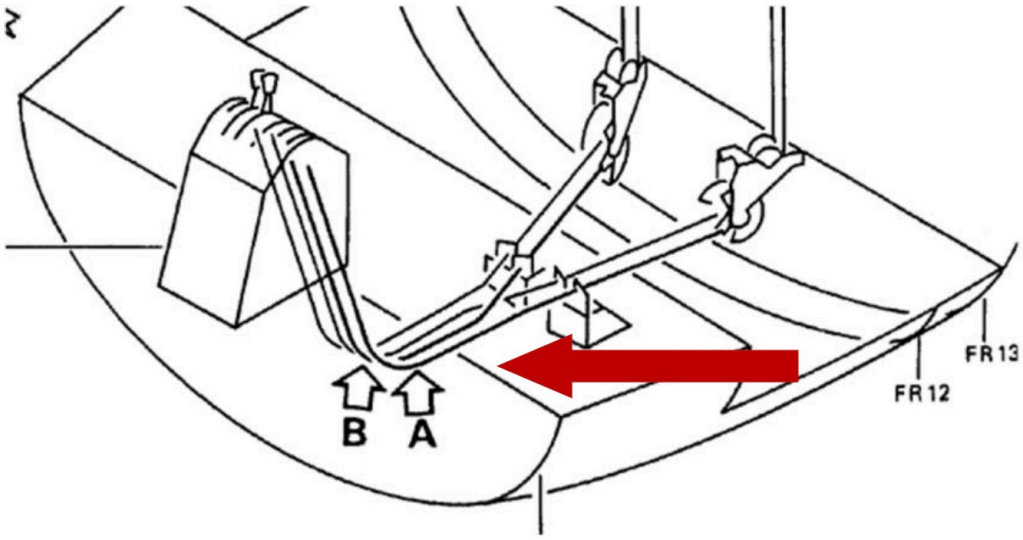


Figure 14: Diagram of the engine control levers and the indication of the breaking point.

1.13. Medical and pathological information

During the investigation did not reveal any elements that might cast doubt on the good psycho-physical condition of the crew members. All crew members were subjected to toxicological screening by examination of the urine, with negative results.

1.14. FIRE

Not applicable

1.15. SURVIVAL

1.15.1. Evacuation of the aircraft

The evacuation process of the aircraft was “reprocessed” thanks to the testimonies of some of the crew members and the passengers on board.

The emergency lights in the cabin worked and the flight attendants, having realized what happened, gave with appropriate timing, instructions to the passengers on how to take the safe position and how to complete the evacuation of the aircraft; in particular, as soon as the aircraft stopped, the flight attendants not having received the evacuation order by the Captain due to the failure of the Intercom system, independently began the evacuation procedure (as expected by the Cabin Crew Operating Manual) of the passengers, assisted by the other flight attendants traveling as CMG.

Passengers were then evacuated from the wreckage, but remained near to it waiting for emergency vehicles to come. The emergency vehicles arrived at the scene after about 10 minutes from the activation, by the TWR, of the signal alarm. Rescuers at the scene helped the occupants of the aircraft by taking care of the transfer of some of them into external medical facilities; all the people examined were subsequently discharged without any kind of complications from a medical point of view.

Picture 11: Cabin conditions detected during the operation inspection

1.15.2. Search and rescue operations

From the examination of the ground radar and the ground-air-ground communications can be noticed that at 19:32'33" the flight AZ1670, after landing, made a detour to the right, stopping close to the intersection called “DE”.

Following this situation, the operator of the TWR, at 19:32'35", made the following radio call: “Alitalia 1670, any problem?” Repeating it twice in a row.

Figure 15: Image of the ground radar screen with some significant timestamps regarding the event.

At 19:32'50" the TWR, while not getting any response from the aircraft YR-ATS and while still being able to see it on the ground radar screen (*Figure 15*) in the same position, he instructed the other aircrafts that were approaching to conduct a missed approach procedure as the position of the YR-ATS made further landings on the 16L runway dangerous.

At 19:33'22", after making two more radio calls without getting any response from the YR-ATS, the TWR activated the emergency alarm.

At 19:34'37" the TWR established the first radio contact with the Fire Service (VVF) on frequency *440.450 MHz*, asking if they had “copied the emergency (received)”. During this contact the VVF acknowledged the emergency communication regarding the runway 16L. The TWR, after stating that from the ground radar seemed that the aircraft had gone off the runway, told the VVF to go and verify the situation. From the request of the VVF, the TWR stated that the aircraft was an ATR 75, with whom they had lost radio contact.

At 19:35'22" on the ground radar screen was revealed the presence of the three outgoing fire trucks at the intersection “C” from station 1, located abeam the intersection, almost opposite the aircraft position (*figure 16*). After leaving their location, the three vehicles of the VVF turned onto the intersection “CD” next to the intersection “D” near the one named “DD”, while heading north.

Figure 16: In red the path followed by the VVF.

At 19:35'59", when the VVF's trucks were already at the height of the intersection "DD", the VVF asked the TWR for some information regarding the exact location of the aircraft. The TWR replied shortly after "Delta Echo". The VVF acknowledged the message, repeating "Roger that, Delta Echo."

After this communication, and after surpassing extensively, by going north, the intersection "DD", the three vehicles of the VVF made a 180 degrees turn and followed the intersection "D" by going southerly towards the threshold of runway 34R.

At 19:37'26", continuing going South, the three trucks re-crossed, in the opposite direction, the intersection " DD", surpassing even the turn called "DE" only to keep being headed to the intersections "DF" and "DG."

At 19:37'4", while the three above mentioned trucks were covering the intersection "D" between "DF" and "DG", the TWR re-established contact with the VVF, wondering whether they were keep going on "DE" or not. To the TWR, the main VVF replied· which, shortly after, called Red 24 (the team with the trucks) to contact the TWR.

At 19:38'30" the TWR authorized the VVF to enter the runway, receiving confirmation from them.

At 19:38'50" the three trucks turned onto the intersection “DH”, but immediately went back on track. At this point on the ground radar screen, traces of the two SAR vehicles of the airport operator (ADR) could be seen, which while being on the intersection “D”, surpassed the “DL”, continuing heading north .

At 19:39'17" the ADR’s vehicles crossed the fire trucks that were coming out from the intersection “DH” on which they had temporarily entered.

At 19:39'27" the TWR, noting that the VVF trucks continued heading south, called them, repeating them to go to the intersection “DE”. Seconds later, at *19:39'37",* the TWR asked the fire station (VVF) the reason why they were at the intersection “D” when actually the TWR had told them to go to the “DE”. At this point the VVF answered that they already went on the “DE”, but had not found anything.

At 19:39'50" the VVF trucks turned onto “DK”, into the right side of runway 34R.

At 19:41'00 "the two ADR’s vehicles, after passing “D”, they headed to “DG”; at 19:41'29" the vehicles were driving by the left side of runway 34R, and thus, were traveling in parallel, with the three VVF trucks that were going along on the same track, but on the right side.

At 19:41'45" the ADR vehicles stopped near the aircraft, while the VVF trucks continued heading North, always keeping the right side of the runway 34R.

At 19:41'56" the TWR communicated to the VVF that: “The SAR vehicles have already identified the aircraft, so where are you going on that track ? I told you to go to the Delta Echo, Delta Echo!”

At 19:42'25" the VVF trucks, who in the meantime had made a U-turn on the runway, informed the TWR that they found a wreck of the airplane, that the “DE” was “all clean” and that they still could not see the plane, pointing out, that it was strange that there were no lights.

At 19:43'02" Red 24 (team) informed the TWR that they found the aircraft, repeating the information at 19:43'22" However, they noted that the plane was completely in dark adding that there was a half-open door.

1.17. ORGANIZATIONAL AND MANAGEMENT INFORMATION

1.17.1. Aircraft operator's YR-ATS

The flight AZ1670 was operated, on behalf of the Italian carrier Alitalia, by the Romanian airline Carpatair, on wet lease base, with aircrafts type ATR 72 for short and medium flights.

Carpatair, as EU operator, was in possession of the following certifications according to the European regulations EU-OPS1, Part M and Part 145: AOC, CAMO and AMO. There were no abnormalities in the manuals used.

1.18. ADDITIONAL INFORMATION

1.18.1. Testimonials

The following lines describe some testimonies useful for the investigations of the ANSV.

Captain

From the testimony deposited by the Captain to the ANSV it is shown that during the landing, he was operating as a PF. He stated that: he maintained a VAPP of 130 KIAS; he correctly followed the ILS procedure and correctly applied the techniques required for a landing with crosswinds. He also stated that, at about 10 feet according to the altimeter, while already on the runway, the aircraft suddenly "collapsed" due to a decrease in the wind gusts or due to a windshear; he continued by describing the contacts with the runway so violent that he slammed his face on the control column (yoke) and found himself without the control of the engines, remaining only with the batteries and the emergency brakes.

He also added that, immediately after the aircraft crashed, he tried to contact the flight attendants to order the evacuation, but realized that the intercom system for both communication within the aircraft's cabin and the TWR was damaged. Once gained access to the passengers' cabin, he noted that they had already been evacuated with the help of the flight attendants; he stated that the door between the luggage compartment (located behind the cockpit) and the passengers' cabin appeared blocked and that the door had been opened from the side of the passengers' cabin. He then got off the aircraft, and then re-enter it again in order to switch off the Battery.

First Officer

The first officer stated that the approach took place in accordance with the normal procedures. She then described that the contacts with the ground (runway) were violent and confirmed that she was not able to use the intercom communication system, or contact the TWR; then she reported to have been instructed by the Captain to go to verbally order the evacuation of the aircraft to the flight attendants. She then claimed that after she re-entered the cockpit in order to give assistance to the Captain, he told her to go back into the passengers' cabin in order to support the flight attendants. After leaving the aircraft, she felt some physical pain.

Chief Cabin attendant

From the testimony deposited by the chief cabin attendant, it is shown that the evacuation procedures of the passengers' cabin had been carried out as expected by the Company Manual. She then confirmed the violence of the contacts with the ground and the inefficiency of the interphone system (having tried to give instructions to passengers through it, without any luck). She then stated that she shouted to the passengers to assume the brace position for an emergency landing. As soon as the aircraft stopped, after checking the conditions outside, she opened the rear exit of the aircraft, and started the evacuation. While she went back to the front of the aircraft, she tried to open the door that separates the luggage compartment from the passenger cabin, which appeared to be locked, with the help of a CMG in order to set the Captain free.

She stated that the emergency lights were operational.

Flight attendant

From the testimony deposited from the other flight attendant it is shown that the evacuation procedures of the passengers' cabin had been carried out as required by the Company Manual. She said that she did not hear the expected landing communications by the Captain. After the aircraft stopped, she could see the emergency exits thanks to the functioning emergency lights.

CMG Crew

The testimonies deposited to the ANSV from the CMG Crew consolidate the reconstruction of the event from the time of the first contact with the ground until the evacuation; The CMG crew assisted the flight attendants during the evacuation procedure and contributed actively to the first operations in order to rescue the passengers.

From the evidence acquired emerged the feeling of not having received the adequate assistance from the intervening rescue vehicles.

1.18.2. Operator's manuals

The manuals of interest include the AFM, the FCOM and the company's OM: from these manuals derives the technical and practical mode of utilization of the aircraft itself, to be adapted to the operating scenario that is (considering the weather conditions, the aircraft configurations, the airports on which it operates, etc.) being dealt with.

Regarding the YR-ATS aircraft, its OM, apart from indicating the wind limitations (see paragraph 1.6.3. of this report), it provides checklists for the flight crew that are approved by the company.

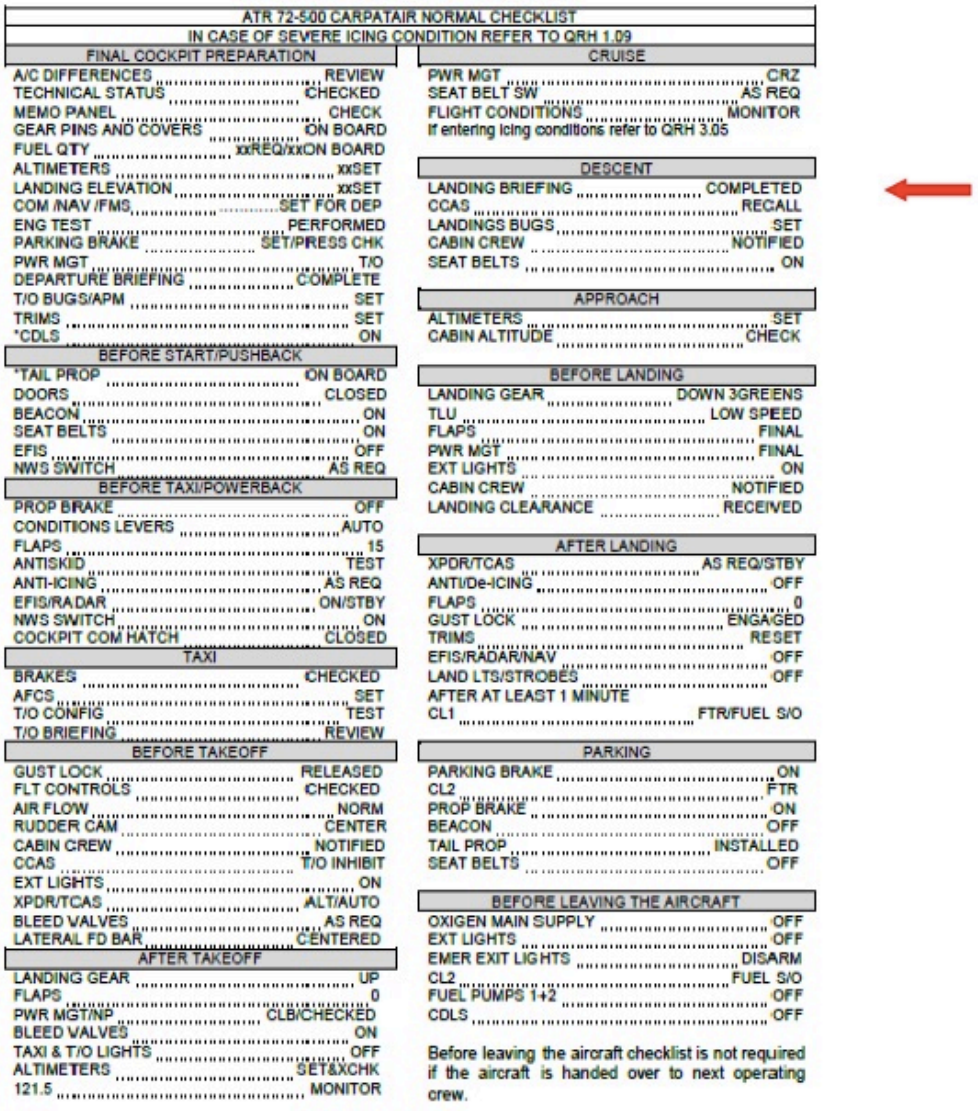
According to the aircraft's checklist, in the section of the descent phase ("*Descent*"), the first item is the "*landing briefing*" (*Figure 17*). This item, as also mentioned in the OM, paragraph 2.7.1., explains that the description of the whole procedure of approach and landing must be done, that the weather conditions of the destination should be taken into account and that the parameters to maintain should also be taken into account (by also taking into account the weather conditions), and in case of a missed approach procedure, this should not be left aside.

As for the calculation of the VAPP, the OM (along with the FCOM) suggests to use the speed times the applicable weight (during landing) plus the correction for the wind; this correction is equal to the highest of one third of the headwind velocity and the value of the reported burst (gust), with a maximum of 15 knots correction.

Specifically, considered a landing weight estimated around 19,045 kg (refer in this respect to paragraph 1.6.3.), the value of VAPP, with no wind, would have been 103 KIAS. That said, given that the wind front component was absent, while the fully crosswind had a value of 24 knots with gusts up to 37 knots, the maximum applicable VAPP, with the correction of the wind factor (which provides for a maximum correction of 15 knots), should

not in any case exceed the 118 KIAS, which is a lower value of 10% compared to the 130 KIAS maintained by the PF until landing.

Always referring to the OM, relatively to the final approach of the runway for landing, it suggests having a 3 degree descent up to 20 feet above the runway and then to perform the flare maneuver with a *pitch* angle of about 2-3 degrees. As for the possibility of a significant rebound as a result of the contact with the ground (*balked landing*), the OM reports that it should be taken into account the possibility of the execution of a go-around procedure.



ATR 72-500 CARPATAIR NORMAL CHECKLIST

IN CASE OF SEVERE ICING CONDITION REFER TO QRH 1.09

FINAL COCKPIT PREPARATION

A/C DIFFERENCES	REVIEW
TECHNICAL STATUS	CHECKED
MEMO PANEL	CHECK
GEAR PINS AND COVERS	ON BOARD
FUEL QTY	xxREQ/xxON BOARD
ALTIMETERS	xxSET
LANDING ELEVATION	xxSET
COM /NAV /FMS	SET FOR DEP
ENG TEST	PERFORMED
PARKING BRAKE	SET/PRESS CHK
PWR MGT	T/O
DEPARTURE BRIEFING	COMPLETE
T/O BUGS/APM	SET
TRIMS	SET
*CDLS	ON

BEFORE START/PUSHBACK

*TAIL PROP	ON BOARD
DOORS	CLOSED
BEACON	ON
SEAT BELTS	ON
EFIS	OFF
NWS SWITCH	AS REQ

BEFORE TAXI/POWERBACK

PROP BRAKE	OFF
CONDITIONS LEVERS	AUTO
FLAPS	15
ANTISKID	TEST
ANTI-ICING	AS REQ
EFIS/RADAR	ON/STBY
NWS SWITCH	ON
COCKPIT COM HATCH	CLOSED

TAXI

BRAKES	CHECKED
AFCS	SET
T/O CONFIG	TEST
T/O BRIEFING	REVIEW

BEFORE TAKEOFF

GUST LOCK	RELEASED
FLT CONTROLS	CHECKED
AIR FLOW	NORM
RUDDER CAM	CENTER
CABIN CREW	NOTIFIED
CCAS	T/O INHIBIT
EXT LIGHTS	ON
XPDR/TCAS	ALT/AUTO
BLEED VALVES	AS REQ
LATERAL FD BAR	CENTERED

AFTER TAKEOFF

LANDING GEAR	UP
FLAPS	0
PWR MGT/NP	CLB/CHECKED
BLEED VALVES	ON
TAXI & T/O LIGHTS	OFF
ALTIMETERS	SET&XCHK
121.5	MONITOR

CRUISE

PWR MGT	CRZ
SEAT BELT SW	AS REQ
FLIGHT CONDITIONS	MONITOR

If entering icing conditions refer to QRH 3.05

DESCENT

LANDING BRIEFING	COMPLETED
CCAS	RECALL
LANDINGS BUGS	SET
CABIN CREW	NOTIFIED
SEAT BELTS	ON

APPROACH

ALTIMETERS	SET
CABIN ALTITUDE	CHECK

BEFORE LANDING

LANDING GEAR	DOWN 3GREENS
TLU	LOW SPEED
FLAPS	FINAL
PWR MGT	FINAL
EXT LIGHTS	ON
CABIN CREW	NOTIFIED
LANDING CLEARANCE	RECEIVED

AFTER LANDING

XPDR/TCAS	AS REQ/STBY
ANTI/De-ICING	OFF
FLAPS	0
GUST LOCK	ENGAGED
TRIMS	RESET
EFIS/RADAR/NAV	OFF
LAND LTS/STROBES	OFF

AFTER AT LEAST 1 MINUTE

CL1	FTR/FUEL S/O

PARKING

PARKING BRAKE	ON
CL2	FTR
PROP BRAKE	ON
BEACON	OFF
TAIL PROP	INSTALLED
SEAT BELTS	OFF

BEFORE LEAVING THE AIRCRAFT

OXIGEN MAIN SUPPLY	OFF
EXT LIGHTS	OFF
EMER EXIT LIGHTS	DISARM
CL2	FUEL S/O
FUEL PUMPS 1+2	OFF
CDLS	OFF

Before leaving the aircraft checklist is not required if the aircraft is handed over to next operating crew.

Figure 17: normal *checklist* used by the operator of the YR-ATS.

1.18.3. Regulations on rescue and firefighting

The Civil Aviation Authority Regulations (ENAC) for the construction and the management of airports, in chapter 9, section 5.5 ss. (Response times), provides as follows :

"**5.5.1** The main objective of the rescue and firefighting service is to ensure a two-minute response time, or in any event, no more than three minutes in every part of the runway, and no more than three minutes elsewhere in the field of movement, while in optimum visibility and surface conditions.

5.5.2 To meet this operational objective as much as possible in visibility conditions that are not optimal, it is necessary for the rescue and firefighting vehicles to have a grid map of the airport and of the surrounding areas and, where requested, of the orographic and environmental conditions, and of adequate technological guidance systems.

5.5.3 Response time is defined the time interval between the forwarded call to the rescue and firefighting service and the time taken by the first vehicle to reach a suitable position for the applied to a rate of at least 50% of the discharge rate as per airport category."

Everything provided by the ENAC is according with everything mentioned in the Annex 14 (*Aerodromes*) at the Convention on International Civil Aviation, vol. 1, which, in relation to the Response Time, states:

"**9.2.23** The operational objective of the rescue and firefighting service should be to achieve a response time not exceeding three minutes to any point of each operational runway, in optimum visibility and surface conditions.

2.9.24 Recommendation. - The operational objective of the rescue and fire fighting service Should be to Achieve a response time not exceeding two minutes to any point of each operational runway, in optimum visibility and surface conditions.

9.2.25 Recommendation. - The operational objective of the rescue and fire fighting service Should be to Achieve a response time not exceeding three minutes to any other part of the movement area in optimum visibility and surface conditions.

Note 1. [*omissis*].

Note 2. - Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination, e.g. water, ice or snow."

1.18.4. The "Manuale Rosso" of Rome Fiumicino's airport

In the Emergency Guide "*Manuale rosso*" (Rules and procedures in case of emergency or airplane crash) of Rome Fiumicino's airport, approved by the ENAC, in forces as to the event date, in the chapter 4 "Event within the airport boundaries," it is specified the following content.

In paragraph 4.1.2 "Information to be provided " is explained that the TWR, during the activation of the emergency services, should provide a set of data, in particular: "1st – origin of the event occurred; 2nd - name and the aircraft type; 3rd- Estimated and landing runway (if such case) as an alternative to the position on the ground (runway, taxiway, Grid Map parking); 4th- any other relevant information.". It is also stated that the TWR "must give precise instructions to the VVF for a more rapid action in the maneuver areas while giving authorizations for the crossings of the runways. If deemed appropriate, in order to facilitate the identification of the point of intervention, the Gridmap (attached to this manual) will be used."

In paragraph 4.3.2 "First Aid Operations" it is stated that "In case of a 'Yellow' level (emergency)', it will be notified the aircraft type, the number of its occupants and the place where the intervention is expected. The fire service, therefore, assisted by the Air Traffic Control Tower, will send the means at the determined place (possibly using the GRID MAP attached to this Manual. [*omissis*] In case of a 'Red' level (accident), in order for the intervention to be more effective, the latter, must be made in different ways depending on the place where the accident occurred. In this purpose, the following circumstances are defined: **a)** an area covering the one of interest and the areas included in the Airport boundaries; within this area, the accident point will be identified through the information that the Control Tower will transmit to the Head of the Rescue Operations of the Fire Department, via radiotelephone, by also having as a reference the Attachment number 7; [omissis]".

The mentioned attachment n. 7 contains the "GRID-MAP Planimetry of the airport area" which divides the airport area into squares identified by letters and numbers.

In the present case, the position of the aircraft YR-ATS corresponded to the square identifiable as "***102-G3***' (*Figure 18*).

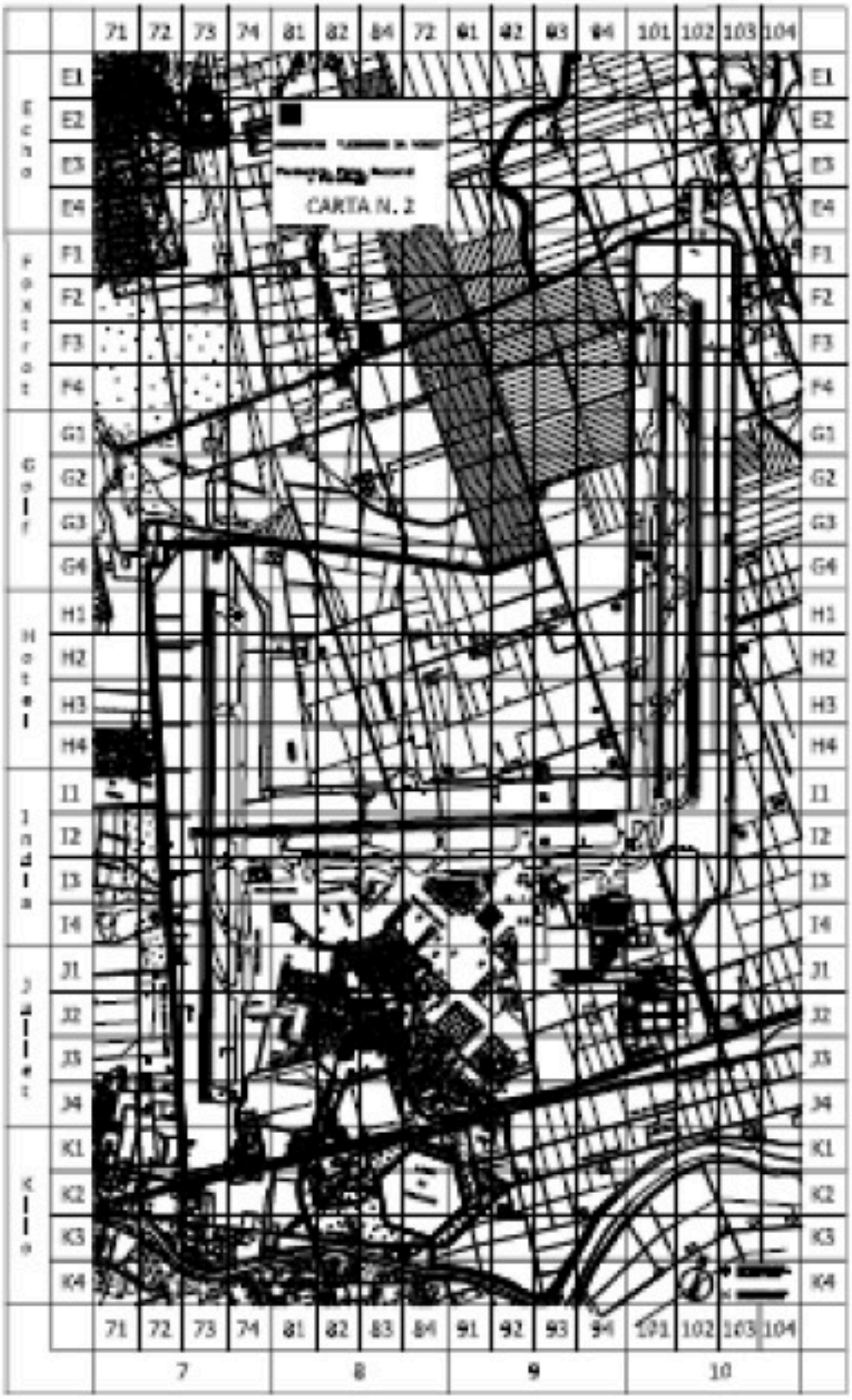


Figure 18: GRID-MAP of Rome Fiumicino's Airport is taken from the "Manuale rosso" at the time of the accident.

CHAPTER II

ANALYSIS

2 GENERAL

Below the objective evidence obtained during the investigation and described in the previous chapter is being analyzed.

The objective of the analysis is to establish a logical link between the evidence obtained and the conclusions made.

2.1. HUMAN FACTOR

The flight and the cabin crew were suitable for operating on the aircraft, being in possession of the prescribed aeronautical ratings and medical certificates.

The flight crew appeared definitely not "homogeneous" from the point of view of experience, because the Captain's experience was far greater compared to the one of the first officer. The First Officer, unlike the Captain, had recently obtained the qualification for the type of aircraft (ATR 42/72) and had a few flight hours with it.

The decision of the captain to make the landing even though during the final phase of the flight had been communicated to the crew that the wind values exceeded the maximum of those reported by OM and the FCOM, is reasonably attributable to the considerable experience of him on the ATR 72, as he was probably convinced that he could still be able to conduct a safe landing regardless the windy conditions. This decision was also influenced by the fact that other aircrafts had managed to land regularly despite of the wind.

With the weather reports made available at the departure airport, the crew of the YR-ATS should have taken note of the possibility to meet a perturbed atmosphere and strong winds that were near the operating limits; considerations that were present in the "landing briefing" which was not

consulted by the Captain. The existence of this particular weather conditions at the destination airport would have to act as a reminder to the Captain to check the parameters during landing.

The weather reports acquired during the flight planning stages and the indication of the potentially critical weather conditions at the destination should have acted as a reminder for the crew to verify, before taking off, to check the eventual existence of any latest weather reports than those they had. At 17:00' UTC was in fact issued a new TAF report.

As it is shown in the following evidence, there is a lack of assertiveness in communication:

- From the non-execution, as mentioned above, of the “landing briefing”, which, besides being a must as described by the company standards, it is a vital factor for the safety of the operations.
- From the communication of the Captain to the first officer of the incorrect value for the approach speed (130 knots), accepted uncritically by the first officer.
- From the fact that both the Captain and the first officer accepted uncritically, without feeling the need to discuss whether to land or not in Rome Fiumicino, the communications received from the TWR, in which they were saying that the wind values for the landing are near the limit/excess of those referenced inside the operating manuals.

It is reasonable to assume that the first officer did not point out to the Captain that the VAPP speed was not the correct speed given the significant gap of experience existing between the two.

2.2. TECHNICAL FACTOR

From the documents examined, including the Maintenance status, the aircraft appeared to be efficient and fully able to be used for the scheduled activity.

The instruments on board were efficient.

There were no technical factors that have contributed to the event.

2.3. ENVIRONMENTAL FACTOR

The weather conditions, the day of the incident, even if they were not precluding flight operations, showed some significant problems, that should not be left unnoticed during the flight planning and during the operational phase.

Evidence acquired (meteorological and FDR data) lead to the conclusion that the presence of a windshear in both the 16L runway and during the final approach was unlikely.

2.4. CONDUCT OF THE FLIGHT

As for the flight planning, the crew, before departing, had acquired the METARs and TAFs of the destination airport or in other terms, the significant weather charts for the navigation (fight). The meteorological situation was complex, with values very close to the operating limitations of the aircraft. And in fact, this complexity should have suggested the crew, as already said, to verify, before takeoff, the existence of more updated weather reports compared to those in possession. (at 17:00' UTC a new TAF report had in fact been issued, which represented the possibility that at the destination airport of wind values at the limit/exceeding those referenced in the OM).

Ground operations at the airport of departure, take-off and the in-flight phase took place without any particular problems, apart from crossing a zone of turbulence while climbing.

During the descent phase, the expected procedures were made, while following the instructions of the air traffic services units and while listening to the ATIS message “Quebec.”

At 19:07'27", at an altitude of about 13,000 feet, the captain asked to begin the checklists related to the “DESCENT” phase; the first officer performed it properly. With the phrase “landing briefing” the Captain confirmed that this one had been done, though, from the communications recorded by the CVR, nothing confirmed such a thing. This very same briefing, in the light of the weather information acquired during the approach phase to the destination airport, could have taken a significant role when talking of decisions that needed to be taken in case of a diverted flight, of the parameters to maintain during the landing (primarily those related to the VAPP), as well as of the piloting techniques that should have been used for landing in presence of a strong crosswind, which also exceeded the limits laid down by the OM (30 knots) and the FCOM (35 demonstrated maximum crosswind knots, which, as mentioned earlier, include according to the information provided by the manufacturer ATR to the ANSV, the eventual value of *gusts*).

During the final approach phase, at 19:29'56", the PF (Captain) communicated to the PNF that he wanted to maintain a speed of 130 KIAS for the final approach; the PNF (First Officer) confirmed that she had accepted and checked, limiting herself probably to the correct positioning of the anemometer speed bug indicator, without expressing any objection related to the specified value. This final approach speed was not in fact compliance with what suggested by the OM (, see paragraph 1.18.2 . for the calculation of the VAPP).

At 19:30'50" the TWR gave the landing clearance on runway 16L, indicating the direction again and the intensity of the wind (250 degrees, intensity 22 knots, gusts up to 37 knots); however, as can be seen from the evidence gathered during the investigation, the TWR, during all the communications with the aircraft, tended to emphasize the value of gusts, as it was a significant value for a safe landing.

The crew, during the last phase of the flight, proceeded up to the “minimum” of the instrumental approach, disconnected the autopilot and the PF (Captain) manually flew the aircraft until the landing; at this stage, the PNF, as previously requested by the PF at 19:31'26", put his hands on the controls to follow the PF.

The aircraft was 10 feet above the runway (as extracted from the FDR data) with an angle pitch set to -3 degrees and an AOA of -2.3 degrees: these negative values are in conflict with those adopted during a normal landing. The FDR indicated that the variation of the pitch from 10 feet up to the touchdown remains set at around -3/-2 degrees; as soon as the aircraft touches the runway, at 19:32', initially with the front gear, the pitch angle is -2.6 degrees and has a high VAPP.

The PF, after the initial contact with the runway and with the aircraft again in air, did not performed a go-around procedure as recommended by the OM in case of a *significant bounce* and pushed his control column (yoke) abruptly “down”; the aircraft then touched a second time the ground violently, bringing damages to the front gear, thus compromising any possibility to perform a safe landing.

At this point, as evidenced by the FDR (in particular from the analysis of the axis pitch effort, or in other terms of the efforts applied on the axis of the pitch control), at the two control columns (PF and PNF’s) were applied opposite inputs: an input to “push down” by the PF, and an input to “pull up” by the PNF. This caused the activation of the PMU (see paragraph 1.11.3), causing the decoupling of the respective aircraft flight controls. The latter, subsequently, reaching the ground with a slight tilt to the left in respect to its longitudinal axis, damaged the left main landing gear, bounced with an inclination of about 10 degrees to the right and damaged, at the same time, the right main landing gear (leaning it towards the outside).

The aircraft at this point to started to misaligning itself from the center line of the runway (about 20 degrees to the right), to tilt 15 degrees to the right to its roll axis while having the 4th contact with the gropund, sliding with the fuselage and stopping just outside the right edge of runway 16L, after completing a rotation of about 170° around its vertical axis, stopping with the nose oriented at 330° magnetic degrees.

2.5. SEARCH AND RESCUE OPERATIONS

From the time of the of the alarm given from the TWR (19:33'22") till the time the vehicles of the VVF reached the aircraft wreck (19:43'02") about 10 minutes have been passed, despite the fact that the position of the aircraft involved in an accident was substantially in front of the station n. 1 of the VVF, at a distance of about 400 meters.

The event happened in night light conditions. The overall visibility, as confirmed by the meteorological data, was not critical.

From the evidences obtained during the course of the inquiry, documented by both the communications between the TWR and the emergency vehicles, and the path of the ground radar, it emerged that the vehicles of the firemen were not able to quickly find the location of the wreck of the YR-ATS. In particular, the Fire Service did not seem to have full knowledge on the intersection's position named "DE".

From the same evidences, it emerged that the TWR communicated to the VVF vehicles, as to facilitate the finding of the location, only the intersection name, "DE", in the vicinity of which, from the above-mentioned ground radar, resulted that the aircraft had stopped. It was not, however, ever made any reference to the GRID-MAP in which, reasonably, the aircraft should have been.

Basically, firemen, despite that fact that their main station was near the involved aircraft, it took them about 10 minutes to reach it, showing no detailed knowledge of the airport and, in particular, of the maneuvering area and the naming of the intersections.

Even the TWR, which thanks to the ground radar had a more defined vision of the situation, was not able to address in an effective and proactive way the emergency vehicles at the accident site. If only the TWR, having realized that the Fire Service had no clear idea of the position of the airplane, had given, with proactive spirit - and not only just the GRID-MAP - useful information to the vehicles of the VVF to quickly reach the "DE" intersection, instead of just repeating that the aircraft was in the vicinity of this intersection, it is reasonable to assume that the accident site would have been achieved by the before mentioned vehicles in less time than the recorded.

Due to the problems encountered during the search and rescue operations, the ANSV has decided to issue, in the course of investigation, two safety recommendations contained in section ***IV*** below.

It should also be pointed out - with reference to the timing of detection of the aircraft wreckage - that a similar criticality had already been highlighted by the ANSV in relation always to the conduct of the search and rescue operations in the incident that occurred at the airport of Palermo Punta Raisi with an A319 aircraft with identification marks EI-EDM on the September 24th 2010.

CHAPTER III

CONCLUSIONS

3 GENERAL

This chapter lists the facts established during the investigation and the causes of the event.

3.1. FACTS

- The crew members were in possession of the necessary aeronautical and qualified titles for the flight concerned.
- During the investigation there was nothing that could reveal the non good psychophysical condition of the crew members.
- The aircraft was properly equipped, with the documents still valid and the maintenance had been carried out in accordance to the local regulations and the approved procedures.
- There was no evidence that suggest that before the event the aircraft had been damaged.
- The radio aids used at the airport of Fiumicino, in particular those necessary for the approach and the Instrument Landing System (ILS) for runway 16L, were properly working.
- The radio communications between the YR-ATS operating the flight AZ1670, and the relevant air traffic control units were held regularly without critical elements.
- The accident occurred in night light conditions during the landing phase at the runway 16L of Rome Fiumicino's airport.
- At 19:30'50" the TWR of Rome Fiumicino, after giving the clearance to land, would again provide the crew of the YR-ATS the direction an the intensity of the wind: 250 degrees, with an intensity of 22 knots, with gusts up to 37. From the evidence obtained it emerged that the TWR, in all of the communications with the other aircrafts landing, tended to highlight the value of the gusts, as it was of a significant value. Upon landing the weather conditions were characterized by the presence of crosswinds and wind gusts that were of a higher value than that allowed for the accident's aircraft .
- The aircraft touched violently the ground with the front gear while "pitching down" in an excessive way and having an approach speed higher compared to the one provided in the OM. In particular, at the moment of the first contact with the ground, the pitch angle was -2.6 degrees with a speed of 125 KIAS and there was no detection of opposite inputs by the two crew members. The above data indicates that the aircraft touched the runway in a controlled flight.

- From the traces found on the runway and by additional evidence acquired it emerged that the aircraft touched the Rome Fiumicino's airport runway at 19:32'03", close to the center line of runway 16L, at a distance of about 560m from the threshold. After the first contact with the runway, the aircraft would attempt the touch down three more times (in order to try to land it), during which the nose gear and later the main landing gear collapsed. After the last contact (4th and last one) with the runway, the aircraft would permanently be supported by the fuselage, crawling for approximately 400m before stopping completely. Throughout the swiping the aircraft's trajectory was leaning to the right, only to stop on the grass, at about 30m from the edge of the runway, near the intersection called "DE". During the course of the sweep, the aircraft was leaning to the right by performing a rotation of about 170° on its vertical axis, stopping with the prow nose oriented at 330° of the magnetic field.
- During the second touchdown with the runway, the engines went out, due to mechanical damage at the linkage of the engine control levers (in particular the ones of the CLA) which were damaged from the collapsing of the front landing gear.
- Following the incident no fire was detected.
- There is no evidence, from the analysis of the CVR, of the execution, by the crew, of the "landing briefing", as suggested by the OM of the company.
- The Captain (PF) decided to maintain an approach speed (130 KIAS) higher than the one suggested in the OM (which was calculated at 118 KIAS [maximum]); the first officer (PNF) behaved assertively and uncritically, accepting twice the quoted speed value communicated by the Captain.
- The Captain (PF) made the aircraft touch the runway with the front landing gear having a pitch angle of -2.6 degrees, value not consistent with neither a technique applicable to a normal landing, nor with the provisions in the OM.
- The Captain and the first officer had both hands on the control columns before and after the first contact; having used simultaneously opposite inputs to the flight controls, the interconnection decoupling between the commands was a direct result of these acts.
- After the first contact with the ground, the procedure called *balked landing* had not been applied as provided in the OM of the company.
- The evacuation took place without major problems, coordinated by the flight attendants assisted by the CMG crew of other company present on board.
- The search and rescue operations were carried out during nighttime in good-visibility conditions.
- Rescuers reached the location of the aircraft 10 minutes after the activation of the state of emergency.

- Communications between the TWR and the Fire Department were not properly effective and no GRID-MAP has been used as suggested in the Safety Guide (Manuale Rosso) of Rome Fiumicino's airport.

3.2. CAUSES

The accident happened due to the human factor. In particular was caused by an improper conduct by the PF (Captain) during landing, not consistent with what is expected from the OM in an environment characterized by the presence of significant problems (presence of crosswind with the values at the limit /excess of those permitted for the ATR 72) and in the absence of an effective CRM.

The event may have been influenced by the following factors.

- The not making of the "landing briefing", which, in addition to being required by the company's standards, would be an important opportunity to put a vital factor for ensuring the safety of the operations.
- Maintaining a VAPP significantly higher than the expected.
- The belief of the Captain (PF), resulting from its significant general and specific experience on the aircraft , that he could still be able to conduct a safe landing despite the presence of critical wind conditions for the type of aircraft.
- The substantial experience gap existing between the captain and the first officer, who reasonably accepted the Captain's decision, making ineffective the CRM techniques.

After the incident, the application of the PEA highlighted critical issues, which did not allow the research and rescue operations to act rapidly.

CHAPTER IV

SAFETY RECOMMENDATIONS

4 RECOMMENDATIONS

From the evidence gathered and the analysis done, the ANSV, during the investigation, issued the following safety recommendations.

Recommendation ANSV-4 / 132-13 / 1 / A / 13

Recipients: ENAC, the national fire service (VVF).

Recommendation: Also in line with what already recommended by the ANSV with the safety recommendation: ANSV-13 / 1836-10 / 5 / A / 12 recommends to the ENAC and the national fire service to adopt, urgently, the initiatives deemed most appropriate under the educational and training profile in order to give the VVF of the Italian airports an effective full knowledge of both the aviation terminology and the airport grounds on which it operates, in order to avoid misunderstandings during the communications related to any aircraft that needs assistance.

Recommendation ANSV-5 / 132-13 / 2 / A / 13

Recipients: ENAC, ENAV SPA.

Recommendation: If the TWR as per the GRID-MAP of interest (provided by both the Civil Aviation Authority Regulations for the construction and management of airports, and the “Red Guide” (Manuale rosso) of Rome Fiumicino’s airport), had used that GRIP-MAP it would have been easier for the VVF to find more quickly the crashed aircraft. Consequently, the ANSV recommended, in general, that the TWR, when giving information about a rescue operation, should also give the correlated references to the GRID-MAP of the respective airport.

To the above safety recommendations had the following feedback

With a note dated on May the 6th of 2013 to the ANSV, the ENAV SPA, in relation to the safety recommendation n. ANSV-5/132-13/2/ A /13, announced that: “the above Safety Recommendation is already engaged in the systematic verification of the Permanent instructions of our airport authorities, so that the requirements on the usage of correlated references to the Grid-Map during rescue operations, is made clear. As a result, there is a need to highlight that the ENAV has the obligation to follow the airport procedures, which in this case arise from the application of the APT-18A. In order to ensure the widest possible application of the recommendations that relate to the

safety of the rescue operations, it is suggested to have a focus point on the subject with the Authority of the sector regulations, in order to refine the procedures with regard to the introduction of the usage of the Grid-Map, even in the presence of other airport references, in order to facilitate the means involved in the rescue operations.."

With the FACTOR model no. 06/2013 of the 23rd of May 2013 (status "closed"), the ENAC, in relation to the safety recommendation n. ANSV-4/132-13/1/A/13, announced the following: "The ENAC has conducted a meeting with the National Fire Service at the end of which it was agreed that the VVF will conduct a review of the contents of its training related to the forces working for Italian airports and will include an adequate training on the procedures related to the Emergency Plan with emphasis on the usage of the correct terminology as well as of the GRID-MAP."

With FACTOR model no. 07/2013 of the 23rd of May 2013 (status "open"), the ENAC, in relation to the safety recommendation n. ANSV-5/132-13/2/A/13, announced the following: "the ENAC, in cooperation with the ATS control authorities and the VVF, will conduct a review of the general requirements for the rescue and fire fighting inside airports and of the usage of aid systems in order to identify the exact location of the crashed aircraft. As a result of this analysis, appropriate changes to the ENAC Regulations for the Construction and the Operation of Airports as well as to the ENAC Circular APT-18A with particular regard to the compulsory use of the Grid Map will be introduced into the Airport Emergency Plans and the airports manual."

With a note dated on June the 24th of 2013 to the ANSV, the Ministry of the Interior-Department of the fire brigade, of the public rescue and of the civil defense, in relation to the safety recommendation n. ANSV-4 / 132-13/1/A/13, announced that "in order to ensure the effective full knowledge of firefighters working at airports, of the aviation terminology, the related training package, usually delivered during the training period, was sent to the ENAV for the correct Function of the Airport Operations - in order to get an initial assessment and an integration. At the same time it was decided to provide local training activities, in consultation with the air traffic manager, whose purpose is to test the emergency communications and to perform identification tests of the abutments points, especially during night shifts, using the *grid map*. Finally it should be noted that a qualified working team is taking action in order to update the main training, the teaching content and the timing of the training and refresher courses aimed at various professionals of the VVF involved in the airport service."

APPENDIX

1. CIAS's comments (Civil Aviation Safety Investigation and Analysis Center).

CIVIL AVIATION SAFETY INVESTIGATION AND ANALYSIS CENTER (CIAS)

To

Air Safety Investigator

Agenzia Nazionale Sicurezza Volo

Dear Sir

We have performed a thoroughly analysis of the report draft regarding the ATR 72 accident that took place at Rome, Fiumicino Airport on 2 Feb 2013 and we don't have any comments.

On the other hand taking in consideration that the main purpose of the report is to increase aviation safety and to prevent further similar accidents, we want to stress out that immediate actions must be required by this report from the ATR manufacturer in order to reduce the operational limitations for allowed maximum wind velocity and gust.

Experienced ATR operators, such as TAROM in Romania for example, have noticed that the aircraft response to strong winds/gust, closed to the maximum allowed by the manufacturer, is very unpredictable. The increase of Vapp described by the manufacturer (considering the wind and gust) will not be enough to avoid a sudden drop of the speed in case of a gust, causing the aircraft to sink abruptly. Experienced pilots (as it is the case with the PIC of the AZ 1670 flight) increased the Vapp with 5-10 kts more than the aircraft manufacturer recommended in case of strong winds/gust in order to avoid the sudden sink of the aircraft as described before. This increase of Vapp leads to a -2/-3 degrees pitch down of the aircraft in order to execute the approach and landing which can cause a nose gear touch down with catastrophic consequences. As mentioned, based on pilot's feedback, TAROM reduced the allowed maximum wind/gust for approach and landing, imposing lower limits than the ATR manufacturer, in order to avoid such events. The limitations imposed by TAROM are for example 30 kts crosswind, comparing with 35 kts for ATR 72 and 45 kts for ATR 42 imposed by the manufacturer, which are 5 kts respectively 15 kts lower than the limitations set by the ATR producer.

It has been noted during operation and training that a pilot with average skills is not able to perform a safe approach and landing at maximum wind/gust as described by the ATR manufacturer. Furthermore, during night operations it is even more difficult to perform the approach and landing at maximum allowed wind velocity/gust as the flare height and aircraft attitude is perceived differently by the pilot.

Phone: +4.021.222.06.35 Fax: +4.0378.107.106
E-mail: info@cias.gov.ro
notificari@cias.gov.ro
40 Bucuresti – Pipera Road, District 1, Bucharest, Romania – 013695 www.cias.gov.ro

Very similar events happened with:

- Aer Arann at Cork, Ireland, on May 12, 2013;
- Lao Airlines Flight 301 at Pakse, Laos, on 16 October 2013;
- Wings AT72 at Sumbawa Besar, on Apr 20th 2015;
- UTAir AT72 at Ulyanovsk, on Apr 20th 2015;
- UTAir Express AT72 at Nizhny Novgorod, on Apr 11th 2015;

where strong winds, even though within ATR limitations, made it impossible for the pilots to perform a safe landing, resulting in incidents or accidents.

To conclude, we considerate that the ATR manufacturer must be made aware that wind/gust limitations must be reduced so that a pilot with average skills can perform a safe approach and landing.

Note:
At Chapter III, point 3.1 Evidences, leading line no 13, we suppose that the approach speed was 130 KIAS and 109 KIAS.

Best regards,

Phone: +4 021 222 05 35, Fax: +4 0378 107 108
E-mail: info@rcas.gov.ro
notificari@rcas.gov.ro
40 Bucuresti – Ploiesti Road, District 1, Bucharest, Romania – 013695 www.rcas.gov.ro