_AIRCRAFT AN 24 YR – AMR

MINISTERIAL INVESTIGATION REPORT

OF THE FLIGHT ACCIDENT OCCURRED ON 13.12.1995

IN POIANE DI SOMMACAMPAGNA (VERONA)

2 SYNOPSIS OF THE ACCIDENT

On 13 .12.1995 the aircraft type A24 registration marks YR –AMR took off from runway 23 of VERONA – VILLAFRANCA airport at 7:54 p.m. L.T., destination TIMISOARA – BUCAREST.

During the take off phase, after having reached the altitude of approximately 100/120 m., the aircraft began to loose altitude until impacting the ground at approximately 1 Km to the right of the runway, abeam the threshold 05.

3 COMMISSION OF INQUIRY – MEMBERS AND APPOINTMENT.

The Minister of Transportation appointed the Commission of Inquiry, telex 44/4319/3508 and 44/4319/3508 dated 14.12.1995.

Due to B. Sc. Francesco ~~Confalonieri~~ Canfarelli's resignation as Commission Chairman, telex 44/1588/3508 (annex n.2), Mr. Giuseppe Li Vigni was appointed Chairman, since he was already part of the Commission as a flight safety expert.

By telex 44/4324/3508 dated 14.12.1995 (annex n.3) the B.Sc. Mr. Alexandru Tanasescu, Chief of Air Operator Survey Division, was appointed as official representative of the Rumanian Civil Aviation Authority.

The Commission is composed of the following members:

CHAIRMAN	Flight Safety Expert GIUSEPPE LI VIGNI (CIVILAVIA FLIGTH SAFETY OFFICE)
MEMBER	Capt. GIOVANNI CORTIS (CIVILAVIA OPERATIVE OFFICE)
MEMBER	B. Sc.. ROBERTA CARLI (VERONA AIRPORT AUTHORITY)
MEMBER	Ms. PAOLA REGIS (CIVILAVIA – FLIGHT SAFETY OFFICE)

MEMBER	Lt. GINO SCHIAROLI (ITALIAN AIR FORCE 3rd WING – VILLAFRANCA)
MEMBER	B.Sc. Mr. FRANCESCO BOSMAN (R.A.I. ROMA)
MEMBER	Capt. ARTURO RADINI (ALITALIA – FLIGHT SAFETY DEPT.)
MEMBER	Capt. MARCELLO RALLI ("HUMAN FACTORS" EXPERT)
MEMBER	B.Sc. Mr. ALEXANDRU TANESCU (RUMANIAN CAA)

The accident was reported by the General Direction of the Italian Civil Aviation to the Minister of Transportation - Aircraft Accidents Department of the Russian Federation. telex 44/4327/3508 dated 18.12.1995 (annex n.4).
Furthermore, it was reported by D.G.A.C. (Directorate General of Civil Aviation) to the Romanian Civil Aviation Authority by telex 44/4317/3508 dated 14.12.1995 (annex n.5).

CHAPTER 1 – INVESTIGATION

1.01. HISTORY OF THE FLIGHT

On 13 .12.1995 the aircraft type AN 24 registration YR – AMR owned by Romavia R.A. Airline, arriving from Bucarest –Timisoara as flight BAT 165, landed at 6:43 p.m. L.T. at Verona – Villafranca Airport.

After passengers disembarked , at 7:05 p.m. L.T., the aircraft was refuelled with 2.500.litres of Jet A1 fuel; refuelling operation ended at approximately 7:10 p.m. L.T.

After cleaning, cabin preparation, passenger boarding and baggage loading the Captain asked the TWR for starting up clearance that was obtained at 7:30 p.m. L.T.

The aircraft moved from ramp at 7:35 p.m. L.T., to reach the CAT. II holding point, according to the instructions received by the tower.

Take off clearance was granted at 7:53 p.m. L.T. Take off took place at 7:54.p.m. L.T.: approximately 50 seconds later the aircraft crashed into an orchard located at approximately 1 Km right of the take off runway abeam the threshold 05.

1. GENERAL INFORMATION

Location	POIANE DI SOMMACAMPAGANA (VERONA)
Date and time	13.12.1995 –7:55 p.m.L.T.
Aircraft	AN 24 YR – AMR
Aircraft Owner	ROMAVIA R.A.
Aircraft Operator	BANAT AIR SERVICE SRL
Type of Flight	INCLUSIVE TOUR PASSENGER SERVICE
Crew	[redacted] + 6 + 1 EXTRACREW
Number of Passengers	41
Phase of Flight	TAKE OFF
Damage	A/C DESTROYED – ALL ON BOARD DEAD
Type of Accident	GROUND IMPACT

1.02 INJURIES

INJURIES	CREW	PASSENGERS
Fatal	8	41
Non-fatal	=	=
Light injuries/no injuries	=	=

1.03 DAMAGE TO THE AIRCRAFT

Destroyed.

1.04 OTHER DAMAGE

Some peach trees were damaged.

1.05 CREW INFORMATION

1.05.1.1. **Captain** - [redacted], born on 16 .10.1957, holding a professional pilot licence n. 1285 issued on 19 .10.1989 and a ATP licence n. 1796/564 issued on 2.6.1993.

1.05.1.2 Medical examination expiry date 13.1.1996 (annex n..6).

1.05.1.3 Type rating : AN 24 V / AN 26 - Captain
Expiry date 19.10.1996

1.05.1.4 Total flight hours : 3645

1.05.1.5	Total hours on the aircraft type	:	2345
	Flight hours during the last six months	:	340
	Flight hours during the last three months	:	195
	Flight hours during the last month	:	81
	Flight hours during the last 24 hours	:	2h.36 (the flight from Timisoara to Verona).

1.05.2.1 **CO-PILOT** : [redacted] born on 17 .07.1943, holding a 1st class professional pilot licence n.352 issued on 18. 07.1975 and an ATP licence n.406 issued on 10. 11.1986.

1.05.2.2 Medical examination – expiry date 29 .11.1996 (annex n..6)

1.05.2.3 Type ratings : AN 24/AN 24V expiry date 21 .11.1996
AN 26 expiry date 11.11.1996
Instructor rating on AN24 / AN24V / AN26 aircraft.

1.05.2.4	Total flight hours	:	7.100
	Total hours on the aircraft type	:	6.500
	Flight hours during the last six months	:	110
	Flight hours during the last three months	:	45
	Flight hours during the last month	:	20
	Flight hours during the last 24 hours	:	2h.36 (the flight from Timisoara to Verona)

1.05.3.1 **Navigator** : [redacted] born on 27.03.1953, holding a navigator licence n.155 issued on 15 .11.1979, expiry date AN24 24 .11.1996

1.05.3.2 Medical examination - expiration date 05.11.1996 (annex n.6)

1.05.3.3	Total flight hours	:	4.320
	Total hours on the aircraft type	:	4126

	Flight hours during the last year	:	215
	Flight hours during the last six months	:	160
	Flight hours during the last three months	:	75h.40
	Flight hours during the last month	:	28h.30

1.05.4.1 **Flight Engineer** : [redacted] born on 12.04.1945, holding a flight engineer licence n.206 issued on 10.07.1974, expiry date AN 24 14.10.1996.

1.05.4.2 Medical examination – expiry date 17.11.1996 (annex n.6)

1.05.4.3	Total flight hours	:	9.800
	Flight hours during the last year	:	350
	Flight hours during the last six months	:	190
	Flight hours during the last three months	:	102
	Flight hours during the last month	:	36

1.05.5.1 **ROMAVIA Flight Attendant**: [redacted] born on 09 .02.1974 holding a cabin attendant certification n.1070 issued on 05.05.1994, expiry date 07.06.1996.

1.05.6.1 **BANAT AIR Flight Attendant:** [redacted] born on 01.02.1975 holding a cabin attendant certification n. 1125 issued on 14.04,1995, expiry. date 29.03 1996

Also on board were [redacted] a trainee flight attendant of BANAT AIR and ILIE VIOREL, a ROMAVIA ground engineer (annex n.7).

1.06 INFORMATION ABOUT THE AIRCRAFT

1.06.1.1 Aircraft manufactured by ANTONOV C.I.S.

1.06.1.2 Type : ANTONOV 24V

1.06.1.3 Serial Number : 03309

1.06.1.4 Place and year of manufacturer: U.R.S.S. 1967

1.06.1.5 Type of operation: Public Passenger Transport

1.06.2.1 Registration Marks : YR – AMR

1.06.2.2 Owner : ROMAVIA R.A.

1.06.2.3 Operator : BANAT AIR SERVICE S.R.L.

1.06.2.4 Home base airport : OTOPENI - BUCHAREST

1.06.3.1 Registration Certificate n. 620 issued on 25.05.1990 (annex n.8)

1.06.4.1 Airworthiness Certificate n.254/1322 issued on 14.11.1995 expiry date 3.03.1996 (annex n.9)

1.06.5.1 Radio Station Certificate n.104 issued on 25.05.1990 (annex n..10)

1.06.5.2 Insurance policy n.10034 issued on 20.09.1995, expiry date 16.12.1995 (annex n.11)

1.06.6.1 Type of engine : AI 24 SERIE 2

1.06.6.2 Serial Number : Left engine n. 4532041
Right engine n.4632067

1.06.6.3 Maximum fuel capacity : 4800 kg
Estimated fuel at take off : 4300 kg

1.06.7.1 Type of Propellers: AV – 72
Left propeller S/N SCI6L845
Right propeller S/N ST3L598

1.06.8.1 Total flight hours on 13.12.1995
Airframe: 8913,53
Left engine: 4681,28
Right engine: 6966,55

1.06.8.2 Hours since last overhaul on 13.12.1995
Airframe: 1063,38
Left engine: 1084,16
Right engine: 1084,16

1.06.9.1 Maximum take off weight : 21000 kg

1.06.9.2 Actual take off weight : 23000 kg approx.

1.06.9.3 Balance at take off : within limits.

The analysis of the aircraft AN 24V marks YR-AMR maintenance records was carried out utilizing documents made available by the Public Prosecutor's Office (copies of the last airframe log book, propeller and engine log book, line inspection records, "journal de bord" from September 1995).

In particular were examined the entries reported in the aircraft log books and in the engines and propellers logs, starting from the last check on the aircraft made by the Rumanian Civil Aviation Authority, as reported on the "Proces – Verbal" n.1795 (annex n.12).

The analysis compared the records in the above mentioned log books with the periodic maintenance operations as requested by the maintenance programme 2nd edition, as well as with the aircraft maintenance expiry dates, referring to 14.12.1995, officially handed over by the Rumanian delegation.

The following elements came to light from the aforementioned analysis:

- at the time of the accident, the maintenance records reported on the log books (that is to say the 300 h/6 months, 900 h/18 months and 1800 h/36 months inspection) proved to be consistent with the situation produced by the Rumanian delegation.
Comparing the above mentioned records with the maintenance programme, it results that the terms for carrying out the checks were not expired.
In particular, the following condition results:

TYPE OF INSPECTION	LAST INSPECTION	EXPECTED INTERVAL BETWEEN INSPECTIONS
300 h.	19.04.95 a/c hours 8734	300 h. +/- 30 h.
6 months	14.11.95	6 months +/- 15 days
900 h.	19.04.95 a/c hours 8734	900 h. +/- 30 days
18 months	12.04.94	18 months +/- 1 month
1800 h.	19.02.93 a/c hours 7884	1800 h. +/- 30 h.
36 months	19.02.93 (aircraft overhaul)	36 months +/- 2 months

-As far as the line inspections were concerned, the records prove the following:

TYPE OF INSPECTION	LAST INSPECTION
Check B	12.12.1995
Check A	Neither the technical log book nor the inspection form have been found. Therefore it was not possible to state whether or not the check was carried out upon landing at Verona-Villafranca Airport.

-As for the TBO intervals and the life limits, the following conditions result:

	LAST OVERHAUL	TBO
Airframe	07.05.92-19.02.93 a/c hours 7884,9200lds	5years/5000lds/5000h
Left engine (*)	21.06.1991	2000 hours/7 years

Right engine (*)	21.06.1991	3000 hours/7 years
Left propeller	29.07.95	2000 hours/6 years
Right propeller	30.11.92	2000 hours/6 years

Therefore the aforementioned intervals prove not to be expired.

(*) data from the "status report" supplied by Romavia.

As for the components, the "status report", produced by Romavia Airline, does not mention any expired components.

1.07 METEOROLOGICAL INFORMATION

Information contained in the following paragraph were delivered by the experts appointed by the Judicial Authority.
It is possible to give an indication of the meteorological conditions prevailing at the day and time of the crash of the aircraft AN 24 registered YR – AMR.

1. the forecast (TAF) issued by the Airport Meteo Office valid from 3:00pm UTC (4.00pm LT) to 12:00pm UTC (1.00am LT) indicated the following parameters:
- variable wind 3 Kts.
- general visibility 3000 m.
- scattered 3-4/8 300 ft, overcast 7000 ft, with forecast general visibility decreasing to 500 m. snow and scattered 3 - 4/8 300 ft and overcast 1000 ft (annex n.13).

2. Metar report at 6:30pm UTC (7:30pm LT), valid at the moment of crash:
- wind 290°/ 2 Kts general visibility 1300 m. (RVR 2000 m. according to the recorded values) snowfall and mist
- overcast 500 ft (OVC 005) temperature 00°C, dew point 00°C QNH 1010hPa (annex n.14).

3. At 2:15pm UTC (3.15pm LT) a snowtam was issued, valid for the following three hours.

4. At 4:00 p.m. UTC (5:00 p.m. L.T.) an icing formation forecast valid for Italian FIR from 4:00 p.m. UTC (5:00 p.m. L.T) 13.12.95 to 01:00 UTC a.m. (02:00 a.m. L.T.) 14.12.95 (annex n.16)

5. Low level significant weather chart with validity from 3:00 p.m. UTC (4:00 p.m. L.T.) to 9:00 p.m. UTC (10:00 p.m. L.T.) (annex n.17)

6. European surface analysis at 6:00 p.m. UTC (7:00 p.m. L.T.) (annex n.18)

7. Significant weather chart FL 100-450 valid from 3:00 p.m. UTC (4:00 p.m. L.T.) to 9:00 p.m. UTC (10:00 p.m. L.T.) (annex n.19)

8. Wind and temperature aloft (FL 050 FL100 FL180 FL240 FL300 FL340 FL390) forecast with validity from 3:00 p.m. UTC (4:00 p.m. L.T.) to 9:00 p.m. UTC (10:00 p.m. L.T.) (annex n.20)

9. Metar summary from 10 a.m. UTC (11:00 a.m. L.T.) to 11:00 p.m. UTC (Midnight L.T.) (annex n.21)

10. Timisoara-Villafranca route including METAR, TAF AND SIGMET(annex n.22)

11. Milano Linate and Udine atmospherical measuring.

12. Nephoscope recording track (for cloud base) (annex .n.24)

13. RVR recording (annex n.25)

14. Diagram of barograph recording (pressure) (annex n.26)

15. Diagram of hygrothermograph recording (temperature and humidity) (annex n.27)

16. Diagram of anemograph recording (wind) (annex n.28)

1.08 RADIO AIDS

The aircraft was equipped with:

2 VHF radio type LANDIS 20
1 HF radio type R-836/US-8K
2 vor-ils type kurs-mp-2
2 ADF ARK - 11
1 radio altimeter type RV-UM

1 meteo radar type RPSN-2 AN
1 transponder type 914 A
1intercommunication TYPE SPU 7 (annex n.10)

1.09 AIR-TO-GROUND COMMUNICATION

From the analysis of the recorded Air to Ground communications between the Control Tower and the aircraft, for what is possible and available from the A.G. experts, there is no evidence of anything out of the ordinary for all of the operations ranging from start up clearance to taxing and take off (annex n.29)
The elapsed time of approximately 24 minutes from start up to take off (7:30 –7:54 p.m. L.T.) is deemed to be normal considering that the air traffic, on the ground for departures and in flight for approaching aircraft was quite intense and, as it is a known fact, at Villafranca Airport, in certain moments and meteorological conditions, take off is carried out in the opposite direction than landing.
Regarding the radio aids, they prove to be operative except for the GAZ LOCATOR that was out of order, as reported on NOTAM n. A 3760/95, valid from 6:07p.m. UTC (7:07 p.m.L.T.) of 13.12.95 to 3:30 p.m. UTC (4:30 p.m. L.T.) of 14.12.95 (EST) (annex n.30).
Communication with the Air Traffic Control Agencies was carried out as usual until the beginning of take off , which occurred at 7:54. p.m. L.T.
From that moment on, no other communication between the aircraft and the Control Agencies (TWR – GARDA APP. – PADOVA CONTROL) was reported.

1.10 INFORMATION ABOUT THE AIRPORT

VERONA-VILLAFRANCA runway alignment is 05/23.
The official distances are:

RWY	TORA	ASDA	TODA	LDA
05	2986	3247	3321	2697
23	2986	3286	3117	2889

The runways normally utilised are :

- 05 for landing, because it is equipped with an instrument landing system (ILS) cat. II.
- 23 for take off

1.11. FLIGHT DATA RECORDER

Type M SRP – 12 – 96. Serial Number J/N 32289 – Flight Data Recorder.
Type K3 – 63. Serial Number J/N 70878 – Maintenance Data Recorder, it was not recovered because not protected with shock resistant covering.
No Voice Recorder was installed on this aircraft.

1.12. EXAMINATION OF THE WRECKAGE

Although the members of the Commission of Inquiry arrived in VERONA the morning after the accident, they could only begin the examination on 15.12.1995, as they had to wait for experts appointed by the Public Prosecutor's Office.
The impact area was in a peach orchard arranged in rows facing North to South.
Signs of the impact could be seen on the trees, but only on the side branches, indicating, at the moment of impact of the right wing against the branches, the aircraft had a high bank.
As a confirmation of the aircraft setting at the moment of impact, there was evidence of splinters of the right wing tip position light at the beginning of the trail and, immediately after, the right aileron was found.
Further evidence of the aforementioned is represented by the condition of the empennage, found beyond the first point of impact.
The right stabilizer was bent 90 degrees so that it rested flat on the ground, the tail fin was parallel to the ground and the left stabilizer was turned upwards.
The examination of the components carried out during the inspection (it was not possible to carry out subsequent in-depth exams because the wreckage was

under sequestration) indicates that the landing gear was retracted and that the flaps were most probably in take off position (15°) (photos n.2 and n.3 refer).

It is not possible to confirm the flap actuator position because no investigation by the expert staff was ordered.

Additional information provided refer to the throttle position which can be seen for each engine from the external indicator.

The indications were 24° for the right engine but there was no pointer for the left engine.

Nevertheless even the information regarding the right engine cannot be considered reliable because the pointer was not protected and it may have moved during impact due to interference of external elements.

The instruments recovered were briefly examined, but it was not possible to get any useful information for the investigation because of the instruments deteriorated state.

However, just for the record, the indications marked on those instruments which were still legible are as follows:

- Radar vacuum indicator: 9mm hg
- Engine vibration indicator: 09
- Cabin altimeter: approximately 250 m.

Regarding the state of deterioration, refer to photographs n. 6,7,8,9,10 and 11.

1.13. MEDICAL AND PATHOLOGICAL INFORMATION.

All of the persons on board the aircraft died at the moment of impact for extended polytrauma (annex n.32)

1.14. FIRE

After the impact, a fire broke out engulfing the entire aircraft, except the aft section.

1.15. SURVIVAL ASPECT

The violent impact against the ground caused the sudden death of all passengers and crew on board. A fire then broke out because of the spillage of fuel from the fuel tanks, that almost completely burned the aircraft wreckage.

Under the present circumstances, the rescuers intervention was useless (both the fire brigade on duty at the military airport and the fire brigade on duty at the civil airport). They arrived at the accident site a few minutes after the impact.

1.16. TECHNICAL INQUIRY

The Commission of experts sent the right powerplant to FIAT – AVIO – TORINO to determine its working condition at the time of the accident.

In fact, some doubts arose regarding both the torque indicator oscillations recorded by the FDR and the position of the propeller blades that showed an apparent feather pitch.

The inspection was carried out following the specific inquiries requested by the staff of experts that aimed to clarify some points that were fundamental:

-The right propeller blade pitch

-The right powerplant r.p.m. setting.

-Possible mechanical failures (existing prior to the accident).

The check was carried out by an investigating staff experienced in engines installed on FIAT aircraft. The experts basically came to the conclusions that at the moment of impact:

-The right propeller was at take off (pitch).

-The right engine was running

-The mechanical system cracks were due to crash (they did not exist before the impact).

On the investigation carried out FIAT AVIO issued a report doc.n.477/96 dated 2/9/1996 that the Ministerial Committee received through the experts staff(annex n.34).

CHAPTER 2 – ANALYSIS

Banat Air Service – S.r.l. based in TIMISOARA (Romania) received the authorization to operate non scheduled passenger service for the 1995-1996 winter season with aircraft type BAC 1/11 in "wet-lease" from the Rumanian Airline Romavia.

The authorization granted only 4 weekly flights (Monday, Wednesday, Friday and Sunday) from 9.10.1995 to 31.03.1996, Bucarest-Timisoara to Verona, flight code BAT 165, and back, flight code BAT 166.

Later, with telex n. 345023/34, Banat Air obtained the authorization to operate in alternative to BAC 1/11, with the aircraft YAK 42 of Lvov Aviation Ukraine. (annex n.36)

According to the "wet lease" contract between Banat Air and Romavia, Romavia undertook to supply Banat Air with the aircraft, the crew and the technical maintenance for the flights.

On 13.12.1995 Banat Air requested and obtained authorization for the flights to Verona to be operated with a Romavia ANTONOV 24 (annex n.38)

These kind of replacements frequently occurred. In fact also for several previous flights, Banat Air had requested and obtained authorization to fly with other types of aircraft from different airlines.

On 13.12.1995 the aircraft type A 24 marks YR – AMR landed in Verona at 6:43 p.m. L.T. with a delay of 43 minutes from the scheduled time (6:00 L.T.) (annex .n. 39).

The follow me car took the aircraft to the parking area B6 (annex n.40); then the handling service started, by the airport handling company staff.

At the beginning during the pre-flight operations, the ramp agent got on board to perform the briefing and at the same time she handed over the meteo – folder to the Captain, containing also a "snowtam" (for the next 3 hours).

The Captain was already informed of the meteorological conditions along the route because he had flown the route a short time before in the opposite direction.

It is therefore possible that the Captain underestimated the importance of the document, only briefly and superficially examining it. Afterwards, the ramp agent asked the crew about a de-icing operation; she received a negative answer.

It is appropriate to underline that take off is not allowed in case of ice, snow or frost on aircraft surfaces, according to Romavia operating procedures.

Immediately after, the arriving flight load sheet was delivered (annex n.41)

This document is clearly incorrect and inconsistent. In fact, as the aircraft take off weight was above the maximum allowed, the Captain declared a taxi fuel of 2.000 kg. It is not possible that such a situation could occur.

Moreover, a limited overweight is not a dangerous condition in itself. In fact, every aircraft certification takes into account the possibility of taking off at maximum weight with a possible engine failure during lift-off, if no other unfavourable conditions exist (for example other failures, wind shear conditions or contamination altering or deteriorating the aircraft aerodynamics).

At 7:05pm L.T. Agip refuelled the aircraft with 2015 kg (lt.2.500) (annex n.42).

In addition to the fuel already in the tank there was a total of approximately 4.500 kg.

Fuel was taken from a tank truck placed in a sheltered zone; it had a temperature of 0° C, equal to the external temperature.

When refuelling was completed, at 7:10 p.m. L.T., baggage loading operation began, according to the instructions given by the Captain to the ramp agent that all baggage had to be loaded in the forward baggage compartment.

During this operation, the Romavia Airline technician gave instructions to the chief ramp agent to load the last ten pieces of baggage in the aft compartment (annex n.43).

The Chief Ramp Agent asked the operation office for confirmation and received authorization to follow the technician's instructions, as the Captain declared he wanted to fill out the load sheet by himself.

For this reason the Banat Air representative gave the Captain all the necessary data (annex n.44) to fill out the document (passenger list, general declaration, cargo manifest and the flight general data) which in any case was never handed over as the Captain expressed the need to minimize the delay and promised to send the load-sheet by fax from the destination airport.

Considering the short time elapsed between the documents delivery and the aircraft off block (approximately 5 minutes), it is reasonable to believe that the load-sheet was never filled out.

During passenger boarding operations, at 7:26 p.m. L.T., the Captain asked the tower for start up clearance which was obtained at 7:30 p.m. .L.T.

However, the Commission was in a position to determine the aircraft weight at take off by referring to the existing data and to those ones contained in the arriving flight load-sheet (annex n.41); specifically:

- 14.500 kg basic operating weight (the aircraft weight including crew fluids and aircraft documents)
- 75 kg 1 extra crew weight (trainee flight attendant)
- 3.600 kg 40 passengers weight x 90 kg each (as stated in the Operative Manual)
- 45 kg the weight of one child
- 546 kg registered baggage weight
- about 4.500 kg fuel weight; including the preceeding flight residual fuel.

Subtracting approximately 200 kg of fuel during the taxing phase (an AN 24 burns 10 kg fuel per minute during taxi), the aircraft weight at the moment of take off should have been approximately 23.000 kg.

As for the aircraft Flight Manual, maximum take off weight is approximately 21.000 kg. Therefore the aircraft was 10% overweight.

At 7:34 p.m. L.T. the aircraft reached CAT.II holding position where it waited for approximately 12 minutes due to incoming air traffic.

The AN24 was preceded at the holding position 23 by an Air France aircraft that, although it had just been de-iced like all the other departing aircraft that evening, decided to go back to the parking area to repeat the de-icing operation due to the long holding time and the intensifying snowfall.

During this holding time there was a discussion on frequency (in Italian) between a Meridiana flight crew and the TWR.

They were talking about the exceeding long holding time that would have obliged all the aircraft to repeat the de-icing procedure (annex n.29). Even though the discussion might not have been understood as it was in Italian, no doubt was left on the opportunity to take off under similar weather conditions without carrying out the expected procedures.

At 7:46pm L.T. the aircraft YR-AMR reached the holding position 23 where it waited for six minutes before obtaining the take off clearance.

In the meantime, the aircraft received instructions for the Standard Instrument Departure (SID) requesting a right turn after take off to heading 239 for 6NM, then a left turn towards Vicenza.

The take off took place at 7:54 p.m. L.T. according to what was recorded by the TWR.

Flight BAT 166 did not answer nor the communication about take off time and the change of frequency made by the tower, nor the following calls on TWR, GARDA APP. and Emergency frequencies (annex n.29).

During take off, the elevator was held into a nose down position until reaching the speed of 137 km/h; it was then moved towards a nose up position reaching 10° nose up at a lift off speed of 175 km/h, after a 600/700 meters short take off run.

This kind of take off technique used by the pilots, although with some differences, is the one recommended by the Antonov 24 Flight Manual. The procedure recommends putting the aircraft in a nose-up attitude of approximately 9°-9°1/2 at 170 km/h (regardless of its take off weight) and then wait for a spontaneous lift-off that should occur at about 180-185 km/h, at a maximum weight of 21.000 kg.

Flaps must be retracted at an altitude of 120 meters and a speed of 230-250 km/h (according to the weight); then a speed of 270-300 km/h must be reached.

Engine power reduction has to be made at a speed of 320-330 km/h.

It is not allowed to start to turn before reaching the height of 200 meters and the speed of 320-330 km/h.

The early rotation is probably due to the anxiety experienced by the pilot because of the weather conditions and the difficulties in maintaining the runway centerline visual references due to heavy snowfall, in spite of the fact that the runway centerline lights were properly functioning.

About 48 seconds after take off, the aircraft crashed, hitting the ground at POIANE DI SOMMACAMPAGNA, 45°23'23" N 10°52'04" E geographic co-ordinates, at about 1 km right of the take off runway, abeam the threshold 05.

After the impact, the aircraft caught fire.

All persons on board died at impact.

On 15.12.1995 the Ministerial Commission of Inquiry reached the accident site to gather the necessary data and locate and recover the flight data recorder that was seized by the Judicial Authority together with the wreckage and the aircraft documents.

Before going on with the analysis, it is important to underline a few points.
The Commission of Inquiry's activity could only take place with the information made available by the Public Prosecutor's Office expert staff. In fact, all the material was seized and held under sequestration.
The expert staff deemed necessary to carry out the following investigations (the results were later given to the Commission):

a) Investigation of right engine and propeller by FIAT-AVIO-TORINO

b) Flight Data Recorder decoding by FUS – BRAUNSCHWEIG (Germany).

The Bs. of Sc., Mr. BOSMAN and Mr. CRINITI, were asked to co-operate with FIAT-AVIO-TORINO.
On the contrary, no members of the Commission were allowed to participate in the decoding operations at BRAUNSCHWEIG.
The decoding results were delivered by the experts at the end of January 1996, followed shortly after by the FUS report (annex n.45)
In the FUS report some doubts arose regarding the validity of reference values indicated by Romanian C.A.A.
Other doubts arose at the Commission first reading of diagrams and charts.
This is the reason why, on different occasions (05.02.1996 – 19.04.1996 – 28.10.1996 and 12.12.1996), the Commission asked the Judicial Authority authorization to once again decode the tape, or to have a copy available. Every time they received a negative reply.
The Commission's doubts were then confirmed by the Romanian C.A.A. (annex n.46), by the "Flight Safety for Air Transportation" State Centre – Moscow and by the Aviation Interstate Committee – Moscow (annex n.48).
The Commission then deemed it was necessary to go to Bucharest and Moscow.
In particular, the main point all these authorities agreed upon is that the FUS used a very old and obsolete decoding system.
More up to date systems would permit a more accurate reading therefore allowing them to analyse all the parameters recorded on the unit.
Consequently, the Commission could exclusively work on the numerical charts and diagrams delivered by the expert staff. Therefore the following analysis is

influenced by the impossibility to obtain a new and more exact decoding. The results obtained are based on a supposed full reliability of the data delivered by the FUS. Considering the moment the aircraft left the ground set at "zerotime", the flight can be reconstructed as following:

- During the first 8 seconds the elevator was initially held in the nose up position and then gradually brought to a neutral position while the speed was increased to 213 Km/h. During this phase, it is possible to notice some small up and down movements of the ailerons. The movements can mean either a normal adjustment of attitude or an early instability developed immediately after take off. performed at too low speed, considering the weight and/or presence of ice on the wing leading edges and on the horizontal stabilizer. The elevator movement was normal and consistent with the development of the flight parameters.
- From 8 to 17secs: in the first two seconds (8 – 10) with the elevator in a slightly nose down position (3°), the speed reached a maximum value of 220 km/h, then decreased to 206 km/h.

The aircraft turned to the right, with an angular velocity of 1°-2° per second (during a well – co-ordinated turn the correct angular velocity is of 3° per second) and at the end of the 17th second it reached a bank angle of 14° corrected by a slight movement of the ailerons to the opposite side.

This kind of maneuver leads us to believe that the Captain was aware of the necessity to level the wings of the aircraft, even if this reaction was not successful.

A right turn after take off, as reported on the Standard Instrument Departure (SID), may have distracted the co-pilot's attention who could only have noticed an initial starting of turn. It is also true that the flight director vertical bar had to "call" a right turn as the heading selector has been found on 239° (departure route provided by the SID that deviates of approximately 11° to the right of the runway alignment).

In these nine seconds, nothing really worrying seemed to have occurred except for the lack of acceleration followed by a deceleration, to which the pilot did not react for approximately 7sec., probably because the event was unexpected and incomprehensible, with the ground still close by and without external visibility.

- From 18 to 19 secs.: during these two seconds the bank angle was 14° to the right with the ailerons in neutral position, the speed decreased to 196 km/h, the elevator was rapidly brought to 7° nose down and the F.D.R. recorded a variation

of vertical acceleration of approximately 0.2 g. and of longitudinal acceleration between 0.19 and 0.3 g.

These parameters represent an abrupt change in the aircraft attitude that suddenly reached 20° nose-up.

- From 20 to 21secs.: during these two seconds the elevator position was brought to 9° down and then again to 4° down, the speed decreased to 185 km/h and, in spite of the 5° down deflection of the right aileron, the aircraft was still turning to the right with an angular velocity up to 6° per second, and a bank angle of approximately 26° to the right.

During this phase of the flight, the pilot continued to react unsuccessfully with respect to the bank angle increase.

It is probable that he concentrated his attention on the oscillation of the longitudinal attitude around 20° nose up and on the speed that continued to decrease. Nevertheless, he seemed to be reluctant to push the elevator completely downward, possibly because of the low altitude and lack of visibility.

- From 22 to 25 secs.: in the next four seconds the right aileron was brought to 13° down causing the angular rotation to stop. However, the bank angle reached 42° to the right and the speed decreased to 179 km/h. Although the attitude continuously changing between 15° and 20° nose up, the elevator was again brought to an almost neutral position.

It is possible to notice that the pilot exerted a more energetic command on the ailerons, causing a momentary cessation of the aircraft rotation along its roll axis.

It is possible to note in the following four seconds that the pilot seemed, at that point, to be reassured that holding the flight controls in a neutral position, would result in a satisfactory roll attitude.

It is possible that he did not continue to correct the excessive nose up attitude for that same reason.

- From 26 to 29 secs.: during these four seconds the speed was stabilised between 175-179 km/h due to a new transitory nose down input, even though it was slight and temporary.

The bank angle decreased slightly to 38° to the right with a rotation speed of 1°-2° per second to the left and the ailerons were once again brought to the neutral position. As the pilot no longer exerted an aileron correction, it is possible to

assume illusory phenomena of spatial disorientation, caused probably by an over emotional state of mind.

- From 30 to 34 secs.: during these 5 seconds, there was an aircraft rotation to the right at an angular velocity of 5° per second. The ailerons were completely moved until the right aileron reached deflection of 13°down, in order to fight the increasingly larger bank that reached 54°.

The elevator was pushed to 2° nose down with a consequent speed increase to 185 km/h.

- From 35 to 42 secs.: during the following eight seconds, owing to the previous movements of the ailerons, the roll rate reversed and the right bank angle decreased to 39°, the right aileron was about 10° down. The elevator was brought to 5° nose up and the speed decreased to 155 km/h.
- Paradoxically, the pilots reacted carrying out actions contrary to those ones that should have been performed. Such a behaviour could confirm that they had "moved" their own subjective axis to approximately 40°, making it their instinctive reference axis, so compulsory as to disregard the indications of the instruments. Also the nose up action exerted on the elevator during this phase seems a slight but reassuring reaction to the increase of speed obtained during the previous five seconds.
- From 43 to 47 secs.: These seconds are the last useful recorded ones. Another action on the ailerons in the opposite direction compared to the previous one, was noted; the right bank angle reached 67°, there was a vertical speed drop (recorded up to 15 km/h) and an elevator upward deflection that reached 30° nose up during the last few instants.

The aircraft now results to be completely out of control and the pilot's reactions, correct but belated, seem only to answer to a survival instinct as, most certainly, they could once again see the ground and the crash appeared unavoidable.

The AN 24 hit the ground with a track of about 300° and with the engines running. Considering the wreckage position compared to the runway threshold 05 and to the track of the impact, the aircraft turn must have been started immediately after the lift off and, in any case, definitely before the end of the runway. As the technical investigation made by FIAT AVIO – TORINO verified that the engines were running at the moment of impact, the Commission supposed that the aircraft unusual attitude immediately after take off would have been caused by ice

contamination on the horizontal stabilizer which was thick enough to alter the aircraft aerodynamics.

To verify this hypothesis, a deputation from the Commission made a flight reconstruction using a flight simulator owned by the Aerospace Engineering Department in Pisa, and previously utilised by the staff of experts of the Verona Prosecutor's Office. The simulator reproduced an aircraft with the similar features as the crashed one.

The experiments consisted of a certain number of take-off with the aircraft horizontal stabilizer contaminated by a quantity of ice determined by the experts, in order to reproduce the crash conditions.

Four take-off were performed in the following conditions:

- 10% overweight compared to maximum take off weight / late "pitch up" recovery maneuver (in order to simulate the pilot's psycho-technical time of reaction).
- 10% overweight compared with the maximum take off weight / prompt recovery maneuver (in order to avoid pitch up development).
- Maximum take off weight / late "pitch up" recovery maneuver (in order to simulate the pilot's psycho-technical time of reaction.)
- Maximum take off weight / prompt recovery maneuver (in order to avoid pitch up development).

From the analysis of the recordings (see diagrams annex n.49) it is possible to verify that the difference of weight (+ 10%) is not a determining factor, if the same reaction time on flight controls is assumed.

FLIGHT 3. CONCLUSIONS

3.1 EVIDENCES

3.1.1 The pilots and the crew members held valid certifications, licences and ratings mandatory for that type of flight.

3.1.2 The AN 24 was certified and had performed all maintenance operations in accordance with regulations.

3.1.3 There was no evidence of any aircraft failure or malfunction preceeding the crash.

3.1.4 The AN 24 was not equipped with a C.V.R. (cockpit voice recorder).

3.1.5 The preceeding flight (Timisoara-Verona), flight time of approximately 3 hours, flew at an altitude where the external temperature was well below freezing point.

3.1.6 The aircraft landed at Verona Airport at 6.43 p.m. L.T. with approximately 2.500kg of fuel remaining in the tanks.

3.1.7 At 3.15 p.m. L.T. a "snowtam" was issued indicating snowfall for the following 3 hours.

3.1.8 At the landing time the meteorological bulletin reported wind 320°/04, general visibility 900 m., RVR 2 km. with continuous light snowfall, overcast at 200 ft., temperature 0°, dew point –0°, QNH 1011.

3.1.9 The aircraft was parked at the B6 stand.

3.1.10 The refuelling amounted to 2015 kg. (2.500 l.)

3.1.11 The total fuel in the tanks amounted to 4.500 kg.

3.1.12 The tank truck used for refuelling, stationed in an external parking area, had been operating during the entire day.

3.1.13 The temperature in the trucks was 0°C.

3.1.14 The snow continued to fall during transit, with an outside temperature of 0°C : it was still snowing at the moment of crash.

3.1.15 The meteorological folder was delivered to the Captain by the airport handling company. There were enclosed a snowtam for the following six hours, TAF valid 16.00/01.00 UTC (17.00-02.00 L.T.), a snowtam in Italian language (·3.1.7. refer) and a forecast regarding icing formation issued at 16.00 UTC (17.00 L.T.) valid for Italian FIR from 16.00 UTC (17.00 L.T.) to 01.00 UTC (02.00 L.T. - 14.12.95)

3.1.16 The Captain refused de-icing and anti-icing procedure.

3.1.17 The Flight Manual and the Company Operations Manual do not allow take off while the surfaces are contaminated with ice, snow or frost.

3.1.18 The aircraft take off weight was of approximately 2000 kg, above M.T.O.W.

3.1.19 The Captain did not give a copy of the load sheet to the ramp agent.

3.1.20 The aircraft computed balance proved to be within limits both at take off and at the time of the accident.

3.1.21 The Captain asked the Tower the start clearance at 7.26 p.m. L.T. and was cleared at 7.30 p.m. L.T.

3.1.22 The aircraft was cleared to taxi and reached the runway 23 cat. II holding position at 7.34 p.m. L.T.

3.1.23 The aircraft held position for approximately 12 minutes because of air traffic congestion. An Air France aircraft, preceeding the BAT 166 flight on take off

sequence, asked the Tower to go back to the parking area for another de-icing and anti-icing procedure, as more than 8 minutes had elapsed from the previous operation.

3.1.24 At 7.46 p.m. L.T. the aircraft was cleared to reach holding position 23 where it remained for 6 minutes before obtaining line up and take off clearance.

3.1.25 Take off took place at 7.54 p.m. L.T. in accordance with the Tower record.

3.1.26 After take off clearance, flight BAT 166 no longer replied to the Tower or to the APP calls, both on active and emergency frequencies.

3.1.27 Immediately after take off, the aircraft started a right roll followed by an abrupt change of pitch, which reached approximately 20° nose up, and a slow deceleration. That trend, even with different oscillations both on roll and pitch axes, remained constant regardless of several unsuccessful interventions by the crew.

3.1.28 Forty-seven seconds after take off the aircraft hit the ground with a bank angle of 67°; a stabilizer position of approximately 30° nose up and speed rapidly decreasing (recorded down to 15 km/h) with a heading of 300° at approximately 1 km. right of the take off runway abeam the threshold 05.

3.1.29 At the moment of impact, the engines were still running with the propellers in take off position. The F.D.R. showed slight oscillations with a power drop (minimum –2% / maximum –10%) on the right engine.

3.1.30 The Commission could not carry out further analysis on the aircraft systems and flight controls, as the wreckage and the F.D.R. were seized by Judicial Authority.

3.2 CAUSES

Considering the findings and the analysis previously developed, the Commission believes it is possible to draw the following conclusions:

3.2.1 The probable cause of the accident was the loss of control of the aircraft due to aerodynamic deterioration caused by ice build up as a consequence of the Captain's decision to depart without undertaking de-icing and anti-icing procedures required by the meteorological conditions existing on the airport, as coded in the Aircraft Flight Manual and in the Airline Operations Manual.

3.2.2 Possible additional causes are allocated to the following:

- the crew's probable spatial disorientation due to the abnormal aircraft aerodynamic response in snowfall condition, darkness and the landing lights probably causing illusory phenomena.

- Overweight of approximately 2000kg. at take off.

- Lack of possibility by the Authorities to control the load sheet as it was not delivered upon specific demand to the handling company representative, nor was it delivered to the Air Traffic Control Office.

- Underestimated meteo conditions

- Right engine slight power loss.

CHAPTER N. 4

RECOMMENDATIONS

The dynamics of the accident made the Commission suggest the following actions to be carried out.

4.1 TO THE MINISTER OF TRANSPORTATION

-The urgent need to set up an independent authority for Flight Safety in Italy; It already exists in other countries with advanced aeronautical cultures. It allows for rapid and well documented investigation of accidents, dangerous events and incidents, with the possibility of direct access to all available information in order to take the necessary precautionary measures regarding Air Transportation Safety.

4.1.1 -To propose to review the current laws making the necessary amendments and modifications. The Ministerial Commission of Investigation, and in the future, the Independent Authority for Flight Safety, should work with direct access to all information, data and documents necessary for an inquiry. They are often not available because of concomitant judicial inquiries.

4.2 TO THE D.G.C.A.

- To put in action, together with the competent Authorities, all initiatives and procedures necessary to implement the possibility of verifying airline companies authorized to fly in Italian territory, as well as the routine control on the respect, on their point, of the existing laws.
- To regulate de-icing and anti-icing procedures, when weather requires, and to draw the airline companies' attention to the need for their pilots to utilize de-icing and anti-icing operations in adverse weather conditions.
- To request that all Airlines provide specific training for "unusual attitude recovery"

- To demand that all aircraft authorized to carry out scheduled or non scheduled passenger transport in Italy be equipped with C.V.R.
- To require that all airlines give their pilots instructions to properly fill out the load sheet and balance chart, and deliver these documents to the Airport Authority or to the handling company prior to departure.
- To implement procedures which allow Airport Authorities to control air carrier documents.
- To ask all the airlines, operators and air traffic control units to use the English language in all air-to-ground communications, particularly when aircraft of different nationalities operate simultaneously.

4.3 TO THE ATC SERVICE

- To provide specific coordination procedures among the various air traffic control units, during adverse weather conditions, with particular attention to take off sequences in order to minimize holding time on ground in presence of snow, freezing rain and icing.
- To use the English language in all air-to-ground communications, especially when aircraft of different nationalities are operating simultaneously.

4.4 TO THE METEOROLOGICAL SERVICE

- To highlight in the weather folder and underline during pre-flight briefing all meteorological phenomenons that are relevant to relevant to the flight operations.
- To issue all meteorological documentation and possible warnings in English only.

4.5 TO THE HANDLING COMPANIES

- To carry out all actions apt to scrupulously implement the regulations issued by D.G.A.C. and D.C.A. with regard to the handling operations and flight dispatch and to amend to this effect all documentation and procedures.

4.6 TO ROMAVIA AIRLINE

- To verify that company policies do not allow exceptions of any kind to the flight safety principles and that no pressure is imposed on the crew that could negatively affect their decisions.
- To verify, through proper auditing, the compliance on the part of all people concerned and of the crew with the rules set forth in the A.F.M. and in the Company Operations Manual (with particular reference to the flight operation and preparation in adverse meteorological conditions) and to implement, if necessary, the required training and operation changes.
- Remind the crew to respect the operational limitations imposed by the A.F.M. and to fill out accurately all the documentation required for the flight.
- To include or implement in the flight training programs the recovery of the aircraft from unusual attitudes.
- To verify the procedures followed by the flight dispatch officer to give all pre-flight information, with particular respect to the importance to highlight existing adverse meteorological conditions relevant to the flight, and to remind the crew of the need of an accurate and adequate pre-flight briefing contacting, if necessary, the Meteorological Office.