COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
IG - 012/CENIPA/2016

OCCURRENCE:	**SERIOUS INCIDENT**
AIRCRAFT:	**PR-MAA**
MODEL:	**A320-232**
DATE:	**18JAN2016**

NOTICE

According to the Law nº 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the different factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of "non-self-incrimination" derived from the "right to remain silent" sheltered by the Federal Constitution.

Consequently, the use of this report for any purpose other than that of preventing future accidents, may induce to erroneous interpretations and conclusions.

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Taking into account the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This is the Final Report of the 18JAN2016 serious incident with the A320-232 aircraft model, registration PR-MAA. The accident was classified as “[OTHR] Others/ Hypoxia”.

During the climbing phase, crewmembers contacted the pilots, reporting a significant absence of oxygen in the passenger cabin.

The crew manually commanded the release of the oxygen masks, which were used by some passengers and crew.

The commander interrupted the climb and requested the air traffic control to return to the Aerodrome of origin (Brasilia), where the landing took place normally.

The aircraft was undamaged.

The crewmembers and passengers left unharmed.

An Accredited Representative of the Bureau *d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile* (BEA) - France, (State where the aircraft was manufactured) was designated for participation in the investigation.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ACC-BS	Brasilia Area Control Center
ADIRS	Air Data Inertial Reference System
AMM	Aircraft Maintenance Manual
ANAC	Brazil's National Civil Aviation Agency
APP-BS	Approach Control Brasilia
ARINC	Aeronautical Radio Incorporated
ATS	Air Traffic Services
BEA	*Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile*
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CFDS	Centralized Fault Display System
CIV	Pilot's Flight Logbook
CMA	Aeronautical Medical Certificate
CMM	Component Maintenance Manual
CPC	Cabin Pressure Controller
CPCS	Cabin Pressure Monitoring and Control System
CVDR	Cockpit Voice and Data Recorder
DECEA	Air Space Control Department
ECAM	Electronic Centralized Aircraft Monitoring
ECS	Environmental Control System
EIS	Electronic Instrument System
EIU	Engine Interface Unit
FL	Flight Level
FMGC	Flight Management and Guidance Computer
FMGS	Flight Management and Guidance System
ICA	Aeronautics Command Instruction
IFR	Instrument Flight Rules
IFRA	Instrument Flight Rating - Airplane
IMAE	Institute of Aerospace Medicine
INSPSAU	Health Inspection
LABDATA	Flight Data Recorders Read-Out and Analysis Laboratory
LGCIU	Landing Gear Control Interface Unit
MCU	Modular Concept Unit
METAR	Aviation Routine Weather Report
MEL	Minimum Equipment List
NVM	Non-Volatile Memory
NuHFASP	São Paulo Air Force Hospital Center

NSCA	Aeronautics Command System Standard
PCM	Commercial Pilot License – Airplane
PF	Pilot Flying
PFD	Primary Flight Display
PLA	Airline Pilot License – Airplane
PM	Pilot Monitoring
PN	Part Number
PPR	Private Pilot License – Airplane
QAR	Quick Access Recorder
RBAC	Brazilian Civil Aviation Regulation
RT	Technical Report
SBAR	ICAO Location Designator - Santa Maria Aerodrome, Aracaju - SE
SBBR	ICAO Location Designator - Presidente Juscelino Kubitschek Aerodrome, Brasilia - DF
SIPAER	Aeronautical Accident Investigation and Prevention System
SDAC	System Data Acquisition Concentrator
SN	Serial Number
SPECI	Selected Special Aeronautical Weather Report
TPR	Aircraft Registration Category of Regular Public Transport
TWR-BS	Brasilia Aerodrome Control Tower - DF
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	**Model:** A320-232 **Registration:** PR-MAA **Manufacturer:** Airbus *Industrie*	**Operator:** TAM Airlines S.A.
Occurrence	**Date/time:** 18JAN2016 - 1759 UTC **Location:** Out of the Aerodrome **Lat.** 15°52'16" S **Long.** 047°55'15" W **Municipality – State:** Brasilia – DF	**Type(s):** [OTHR] Others **Subtype(s):** Hypoxia

1.1 History of the flight.

The aircraft took off from the Presidente Juscelino Kubitschek Aerodrome (SBBR), Brasilia - DF, to the Santa Maria Aerodrome (SBAR), Aracaju - SE, at about 1745 (UTC), in order to perform a regular transport flight, with six crewmembers and 179 passengers on board.

With about fifteen minutes of flight, when crossing the Flight Level (FL) 100, during the climb, the aircraft presented oscillation in the amount of air flow at the exit of the cabin nozzles. When crossing the FL275, the chief flight attendant reported an absence of oxygen on the aircraft.

Before the report, the crew manually commanded the release of oxygen masks, which were used by some passengers and crew.

The crew interrupted the climb on the FL275 and asked the air traffic control to return to SBBR, where the landing took place without any problems.

The aircraft was undamaged. All occupants left unharmed.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	6	179	-

1.3 Damage to the aircraft.

There was no damage to the aircraft.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours		
	Pilot	Copilot
Total	11.420:00	5.310:00
Total in the last 30 days	73:00	78:00
Total in the last 24 hours	05:45	05:45
In this type of aircraft	8.960:00	4.108:00
In this type in the last 30 days	73:00	78:00
In this type in the last 24 hours	05:45	05:45

N.B.: The data related to the flown hours were obtained through the pilots' CIV.

1.5.2 Personnel training.

The pilot took the PPR course at the Sorocaba Aeroclub – SP, in 1978.

The copilot took the PPR course at the Jundiaí Aeroclub – SP, in 2009.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PLA License and had valid A320 aircraft type Rating (which included the A320-232 model) and IFRA Rating.

The copilot had the PCM License and had valid A320 aircraft type and IFRA Ratings.

The flight attendants had valid A320 aircraft type Rating.

1.5.4 Qualification and flight experience.

The pilots were qualified and had experience in the type of flight.

1.5.5 Validity of medical certificate.

All crewmembers had valid CMAs.

1.6 Aircraft information.

The aircraft, serial number 1595, was manufactured by Airbus Industrie, in 2001, and it was registered in the TPR category.

The aircraft had valid Airworthiness Certificate (CA).

The technical maintenance records were updated.

The aircraft was showing the following failure messages: Air Cross Bleed Fault and Hot Air Fault, being released for the flight according to the Minimum Equipment List (MEL).

1.7 Meteorological information.

The METAR and the SPECI of the SBBR provided the following information:

METAR SBBR 181700Z 29012KT 9999 BKN019 24/20 Q1014=

SPECI SBBR 181729Z 31012KT 2500 -RA BKN017 23/20 Q1014=

SPECI SBBR 181745Z 29013KT 9999 BKN017 BKN070 24/20 Q1013=

METAR SBBR 181800Z 29014KT 9999 VCSH BKN017 BKN070 24/20 Q1013=

It was found that, at the time of the final approach, the conditions were favorable to the visual flight, with visibility above 10km and rain in the neighborhood. The wind had an intensity of 14kt.

1.8 Aids to navigation.

All navigation and landing aids operated normally when the aircraft approached.

1.9 Communications.

According to the transcripts of the communication audios between the PR-MAA and the control agencies, it was found that the crew kept radio contact with the ACC-BS and with the APP-BS, without any technical abnormality of communication equipment during the flight.

The crew requested the ACC-BS to return to the Aerodrome of origin. The aircraft was in FL275. There was no declared emergency or urgency to the control agencies.

The climb was interrupted and the crew started the descent to the IFR procedure in Brasilia. The control agencies were not aware about the reason for the return of the aircraft to the airport of origin.

1.10 Aerodrome information.

The occurrence took place out of the Aerodrome.

1.11 Flight recorders.

The aircraft was equipped with a CVDR, Honeywell, Part Number (PN) 050-2681-103-2.

The recorder was sent to the facilities of the CENIPA's LABDATA, in Brasília, to carry out the readings of the flight records and communications in the cockpit.

The recorded voice data from the CVDR was obtained successfully. During the incident, the communication between the commander and the chief flight attendant, through the intercom, highlighted the moment that preceded the release of the oxygen masks by the commander, according to the cabin's audio transcript:

> Chief Flight Attendant: "It feels really bad here. [...] It's horrible, it's horrible. It's depressurizing".
>
> Commander: "No, it's not depressurizing".
>
> Chief Flight Attendant: "Drop the masks, we're sick".
>
> Commander: "Okay, I'm dropping them"

Figure 1 shows the flight data, recorded and validated by the CVDR, which had a maximum Cabin Altitude of 6,000ft and a maximum Cab Diff Press of 6.88psi.

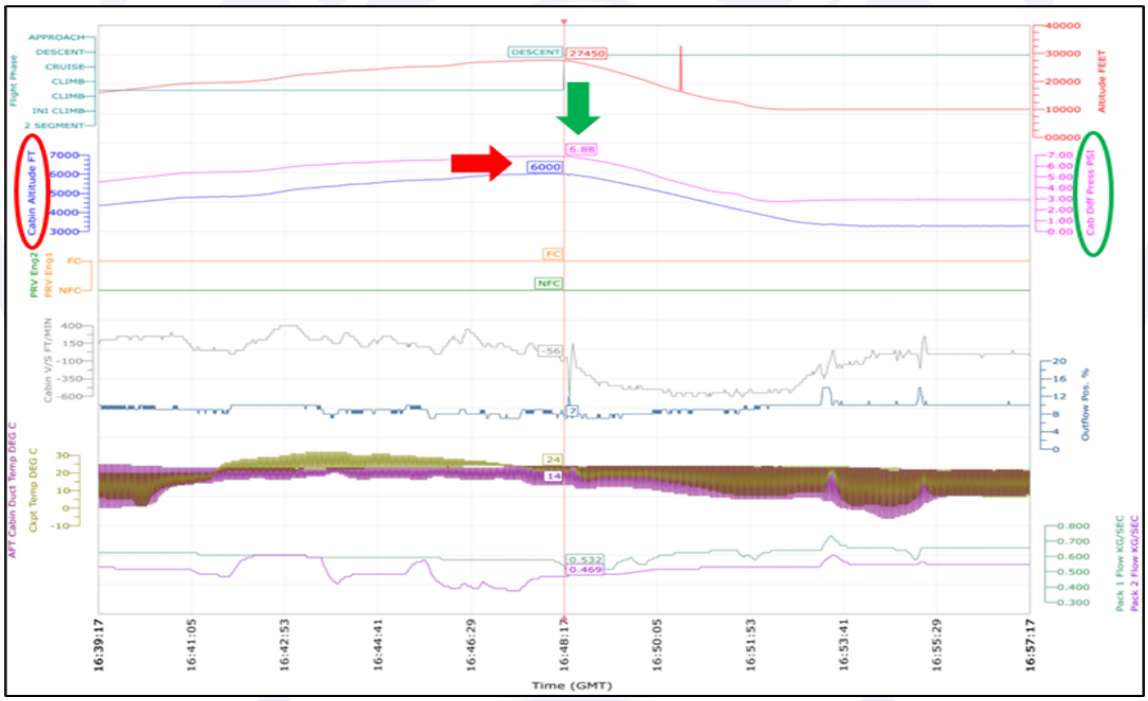


Figure 1 - CVDR data, highlighted the Cabin Altitude 6.000ft (red arrow) and Cab Diff Press 6.88psi (green arrow).

1.12 Wreckage and impact information.

Nil.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

The crew consisted of two pilots and four flight attendants.

Personal medical information of the crewmembers

The commander had a valid CMA and, according to his latest health inspection (INSPSAU), he was physically and mentally healthy, being able for the intended purpose, and should wear corrective lenses for close-up vision. He reported that he did not use medication regularly.

The copilot had a valid CMA and, according to his latest INSPSAU, he was physically and mentally healthy, being able for the intended purpose. He also reported not taking regular medication.

The chief flight attendant, positioned at the front of the aircraft, was physically and mentally healthy and her CMA was valid, being able for the intended purpose.

She had been away from the roster for about a year, due to treatment with the use of controlled medication (antidepressant), being discharged two months before this occurrence.

Regarding the aforementioned medication, it was found that withdrawal symptoms could occur after the interruption of its use, ranging from a few hours to a week or more. The symptoms of withdrawal could be restricted to tremor, agitation, insomnia, anxiety, headache, difficulty concentrating, sweating, muscle and abdominal spasms, changes in perception and, more rarely, delirium and seizures.

The flight attendant who was in front position 2, according to medical evaluation, was physically and mentally healthy. She had a valid CMA, being able for the intended purpose.

According to the report of this crewmember, she made occasional use of prescription drugs (painkillers and antidepressants).

As for the medication, although its use was not contraindicated for the flight, it could cause, in some cases, the following side effects: headache, palpitations, blurred vision, dry mouth, gastrointestinal discomfort, nausea, fatigue, chills, feeling tremor, attention disorder, vertigo, lethargy, drowsiness, anxiety, nervousness, tension, excessive sweating, malaise, muscle contraction and psychomotor restlessness.

According to the information gathered in the interview, this crewmember had fifteen years of experience in the air activity and had previously worked in other aviation companies. As reported, throughout her aviation career, the training in depressurization and hypoxia received was only theoretical, based on the light and sound signals of the aircraft. In her perception and understanding, hypoxia was something like "shortness of breath".

The other flight attendants were positioned at the rear of the aircraft. The flight attendant positioned next to door R2, in the rear position 1, had a valid CMA, being able for the intended purpose.

According to information gathered, she reported that she had nine years of experience in the air activity and had never been in a similar situation. Like the other crewmembers, she also reported that she had no practical training in depressurization, as well as its signs and symptoms, but only a training based on the aircraft's light and sound signals in such situations. She reported that she was "trained to trust the machine and the signals it gave".

Finally, the fourth flight attendant, who was also in the rear galley, had a valid CMA, being able for the intended purpose.

The crewmembers were submitted to toxicological examination on 21JAN2016. The final result confirmed the absence of psychoactive substances.

Information about perception of signs and symptoms during the flight

The perceptions of the crew about the flight were varied. During takeoff, the aircraft showed variation in airflow output and the passenger cabin temperature was low, causing a very cold sensation.

As reported, the flight attendants positioned in the front galley of the aircraft had experienced symptoms of malaise that had intensified throughout the flight. The other crewmembers had not clearly identified any symptoms until the masks had been released.

The symptoms described by the chief flight attendant were: strong feeling of faintness, pressure in the abdomen, slowness and lack of attention. These effects intensified until a feeling of loss of strength and fainting.

During the flight, she remained in contact with the commander and with the flight attendant who accompanied her, on occasions when they spoke of concern about the alleged abnormal behavior of the aircraft. According to her report, when the flight attendant next to her reported that she was also feeling bad, she opted to request the manual release of the oxygen masks.

She reported that, from where she was, she could see the entire corridor of the aircraft until the end and noted that "the passengers were very quiet and silent", and found this a strange fact, because it was a flight with many children on board.

The other flight attendant in the front position, seated next to the flight attendant, also reported symptoms of malaise during the flight. She referred that, at a given moment of the flight, she felt abdominal pain, described as "twisting abdomen". In addition, she also felt pain in the nape, head and neck. In her report, she used the expression "neck pulling" to describe the discomfort she felt.

The flight attendants positioned at the rear of the aircraft had not identified any abnormal behavior of the aircraft, nor had they reported any malaise. However, they signaled the perception of being very cold.

The flight attendant standing next to door R2 reported that, right at the beginning of the flight, she felt drowsy, but didn't associate it with anything. During the takeoff, while the seat belts were supposed to remain fastened, she fell asleep.

Finally, the fourth flight attendant, also positioned at the rear of the aircraft, had not observed any sensation or symptom. According to her report and the data collected in CVDR, she noticed a moment of discomfort due to the noise and the low temperature at the beginning of the flight, however, the situation had already improved when she received the contact from the aircraft commander.

In the pilots' perception, there were no indications of the aircraft or any symptoms or sensations, during the flight, that indicated the possibility of depressurization.

The commander reported that, after the event, he considered that he might have presented “tunnel vision” while trying to identify what caused the problem with the aircraft's air outlet.

Information about the simulation exercise in the hypobaric chamber

Faced with a possible silent depressurization, with the hypothesis that there was a failure of the aircraft equipment that did not allow correct measurements of the pressurization parameters and the emission of depressurization warning signals, the Investigation Team decided to carry out a simulation exercise in a hypobaric chamber.

The crewmembers were submitted to the simulated exercise at the IMAE, in Rio de Janeiro - RJ.

The purpose was to expose the crew to the condition of controlled hypoxia, in order to assess whether the symptoms felt were the same as those perceived during the flight of the incident.

The crewmembers reported that the training in depressurization and hypoxia, received during the initial and periodic training, was only theoretical, based only on the identification of the light and sound signals of the aircraft.

A flight was carried out with the following profile:

a) verification of oximetry and heart rate on the ground;

b) peak up to 5,000ft (sinus and ears test);

c) denitrogenation for 30 minutes (pre-test);

d) climb to 22,000ft;

e) hypoxia test at 22,000ft (removal of the oxygen mask and testing);

f) perception, by the crewmembers, of their symptoms of hypoxia and verification of oximetry and heart rate at 22,000ft; and

g) descent to the ground.

For health reasons, it was not possible for the copilot to go to the simulation exercise in the hypobaric chamber.

It was also not possible for the flight attendant of the front position 2 to participate, because during the preparation of the chamber for the simulation exercise, she did not show conditions to do it.

She reported hyperventilation and tachycardia, as well as a tingling complaint in her hands, even though she had not been without an oxygen mask at any time since the beginning of the simulation exercise.

As a result, the simulated exercise made it possible to identify that, of the four crewmembers who participated in the simulation, only the chief flight attendant reported some similarity between the symptoms experienced in the flight of the incident and in the hypobaric chamber, as shown in Figure 2.

Tripulante	Posição na aeronave	Sintomas relatados anteriormente	Sintomas apresentados no teste
Comandante	*Cockpit*	Nenhum sintoma de mal-estar fisiológico. Possível "visão de túnel".	Diminuição do nível de consciência. Apresentou palidez. Referiu ouvido (??). Reportou percepção auditiva alterada ("como filme mudo").
Copiloto	*Cockpit*	Nenhum sintoma de mal-estar fisiológico.	Não se aplica.
Comissária-chefe	Posição dianteira 1	Mal-estar intenso, pressão abdominal, lentidão, perda de força, sensação de corpo "pesado" e de desmaio.	Tremor, formigamento em partes do corpo (sobretudo boca), "moleza" e sensação de corpo "pesado".
Comissária	Posição dianteira 2	Mal-estar intenso, dor abdominal, dor na nuca e pescoço (cabeça e pescoço repuxando)	Mal-estar apresentado antes da realização do exercício, inviabilizando a realização do exercício.
Comissária	Posição traseira 1	Não possuía lembranças do dia. Estava dormindo durante o voo. Relatou frio e sono intenso. Apresentou vermelhidão no corpo.	Calor, otalgia e sensação de corpo pesado, sobretudo nos braços e mãos.
Comissária	Posição traseira 2	Nenhum sintoma de mal-estar fisiológico.	Leve sensação de desorientação, pressão no rosto; palidez; perda de concentração.

Figure 2 - Comparative chart of previously reported symptoms and symptoms presented during the simulated exercise.

During the exercise, it was observed that the symptoms presented by the commander and the flight attendant in the rear position 2 appeared after a longer time of exposure to hypoxia conditions, when compared to the other participants in the simulation.

Both only used the oxygen mask when instructed by the medical team.

It was also observed that the crewmembers who had greater resistance to hypoxia in the simulated exercise were among those who did not identify signs and symptoms compatible with malaise or loss of performance during the flight that originated the occurrence.

The commander presented focused attention on the execution of some tasks and the reduction of his level of situational awareness, to the point of having difficulties in responding to the commands that were issued by the medical team. According to his report, he had the feeling of “wanting to do it and not being able to”.

As noted, the commander showed pallor, slowness and had decreased oxygen saturation. He reported that he felt discomfort in his ear and that, during the simulation, his auditory perception was altered. Although he remained focused on performing the test, he had low performance on the proposed tasks while exercising in the hypobaric chamber.

However, there were cases in which the symptoms presented in the simulated exercise differed from some reports, since, during the flight, the most intense complaints were presented by the flight attendants positioned in the front galley.

The other crewmembers had difficulties in mentioning symptoms or complaints compatible with a possible hypoxia effect.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The commander had been in airline operations for 28 years. He was described by the other members of the crew as an accessible professional, easy to live with and who established good communication with everyone.

The copilot worked in commercial aviation for five years. In his report, the commander described the copilot as a practical and proactive person, as he had observed on flights taken the day before.

According to reports, the crewmembers were in agreement as to the division of tasks that had been stipulated, with the copilot taking over the flight commands at that leg (SBBR-SBAR).

The flight attendants were described as experienced professionals, the least experienced had been in the job for six years. The chief flight attendant had nine years of experience and was positioned at the front part of the aircraft, accompanied by another flight attendant, who had fifteen years of experience in aviation. Both were the most experienced flight attendants on that flight.

The crewmembers reported that, at the beginning of the climb after the takeoff, there was an increase in the airflow inside the aircraft. The flight attendants described that the gaspers were releasing a strong jet of air, accompanied by drops of water. They noted that, at that moment, many passengers closed the air vents.

According to the pilots, there was also an intense noise in the cockpit at that time. Initially, the cause of the noise had not been identified, which led the commander to consult the passenger cabin and contact the ground crew for support.

According to the information collected, the crew remained on alert due to this variation in the flight. The flight attendants at the front of the aircraft reported that they were vigilant as to the possibility of depressurization, after the abnormality in the operation of the air vents.

They also reported that the flight was unusually quiet. These circumstances referred to the remembrance, by the flight attendants, of the case of an accident caused by slow depressurization, by the company Helios, in 2005.

In communications with the commander, the chief flight attendant was informed that there were no problems with the pressurization of the aircraft. According to the report of the flight attendants located at the rear, after the aircraft climbed, the situation was under control and the abnormal noise had already ceased.

A few minutes after that contact, the chief flight attendant reported to the commander that there was an abnormality with the aircraft and requested the release of the oxygen masks. Although he had not identified pressurization problems, the commander complied with the request, manually lowering the masks.

According to the reports obtained and the CVDR records, the request for the masks was motivated by intense discomfort perceived by the flight attendants at the front of the passenger cabin, who reported feeling unwell.

The crew was unable to specify what information was checked during the flight and what the aircraft's cabin altitude was at the time the complaints of depressurization were reported.

According to the reports of the aircraft commander, who performed the flight monitoring and these conditions, his attention was focused on the information related to the outflow valve indications in the ECAM. In his experience, this valve would indicate pressurization problems, if they occurred.

The copilot reported that he remained focused on tasks related to the command of the aircraft and, throughout the flight, did not observe any indication of depressurization. Even after the event, he reported that he did not identify any signs or symptoms of hypoxia.

The management of the situation, after the activation of the masks, was described by the crew as troubled. The flight attendants had to deal with the reactions of the passengers and, due to everyone's emotional conditions, there were difficulties in carrying out verbal instructions.

There was no declaration of an emergency situation by the pilots to the passengers or to the air traffic control. Authorization to descend to 10,000ft was requested. However, the procedure was performed according to the descent parameters of a normal flight.

According to the pilots' perception, the division of tasks when reaching 10,000ft was affected by the conditions present on that flight, but they were properly managed.

During communication with the air traffic controller, there was a misunderstanding about the runway that would be used. Due to the need to change runways, some procedures that were commonly performed in advance were performed during the approach for landing.

Still according to the pilots' report, there was no emergency declaration because there was no understanding that the aircraft had depressurized. The masks were lowered to meet the request of the chief flight attendant, however, without any indication from the aircraft that suggested depressurization.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

After landing, the control agency instructed the crew to taxi and park the aircraft in a remote area of the Aerodrome. The crewmembers and passengers disembarked through the main door.

There was the presence of the Federal Police at the time of disembarkation. There was no presence of medical teams and firefighters on the aircraft.

1.16 Tests and research.

The aircraft's pressurization control system, according to the Airbus AMM, Rev. Date 01NOV2015, was composed of the following main components:

Cabin Pressure Controller (CPC)

Two identical and independent digital controllers automatically controlled the system, maintaining the proper cabin pressure. They received signals from the ADIRS, from the FMGC, from the EIU and from the LGCIU.

When the system was in automatic or semi-automatic mode, one controller remained active and the other was on hold. Controllers also generated signals for the ECAM.

For manual mode operation, each controller had a backup section, which was powered by an independent power supply in the position of controller n°1. This section also had a pressure sensor that generated the cabin altitude and the pressure signal for the ECAM, when MAN mode was selected. The controllers communicated via a link between channels.

The CPCs (11HL and 12HL) had the following functions:

- automatic cabin pressure control;

- backup indication for manual control;

- alarm functions (ECAM notices); and

- self monitoring and fault indication BITE + CFDS.

Two identical CPCs were used for redundant system control. Each contained:

- a cabin pressure sensor;

- the bus interface ARINC for SDAC (ECAM), CFDS, FMGS and ADIRS;

- the discrete interface for LGCIU and EIU;

- the logic of digital control;

- the interface with the landing field elevation selector;

- the interface with the other CPC; and

- the interface with the 10HL outlet valve actuator.

An electrically supplied part separated from the CPC at position 1 was the backup circuit and it contained:

- a pressure sensor; and

- an analog circuit.

They generated the output of the discrete limit function and the analog outputs of the system.

The controllers were housed in a standard 2 Modular Concept Unit (MCU) (Ref. ARINC 600) and were installed on the 95VU and 96VU shelves of the 90VU main rack.

The CPC received signals from different sources. All signals sent were digital or discrete. The CPC backup indication circuit sent only analog signals to the EIS.

Outflow Valve

The outlet valve was on the right side of the fuselage, behind the rear cargo compartment and below the flotation line.

The outflow valve set consisted of a rectangular structure, mounted on the aircraft structure, with inward and outward opening controls connected to the actuator.

The actuator contained the drives of the two automatic engines and the manual engine. Both automatic engines operated the valve in automatic mode and the manual engine operated it in manual mode. In the automatic mode, the operation controller signaled the valve position to the ECAM.

Safety Valve

Two independent pneumatic safety valves prevented the cabin pressure from becoming too high (8.6psi) or too low (1psi).

They were located on the rear pressure bulkhead, above the flotation line.

Pressurization System Operation

The operation was divided into the following ways, according to the Airbus AMM:

- Automatic operation

These were two identical, independent and automatic systems. Each system has a CPC that controls the pressure through an outflow valve.

In the automatic operation, the CPCs used the FMGS and ADIRS data. The active CPC controls with the auto-motor the outflow valve for the required position and provided data for indication in the EIS.

Only one CPC operates the system at a time, with the other system on standby. The change of control from one CPC to the other is fully automatic after each flight, on landing. The CPCs will also change in flight if there is a failure or part of a failure of one of the control systems.

- Semi-automatic operation

If the data from the FMGS is not available, the landing field elevation can be manually adjusted with the LDG ELEV selector on the CABIN PRESS overhead panel 25VU. Then, the CPCs controls the outflow valve with data from the ADIRS and from the LDG ELEV selector.

- Manual operation

The MAN V/S selector switch controls the manual motor of the outflow valve when the MAN SEL switch is selected to MAN. These controls are installed in the cockpit, on the CABIN PRESS overhead panel 25VU.

In manual mode, the CPC backup channel in position n°1 is used. It has a pressure sensor to generate the excess cabin altitude warning and pressure outputs for the indication in the EIS.

The CPCS ensures that the pressure in the pressurized fuselage system is safe and comfortable for passengers and crew. The CPCs control completely and automatically the amount of air leaving the fuselage through an outflow valve.

A manual system controls the CPCS if the automatic system is not active. Two safety valves are installed in the pressure bulkhead, which prevents the pressure in the fuselage from becoming too high or too low.

The aircraft's Pressurization Control System, according to the Airbus AMM, can be viewed schematically in Figure 3.

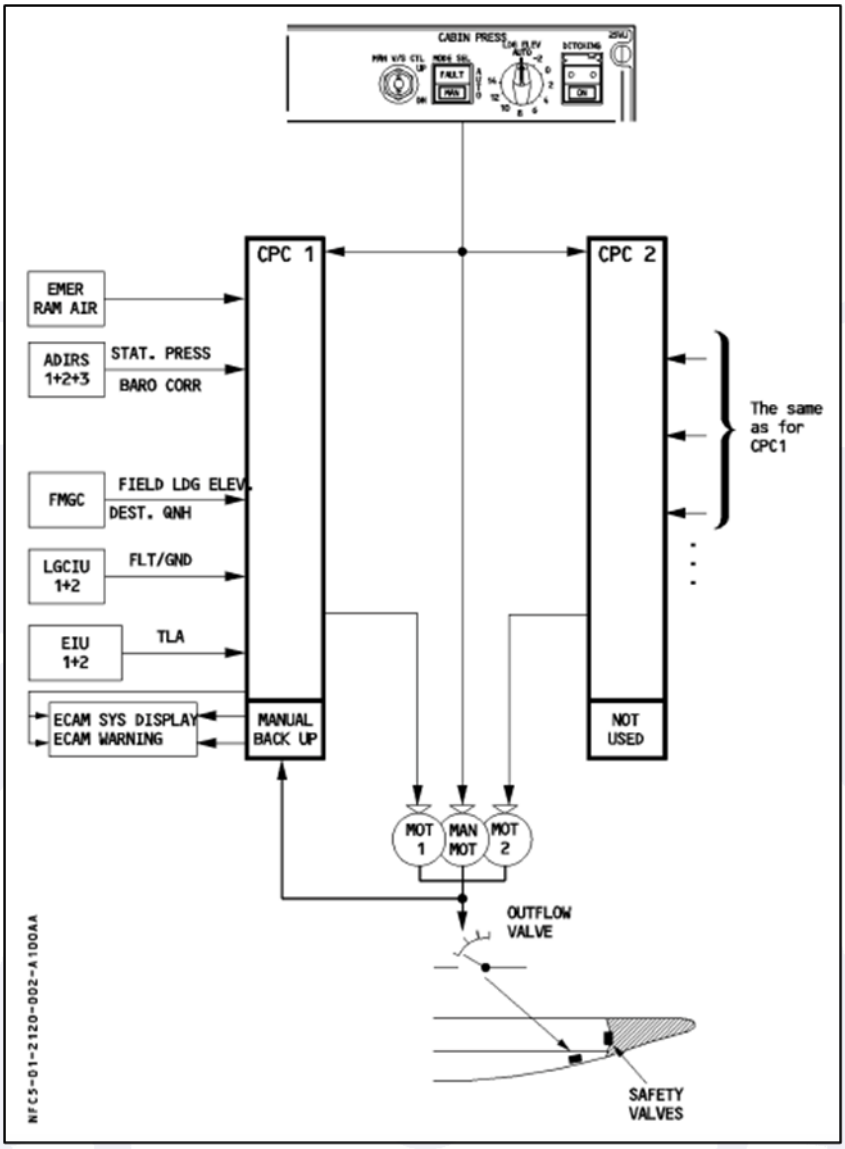


Figure 3 - Pressurization Schematic, according to the Airbus AMM.

Functional examinations in the CPC

According to the operator, there was no report related to the ECS during the event.

According to the crew and the data from the QAR, the AIR PACK 1 + 2 FAULT message from the PFD resulted from a crew action to select both PACKS OFF at the end of the flight, at 1714 (UTC), after descending, around 5,000ft.

The aircraft was equipped with CPC PN 20791-02AB and Serial Number (SN) 0254456, plus CPC PN 9022-15702-10 and SN 9958618, manufactured by Nord-Micro GmbH & Co.

Both CPCs of the aircraft were removed and subjected to the reading of NVM and functional tests at the manufacturer Nord-Micro, in Germany. The Nord-Micro developed, manufactured and integrated fully automatic cabin pressure control systems, designed for the aircraft manufacturer in question.

There were no fault entries in the non-volatile memory. The CPCs have passed the function test, according to the CMM. The pressure sensors were checked as part of the CMM function test procedure.

Based on the detailed analysis of the information and data above, there was no evidence of any abnormal functioning of the CPC during the occurrence.

1.17 Organizational and management information.

The aircraft was operated by TAM Airlines and had been used for a scheduled flight by the airline.

The crew scheduled for that flight was composed of six crewmembers, two pilots and four flight attendants. Such team complied with the procedures recommended by current legislation and by the company.

The management of the roster for that crew prevised the accomplishment of eleven flight legs in five days. With the exception of the three flights carried out the previous day, the crewmembers had not yet worked together.

According to the data obtained, the initial training offered by the organization prevised the approach of content related to the aircraft's depressurization. The crewmembers did not receive physiological training and had little theoretical knowledge to identify the clinical manifestations related to hypoxia.

The focus of the training offered to flight attendants was on the signals indicated by the aircraft to detect pressurization problems (lights and sounds) and the procedures to be adopted in the case of this emergency.

Regarding the procedures after the masks were released, the flight attendants team reported that they had received adequate training to deal with this emergency situation.

However, the flight attendants reported that some difficulties arose due to the behavior of some members of the team, who presented confused speech or mistaken guidelines to passengers. In the team's perception, this behavior could be attributed to the effects of a possible hypoxia, due to the depressurization of the aircraft.

1.18 Operational information.

The aircraft took off from SBBR to SBAR, at about 1745 (UTC), in order to carry out a regular transport flight, with six crewmembers and 179 passengers on board.

Incident flight

The copilot was in the role of Pilot Flying (PF) and the commander was in the role of Pilot Monitoring (PM).

During the climb, there was a complaint about a loud sound in the cabin, coming from the ventilation / pressurization system. The commander made contact with the chief flight attendant in order to verify if such noise had been perceived by the rest of the crew, receiving confirmation that the air flow in the passengers' cabin had become more intense, with the thermal sensation decreasing considerably and with a lot of noise.

The commander informed that he would verify the situation, contacted maintenance in Brasilia to verify the troubleshooting and reported the situation (excessive noise and increased air flow).

The commander instructed the copilot to continue the climb, while he checked to see if there were any problems that prevented the flight from continuing.

The pilots reported that, after this contact, the air flow started to decrease. The commander expressed dissatisfaction with the situation and said that it would be necessary to monitor the case, making new contact to check the conditions in the passengers' cabin.

The chief flight attendant reported that the noise had reduced, but it was still very cold and a lot of air was coming out. The commander, at that moment, informed her that he was monitoring the situation and that everything was normal with the pressurization.

During the climb, the chief flight attendant made new contact and reported that she was feeling very bad and that the aircraft was depressurizing. The commander replied that the aircraft was not depressurizing, that the parameters of the pressurization system were normal. The flight attendant asked for the oxygen masks to be released, as people were sick.

Right after the request of the chief flight attendant, the commander asked the copilot to put on the mask and commanded the masks release manually for the passengers (MASK MAN ON), on the oxygen panel (Figure 4).

Figure 4 - Oxygen panel, highlighted by the red switch MASK ON MAN.

There were two ways to release oxygen masks to the passengers' cabin, according to the Airbus AMM:

1. Automatically, via Passenger Oxygen System.

Trigger logic: if the cabin pressure altitude exceeded 14,000ft (+ 250 / -750), the altitude switch would close and energize the unit door unlocking solenoids (via several electrical relays).

Note: If the HIGH ALT SWITCH button switch was in the ON position, the trigger limit was increased from 14,000ft to 16,000ft.

2. Manually by the Flight Crew.

Following the red warning CAB PR EXCESS CAB ALT triggered. The CAB PR EXCESS CAB ALT warning was triggered by the CPCS, if it detected that the cabin altitude had reached 9,550ft.

It is important to mention that either of the two CPCS (for example, CPC1 or CPC2, and not just the active CPC) could trigger the CAB PR EXCESS CAB ALT warning.

In this case, if the aircraft's altitude was above FL160, the flight crew should initiate an emergency descent to limit the cabin's altitude.

However, if the cabin's altitude continued to increase above 9,550ft and exceeded 14,000ft, the procedure would require the crew to manually release the passengers' oxygen masks (Figure 5).

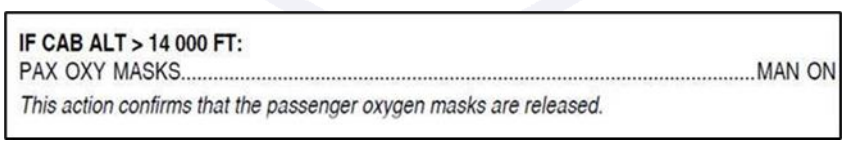


Figure 5 - Checklist A320-232, in case the CAB ALT was higher than 14.000ft.

This was done by pressing the MASK MAN ON P/B button on the top panel.

After the commander's release of the passenger masks, the climb was interrupted by the crewmembers and descent procedures were adopted. The return to SBBR and FL100 was requested for the ACC-BS.

An emergency was not declared, through radio message to the Air Traffic Services (ATS), by the aircraft crew.

During the descent, the commander made another contact with the flight attendant to verify that the masks had been released without problems, receiving positive confirmation. The flight attendant said the situation was bad, but under control. There were some children crying.

In new contact with the passengers' cabin, there was the information that a person was feeling very ill, with symptoms of fainting.

The commander mentioned the need to monitor the cabin's oxygenation in order not to lose consciousness. He reported a burning smell, but concluded that it could have come from the masks, which use a chemical process to generate oxygen. During the dialogue in the cabin, the commander stated that "it apparently did not depressurize (the aircraft), but there was a problem with the air".

Upon reaching 10,000ft, the removal of the masks was authorized and landing procedures were initiated. The commander took over the flight controls, as prevised in the company's procedures, for being an overweight landing.

In the final approach for landing, in the communication from the cockpit, the pilot and the copilot talked about what happened. Someone questioned what could have happened, as the aircraft had not depressurized. The commander reported that there was a different smell in the air and that something was wrong, as he felt better after putting on the mask.

Contact with maintenance was made and the following situation was reported:

> "We crossed 10,000ft, the air coming out of the outlets was ten times stronger. Pressurization was normal. The chief flight attendant asked for masks".

Maintenance asked again about pressurization and the following was reported:

> "We checked the screen several times (ECAM) and everything was normal".

Then the commander mentioned that something was wrong and that it was difficult to "pull the air".

Landing after returning to the Aerodrome of origin

According to the information obtained, after the return of the aircraft, the Aerodrome operator was not aware of what had happened and the Aerodrome was not adequately prepared to serve passengers. There was a Federal Police vehicle waiting for the disembark, to check what had happened.

There were reports of discomfort from some passengers when dealing with oxygen masks, lightly burning their fingers or part of their hands, but the support of an ambulance or medical staff had not been requested.

Upon disembarkation, both passengers and crew were directed to another flight.

Throughout the investigation process, there were disagreements among the crew about the severity of the event. There was also a concern related to the repercussion of the event for the continuation of the professional career in aviation.

Field Investigation on the aircraft

During the field investigation, on the day of the incident, three hours after the aircraft landed, a team of investigators from the CENIPA followed the aircraft's pressurization

procedures on the ground. The pressurization test parameters behaved within the normal range (Figure 6).

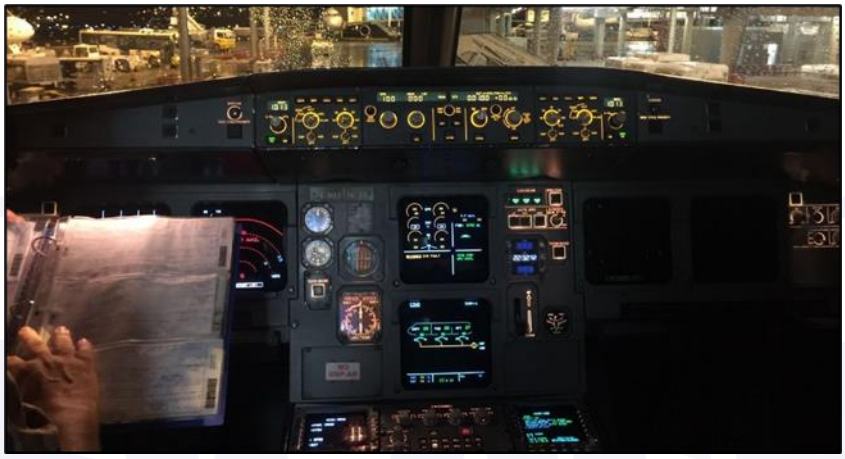


Figure 6 - Pressurization test during the field investigation on the aircraft.

Pressurization System Operation Manuals

The control and pressurization indicators of the A320-232 aircraft are demonstrated on the ECAM CRUISE PAGE.

The cabin pressurization was in automatic operation mode.

According to data extracted from the CVDR and pilots' reports, there was no alert that the parameters of CAB ALT FT, CAB V/S FT/MIN and §P indication were out of normal limits.

In Figures 7 and 8, according to the Flight Crew Operating Manual A319 / A320 / A321, the CAB ALT indicator pulsates if the altitude reaches 8,800ft and turns red if the cabin altitude reaches 9,550ft. The pressure differential indicator (§P) is amber when it is out of the normal range, when §P <- 0.4psi or> 8.5psi.

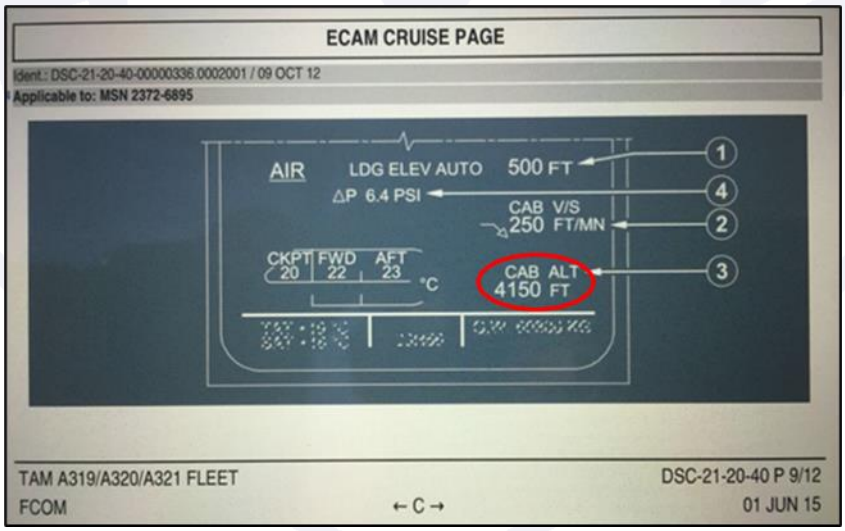


Figure 7 – ECAM's illustration, highlighted the CAB ALT indication.

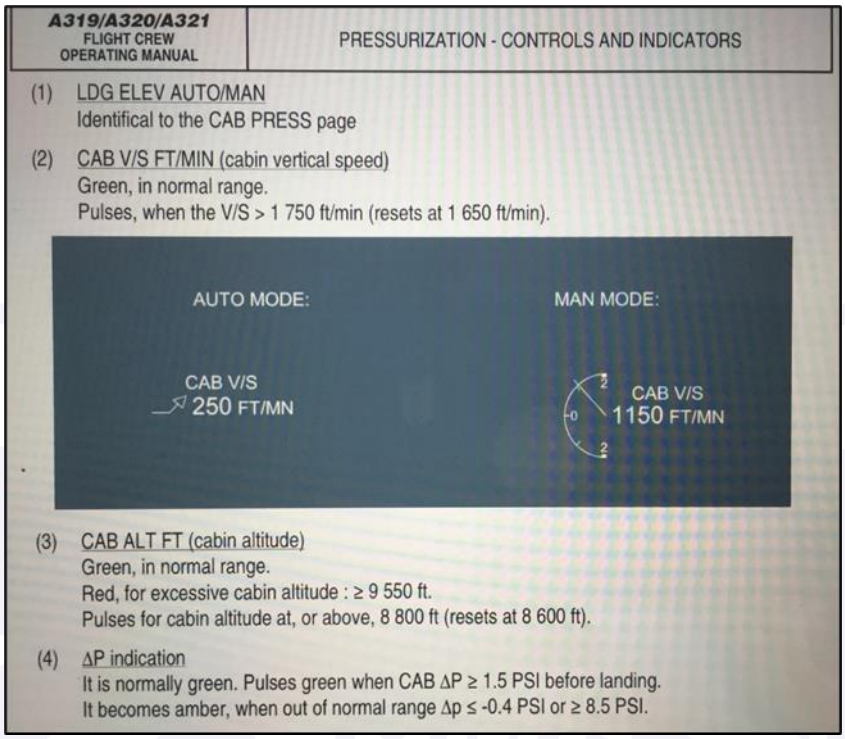


Figure 8 - Operating range of pressurization indicators, according to the Flight Crew Operating Manual A319 / A320 / A321.

In addition to the change to the red color of the CAB ALT indicator, equal to or above 9,550ft, the AURAL WARNING CRC is also activated in this case, as shown in Figure 9.

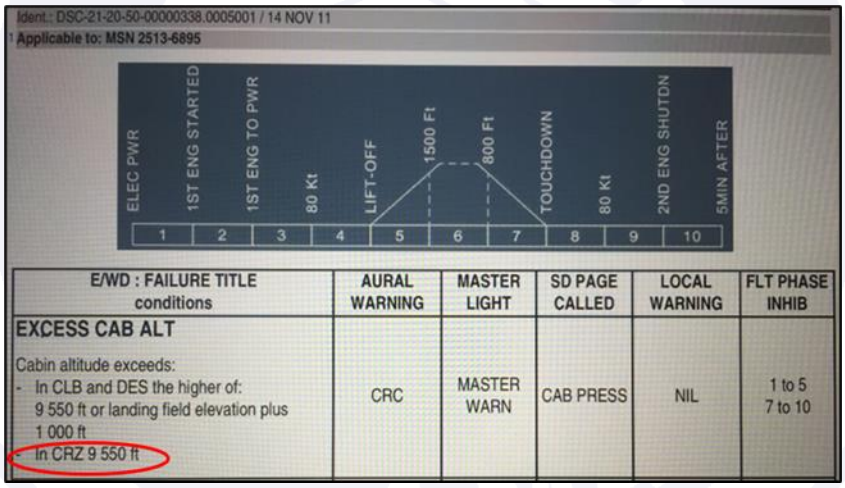
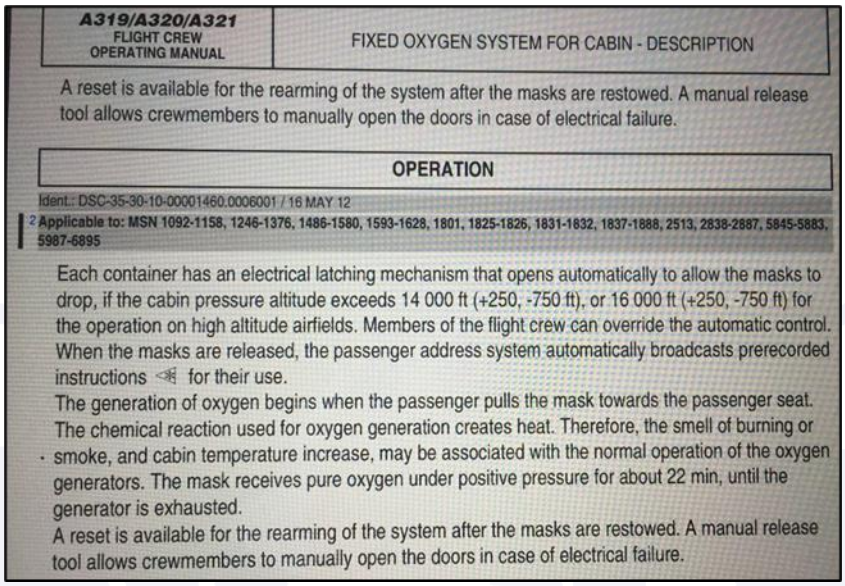


Figure 9 - AURAL WARNING CRC if exceeded on CAB ALT cruise (highlighted), according to the Flight Crew Operating Manual A319 / A320 / A321.

According to the company's Flight Crew Operating Manual A319 / A320 / A321, if the cabin altitude exceeds 14,000ft (+250, - 750ft) or 16,000ft (+250, - 750ft) at high altitude Aerodromes, masks are automatically released (Figure 10).



A319/A320/A321
FLIGHT CREW
OPERATING MANUAL

FIXED OXYGEN SYSTEM FOR CABIN - DESCRIPTION

A reset is available for the rearming of the system after the masks are restowed. A manual release tool allows crewmembers to manually open the doors in case of electrical failure.

OPERATION

Ident.: DSC-35-30-10-00001460.0006001 / 16 MAY 12

Applicable to: MSN 1092-1158, 1246-1376, 1486-1580, 1593-1628, 1801, 1825-1826, 1831-1832, 1837-1888, 2513, 2838-2887, 5845-5883, 5987-6895

Each container has an electrical latching mechanism that opens automatically to allow the masks to drop, if the cabin pressure altitude exceeds 14 000 ft (+250, -750 ft), or 16 000 ft (+250, -750 ft) for the operation on high altitude airfields. Members of the flight crew can override the automatic control. When the masks are released, the passenger address system automatically broadcasts prerecorded instructions for their use.

The generation of oxygen begins when the passenger pulls the mask towards the passenger seat. The chemical reaction used for oxygen generation creates heat. Therefore, the smell of burning or smoke, and cabin temperature increase, may be associated with the normal operation of the oxygen generators. The mask receives pure oxygen under positive pressure for about 22 min, until the generator is exhausted.

A reset is available for the rearming of the system after the masks are restowed. A manual release tool allows crewmembers to manually open the doors in case of electrical failure.

Figure 10 - Operation related to the release of the oxygen masks, according to the Flight Crew Operating Manual A319 / A320 / A321.

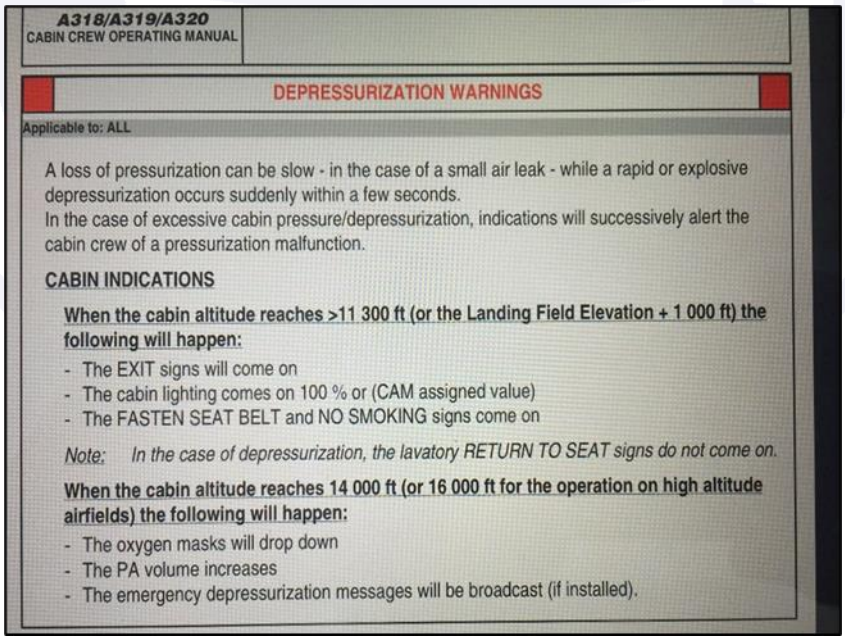
On that flight, the aircraft was climbing, crossing the FL275. There was no automatic release of the masks. This was done, manually, by the crew, at the request of the chief flight attendant.

According to the company's Flight Crew Operating Manual A319 / A320 / A321, when the cabin altitude reached 11,300ft, the following indications would occur in the passengers' cabin (Figure 11):

- the EXIT signal lights up;

- the passengers' cabin lights go to 100%; and

- the FASTEN BELT and NO SMOKING lights are ON.



A318/A319/A320
CABIN CREW OPERATING MANUAL

DEPRESSURIZATION WARNINGS

Applicable to: ALL

A loss of pressurization can be slow - in the case of a small air leak - while a rapid or explosive depressurization occurs suddenly within a few seconds.
In the case of excessive cabin pressure/depressurization, indications will successively alert the cabin crew of a pressurization malfunction.

CABIN INDICATIONS

When the cabin altitude reaches >11 300 ft (or the Landing Field Elevation + 1 000 ft) the following will happen:

- The EXIT signs will come on
- The cabin lighting comes on 100 % or (CAM assigned value)
- The FASTEN SEAT BELT and NO SMOKING signs come on

Note: In the case of depressurization, the lavatory RETURN TO SEAT signs do not come on.

When the cabin altitude reaches 14 000 ft (or 16 000 ft for the operation on high altitude airfields) the following will happen:

- The oxygen masks will drop down
- The PA volume increases
- The emergency depressurization messages will be broadcast (if installed).

Figure 11 - Depressurization warnings, according to the Flight Crew Operating Manual A319 / A320 / A321.

As reported by the flight attendants, none of the passengers' cabin alerts were triggered.

1.19 Additional information.

The ICA 100-37 / 2018, item 3.14.4.1, valid at the time, instructed that an aircraft in emergency should transmit radiotelephone messages preceded by the expressions MAYDAY or PAN PAN, respectively, in distress situations or urgency, preferably pronounced three times.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a passenger transport flight between SBBR-SBAR.

During the pre-flight preparations, the aircraft was displaying the following failure messages: Air Cross Bleed Fault and Hot Air Fault. However, maintenance actions prevised their release, according to the MEL.

The aircraft was climbing, crossing the FL275, when the chief flight attendant asked for the oxygen masks to be released.

In case of depressurization, the aircraft should emit signals indicating this condition, as well as automatically release oxygen masks, if the cabin altitude reached levels that could cause hypoxia. However, according to the six crewmembers, no visual or audible warning of depressurization was announced by the aircraft.

In addition, according to the data extracted from the CVDR, the absence of AURAL WARNING CRC and the color change (red) of the CAB ALT indicator in the ECAM was verified, which would be activated in case of cabin values equal to or above 9,550ft.

The data also showed that the parameters of CAB ALT FT, CAB V/S FT/MIN and §P indication remained normal (green color indications).

Even so, in the face of the suspicion of silent depressurization (not announced by the aircraft), examinations, research, and analyses on the components of the system were performed.

The two CPCs were sent for analysis at Nord-Micro, in Germany, and there were no flaws in the bench tests.

According to the analyzes in the CPCS, failures were not detected and no problems were detected in the control of pressurization.

There were no fault entries in the non-volatile memory. The CPCs have passed the functional test, according to the CMM. The pressure sensors were checked as part of the CMM function test procedure.

With the information available, it was demonstrated that the CPCS functioned as planned (without malfunction or failure).

The hypothesis of incorrect control of the cabin pressure, caused by the detection of wrong pressure values, without an alarm displayed to the crewmembers, was also addressed. This would only be possible in the event of a triple failure on the aircraft, which is extremely unlikely. There was no evidence that they were consistent with this failure scenario.

Such data are indicative that there was no depressurization at any time during the flight. It was also not possible to identify any evidence of aircraft failure.

During the investigation, it was identified that, at the beginning of the flight, there was an event involving an increase in air flow in the aircraft. According to the CVDR audio

records, the pilots identified an increase in airflow through the cabin sockets, when the aircraft crossed approximately the FL100.

This increase in air flow resulted in intense noise in the cockpit and, in the passengers' cabin, there was also a drop in temperature.

No factors associated with abnormal behavior in increasing flow and low temperature were identified with possible unannounced depressurization of the cabin.

When considering that the evidence of decompression was sensitive, triggered by the chief flight attendant and reinforced by the flight attendant of the front position 2, the Investigation Team decided to carry out a simulation exercise in a hypobaric chamber, in order to compare the physiological sensations experienced by the crewmembers, in the incident, with the physiological sensations in a situation of real hypoxia in the chamber.

It is noteworthy that none of the crewmembers knew the symptoms of a real hypoxia.

As prevised in the medical literature, people do not manifest symptoms of hypoxia in the same way and with the same intensity, as well as have different levels of resistance to the adverse effects of exposure to hypoxia conditions.

In the pilots' perception, before the simulation, there were no symptoms or sensations during the flight that indicated the possibility of depressurization. With the reservation that the commander considered that he might have presented "tunnel vision" while trying to identify what caused the problem with the aircraft's air outlet.

According to the commander, after the simulation in the chamber, he suspected that the condition of "tunnel vision" could be similar to the sensation experienced in flight.

It was not possible for the copilot to go to the simulation, due to health issues.

In the interviews, before the simulation, the flight attendants positioned at the bottom of the aircraft had not identified any signs or symptoms, nor did they report any malaise. After the simulation, they did not identify similarities in the sensations of hypoxia in the chamber with possible sensations experienced in the flight of the occurrence.

The chief flight attendant reported similarities in the sensations experienced in the simulation in relation to those experienced in the flight of the occurrence.

The flight attendant of the front position 2 did not participate in the simulation. During the preparation for the exercise, she was unable to do it.

This flight attendant reported hyperventilation and tachycardia, as well as a tingling complaint in her hands, even though she had not been without the oxygen mask at any time since the beginning of the simulation exercise.

In short, of the four crewmembers who completed the simulated flight in the chamber, only the chief flight attendant showed similarity in most of the symptoms experienced in the actual flight. The flight attendant from the front position 2 presented a picture of anxiety and symptoms that prevented the simulation from continuing. The other crewmembers had difficulties in reporting symptoms or complaints compatible with a possible hypoxia effect on the occurrence's flight.

In this case, it was reported that the increase in the outflow of air, at the beginning of the flight, startled the crew. The flight attendants in the front galley were concerned about flight conditions and were alert to the possibility of depressurization.

According to the data obtained during the interviews, part of the flight attendant crew dealt with memories evoked at the beginning of the flight, related to an already known occurrence, in which there was depressurization and fatal accident with a foreign airline aircraft.

According to the chief flight attendant, what motivated the request for oxygen masks was her perception that there was a problem with the aircraft's pressurization, due to the malaise she was feeling.

This malaise was characterized by a strong feeling of fainting, pressure in the abdomen and perception of slowness. These manifestations intensified until a feeling of loss of strength and fainting, when she chose to contact the commander of the aircraft.

She reported that, from where she was, she could see the entire corridor of the aircraft until the end and noted that "the passengers were very quiet and silent". She found this a strange fact, from her experience, because it was a flight with many children on board. She also noticed that the flight attendant sitting next to her was feeling very bad.

As reported, the flight attendants positioned in the front galley of the aircraft had experienced symptoms of malaise that had intensified throughout the flight. The other crewmembers had not clearly identified any symptoms until the masks had been released.

The chief flight attendant had received the opinion - able for the intended purpose, at her last INSPSAU and, on that occasion, reported that she had undergone health treatment about a year earlier. Due to this treatment, she had been away from the roster for about a year and had returned to the flight less than a month ago.

During the period of her treatment, she used controlled medications, which could trigger withdrawal symptoms after stopping their use, ranging from a few hours to a week or more. The symptoms of withdrawal could be restricted to tremor, agitation, insomnia, anxiety, headache, difficulty concentrating, sweating, muscle and abdominal spasms, changes in perception and, more rarely, delirium and seizures.

Bearing in mind that the symptoms presented by this flight attendant, on the flight in question, had similarities with those described in cases of withdrawal from the drug, the Investigation Team raised the hypothesis that this may have generated an anxiety crisis and the same symptoms described in the previous paragraph, associated with the lack of the medication.

The abstinence situation can be associated with the great concern of increasing air flow at the beginning of the flight and the memory of the famous accident of the Helios flight, in 2005, due to the depressurization. Such circumstances, possibly, raised the level of anxiety of the crewmembers and favored physiological responses that culminated in the perceived malaise.

The flight attendant in front position 2 also reported symptoms of malaise during the flight. She stated that, at a given time on the flight, she experienced abdominal pain, described as "twisting abdomen". In addition, she also felt pain in the nape, head and neck. In her statement, she used the expression "neck pulling" to describe the uncomfortable feeling.

According to her report, on the day of the incident, she had used drugs prescribed by a health professional. This medication, as previously described, had a range of side effects that resembled some of the symptoms experienced by this flight attendant.

In this scenario, it was not possible to rule out the hypothesis that the malaise presented by the flight attendants positioned in the front galley of the aircraft may have resulted from a greater sensitivity to abstinence and / or the use of certain medications.

Although there were no indications of depressurization of the aircraft and the commander confirmed that there were no pressurization problems, the intensity of the responses experienced in those conditions may have produced the feeling of urgency, leading to the decision to request the release of oxygen masks to solve the problem.

Despite having doubts about the unusual behavior of the air flow in the aircraft, the commander remained convinced about the procedures performed, maintaining his position that the aircraft was properly pressurized, even when questioned.

This directing of attention to less accurate and relevant information, such as the repetitive consultation of partial information (through outflow valve positions), reduced the ability to analyze the situation, which may have impacted on the quality of management of that emergency.

The crewmembers that composed the flight was considered experienced and had received the training established by the company, in line with the requirements of the legislation in force at the time of the occurrence. However, the programmatic content of the training did not include the exploration, in practice, of the physiological signs and symptoms of hypoxia.

The crewmembers had no practical physiological training in hypoxia before the event that caused this occurrence.

In the theoretical training carried out by the crew, the detection of depressurization was addressed with emphasis on the aircraft signals that should be observed and identified by each crewmember, according to their function.

Thus, the superficiality with which the topic of hypoxia was addressed in their training consisted of a vulnerability in the training processes offered by the organization, as some pertinent information that could assist in the decision-making process were no longer transmitted.

Although, at the theoretical level, the presentation of symptoms and indicators of this physiological state could facilitate the recognition of abnormal situations in flight, especially in circumstances of failure of the aircraft's warning system, the crewmembers lacked to experience such symptoms and to compare them to what they were feeling at the time.

Although it was not a requirement in the legislation in force at the time of the occurrence, physiological training is a barrier in favor of flight safety, as it improves the ability to identify and manage situations of high demand for the human organism.

The knowledge acquired about this type of emergency and the possible effects that it may cause could promote better conditions for the management of emotional responses and sedimentation of the skills required to support the decision-making process in such cases.

During the investigation process, it was possible to identify that, despite having the necessary knowledge to deal with the situation experienced after the release of oxygen masks, this situation was not interpreted by the pilots as an in-flight emergency.

It should be noted that the decision on whether or not to declare an emergency in flight is a prerogative of the aircraft commander. In this case, the fact that they had not identified any problem with the aircraft led the pilots to consider the activation of the oxygen masks as a precautionary measure.

However, the absence of the emergency declaration, the difficulties in managing the passengers' cabin and the performance of procedures in an accelerated manner due to the need to change runways, showed aspects in the emergency management that could be improved.

There were reports that some passengers felt some discomfort when dealing with oxygen masks, feeling a slight burning sensation in the fingers or part of the hands, but there was no ambulance or medical team after the aircraft landed, due to the absence of an emergency statement or support request.

On their return, the crewmembers' perception was that the event had not been a serious situation and they did not consider the hypothesis that any passenger or crewmember might need medical attention.

The control agencies were not aware of the reason for returning the aircraft to the airport of origin. Due to this fact, Brasilia's ground control instructed the crew to taxi and park the aircraft in a remote area of the airport. There was the presence of the Federal Police at the time of disembarkation.

According to the ICA 100-37 / 2018, item 3.14.4.1, valid at the time, an aircraft in emergency should transmit radiotelephone messages preceded by the expressions MAYDAY or PAN PAN respectively, in distress or emergency situations, preferably pronounced three times.

When considering the occurrence scenario, it is possible that the lack of aircraft indications led to a devaluation of the possible risks associated with that flight condition.

Added to this context are the divergences regarding the perception of urgency, as well as the possible concern with the repercussion of the event, which may have favored the decision not to declare an emergency.

Such fact may be the result of a culture shared among crewmembers, especially among pilots, with an interest in pursuing a career in international aviation, as the involvement in events classified as a serious incident or accident can cause losses to the professional's curricular evaluation.

Thus, either due to lack of knowledge, misinterpretations as to what had occurred or, still, due to the fear of a negative impact on the career, there was a failure to comply with the procedures provided for an emergency situation in flight.

Although this fact did not have a direct relationship with the event, it denoted a latent condition that weakens the culture of flight safety, since, in another situation, important measures would no longer be adopted.

3. CONCLUSIONS.

3.1 Facts.

a) the crewmembers had valid CMAs;

b) the pilots had valid A320 aircraft type Rating (which included the A320-232 model) and IFRA Ratings;

c) the flight attendants had valid A320 aircraft type Rating;

d) the crewmembers were qualified and had experience in the kind of flight;

e) the aircraft had valid CA;

f) the aircraft was within the weight and balance limits;

g) the technical maintenance records were updated;

h) the weather conditions were favorable for the flight;

i) during the climbing, when crossing the FL100, there was an increase in the air flow inside the aircraft;

j) the flight attendants positioned at the front of the aircraft reported that they were vigilant as to the possibility of depressurization, after the abnormality in the operation of the air vents perceived in the FL100;

k) during the climb, after the FL100, the commander made contact with the maintenance in Brasilia, in order to check the situation (excessive noise and increased air flow);

l) at approximately FL275, the chief flight attendant contacted the cockpit, reporting a significant absence of oxygen in the passengers' cabin;

m) the commander reported that the aircraft was not depressurizing;

n) the commander manually triggered the release of the oxygen masks (MASK MAN ON);

o) the commander interrupted the climb and requested the air traffic control to return to SBBR;

p) according to the crewmembers, no visual or audible warning of depressurization was announced by the aircraft, in the cockpit or in the passengers' cabin;

q) according to data extracted from the CVDR, the parameters of CAB ALT FT, CAB V/S FT/MIN and pressure differential (§P indication) remained normal (green light);

r) the flight data, recorded and validated by the CVDR, showed a maximum Cabin Altitude of 6,000ft and a maximum Cab Diff Press of 6.88psi;

s) during the aircraft's pressurization tests on the ground, the pressurization parameters behaved within normal limits;

t) the two CPCs were sent for analysis at Nord-Micro, in Germany;

u) there were no failures in the bench tests in the two CPCs;

v) the chief flight attendant in the passengers' cabin reported feelings of depressurization;

w) the chief flight attendant had recently returned to the flight roster after a seven months' leave for medical reasons of anxiety, depression, and insomnia;

x) during the period of her treatment, the chief flight attendant made use of controlled medication (antidepressant);

y) the flight attendant from the front position 2 also reported symptoms of discomfort during the flight;

z) on the day of the incident, the flight attendant in front position 2 had used prescription drugs (analgesics and antidepressants);

aa) the crewmembers did not receive physiological training and had little theoretical knowledge to identify the clinical manifestations related to hypoxia;

bb) the training in depressurization and hypoxia, received by the flight attendants, during initial and periodic training, was theoretical, based on the identification of the light and sound signals of the aircraft;

cc) a hypoxia simulation exercise was carried out, with four crewmembers, in the IMAE hypobaric chamber;

dd) of the four crewmembers who participated in the simulation, only the chief flight attendant reported some similarity between the symptoms experienced in the flight of the occurrence and in the hypobaric chamber;

ee) it was not possible to collect blood from the crew and passengers immediately after the occurrence;

ff) the crewmembers were submitted to toxicological examination and the final result confirmed the absence of psychoactive substances;

gg) no rescue or emergency was declared by the crew, for the control agencies;

hh) the control agencies were not aware of the reason for the aircraft's return;

ii) the aircraft was undamaged; and

jj) all occupants left unharmed.

3.2 Contributing factors.

- **Attention – undetermined.**

During the verification of the ECAM, the pilots stopped consulting information about the aircraft's pressurization system, as well as the cabin altitude indication, and the commander fixed his attention on the information from the outflow valve.

Such behavior denoted a focus on attention to less relevant stimuli for understanding the situation, which may have reduced the ability to analyze the emergency presented in flight.

Training – undetermined.

Although the crew members had the training provided for the function they performed, the theoretical content on hypoxia proved to be insufficient to ensure basic knowledge to identify the clinical manifestations related to hypoxia. Such a situation may have contributed to a deficient identification of the real symptoms and effects of hypoxia.

- **Emotional state – undetermined.**

The context of uncertainty installed by the sudden increase in airflow at the beginning of the flight, as well as by the unpredictability of the course of action to be adopted, may have favored a change in the emotional state of part of the crew, to the point of promoting a picture of intense malaise, which culminated in the request for the release of the oxygen masks.

- Decision-making process – undetermined.

The lack of consultation with some information pertinent to the conditions and parameters of the aircraft during the flight, prevented a broader analysis of the condition experienced, which may have limited the possibilities for corrective actions and impacted on the quality of the situation management.

- **Medicine intake – undetermined.**

A hypothesis was raised that the malaise presented by the flight attendants positioned in the front galley of the aircraft may have resulted from a greater sensitivity to abstinence and/or use of antidepressant/analgesic medications.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 "Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State".

Recommendations issued at the publication of this report:

To the Brazil's National Civil Aviation Agency (ANAC):

IG-012/CENIPA/2016 - 01 **Issued on 07/21/2021**

Evaluate the feasibility of working with the regular transport airlines (RBAC 121) to improve the training offered to the crewmembers, on the effects and symptoms of hypoxia, in order to increase the possibilities of identifying the physical symptoms related to this occurrence, in addition to the signals indicated by the aircraft to detect pressurization problems (lights and sounds).

IG-012/CENIPA/2016 - 02 **Issued on 07/21/2021**

Evaluate the feasibility of working with the regular transport airlines (RBAC 121), in order to alert the crewmembers about the effects of the use and/or abstinence from antidepressant medications in the performance of their professional activities.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On July 21th, 2021.