COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
IG - 045/CENIPA/2014

OCCURRENCE:	**SERIOUS INCIDENT**
AIRCRAFT:	**PT-MZX**
MODEL:	**A320-232**
DATE:	**28FEB2014**

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 28FEB2014 serious incident with the A320-232 aircraft, registration PT-MZX. The serious incident was classified as “[SCF-NP] System/Component Failure or Malfunction Non-Powerplant / Unintentional/Combustion Decompression”.

During the descent to land at the Antônio Carlos Jobim International Aerodrome - RJ, the aircraft had problems in the pressurizing system. The oxygen masks fell automatically and the crew made an emergency descent. The landing occurred normally.

The aircraft did not have damage.

All occupants 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 designed/manufactured) was designated for participation in the investigation.

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ACARS	ARINC Communication Addressing and Reporting System
AEVC	Avionics Equipment Ventilation Computer
BEA	*Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile*
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
CVR	Cockpit Voice Recorder
DMU	Data Management Unit
ECAM	Electronic Centralized Aircraft Monitoring
EO	Engineering Order
FDR	Flight Data Recorder
IFR	Instrument Flight Rules
IFRA	Instrument Flight Rating - Airplane
IIC	Investigator In Charge
NFF	No Fault Found
PCM	Commercial Pilot License – Airplane
PFR	Post Flight Report
PLA	Airline Pilot License – Airplane
PPR	Private Pilot License – Airplane
QAR	Quick Access Recorder
RS	Safety Recommendation
SATCOM	Satellite Communication
SBGL	ICAO Location Designator - Galeão Aerodrome - Antônio Carlos Jobim, Rio de Janeiro - RJ
SBSV	ICAO Location Designator - Deputado Luís Eduardo Magalhães Aerodrome, Salvador - BA
SIPAER	Aeronautical Accident Investigation and Prevention System
TPR	Aircraft Registration Category of Regular Public Air Transport
UTC	Universal Time Coordinated
VRF	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** A320-232 **Registration:** PT-MZX **Manufacturer:** Airbus Industrie	**Operator:** TAM Airlines S.A
Occurrence	**Date/time:** 28FEB2014 - 1909 UTC **Location:** Outside the Aerodrome **Lat.** 22°48'36"S **Long.** 043°15'02"W **Municipality – State:** Rio de Janeiro - RJ	**Type(s):** [SCF-NP] System/Component Failure or Malfunction Non-Powerplant **Subtype(s):** Unintentional/Explosive Decompression

1.1 History of the flight.

The aircraft took off from the Deputado Luís Eduardo Magalhães Aerodrome, Salvador - BA (SBSV), to the Antônio Carlos Jobim International Aerodrome (SBGL), Rio de Janeiro - RJ, at 1748 (UTC), in order to transport personnel, with 6 crewmembers and 149 passengers on board.

About twenty minutes before the landing, during the descent, the aircraft presented problems in the pressurizing system. The oxygen masks fell automatically and the crew performed an emergency descent.

The landing occurred without problems.

The aircraft did not have any damage.

All occupants left unharmed.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	6	149	-

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.

Hours Flown		
	Pilot	Copilot
Total	7.500:00	7.200:00
Total in the last 30 days	73:45	75:42
Total in the last 24 hours	12:34	12:34
In this type of aircraft	2.500:00	3.800:00
In this type in the last 30 days	73:45	75:42
In this type in the last 24 hours	12:34	12:34

N.B.: The data related to the flown hours were obtained through the Operator's records.

1.5.2 Personnel training.

The pilot took the PPR course at the São Leopoldo Aeroclube - RS, in 1994.

The copilot took the PPR course at the Rio Grande do Sul Aeroclube - RS, in 2001.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PLA License and had valid A320 aircraft and IFRA Ratings.

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

1.5.4 Qualification and flight experience.

The pilots were qualified and had experience in that kind of flight.

1.5.5 Validity of medical certificate.

The pilots had valid Aeronautical Medical Certificates (CMA).

1.6 Aircraft information.

The aircraft, serial number 1613, was manufactured by the Airbus Industrie, in 2001, and was registered at the TPR category.

The aircraft had valid Airworthiness Certificate (CA).

The airframe and engine logbook records were updated.

The last inspection of the aircraft, the "Daily Check" type, was carried out on 27FEB2014, by the TAM Airlines VIX maintenance organization, in Vitória – ES, having flown 15 hours after the inspection.

The last overhaul of the aircraft, the "Check A" type, was carried out on 09JAN2014, by the TAM Airlines CWB maintenance organization, in São José dos Pinhais - PR, having flown 422 hours after the overhaul.

The aircraft had a total of 42.176 hours and 35 minutes of flight at the moment of the occurrence.

ECAM - Electronic Centralized Aircraft Monitoring

The A320-232 had an electronic monitoring system, the Electronic Centralized Aircraft Monitoring (ECAM). This system presented information to the pilots through a screen located in the instrument panel of the aircraft and had the following purposes:

- provide pilots with information on aircraft systems;

- monitoring aircraft systems; and

- indicate required actions of the crew in normal, abnormal and emergency situations.

The system also provided feedback to pilots. To the extent that they performed the actions required for a particular checklist, the rows corresponding to those procedures were suppressed from the screen.

This feature was part of the "paperless cockpit" philosophy of the aircraft manufacturer.

The A320-232's pressurizing system operated automatically, through valves that controlled the pressure inside the aircraft. That way, if it was flying at 35,000ft, for example, the interior of the cabin would be at a lower altitude (around 8,000ft), ensuring the safety and comfort of everyone on board.

Due to the importance of this system for safely conducting the flight, some parameters were constantly monitored. Alerts associated with it were communicated to pilots in case of malfunction or emergency.

In case of depressurization the aircraft, the oxygen masks were automatically activated.

DMU - Data Management Unit

The Data Management Unit (DMU) was a unit that received various parameters from several sensors installed on the aircraft. It received this information and sent it to Flight Data Recorder (FDR), Quick Acces Recorder (QAR), and the ARINC Communication Addressing and Reporting System (ACARS).

ACARS - ARINC Communication Addressing and Reporting System

The ACARS was responsible for transmitting, through VHF or Satellite Communication (SATCOM), the information collected by DMU, which was interpreted by software. The interpretation of these data generated a report called the Post Flight Report (PFR).

AEVC - Avionics Equipment Ventilation Computer

The Avionics Equipment Ventilation Computer (AEVC) controlled the operation of fans and valves in the avionics ventilation system, among them, the Skin Air Inlet and Outlet Valves.

The Skin Air Outlet Valve (FIN 22HQ) had a rectangular flap called a small flap.

1.7 Meteorological information.

The conditions were favorable for the visual flight.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place outside the Aerodrome.

1.11 Flight recorders.

The aircraft was equipped with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR).

The recorders were installed and in perfect working order. However, the aircraft remained energized after landing, which resulted in the loss of the CVR information regarding the flight of the incident.

The Post Flight Report (PFR) data was downloaded at the aircraft operator's premises under the supervision of the Investigator in Charge (IIC). Since the PFR information came from the same source that fed the FDR, it was not necessary to extract the data from the FDR.

1.12 Wreckage and impact information.

Nil.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Not investigated.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Not investigated.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

The PFR contained the fault records in real time. Since its information came from the DMU, the origin and the fidelity of its data were the same as the FDR, reason why it was not necessary to download the flight data recorder.

The following messages were recorded in the PFR:

Leg	0	Flight Number	JJ3193
From	SSA	First Event Date	28 Feb 14 - 11:06
To	GIG	Last Event Date	28 Feb 14 - 19:30

CMS:PFR_TAB

Fault tracking	Phase	Date Time	ATA	Source	Title	Class	Occurrence History	Priority	Work	Note
REPETITIVE	05-LIFT OFF	28 Feb 14 - 17:48	212653	AEVC	SKIN AIR OUTLET V 22HQ		xxx.xx.x.xx..xx			
	06-CRUISE	28 Feb 14 - 18:13	2126		VENT SKIN VALVE FAULT		xx	Medium		
	06-CRUISE	28 Feb 14 - 18:14	2126		VENT BLOWER FAULT		x	Low		
	06-CRUISE	28 Feb 14 - 19:07	2126		VENT SKIN VALVE FAULT		xx	Medium		
	06-CRUISE	28 Feb 14 - 19:09	2126		VENT EXTRACT FAULT		x	Medium		
	06-CRUISE	28 Feb 14 - 19:08	213134	ECAM 2	SDAC1:NO CPC1 ANALOG SIGNAL		x			
	06-CRUISE	28 Feb 14 - 19:09	2131		CAB PR EXCESS CAB ALT		x	High		
	06-CRUISE	28 Feb 14 - 19:10	2131		CAB PR LO DIFF PR		x	Medium		
	06-CRUISE	28 Feb 14 - 19:16	2131		CAB PR SAFETY VALVE OPEN		x	High		
REPETITIVE	09-80 KTS	28 Feb 14 - 19:27	2126		VENT AVNCS SYS FAULT		xxx.x..x.x...xx	High		

Figure 1 - PFR screen with the messages associated with the incident flight.

The equipment divided the flight into numbered phases. The Phase 05-LIFT OFF corresponded to the period between takeoff and the moment the aircraft reached 1,500ft high.

At this stage of the flight, some less critical warning messages were inhibited, in order to allow the crewmembers to concentrate fully on takeoff procedures without deviance. SKIN AIR OUTLET V 22HQ was inhibited at this stage.

The Phase 06-CRUISE corresponded to the period from when the aircraft reached 1,500ft high, after takeoff, to landing, including all cruise and descent. At this stage, the SKIN AIR OUTLET V 22HQ message was not inhibited.

During the research related to the pressurizing system and its components, tests were performed on the Skin Air Outlet Valve, conducted by SAFRAN Technofan LLC. During the tests, it was found that the small flap did not close completely when the valve was electrically driven. It remained open of 1 to 2 millimeters. In Figures 2 and 3 it is possible to see the gap (opening) of 1 to 2 millimeters, indicated by the green arrows.

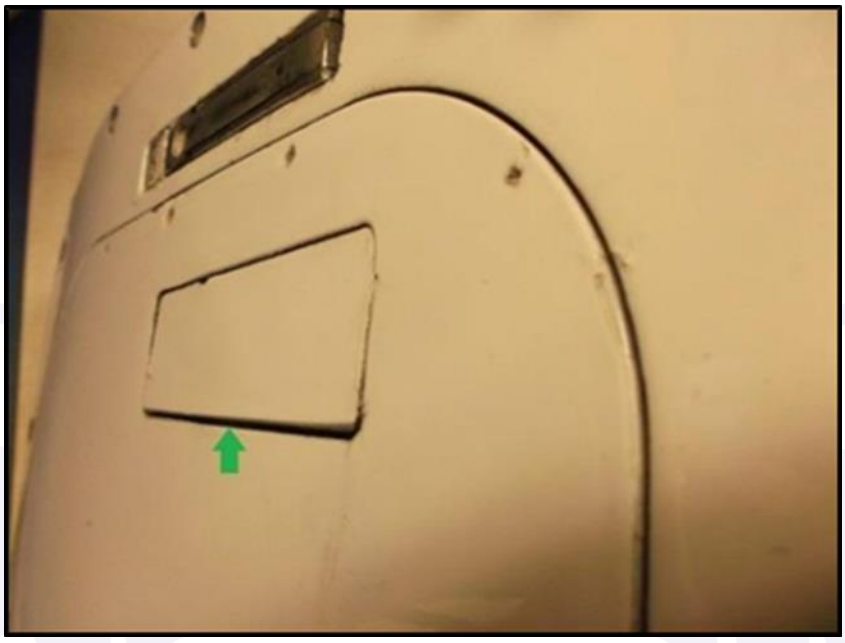


Figure 2 - External view of the small flap partially open, after closing by electric activation.

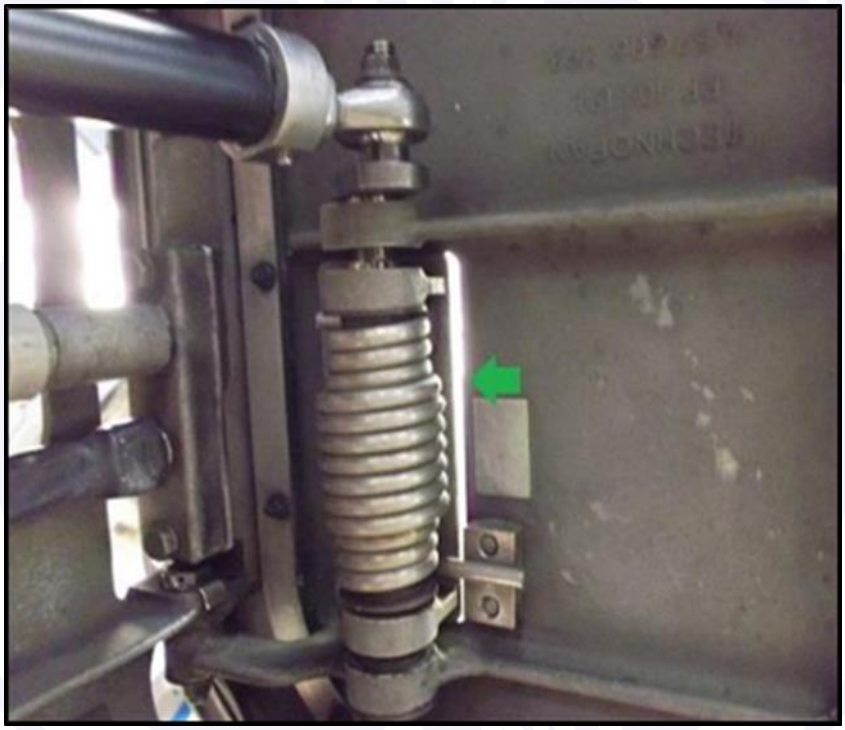


Figure 3 - Internal view of the small flap partially open, after closing by electric activation.

However, when the valve was manually operated, the small flap closed completely, as shown in Figures 4 and 5.

Figure 4 - External view of the fully closed small flap, after manual activation.

Figure 5 - Internal view of the small flap fully closed, after manual activation.

The tests were inconclusive on the relation between the 1 to 2 mm gap and the cabin depressurization. For many times, an attempt was made to reproduce the event observed in flight without success. In this way, the component was considered "approved" in all attempts.

The leakage caused by the gap was considered small, insufficient to have generated the depressurization of the cabin.

At the end of the tests, the component manufacturer concluded that the Skin Air Outlet Valve did not fail (No Fault Found - NFF).

In addition to the Skin Air Outlet Valve, the pressurization system had an Avionics Equipment Ventilation Computer. This computer controlled the operation of fans and valves of the avionics ventilation system, among them the Skin Air Outlet Valves.

The operator was already performing the replacement of the AEVC software by a more up-to-date version in its entire fleet.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

The aircraft was within the weight and balance limits specified by the manufacturer.

The incident flight was the third leg of the day. It was added by request of the flight schedule and was within the crew regulations, without the need for extension.

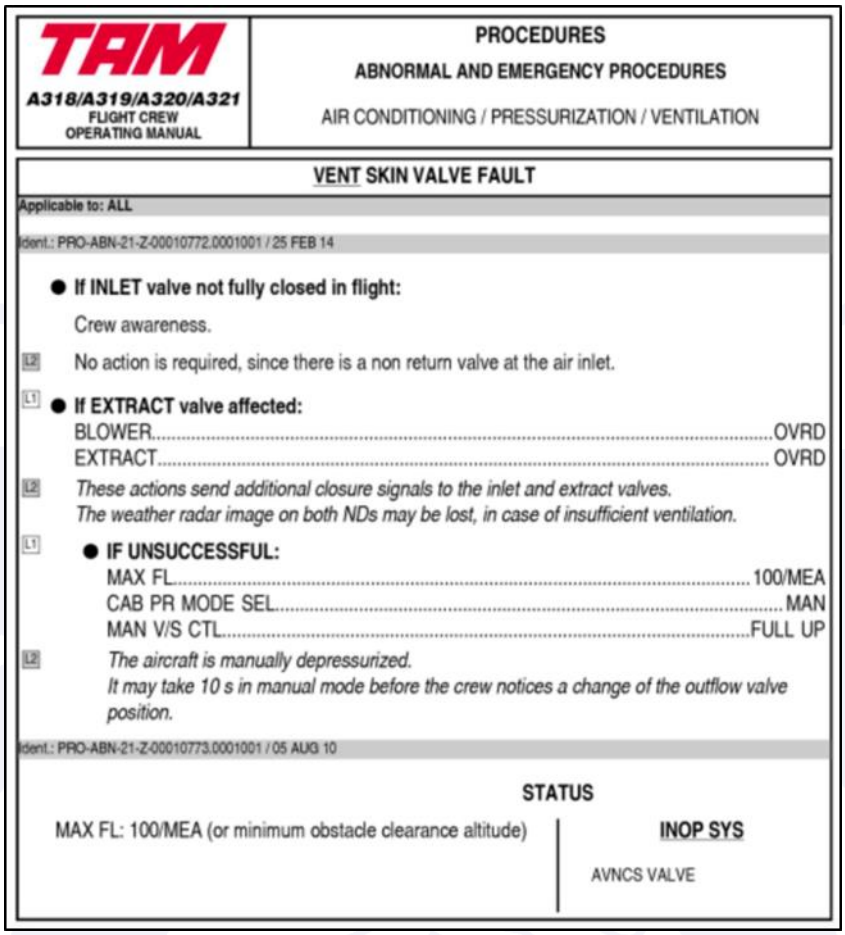
The crew took over the aircraft without any problems.

The take-off took place at 1748 (UTC). Also at 1748 (UTC), SKIN AIR OUTLET V 22HQ was registered. Because it was Phase 05-LIFT OFF, this message was inhibited by the system and no associated warning appeared on the pilot’s display.

At 1813 (UTC), when the aircraft was at Phase 06-CRUISE at cruising level (35,000ft), the VENT SKIN VALVE FAULT message appeared on ECAM. At this stage, the messages were no longer inhibited by the system.

The pilots carried out the planned corrective actions, and the system was taken to the OVRD condition, according to the checklist. The message has been deleted.

A minute later, at 1814 (UTC), the message "VENT BLOWER FAULT" appeared on the ECAM. For this message, there were no associated actions, since the system had already been placed in OVRD.



TAM

A318/A319/A320/A321
FLIGHT CREW
OPERATING MANUAL

PROCEDURES

ABNORMAL AND EMERGENCY PROCEDURES

AIR CONDITIONING / PRESSURIZATION / VENTILATION

VENT SKIN VALVE FAULT

Applicable to: ALL

Ident.: PRO-ABN-21-Z-00010772.0001001 / 25 FEB 14

● If INLET valve not fully closed in flight:

Crew awareness.

L2 No action is required, since there is a non return valve at the air inlet.

L1 ● If EXTRACT valve affected:

BLOWER.....OVRD
EXTRACT.....OVRD

L2 *These actions send additional closure signals to the inlet and extract valves.*
The weather radar image on both NDs may be lost, in case of insufficient ventilation.

L1 ● IF UNSUCCESSFUL:

MAX FL.....100/MEA
CAB PR MODE SEL.....MAN
MAN V/S CTL.....FULL UP

L2 *The aircraft is manually depressurized.*
It may take 10 s in manual mode before the crew notices a change of the outflow valve position.

Ident.: PRO-ABN-21-Z-00010773.0001001 / 05 AUG 10

STATUS

MAX FL: 100/MEA (or minimum obstacle clearance altitude)	INOP SYS
	AVNCS VALVE

Figure 6 - Operator checklist associated with pressurizing system failures.

During the descent, when the aircraft approached the FL200 (20,000ft), the crew felt discomfort. It was observed by the pilots that the cabin altimeter was rising very fast.

Then, starting at 1907 (UTC), a series of messages associated with the system appeared and emergency descent procedures emerged in ECAM.

The PFR recorded the following messages:

- 19h07min (UTC) - VENT SKIN VALVE FAULT;

- 19h09min (UTC) - VENT EXTRACT FAULT;

- 19h09min (UTC) - CAB PR EXCESS CAB ALT;

- 19h10min (UTC) - CAB PR LO DIFF PR; and

- 19h16min (UTC) - CAB PR SAFETY VALVE OPEN.

During the issuance of these messages, the pilots began the next step of the checklist procedures, fulfilling all the items described below under the IF UNSUCCESFULL inscription, in Figure 6 above.

The crew made an emergency descent, using oxygen masks, in coordination with the Air traffic control unit.

The aircraft depressurized and the oxygen masks of the passenger cabin fell automatically.

Upon reaching FL100, with the situation controlled, the oxygen masks were removed.

The Air traffic control questioned whether the situation had been controlled and whether the aircraft would need any ground aid. The crew dismissed additional means of emergency support.

The descent procedure was performed and the landing occurred normally.

1.19 Additional information.

Nil.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

This was a regular passenger transport flight between SBSV and SBGL Aerodromes. This was the third leg of the day. It was added to the routine of the crew by request of the flight schedule. Such inclusion did not go beyond the limits of the work schedule and, according to them, did not represent an overload in their activities.

The data recorded in the PFR registered the message SKIN AIR OUTLET V 22HQ at 1748 (UTC), time of takeoff. However, this message was inhibited because the aircraft was in Phase 05-LIFT OFF. Inhibition of messages on takeoff (Phase 05-LIFT OFF) only occurs up to 1,500ft, which the plane reaches in a few minutes.

Therefore, if the failure was not intermittent (it remained manifesting), the message would appear on the pilots' display and would require a consultation procedure to checklist and carry out actions associated with the failure. However, as the failure was intermittent, the pilots proceeded on the climb normally.

The aircraft surpassed 1,500ft in height and entered Phase 06-CRUISE. No messages were recorded by PFR within 25 minutes. It is noteworthy that in this phase of the flight (Phase 06) the messages were no longer inhibited by the system.

At 1813 (UTC), the PFR recorded the message VENT SKIN VALVE FAULT. With the appearance of the message, the pilots took the pressurizing system to the OVRD condition, according to the checklist. This action caused the message to be suppressed.

A minute later, at 1814 (UTC), the message VENT BLOWER FAULT appeared. For this message, no associated actions appeared in the ECAM, since the pilots had already placed the system in OVRD.

Starting at 1907 (UTC), a series of messages associated with the system appeared and emergency descent procedures emerged in ECAM.

The pilots began an emergency descent following the procedures provided in the checklist.

The data recorded in the PFR showed that the aircraft presented intermittent problems associated with the pressurizing system from the moment of take-off. The intermittent nature of the problems in the system explains the time gap between messages recorded by the PFR.

Tests performed on Skin Air Outlet Valve found that the small flap did not close completely when the valve was electrically driven, leaving a gap of 1 to 2 millimeters. However, the leakage caused by the small flap opening was considered small.

Numerous attempts were made to try to reproduce a depressurization event, but all of them were unsuccessful. Thus, it was not possible to establish a direct relationship between the presence of the gap and the depressurization of the aircraft.

Despite this, the PFR recorded message history relates to an intermittent Skin Air Outlet Valve failure condition, which may establish an indirect relationship between the operational condition of the component and the depressurization of the aircraft.

The registration of the message CAB PR EXCESS CAB ALT, associated to the fact that the oxygen masks were activated automatically, showed that cabin altitude exceeded the 9,550ft limit. Therefore, there was depressurization of the aircraft.

The cabin depressurization occurred during the descent procedure, while the pilots performed the steps described below under the IF UNSUCCESFULL inscription of the checklist when the aircraft crossed approximately 20,000ft.

The steps of the procedure contained the following items:

- IF UNSUCCESSFULL
  - MAX FL 100/MEA
  - CAB PR MODE SEL MAN
  - MAN V/S CTL FULL UP

The aircraft is manually depressurized.

It may take 10s in manual mode before the crew notices a change of the outflow valve position.

The description of the procedure made it clear that the aircraft would be depressurized after the actions were performed.

The checklist brought the procedures in sequence but did not highlight the need to reach the MAX FL 100 / MEA before completing subsequent items. In this way, it is possible to assume that a crew, when starting a descent for the FL100, continued to perform the actions previsted in the checklist, taking the CAB PR MODE SEL to MAN and the MAN V / S CTL to FULL UP.

This action would force the Outflow Valve to the fully open position, causing the aircraft to depressurize, and if the depressurization occurred at an altitude above the threshold limit of the oxygen masks, they would automatically fall off.

All items in the checklist were performed by pilots, including moving the CAB PR MODE SEL to MAN.

However, since the CVR data were not preserved, it was not possible to retrieve the dialogues between the pilots at the time of the procedure. Therefore, it was not possible to determine if the cabin depressurization occurred at the exact moment when the crew performed the checklist actions, in particular the movement of the CAB PR MODE SEL to MAN and the MAN V / S CTL to FULL UP.

The tests performed on the Skin Air Outlet Valve failed to establish a relationship between the existing gap and the depressurization on the aircraft. However, the actions of the pilots, by performing the checklist procedures without waiting for the FL100 arrival, contributed to the loss of pressure inside the cabin.

In this context, it is possible that an intermittent failure in the components of the aircraft pressurizing system due to handling, storage or use under inadequate conditions has caused changes in its intended design behavior, contributing to the depressurization of the aircraft in flight.

Also, a misinterpretation of the wording of the checklist may have led the crew to choose to move the CAB PR MODE SEL to the MAN position and the MAN V / S CTL to FULL UP before the aircraft was below FL100 / MEA, which caused the loss of pressure of the cabin through the manual opening of Outflow Valve, characterizing a possible inadequacy of the material (checklist) available for the crew to perform their functions.

3. CONCLUSIONS.

3.1 Facts.

a) the pilots had valid Aeronautical Medical Certificates (CMA);

b) the pilots had valid A320 aircraft and IFRA Ratings;

c) the pilots were qualified and had experience in that kind of flight;

d) the aircraft had valid Airworthiness Certificate (CA);

e) the aircraft was within the limits of weight and balance;

f) the technical maintenance records were updated;

g) weather conditions were favorable for the flight;

h) the aircraft took off from SBSV to SBGL at 1748 (UTC);

i) the take-off and climb phases were performed without any abnormality;

j) during the descent procedure, when crossing FL200, the aircraft had a cabin depressurization;

k) tests performed on the Skin Air Outlet Valve found that the small flap did not close completely when the valve was electrically activated;

l) when the valve was manually activated, the small flap closed completely;

m) the tests were not conclusive on the relation between the gap in the valve and the depressurization of the aircraft;

n) the tests were inconclusive on the relation between the version of the AEVC installed in the aircraft and the cabin depressurization;

o) the pilots performed the procedure for VENT SKIN VALVE FAULT;

p) there was the cabin depressurization;

q) the landing occurred without additional abnormalities on SBGL;

r) the aircraft was not damaged; and

s) all occupants left unharmed.

3.2 Contributing factors.

- **Material handling – undetermined.**

Although the tests performed by the component manufacturer have concluded that the Skin Air Outlet Valve (FIN 22HQ) was not faulty and the leakage caused by the small flap (gap) position was considered small to cause cabin depressurization, the mentioned valve malfunction was recorded during the event and this gap was the only abnormality found in the pressurization system during the Investigation.

In this context, it has not been possible to rule out the possibility that an intermittent failure in the aircraft's pressurization system components, due to handling, storage or use under inadequate conditions has caused changes in its expected design behavior.

- **Aircraft maintenance – undetermined.**

It was not possible to rule out the possibility that a transitory change in the functioning of the components of the pressurization system occurred due to some inadequacy of the maintenance services performed on the aircraft, preventive or corrective.

- **Decision-Making Process – undetermined.**

A misinterpretation of the checklist writing may have prompted crewmembers to switch the CAB PR MODE SEL to MAN position and MAN V/S CTL to FULL UP before the aircraft was below FL100/MEA, which caused the cabin pressure to be lost by manually opening Outflow Valve.

- **Support Systems – undetermined.**

It was not possible to discard the hypothesis that the pilots moved the CAB PR MODE SEL to the MAN position and the MAN V/S CTL to FULL UP before the aircraft was below the FL100/ MEA, due to an inadequate checklist provided for crewmembers to perform their duties, since it did not emphasize the need to reach FL100/MEA before proceeding with the next action.

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-045/CENIPA/2014 - 01 **Issued on 04/08/2019**

Monitor, through the reports of difficulties in service, the occurrence of failures involving the A320 aircraft pressurizing system.

IG-045/CENIPA/2014 - 02 **Issued on 04/08/2019**

Act with the aircraft manufacturer to ensure that the wording and language used in the A320 checklist are clear and emphasize when each action should be performed, particularly with regard to moving the CAB PR MODE SEL to the MAN position and from the MAN V/S CTL to FULL UP in the procedure for VENT SKIN VALVE FAULT.

IG-045/CENIPA/2014 - 03 **Issued on 04/08/2019**

Act with the operator of the aircraft to ensure that pilots correctly interpret the items and actions described in the emergency checklist, especially as to when the CAB PR MODE SEL should be moved to the MAN position and the MAN V/S CTL to FULL UP in Procedure Execution for VENT SKIN VALVE FAULT.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

On 16APR2014, the operator published an Engineering Order (EO) establishing the replacement of the Avionics Equipment Ventilation Computer (AEVC) software across the

company's A320 fleet. The AEVC controlled the operation of fans and valves of the avionics ventilation system, among them, the Skin Air Outlet Valves.

Nowadays, the operator fleet uses the latest version of AEVC, P / N 87292325V07, manufactured by Thales Group.

On April 08th, 2019.