



Taiwan Transportation Safety Board

Major Transportation Occurrence Draft Final Report

May 2, 2019

Mandarin Airlines Co., Ltd Flight AE7931

ATR72-212A

National Registration Number B-16851

**The aircraft cabin experienced brief loss of pressure
during descending**

Report Number: TTSB-AOR-20-xx-xxx

Report Date: xx, 2020

According to the Aviation Occurrence Investigation Act of the Republic of China and the International Civil Aviation Organization (ICAO) Annex 13, this report is only for the improvements of flight safety.

Aviation Occurrence Investigation Act of the Republic of China, Article 5:

The objective of the TTSB's investigation of major aviation occurrence is to prevent recurrence of similar occurrences. It is not the purpose of such investigation to apportion blame or liability.

ICAO Annex 13, Chapter 3, Section 3.1:

The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

Executive Summary

On May 2, 2019, Mandarin Airlines passenger flight AE7931, an ATR72-212A aircraft, registration number B-16851, took off from Kaohsiung International Airport for Hualien Airport at 14:32 with 1 captain, 1 first officer, 2 cabin crew members, 1 accompanying crew member, and 48 passengers, a total of 53 persons on board. The aircraft experienced cabin depressurization during descending. After the situation was managed by the flight crew, the aircraft landed at Hualien Airport at 15:28, with no further event. All passengers and crewmembers are safe.

After the aircraft landed at Hualien Airport, the maintenance personnel discovered that the spring of the aircraft's air-conditioning ground connection check valve might have broken before the aircraft took off from Kaohsiung Airport, resulting in the check valve not being able to be secured in fully closed position. Before the occurrence, Mandarin Airlines had not included the technical progress status for the check valve, published by the aircraft manufacturer, in the maintenance notice that required formal assessment. Mandarin Airlines did not refer to the retrofit information letter on the check valve, published by the aircraft manufacturer, for the replacement of the check valve with a modified design. On Mandarin Airlines' inspection checklists, there was no job description about checking and confirming whether the check valve was secured in fully closed position after the ground air-conditioning unit was removed.

After taking off, the engine provided the cabin with sufficient air supply to maintain the cabin altitude during the climb and cruise phase; however, during the descending phase, the engine thrust was reduced to idle, and the cabin altitude climbed to exceed threshold as the air supply decreased. Therefore, the EXCESS CAB ALT warning was triggered. The flight crew donned oxygen masks and declared MAYDAY to the ATC.

According to the Republic of China (ROC) Aviation Occurrence Investigation Act, and the content of Annex 13 to the Convention on International Civil Aviation (ICAO), Taiwan Transportation Safety Board (hereinafter referred to as the “TTSB”) was responsible for conducting an independent investigation of the occurrence. The investigation team also included members from: BEA (Bureau d'Enquêtes et d'Analyses, France), CAA Taiwan (Civil Aeronautics Administration, MOTC) and Mandarin Airlines Co., Ltd.

The ‘Draft Final Report’ of the occurrence investigation was completed in January 2020. In accordance with the procedures, it was reviewed at TTSB’s 11th Council Meeting on May 1, 2020 and then sent to relevant organizations and authorities for comments. After comments were collected and integrated, the report was reviewed and approved by TTSB’s xxth Council Meeting on XX XX, 2020. The report was published on XX XX, 2020.

There are a total of 6 findings from the draft Final Report but no safety recommendations issued to the related organizations.

Findings as the result of this investigation

Findings Related to Probable Causes

1. The check valve inside the ground air-conditioning connection might have been damaged and could not be secured in fully closed position before the aircraft took off from Kaohsiung Airport. Therefore, the aircraft’s pressurization system was connected to the atmosphere outside the cabin. When the aircraft descended from cruise altitude, the EXCESS CAB ALT warning was triggered when the cabin pressurization system failed as a result of the flight altitude, the reduction of air supply from the air-conditioning system, and the check valve could not be secured in fully closed position.

Findings Related to Risk

1. Before the occurrence, Mandarin Airlines had not evaluated the retrofit information letter (RIL-2018-03) about the modified check valve published by the manufacturer on February 2018, and had not replaced the check valve with the modified design.
2. Before the occurrence, on Mandarin Airlines' Pre-flight, Transit or Daily checklist, there was no job description about checking and confirming whether the check valve was secured in fully closed position after the ground air-conditioning unit was removed.
3. When the occurrence flight cruised at FL130, air from the cabin leaked through the check valve not secured in fully closed position and into the atmosphere. Cabin altitude gradually increased from approximately 2,000ft to approximately 8,000ft. If the flight crew had checked the exact figures of cabin altitude during the cruising phase, they could have been aware of the higher-than-normal cabin altitude earlier.

Other Findings

1. The occurrence flight crews were holders of valid airman certification and medical examination issued by Civil Aeronautics Administration, and were qualified by the Civil Aeronautics Administration and Mandarin Airlines. There was no abnormal finding from the training and check records related to this occurrence. There was no evidence indicating the performance of the flight crew was influenced by alcohol effects during the occurrence.
2. The airworthiness and maintenance of the occurrence aircraft were in compliance with the Civil Aeronautics Administration and Mandarin Airlines standards. Except for the malfunction of the ground air-conditioning check valve, there was no abnormal finding on other systems or the engine.

Safety Recommendations

Safety Recommendations

N/A

Improvement Measures Accomplished

Mandarin Airlines Co., Ltd

1. A comparison chart listing the reference cabin altitude at different flight levels and corresponding management measures was updated in Session 1.2.14 CLIMB-CRUISE and Session 2.5.5 EMERGENCY DESCENT of the ATR72-600 Flight Crew Training Manual, to help flight crews identify and manage cabin pressure anomaly at early stage.
2. A briefing report about the occurrence, along with key checking items at 10,000ft and explanation of different cabin altitudes, was included in the monthly newsletter, to help flight crew members study the estimations and recommended procedures for similar occurrences.
3. The Pre-flight, Transit and Daily checklists for aircraft ATR72-600 were revised. If the ground air-conditioning unit is connected to the departing aircraft, the flight crew should confirm the position of the air conditioning ground connection check valve after the unit is removed.
4. The occurrence aircraft (B-16851) and the other four aircrafts (B-16852 - B-16856) have replaced the old check valves with the modified air conditioning ground connection check valves to prevent the occurrence.
5. The air conditioning ground connection check valve was included as an A Check item in the ATR72-600 Aircraft Maintenance Procedures (AMP).
6. Regarding quality procedure QP-MP-03, detailed operational procedures for notice of maintenance, such as engineers to evaluate TPS, etc. was updated in the Maintenance Manual, AD and Operation Procedures for Notice of Maintenance Management. By August 30, 2019, all TPS were evaluated. New released TPS will be downloaded from the ATR website for further

evaluation every month.

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Abbreviation

CVR	Cockpit Voice Recorder
EWD	Engine Warning Display
FCOM	Flight Crew Operating Manual
FCTM	Flight Crew Training Manual
FDR	Flight Data Recorder
ILS	Instrument Landing System
PF	Pilot Flying
PM	Pilot Monitoring
PWC	Pratt & Whitney Canada
QRH	Quick Reference Handbook
RIL	Retrofit Information Letter
SID	Standard Instrument Departure
TPS	Technical Progress Status
UTC	Coordinated Universal Time

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Chapter 1 Factual Information

History of Flight

On May 2, 2019, Mandarin Airlines Co., Ltd (hereinafter referred to as “Mandarin Airlines”) passenger flight AE7931, an ATR72-212A¹ aircraft, registration number B-16851, took off from Kaohsiung International Airport (hereinafter referred to as “Kaohsiung Airport”) for Hualien Airport at 14:32² with 1 captain, 1 first officer, 2 cabin crew members, 1 accompanying crew member, and 48 passengers, a total of 53 persons on board. The aircraft experienced cabin depressurization during descending. After the situation was managed by the flight crew, the aircraft landed at Hualien Airport at 15:28, with no further event. All passengers and crewmembers are safe.

The captain occupied the left seat in the cockpit and was the pilot flying (PF) of the occurrence flight. The first officer occupied the right seat and was the pilot monitoring (PM). The occurrence flight took off from Kaohsiung Airport runway 09 and followed HENGCHUN ONE (NH1) standard instrument departure (SID) procedures before tracking northbound along B591. At 15:04:04, the aircraft was descending from cruising altitude FL130. Approximately 36 nautical miles south-southwest of Hualien Airport on B591 route, the Cockpit Master Caution System was triggered³ with the CAB ALT warning showing on the Engine Warning Display (EWD). The pressure altitude was 11,890ft with a cabin altitude of 9,398ft at that time. At 15:04:17, while the flight crew was discussing the

¹ATR72-212A: aircraft model as per type design; ATR72-500: commercial designation for ATR72-212A equipped with the old avionic suite; ATR72-600: commercial designation for ATR72-212A equipped with new avionic suite. The occurrence aircraft is a ATR72-600.

² Unless otherwise indicated, all the times in this report refer to Taipei Local Time (UTC+8 hours) in 24-hour clock time, and is based on Flight Data Recorder (FDR) time.

³ Master caution.

situation, the Cockpit Master Warning System was triggered⁴ with EXCESS CAB ALT showing on the EWD. The pressure altitude was 11,629ft and the cabin altitude was 9,833 at this time. The captain declared EMERGENCY DESCENT. After the flight crew performed procedures, such as deploying oxygen masks and goggles, and confirming that the communication between the flight crew was established, the first officer declared MAYDAY to Taipei Approach.

At 15:04:45, the cabin altitude peaked at 10,241ft before it began to descent. At 15:05:19, the EXCESS CAB ALT warning was cancelled when the aircraft descended to a pressure altitude of 10,284ft and the cabin altitude was 9,833ft. At 15:06:03, the flight crew requested approval from Taipei Approach to descend to a pressure altitude of 5,000ft and MAYDAY was canceled. Oxygen masks were removed. The aircraft leveled at a pressure altitude of 5,000ft to confirm that all the procedures were completed.

At 15:14, the flight crew requested radar vectors for the runway 03 instrument landing system (ILS) approach from Taipei Approach. At 15:28, the aircraft landed at Hualien Airport without further event. The flight path of the occurrence aircraft is shown in Figure 1.1-1.

⁴ Master warning.

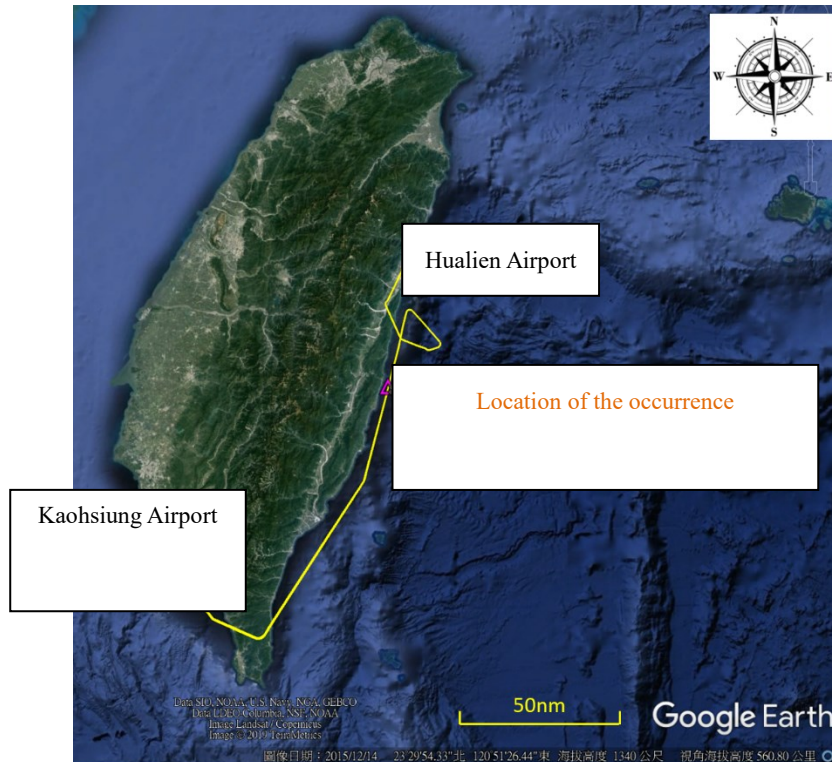


Figure 1.1-1 Flight Path of the Occurrence Aircraft

Injuries to Persons

None

Damage to Aircraft

N/A

Other Damage

N/A

Personnel Information

Flight Crew Background and Experience

Flight crew basic information is shown in Table 1.5-1.

Table 1.5-1 Flight Crew Basic Information

Item	Captain	First Officer
Gender	Male	Male
Age as of the Occurrence	44	28
Commenced Employment with Mandarin Airlines	April 2017	March 2018
License Type Issued	ATPL-Aeroplane	CPL-Aeroplane
Aircraft Type Rating	ATR-72-600, A320	ATR-72-600
Date of Issue	December 7, 2017	July 26, 2018
Date of Expiry	December 6, 2022	July 25, 2023
Medical Certificate Issued	First Class	First Class
Date of Expiry	September 30, 2019	July 31, 2019
Total Flying Time ⁵	7,587 hours and 11 minutes	666 hours and 56 minutes
Total Flying Time on the Occurrence Aircraft	1,129 hours and 11 minutes	416 hours and 56 minutes
Total Flying Time Last 12 Months	913 hours and 06 minutes	416 hours and 56 minutes
Total Flying Time Last 90 Days	219 hours and 29 minutes	170 hours and 39 minutes
Total Flying Time last 30 Days	77 hours and 03 minutes	63 hours and 53 minutes
Total Flying Time Last 7 Days	22 hours and 12 minutes	14 hours and 27 minutes
Total Flying Time Last 24 Hours	4 hours and 21 minutes	6 hours and 24 minutes
Available Rest Period before Occurrence ⁶	38 hours and 03 minutes	16 hours and 09 minutes

Captain

The captain, a Republic of China citizen, was a military pilot. After he retired, he served as captain on the Boeing B777 and the Airbus A320/321/330 fleet in other airlines. He joined Mandarin Airlines in April 2017. After he completed the

⁵ Flying time of the table includes the flying time of occurrence till the flight mission is completed.

⁶ According to Aircraft Flight Operation Regulations, rest period stands for “a continuous and defined period of time, subsequent to and/or prior to duty, during which flight or cabin crew members are free of all duties”.

transition training for the ATR72-600 flight and passed the airway check, he served as captain on the ATR72-600 fleet. As of the occurrence, he had accumulated a total flight time of 7,587 hours and 11 minutes, which included 1,129 hours and 11 minutes on the ATR72-600 aircraft.

The captain held an Airline Transport Pilot License (ATPL) issued by the Civil Aeronautics Administration (CAA) of the Republic of China with *Aeroplane, Land Multi-Engine, Instrument Rating ATR-72-600 A-320, and privileges for operation of radiotelephone on board an aircraft without limitation.* The captain's English language proficiency was recorded as *ICAO L4 with an expiry date of July 29, 2021.*

The captain's most recent annual proficiency training before the occurrence was conducted on October 28, 2018. The training covered EXCESS CAB ALT, EMERGENCY DESCENT, etc. The training result was completed. The subsequent annual proficiency check was passed on October 29, 2018. The latest annual aircraft check was passed on January 18, 2019. A review of the captain's personal training and check records indicated no anomaly. The captain's first class medical certificate was issued on March 15, 2019 with the limitation that "the holder shall wear corrective lenses". The captain was wearing corrective lenses during the occurrence. Post-occurrence alcohol testing revealed that the captain's alcohol concentration was 0.

First Officer

The first officer, a Republic of China citizen who completed self-financed pilot training in the United States, obtained the American Commercial Pilot License (CPL) in October 2016. He joined Mandarin Airlines in March 2018. After he completed training for the ATR72-600 aircraft and passed airway check in November 2018, he served as first officer on the ATR72-600 fleet. As of the

occurrence, he had accumulated a total flight time of 666 hours and 56 minutes, which included 250 hours of flight training and 416 hours and 56 minutes on the ATR72-600 aircraft.

The first officer held a Commercial Pilot License (CPL) issued by the Civil Aeronautics Administration (CAA) of the Republic of China with *Aeroplane, Land, Multi-Engine, Instrument Aeroplane ATR-72-600, and privileges for operation of radiotelephone on board an aircraft with the limitation that “ATR-72-600 F/O”*. The captain's English language proficiency was recorded as *ICAO L5 with an expiry date of March 27, 2024*.

The first officer’s most recent annual proficiency training before the occurrence was completed on February 14, 2019. The training covered EXCESS CAB ALT, EMERGENCY DESCENT, etc. The training result was completed. The subsequent annual proficiency check was passed on February 15, 2019. A review of the first officer’s personal training and check records indicated no anomaly. The first officer’s first class medical certificate was issued on July 17, 2018 with the limitation that “the holder shall wear corrective lenses”. The first officer was wearing corrective lenses during the occurrence. Post-occurrence alcohol testing revealed that the captain's alcohol concentration was 0.

Aircraft Information

Aircraft and Engine Basic Information

Basic information of the occurrence aircraft as of May 1, 2019 is shown in Table 1.6-1

Table 1.6-1 Aircraft Basic Information Table

Aircraft Basic Information Table	
Nationality	Taiwan, R.O.C
Aircraft Registration Number	B-16851
Aircraft Model	ATR72-212A
Manufacturer	ATR-GIE Avions de Transport Régional
Aircraft Serial Number	1460
Date Manufactured	November 24, 2017
Delivery Date	November 24, 2017
Owner	Avation Taiwan Leasing II Pte. Ltd.
Operator	Mandarin Airlines Co., Ltd.
Number of Certificate of Registration	106-1523
Certificate of Airworthiness	107-11-242
Validity Date of Certificate of Airworthiness	November 15, 2019
Total Flight Time	2,865 hours and 57 minutes
Total Flight Cycles	4,393
Last Check, Date	PA6 Check/ April 22, 2019
Flight Hours since Last Check	56 hours and 50 minutes
Cycles Elapse since Last Check	89

The occurrence aircraft was installed with two PW127M engines manufactured by Pratt & Whitney Canada (“PWC”). Information about the engines as of May 1, 2019 is shown in Table 1.6-2.

Table 1.6-2 Engine Basic Information Table

Engine Basic Information		
Number/Position	No. 1/left	No. 2/right
Manufacturer	PWC	PWC
Model	PW127M	PW127M
Serial Number	PCE-ED1516	PCE-ED1517
Manufacture Date	April 23, 2017	April 24, 2017
Time since Installed	2,865 hours and 57 minutes	2,865 hours and 57 minutes
Cycle since Installed	4,393	4,393

Aircraft Maintenance Information

A review of the last 3 months of the occurrence aircraft's technical log book and deferred maintenance records indicated that there was no anomaly related to the cabin pressurization system. A review of the occurrence aircraft's airworthiness directives and technical bulletins indicated that they were in compliance with applicable standards. No anomaly was detected in the latest PA6 check⁷ before the occurrence. A review of the maintenance record of the occurrence aircraft indicated that there were no defects reported under the minimum equipment list, or deferred maintenance item when the aircraft took off from Kaohsiung International Airport.

Cabin Pressurization System and Ground Connection Check Valve

The occurrence aircraft experienced cabin pressure anomaly during the flight. After the aircraft landed at Hualien Airport, ground maintenance personnel examined the aircraft in accordance with the maintenance manual. The ground connection check valve, component number 41125A01, was found failure and could not be secured in the fully closed position (as shown in Figure 1.6-1). The examination also found that the air-conditioning distribution tube downstream the valve was dented. The check valve and the downstream air-conditioning distribution tube were replaced by the maintenance personnel according to the maintenance manual. After testing, the aircraft was in normal condition again.

⁷ PA6 Check is the 6th A Check. A Check is performed every 500 flight hours. PA6 Check is performed after 3,000 flight hours.



Figure 1.6-1 Failure Position of the Ground Connection Check Value

The ground connection check valve is located on the right side of the belly of the fuselage, as shown in Figure 1.6-2, equipment number 6352HQ. Its exterior is shown in Figure 1.6-3. When the aircraft is parked on the ground, conditioned air can be supplied to the cockpit and cabin through the check valve from the air-conditioning unit.

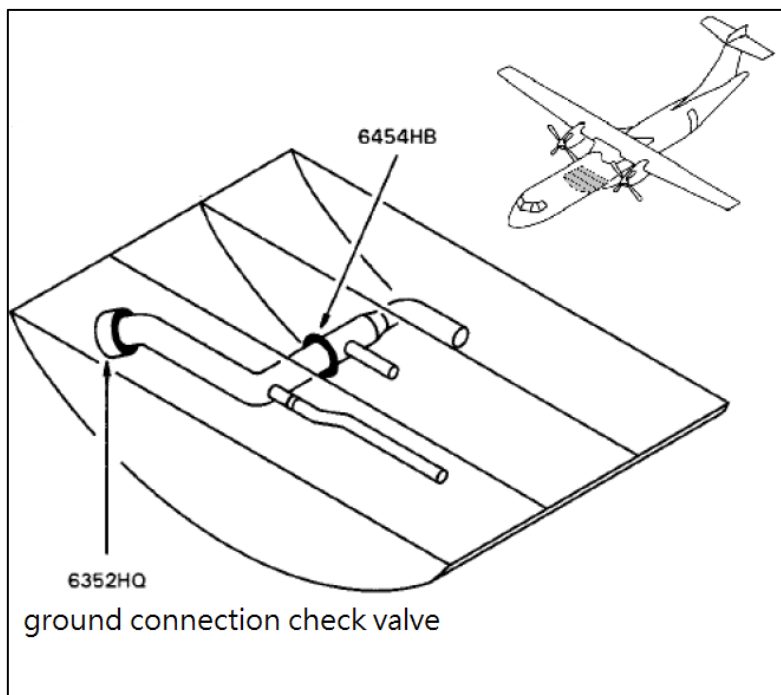


Figure 1.6-2 Installation Position of the Ground Connection Check Valve



Figure 1.6-3 Exterior of the Ground Connection Check Valve

In October 2015, the aircraft manufacturer issued TPS21-22-001 Technical Progress Status (TPS). The TPS mentioned the occurrence of cabin pressure anomaly as a result of the ground connection check valve, component number 41125A01, not secured at a fully closed position due to the failure of valve spring. It also mentioned that when the cabin pressure was compromised, the air-

conditioning distribution tube downstream of the check valve might be damaged due to the difference between pressure inside and outside the cabin. To avoid this occurrence, the aircraft manufacturer recommended checking the check valve position and ensuring it is secured in the fully closed position after every time the air-conditioning unit is moved. The 8th edition released in April 2018 is the latest updated version for this TPS.

In February 2018, the aircraft manufacturer released the RIL-2018-03, a Retrofit Information Letter (RIL) about the check valve, providing the check valve with a modified design (component number 41125A020001). The modified design is fully compatible with the old check valve, component number 41125A01, in the occurrence aircraft, and is interchangeable.

Weather Information

N/A.

Aids to Navigation

N/A

Communication

N/A

Aerodrome

N/A

Flight Recorders

Cockpit Voice Recorder

The aircraft is equipped with a solid-state Cockpit Voice Recorder (CVR)

manufactured by L-3 Aviation Products, component number 2100-1225-22. The CVR is capable of recording 2 hours of high quality audio, with sound sources from the captain's microphone, the first officer's microphone, the broadcasting system microphone and the cockpit area microphone. CVR readout and download was successful and the audio quality was good. CVR consisted of 124 minutes and 14.5 seconds of recording, including the take-off, the cruise, the approach, the occurrence and the landing of the occurrence flight. 12 minutes of information relevant to the occurrence were transcribed by the investigation team.

Flight Data Recorder

The aircraft is equipped with a solid-state Flight Data Recorder (FDR) manufactured by L-3 Aviation Products, component number 2100-4245-00. After the occurrence, the Safety Board analyzed the data in accordance with the data decoding document developed by the aircraft manufacturer. The FDR contained 60 hours, 46 minutes and 37 seconds of data. The total number of recorded parameters was 1,008. All parameters are based on UTC time⁸. Extract of the FDR data related to the occurrence is shown below:

1. At 14:24 Taipei Local Time, FDR started recording.
2. At 14:32 Taipei Local Time, the aircraft took off from Kaohsiung Airport.
3. At 15:02:30 Taipei Local Time, the pressure altitude of the aircraft was 12,950ft and the cabin altitude started to climb from about 8,000ft.
4. At 15:04:17, the master warning was triggered. The pressure altitude of the aircraft was 11,629ft and the cabin altitude was 9,833ft at this time. "Excess cabin altitude" was displayed on the Cockpit Display System.

⁸ UTC Time + 8 hours = Taipei Local Time

5. At 15:04:45 Taipei Local Time, the pressure altitude of the aircraft was 11,090ft and the cabin altitude peaked at 10,241ft.
6. At 15:05:19 Taipei Local Time, the pressure altitude of the aircraft was 10,284ft. The EXCESS CAB ALT warning was cancelled when the cabin altitude became 9,833ft.
7. The aircraft landed at Hualien Airport at 15:28:50 Taipei Local Time.
8. At 15:34 Taipei Local Time, FDR stopped recording.

The flight path of the occurrence aircraft is shown in Figure 1.1-1. Figure 1.11-1 depicts the data plot of the recorded parameters for the aircraft.

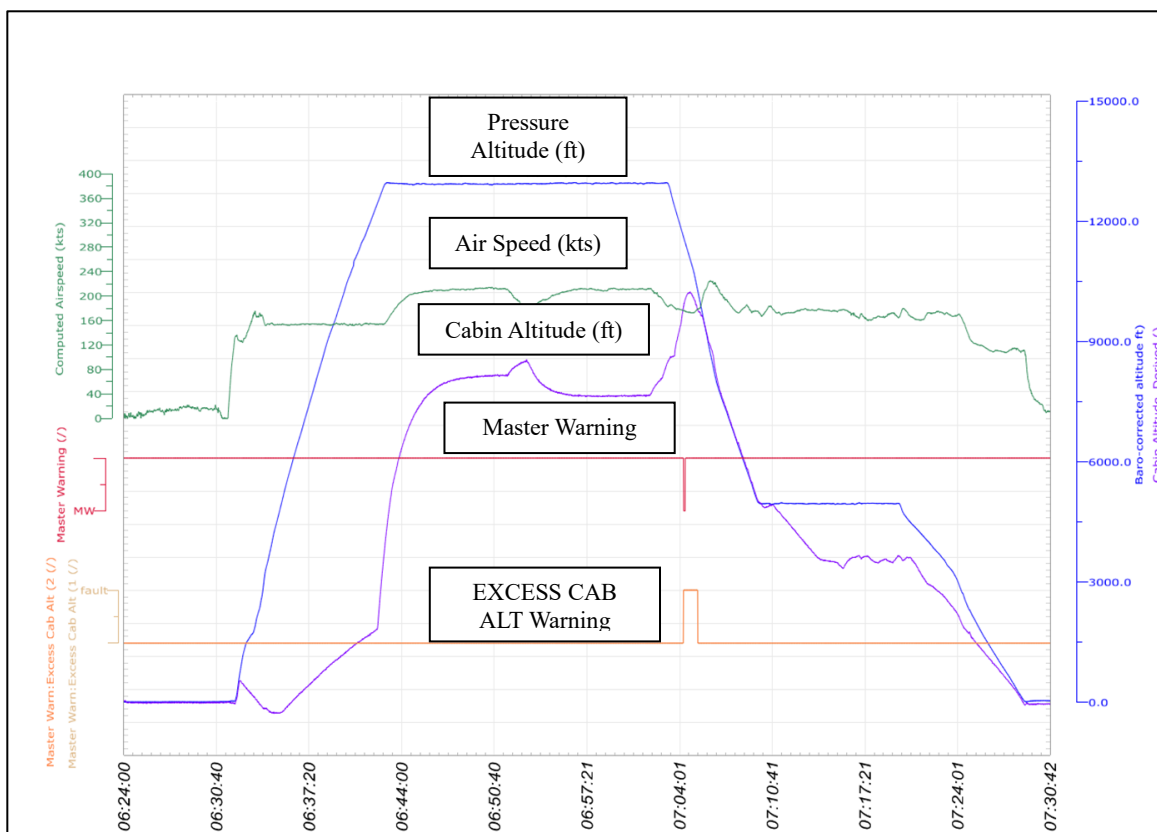


Figure 1.11-1 Flight Data Plot of the Occurrence Aircraft

Wreckage and Impact Information

N/A

Medical and Pathological Information

N/A

Fire

N/A

Survival Aspects

N/A

Tests and Research

N/A

Organizational and Management Information

N/A

Additional Information

Related Content in Flight Operations Manual

Quick Reference Handbook

Contents in the Mandarin Airlines ATR72-600 Quick Reference Handbook⁹ that are relevant to the occurrence: CABIN ALTITUDE, EXCESS CAB ALT and EMERGENCY DESCENT. Extracts are shown below:

⁹ VERSION REV 0 TR02, valid from January 16, 2019

A21.08	CABIN ALTITUDE
▶ CABIN ALTITUDE : MONITOR	

EXCESS CAB ALT	A21.10
▶ CAB PRESS indicatorCHECK	
■ If rapid decompression	
▶ AFM - EMERGENCY DESCENT procedure (E99.04)APPLY	
■ If cabin altitude > 10 000 ft confirmed	
▶ CAB PRESS RATE knob 9 O'CLOCK (MAN POSITION)	
▶ CAB PRESS MODE SEL MAN	
▶ CAB PRESS RATE knob DECREASE	
■ If EXCESS CAB ALT persists	
▶ CREW OXY MASKS DON	
▶ CREW COMMUNICATIONS ESTABLISH	
▶ OXYGEN PAX SUPPLY AS RQRD	
▶ OXYGEN PRESSURE CHECK	
▶ DESCENT INITIATE AS RQRD	
▶ MAX FL : 100/MEA	

E99.04	EMERGENCY DESCENT	
▶ CREW OXY MASKS AS RQRD		
▶ CREW COMMUNICATIONS AS RQRD		
▶ GOGGLES AS RQRD		
▶ DESCENT INITIATE		
▶ PL 1+2 FI		
▶ CL 1+2 100% OVRD		
▶ OXYGEN PAX SUPPLY AS RQRD		
▶ IAS : VMO/MMO (or less if structural damage is suspected)		
▶ SIGNS ON		
▶ ATC NOTIFY		
▶ MEA CHECK		

Flight Crew Operating Manual

Contents in the Mandarin Airlines ATR72-600 Flight Crew Operating Manual¹⁰ that are relevant to the occurrence: AUTO PRESS FAULT-Alert, EXCESS CAB ALT-Alert, CABIN ALTITUDE-Alert and AUTO PRESS FAULT. Extracts are shown below:

¹⁰ VERSION REV 0 TR01, valid from January 16, 2019

4.1 AUTO PRESS FAULT-Alert

_27a18dfe-790a-488f-b610-1237d44c51d6		2.4 ALL
CONDITION	VISUAL	AURAL
Digital controller failure	<ul style="list-style-type: none"> - MC light flashing amber - AIR AUTO PRESS amber message on EWD - FAULT amber light on CAB PRESS MOD SEL pb - AUTO PRESS amber message on Cabin SD page 	SC

AUTO PRESS FAULT is triggered if the digital control is inoperative.

4.3 EXCESS CAB ALT-Alert

_481be014-82ee-47ff-9fc3-e10042ee6f6e		0.2 ALL
CONDITION	VISUAL	AURAL
Cabin altitude > 10 000 ft (15 000 ft in High Altitude mode)	<ul style="list-style-type: none"> - MW light flashing red - EXCESS CAB ALT red message on EWD - Red reverse video ALT flashing on Air Cabin SD page 	CRC

EXCESS CAB ALT-Alert is triggered if the cabin altitude exceeds 10,000ft (or 15,000ft in high altitude mode).

4.4 CABIN ALTITUDE-Alert

_4c828a69-264b-4dab-a623-a97b9742f79d		0.2 ALL
CONDITION	VISUAL	AURAL
9 500 ft < Cabin altitude < 10 000 ft - OR - 14 000 ft < Cabin altitude < 15 000 ft (in High Altitude mode)	<ul style="list-style-type: none"> - MC light flashing amber - CAB ALT amber message on EWD 	SC

CABIN ALTITUDE-Alert is triggered if the cabin altitude exceeds 9,500ft and is lower than 10,000ft (or if the cabin altitude exceeds 14,000ft and is lower than 15,000ft in high altitude mode).

AUTO PRESS FAULT

840538b9-f542-468b-9d3f-202570c694de 3.2
ALL

AUTO PRESS FAULT						
▶ CAB PRESS RATE knob9 O'CLOCK (MAN position)						
▶ CAB PRESS MODE SEL MAN						
▶ CAB PRESS RATE knobAS RQRD TO ADJUST TARGET CAB ALT						
FL	140	170	200	220	240	250
TARGET CAB ALT (ft)	2 500	3 300	4 200	5 200	6 200	6 800
<ul style="list-style-type: none"> ● Before descent <ul style="list-style-type: none"> ■ If CAB ALT above landing elevation <ul style="list-style-type: none"> ▶ CAB PRESS RATE knob DECREASE ▶ CAB ALT RATE..... ADJUST 400 ft/min DN ■ If CAB ALT below landing elevation <ul style="list-style-type: none"> ▶ CAB PRESS RATE knob INCREASE ▶ CAB ALT RATE..... ADJUST 1 000 ft/min UP MAX ● When CAB ALT = landing elevation <ul style="list-style-type: none"> ▶ CAB PRESS RATE knob 9 O'CLOCK (MAN position) & MONITOR ● After landing <ul style="list-style-type: none"> ▶ CAB PRESS RATE knob MAX INCREASE 						

AUTO PRESS FAULT is triggered if the flight crew modifies the cabin pressure manually. The procedure demonstrates the target cabin altitude in different flight levels, for example, the target cabin altitude in FL140 is 2,500ft.

Flight Crew Training Manual

In Session 1.2 Standard Operation Procedures of the Mandarin Airlines ATR72-600¹¹ Flight Crew Training Manual (FCTM), the procedures related to the climb and cruise are shown below:

¹¹ VERSION REV 3, valid from April 22, 2019

1.2.14 CLIMB – CRUISE

Flight events	PM	PF
PASSING 10,000 or REACHING CRUISE ALTITUDE	▶CALL "TEN THOUSAND" ▶DO ALL SYSTEM PAGES CHECK DURING CLIMB ALL SYSTEMS SCAN PRESSURIZATION MONITOR Check ΔP, CAB ALT, and CAB RATE on SD page. CM1 LANDING LIGHTS OFF WING LIGHTS OFF	▶CALL "CHECK"
1,000FT TO LEVEL OFF	▶ANNOUNCE "ONE THOUSAND"	▶CALL "CHECK"
APPROACHING CRUISE LEVEL/ ALTITUDE	DELTA ISA CHECK FMA X CHECK ▶CALL "CHECK" ▶CALL "CHECK"	FMA MONITOR FL/ALT INTERCEPTION ▶CALL "ALT STAR" ▶CALL "ALT GREEN"
AT CRUISE FL/ ALT	SPEED BUG CHECK ▶CALL "CHECK"	SPEED BUG CHECK ▶CALL "SPEED XXX MAGENTA"
10 KTS BEFORE CRUISE SPEED	▶DO PWR MGT SELECTOR CRZ TQ BUGS CHECK CRUISE PARAMETERS MONITOR Confirm TQ, FF, IAS, and TAS match with ▶CALL "CRUISE POWER SET"	▶CALL "SET CRUISE POWER" CRUISE PARAMETERS MONITOR Confirm TQ, FF, IAS, and TAS match with expected cruise parameters ▶CALL "CHECK"
DURING CRUISE	SYSTEMS MONITOR PERIODICALLY DEST REMAINING FUEL CHECK FMS PREDICTIONS CHECK WPT, DEST ETA, TOD, DEST RAIM, and EFOB REFER TO FCOM/ FOM	TOP OF DESCENT CHECK REMAINING FUEL & HOLDING TIME MONITOR
IF ENCOUNTER TURBULANCE		

The flight crew should monitor the cabin pressurization status when the aircraft climbs above 10,000ft or reaches the cruising altitude. The flight crew should also check the difference between the pressure inside and outside the cabin (ΔP), the cabin altitude, and the rate of change of the cabin altitude on the system panel. During the cruise phase, the flight crew should monitor different system panels regularly.

Interview Information

Summary of Interview with Captain

The occurrence flight was the captain's 5th flight of the day. He occupied the left seat in the cockpit and was the pilot flying (PF). After taking off from Kaohsiung Airport, the occurrence aircraft followed normal departure procedures. When the aircraft climbed to cruise altitude FL130, the cabin crew reported to the cockpit that the left engine was particularly loud and inquired if there was any problem about it. The flight crew checked the system parameters and found everything to be normal. The accompanying crew member conducted a visual inspection of the area and reported no anomaly.

ATC then approved the occurrence aircraft to descend from FL130, performed an Instrument Landing System (ILS) approach to Hualien Airport runway 03, and informed the aircraft to fly above 5,000ft at waypoint ARBOR. The captain set altitude as final approach fix, at 2,100ft. The LNAV-VNAV mode¹² was enabled, and the aircraft descended at approximately 1,200ft/min. When the aircraft descended to 10,900ft, the amber CAB ALT warning light was triggered on EWD. The first officer checked the readings on the instrument panel that the cabin altitude was 8,900ft. It quickly climbed to 9,900ft and triggered the red EXCESS CAB ALT warning. The altitude of the aircraft at that time was around 10,600ft.

The captain declared EMERGENCY DESCENT immediately. The flight crew performed memory items, including wearing oxygen masks and goggles, and established communication between the crew members. The cabin crew were informed of the emergency descent. MAYDAY was declared to ATC and a descent altitude to 5,000ft was requested. The occurrence aircraft was already descending when the occurrence happened. When the flight crew completed the

¹²LNAV, lateral navigation: it is used to calculate, display and provide a horizontal approach chart or flight path guidance for aircraft regional navigation devices. VNAV, vertical navigation: it is used to calculate, display and provide a vertical approach chart or flight path guidance for aircraft regional navigation devices.

procedures mentioned above, the cautions and warnings on EWD had been cancelled. The cabin altitude returned to normal range. The altitude of the aircraft was below 10,000ft at that time. Oxygen masks in the cabin were considered unnecessary. Considering that the aircraft was near coastal mountains and the cloud-covered ground obstacles were not visible. The captain decided to maintain the original LNAV descent. Therefore, the aircraft was not descending rapidly.

When the aircraft descended to 6,000ft, the captain considered the threat of depressurization had been dismissed, so he asked the first officer to remove his oxygen mask. After confirming it was safe to do so, the captain then took off his oxygen mask. The flight crew then inquired the cabin condition. The aircraft leveled at 5,000ft. After confirming that all the items in the emergency procedures were implemented, the flight crew canceled MAYDAY and requested approach again. The aircraft was radar-vectored by ATC. At 15:28, it landed at Hualien Airport.

On the day of the occurrence, the aircraft condition was normal. Other than scratches on the cabin door and notes related to the radome, there was no deferred maintenance item that would affect the aircraft operation on the technical log book. When the aircraft climbed to 10,000ft during the occurrence flight, the flight crew checked all the instrument panels. All the parameters, including the pressurization system, were displayed in green color, indicating that they were within normal range. However, the exact figures of the cabin altitude and ΔP were not marked down. No anomaly in the air-conditioning system and the pressurization system were identified before the occurrence. During the flight mission, the two systems were both in automatic mode and were not switched to the manual mode.

The maximum flight altitude for ATR72-600 aircraft on a normal domestic

route is around 14,000ft. Simulator-based training courses on cabin pressure failure simulated the explosive depressurization at 25,000ft altitude and gradual depressurization. In both situations, the emergency descent was performed eventually.

The captain considered himself physically and mentally well during the occurrence. He thought the first officer performed well and demonstrated the ability required to implement procedures, provide advice and maintain effective communication during the occurrence.

Summary of Interview with First Officer

The occurrence flight was the first officer's first flight of the day. He occupied the right seat in the cockpit and was the pilot monitoring (PM). At 14:31, the occurrence flight took off from Kaohsiung Airport and followed HENGCHUN ONE (NH1) standard instrument departure (SID) procedures. When the aircraft climbed to 10,000ft altitude, the cabin chief asked the cockpit if there was anomaly identified in No. 1 engine because the cabin crew heard "sa sa" sounds from the engine, which had never been heard before. The flight crew checked 4 system panels and found that the figures, including engine oil pressure, temperature and revolutions, were all within the normal green band. The only difference between the two engines was fuel consumption, for which No. 1 engine was 370 and No. 2 engine was 365. The amount of fuel in No. 1 engine was 40kg less than that in No. 2 engine, but this was within allowable range. Cabin altitude and ΔP were both within the normal green band, but exact figures were not marked down. The flight mission continued after the accompanying crew members conducted a visual check of the area and considered it normal.

When the aircraft climbed to cruising altitude FL130, the flight crew requested to ATC to fly directly to waypoint ARBOR, which was approved. ATC

then approved the descent and Instrument Landing System (ILS) approach to Hualien Airport runway 03. The captain set altitude as final approach fix at 2,100ft. LNAV-VNAV mode was enabled.

When the aircraft descended to 10,900ft, master caution was triggered and CAB ALT was displayed on EDW. The first officer checked the instrument panel in accordance with procedures. He found that the cabin altitude was 8,900ft and it quickly climbed to 9,900ft and then 1,600ft. The red EXCESS CAB ALT master warning was triggered as a result. The altitude of the aircraft at this time was approximately 10,600ft, same as the cabin altitude. The cabin pressure was not established.

The captain declared EMERGENCY DESCENT immediately. The flight crew performed memory items. The first officer declared MAYDAY to ATC. The aircraft had been descending before the emergency descent. Therefore, when the flight crew completed donning the oxygen masks and the goggles, established communication between the crew members, and declared MAYDAY to ATC according to procedures, the warning on EWD was cancelled. To avoid being too close to mountains, the flight crew requested the ATC to cancel the permission to approach and requested the descent to altitude 5,000ft. When descended to 5,000ft, the flight crew requested approach again after confirming that all the procedures were completed, and the aircraft condition was stable and functioned normally.

The aircraft condition was normal in the inspection before take-off for the occurrence flight. There was no special note or caution to be taken mentioned in the technical log book. Before the occurrence, there was no anomaly in the air-conditioning system and the pressurization system. During the flight mission, the two systems were both in automatic mode and were not switched to the manual

mode.

The first officer considered himself mentally and physically capable of managing the situation during the occurrence, despite being slightly nervous. He showed no sign of fatigue. The first officer considered the captain’s performance to be normal.

Sequence of Events

Sequence of major events of the occurrence is shown in Table 1.18-1.

Table 1.18-1 Sequence of Events

Time	Event	Information Source
14:32	Took off from Kaohsiung Airport	FDR
14:43	Climbed to cruising altitude (FL130)	FDR
15:03	Descended from cruising altitude	FDR
15:04:04	Pressure altitude 11,890ft, cabin altitude 9,398ft. Master caution was triggered with CAB ALT displayed on EWD.	FDR, CVR
15:04:17	Pressure altitude 11,629ft, cabin altitude 9,833ft. Master warning was triggered with EXCESS CAB ALT displayed on EWD.	FDR, CVR
15:04:21	The captain declared EMERGENCY DESCENT. The flight crew donned oxygen masks and goggles, and established communication between the flight crew.	CVR
15:04:40	The first officer declared MAYDAY to Taipei Approach. The aircraft continued the descent in the original navigation mode.	CVR
15:04:45	Maximum cabin altitude reached at 10,241ft before it began to drop.	FDR
15:05:19	Descended to pressure altitude 10,284ft. Cabin altitude at 9,833ft. EXCESS CAB ALT warning was cancelled.	FDR
15:06:03	The flight crew requested to ATC to descend to pressure altitude 5,000ft, MAYDAY was canceled. Oxygen masks were removed. The aircraft leveled at pressure altitude 5,000ft to confirm all procedures were completed.	CVR
15:14	The flight crew requested to ATC radar vectors for the Hualien Airport runway 03 Instrument Landing System (ILS) approach.	CVR
15:28	Landed at Hualien Airport	FDR

Chapter 2 Analysis

2.1 General

The occurrence flight crews were holders of valid airman certification and medical examination issued by Civil Aeronautics Administration (CAA), and were qualified by the Civil Aeronautics Administration (CAA) and Mandarin Airlines. There was no abnormal finding from the training and check records related to this occurrence. There was no evidence indicating the performance of the flight crew was influenced by alcohol effects during the occurrence.

According to the maintenance information of the occurrence aircraft, no defect entry related to the occurrence was made in the aircraft maintenance records and aircraft check records throughout the 3 months before the occurrence. The implementation of airworthiness directives was in compliance with relevant regulations. When the occurrence flight took off from Kaohsiung Airport, there were no defects or inoperative items reported under the minimum equipment list, or deferred maintenance items. In a review of the FDR and CVR records of the occurrence flight, other than the cabin pressurization system anomaly, no other anomaly was identified in the aircraft system or engine.

1.2 Cabin Pressurization System

An aircraft-related analysis was conducted in terms of cause and influence of the cabin pressurization system anomaly, retrofit information provided by the aircraft manufacturer, and improvement measures implemented by Mandarin Airlines.

1.2.1 Analysis of Cabin Pressurization System Anomaly

The occurrence aircraft was connected to ground air-conditioning unit at

Kaohsiung Airport before the occurrence. According to the ground inspection conducted after the occurrence at Hualien Airport, the valve spring applying pressure to the blade of the ground connection check valve was broken, resulting in the valve not being able to be secured in fully closed position. The check valve connected the pressurized cabin from inside to outside. When the aircraft was parked on ground, the ground air-conditioning unit can be connected to the aircraft through the check valve, providing the cockpit and cabin with conditioned air. When the valve functioned normally, conditioned air is supplied one-way from outside to inside the cabin. When the ground air-conditioning tube was removed, the spring applied pressure to the blade, so the valve was automatically spring-forced back to the closed position. When the cabin started to be pressurized, the valve can also be secured in the fully closed position because of the difference of pressure inside and outside the cabin.

According to the post-occurrence inspection, the spring applying pressure to the blade of the valve was broken, resulting in the valve not being able to be secured in fully closed position. When the valve was not fully closed, the pressurized cabin was connected to the atmosphere outside the cabin, and the air leaked out of the pressurized cabin from the check valve. When the engine air supply decreased, the cabin altitude rose and the cabin pressure cannot be maintained as a result.

When the ground connection check valve was not fully closed, the aircraft pressurization system would be influenced by the altitude and the engine air supply. According to the FDR data of the occurrence aircraft, the thrust of the engine during take-off and climbing provided sufficient air to maintain the cabin altitude below 2,000ft (before Point A in Figure 2.2-1). When the occurrence aircraft reached cruising altitude (13,000ft), the thrust of the engine decreased, and so did the airflow in the air-conditioning system, resulting in the rise of cabin

altitude (after Point A in Figure 2.2-1), but it was maintained at approximately 8,000ft. However, when the aircraft descended from cruising altitude (Point B in Figure 2.2-1), the thrust of the engine reduced to idle, therefore the cabin altitude rose rapidly as a result of the decrease in air supply from the air-conditioning system. After approximately 2 minutes and 30 seconds, at 15:04:17, the EXCESS CAB ALT warning was triggered.

To sum up, the check valve inside the ground air-conditioning connection might have been damaged before the occurrence flight took off. Therefore, the aircraft's pressurization system was connected to the atmosphere outside the cabin. As the aircraft descended from cruise altitude, the EXCESS CAB ALT warning was triggered when the cabin pressurization system failed as a result of the altitude, the reduction of cabin air inflow, and the check valve was not secured in closed position.

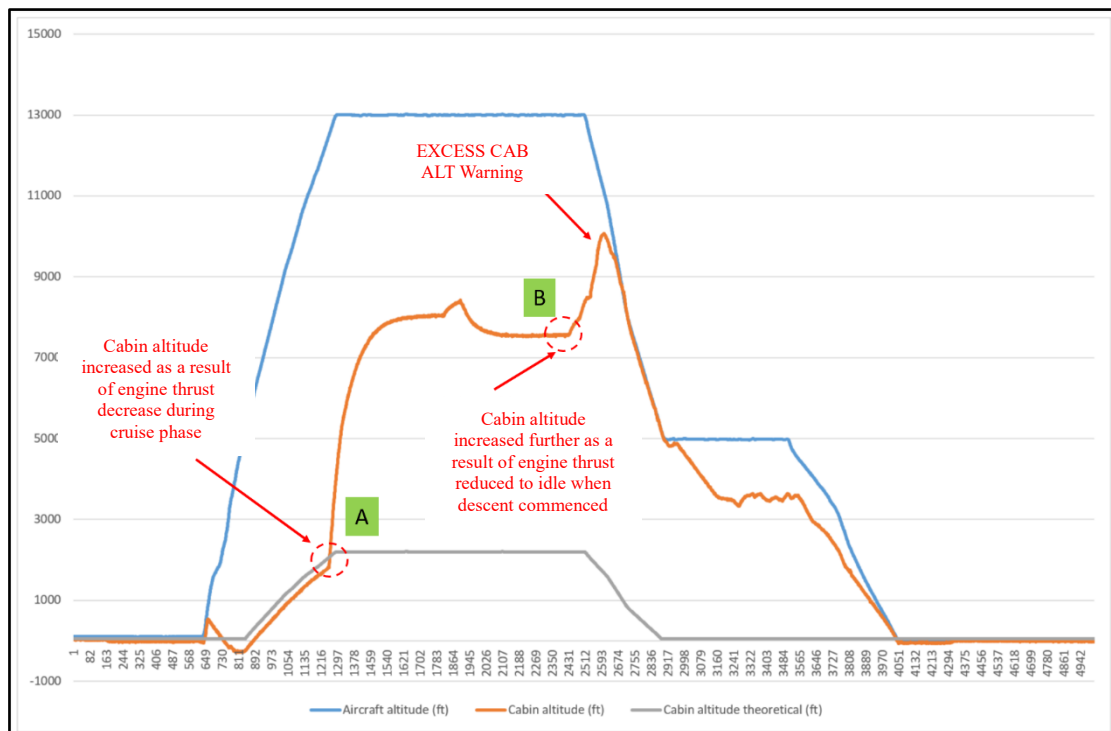


Figure 2.2-1 Cabin Altitude and Relevant Information Plot

1.2.2 Retrofit Information on Ground Connection Check Valve

TPS21-22-001 Technical Progress Status (TPS) released by the aircraft manufacturer mentioned the occurrence of cabin pressure anomaly as a result of the ground connection check valve (component number 41125A01), not secured at fully closed position due to an inoperative spring. To avoid the occurrence, the aircraft manufacturer recommended inspecting the check valve position and ensuring it is secured in the fully closed position, after every time the ground air-conditioning unit is moved. Before the occurrence, there was no job description about the ground connection check valve in Mandarin Airlines' daily check list of the occurrence aircraft.

In February 2018, the aircraft manufacturer released a retrofit information letter (RIL-2018-03) about the modified check valve (component number 41125A020001). According to RIL-2018-03, the modified check valve improved the component reliability and can avoid cabin depressurization as a result of an inoperative spring of the valve. The modification features the following:

- Two devices have been added to secure the valve blades in a stable position
- A middle dead point has been added to eliminate vibration
- A teflon-coated gasket between the shaft and the spring

The modified check valve is interchangeable with the original one (component number 41125A01). The exterior of the two check valves are shown in Figure 2.2-2.

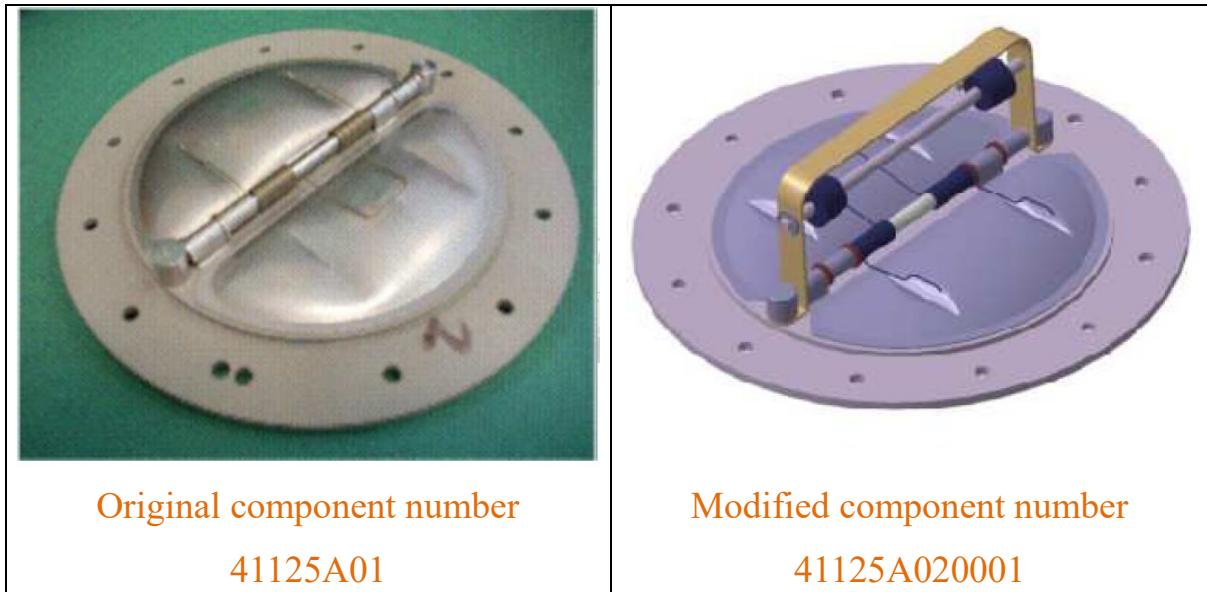


Figure 2.2-2 Original Check Valve (Left) and Modified Check Valve (Right)

After the occurrence, Mandarin Airlines implemented the following improvement measures based on the aircraft manufacturer's recommendation on check operation and product retrofit information mentioned above.

- *The replacement of the air conditioning ground check valve for the occurrence aircraft (B-16851) was completed after the occurrence. The replacement of the new check valve for the other four ATR72 aircrafts (B-16852-B-16856) were implemented on May 14 and May 15, 2019. ATR72 aircrafts (B-16857, B-16858) delivered this year were manufactured with the new check valve (standard modification).*
- *According to the TPS21-22-001 recommendation, the Flight Crew Department revised the Pre-flight, Transit and Daily Checklist on May 3, 2019, with an additional note: if the ground air-conditioning unit is connected to a departing aircraft, the flight crew should confirm that the air conditioning ground check valve is secured at fully closed position after the unit is removed.*

- *In addition to performing checks based on MPD/AMP C check ZL192-GVI-100000-1, the visual check of the air conditioning connection check valve was updated as a check item every 500FH in the AMP. (Item No. 212251-99-1).*

Regarding the occurrence of the cabin pressure anomaly as a result of the inoperative air conditioning ground connection check valve, the aircraft manufacturer had provided relevant retrofit information. After evaluating the information, Mandarin Airlines implemented the corresponding improvement measures. Along with updating the visual check of the ground connection check valve as a check item in the daily check and in the check every 500FH, the replacement of the modified check valve was completed for all the aircrafts in the fleet. Therefore, TTSB proposed no further recommendations regarding the inoperative air conditioning ground connection check valve that may result in cabin pressure anomaly.

1.3 Cabin Altitude Monitor and Anomaly Management

According to the effective Mandarin Airlines ATR72-600 Aircraft Flight Crew Training Manual at the occurrence, when the aircraft climbed to 10,000ft and/or during the cruise phase, the flight crew should monitor all the cockpit system panels, including the difference between the pressure inside and outside the cabin (ΔP), the cabin altitude and the rate of change of the cabin altitude.

CVR transcript and interview records revealed that when the aircraft climbed to 10,000ft pressure altitude, the flight crew monitored all the cockpit system panels as described above. At that time, all the figures, including those of the air-conditioning system and the pressurization system, were in green or within the green band. The flight crew therefore assumed all the systems were functioning properly and did not pay special attention to the exact cabin altitude.

According to the Mandarin Airlines ATR72-600 Aircraft Flight Crew Training Manual, the target cabin altitude at FL140 is 2,500ft. Therefore, under normal circumstances, the cabin altitude of the occurrence flight at FL130 should be slightly lower than 2,500ft. FDR data revealed that when the occurrence flight cruised at FL130, the cabin altitude gradually increased from approximately 2,000ft to approximately 8,000ft before the descent of the aircraft. If the flight crew had checked the exact altitude during the cruise phase, they could have noticed the higher-than-normal cabin altitude earlier.

When the flight crew commenced the descent, the engine thrust was reduced to idle. The air supply from the air-conditioning system decreased further. The cabin altitude increased further and triggered the CAB ALT caution. At that time, the flight crew were aware of the anomaly. When they checked the cabin altitude, it had reached 9,900ft and the EXCESS CAB ALT warning was triggered immediately. Considering the situation as rapid depressurization, the flight crew initiated emergency descent procedures.

After the occurrence, Mandarin Airlines updated the Flight Crew Training Manual of the occurrence aircraft. A comparison chart listing the reference cabin altitude at different flight levels and corresponding management measures was added in Session 1.2.14 CLIMB-CRUISE and Session 2.5.5 EMERGENCY DESCENT, to help the flight crew identify and manage the cabin pressure anomaly at an early stage. Mandarin Airlines also included a briefing report about the occurrence in the monthly newsletter, for all flight crew members to study. Therefore, TTSB proposed no further recommendations regarding aircraft operation.

Chapter 3 Conclusion

In this Chapter, findings derived from the factual information gathered during the investigation and the analysis of the occurrence are presented. The findings are presented in three categories: **Findings Related to Probable Causes**, **Findings Related to Risks** and **Other Findings**.

Findings Related to Probable Causes

The Findings Related to Probable Causes demonstrates key factors that have operated in the occurrence, or almost certainly operated in the occurrence. These findings are associated with unsafe acts, unsafe conditions, or safety deficiencies associated with the occurrences, etc.

Findings Related to Risks

The Findings Related to Risks demonstrates potential risk factors that compromise aviation safety. These factors include unsafe acts, unsafe conditions, and safety deficiencies that endanger the organization and the system. These factors do not contribute to the occurrence, but increase the probability of the occurrence. Furthermore, some of the findings in this category identify safety deficiencies that are unlikely to be related to the occurrence but, nonetheless, should be pointed out for the sake of aviation safety in the future.

Other Findings

Other Findings identify elements that have the potential to enhance aviation safety, resolve a controversial issue, or clarify an ambiguity point which remains to be resolved. Some of the findings are of general interests that are often included in the ICAO format occurrence report for informational, safety awareness, education and improvement aviation safety purposes.

1.1 Findings Related to Probable Causes

1. The check valve inside the ground air-conditioning connection might have been damaged and could not be secured in fully closed position before the aircraft took off from Kaohsiung Airport. Therefore, the aircraft's pressurization system was connected to the atmosphere outside the cabin. As the aircraft descended from cruise altitude, the cabin pressure warning was triggered when the cabin pressurization system failed as a result of the flight altitude, the reduction of cabin air inflow, and the check valve not being able to be secured in fully closed position. (1.6.3, 2.2.1)

1.2 Findings Related to Risk

1. Before the occurrence, Mandarin Airlines had not evaluated the retrofit information letter (RIL-2018-03) about the modified check valve published by the manufacturer on February 2018, and had not replaced the check valve with the modified design. (1.6.3, 2.2.2)
2. Before the occurrence, on Mandarin Airlines' Pre-flight, Transit or Daily checklist, there was no job description about checking and confirming whether the check valve was secured in fully closed position after the ground air-conditioning unit was removed. (1.6.3, 2.2.2)
3. When the occurrence flight cruised at FL130, air from the cabin leaked through the check valve not secured in fully closed position and into the atmosphere. The cabin altitude gradually increased from approximately 2,000ft to approximately 8,000ft. If the flight crew had checked the exact figures of cabin altitude during the cruising phase, they could have been aware of the higher-than-normal cabin altitude earlier. (1.6.3, 1.11.2, 1.18.1.3, 2.3)

1.3 Other Findings

1. The occurrence flight crews were holders of valid airman certification and medical examination issued by Civil Aeronautics Administration, and were qualified by the Civil Aeronautics Administration and Mandarin Airlines. There was no abnormal finding from the training and check records related to this occurrence. There was no evidence indicating the performance of the flight crew was influenced by alcohol effects during the occurrence. (1.5, 2.1)
2. The airworthiness and maintenance of the occurrence flight were in compliance with the Civil Aeronautics Administration and Mandarin Airlines standards. Except for the malfunction of the ground air-conditioning check valve, there was no abnormal finding on other systems or engine. (1.6.2, 1.6.3, 2.1)

Chapter 4 Safety Recommendations

4.1 Safety Recommendations

No.

4.2 Improvement Measures Accomplished

Mandarin Airlines Co., Ltd.

1. A comparison chart listing the reference cabin altitude at different flight levels and corresponding management measures was updated in Session 1.2.14 CLIMB-CRUISE and Session 2.5.5 EMERGENCY DESCENT of the ATR72-600 Flight Crew Training Manual, to help flight crews identify and manage cabin pressure anomaly at early stage.
2. A briefing report about the occurrence, along with key checking items at 10,000ft and explanation of different cabin altitudes was included in the monthly newsletter, to help flight crew members study the estimations and recommended procedures for similar occurrences.
3. The Pre-flight, Transit and Daily checklists for aircraft ATR72-600 were revised. If the ground air-conditioning unit is connected to the departing aircraft, the flight crew should confirm the position of the air conditioning ground connection check valve after the unit is removed.
4. The occurrence aircraft (B-16851) and the other four aircrafts (B-116852 B-16856) have replaced the old check valves with the modified air conditioning ground connection check valves to prevent the occurrence.
5. The air conditioning ground connection check valve was included as an A Check item in the ATR72-600 Aircraft Maintenance Procedures (AMP).
6. Regarding quality procedure QP-MP-03, detailed operational procedures for notice of maintenance, such as engineers to evaluate TPS, etc. was updated

in the Maintenance Manual, AD and Operation Procedures for Notice of Maintenance Management. By August 30, 2019, all TPS were evaluated. New released TPS will be downloaded from the ATR website for further evaluation every month.

Attachment 1 ATR(BEA) comments about draft and TTSB resolutions.



ATR

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Attention to :
Mr David Romat
Safety Investigator
BEA

Cc Christopher McGregor
Johan Condette
SAFETY
Ref: V-43/20

Blagnac, July 29th, 2020

Dear David,

Please find here below ATR comments to Mandarin Airlines flight AE7931 occurrence report.

The report has captured correctly the technical analysis of the problem.

ATR would suggest to change the event characterization "cabin depressurization" with "Excess cabin altitude" warning since it is more in line with the technical explanation of the occurrence.

Your sincerely,

Paul Jouas
Flight Safety Director
Accident / Incident Investigator

atrbroadcast atraircraft atraircraft atr

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Comment number	Page	Extract of the report	Proposed changes	Rationale
1	3	The aircraft experienced cabin depressurization during descent	The aircraft experienced an "Excess cabin altitude" warning during descending	Depressurization refers to sudden lack of pressurization. In this event, it's the engine power reduction coupled with the leak from the duct which generated insufficient flow to maintain the cabin pressure altitude
2	3	After the aircraft landed at Hualien Airport, the maintenance personnel discovered that the spring of the aircraft's air-conditioning ground connection check valve might have broken before the aircraft took off from Kaohsiung Airport, resulting in the check valve not being able to be secured in fully closed position	add the paragraph	could be interesting to add in the report if the air conditioning ground cart has been used before the flight
3	15	The aircraft experienced cabin depressurization during descending.	The aircraft experienced an "Excess cabin altitude" warning during descent	same as comments #1

2

Comment number	Page	Extract of the report	Proposed changes	Rationale
	Page 21	The maximum flight altitude for ATR72-600 aircraft on a normal domestic route is around 14,000	The maximum flight altitude for ATR72-600 aircraft On a normal domestic route is around 14,000, the flight altitude of a ATR 72-600 is usually around 14,000 ft in the Mandarin Airlines network.	Add clarification
	Page 22	The amount of fuel in No. 1 engine was 40kg less than that in No. 2 engine,	The amount of fuel used in No. 1 engine was 40kg less than that in No. 2 engine,	Add clarification

3

<p>4</p>	<p>Page 27 2.2.1</p>	<p>When the occurrence aircraft reached cruising altitude (13,000ft), the thrust of the engine decreased, and so did the airflow in the air-conditioning system, resulting in the rise of cabin altitude (after Point A in Figure 2.2-1), but it was maintained at approximately 8,000ft.</p>	<p>When the occurrence aircraft reached cruising altitude (13,000ft), there is a sudden rise of cabin altitude (after Point A in Figure 2.2-1) probably due to the collapse of the air-conditioning distribution tube downstream the valve, which increases the external leakage, not compensated by the air conditioning system. The cabin altitude was finally maintained at approximately 8,000ft.</p>	<p>The decrease of engine thrust cannot alone explain the increase of the cabin altitude, as the engine thrust in cruise condition is still sufficient to maintain the required regulated pressure and flow supplied to the cabin.</p>
<p>5</p>	<p>PAGE 27 2.2.1</p>	<p>Cabin altitude increased as a result of engine thrust decrease during cruise phase</p>	<p>Cabin altitude increased as a probable result of the collapse of the air-conditioning distribution tube downstream the valve.</p>	<p>The decrease of engine thrust cannot alone explain the increase of the cabin altitude, as the engine thrust in cruise condition is still sufficient to maintain the required regulated pressure and flow supplied to the cabin.</p>

Report chapter	Extract of draft report	ATR (BEA) proposed changes	TTSB actions
Executive summary	民國 108 年 5 月 2 日，華信航空股份有限公司一架 ATR72-212A 型客機，國籍標誌及登記號碼 B-16851，航班編號 AE7931，於 1432 時自高雄國際機場起飛，執行飛往花蓮機場之飛航任務，機上載有正、副駕駛員各 1 人、客艙組員 2 人、隨機機務 1 人、乘客 48 人，共計 53 人。該機於下降過程中發生客艙失壓情形，經飛航組員處置後，於 1528 時降落在花蓮機場，人機均安。	The aircraft experienced an "Excess cabin altitude" warning during descending	Accept related report change in Chinese: …。該機於下降過程中「客艙高度過高」警告作動，…
Executive summary	事故機於花蓮機場落地後，維修人員檢查發現該機空調地面連接單向閥自高雄機場起飛前可能已因閥門彈簧斷裂，使單向閥閥門無法維持在全關閉位置。	add the paragraph	Not accept The related contents was already included in 2.2.1.
1.1	民國 108 年 5 月 2 日，華信航空股份有限公司（以下簡稱華信航空）一架 ATR72-212A1 型客機，國籍標誌及登記號碼 B-16851，航班編號 AE7931，於 1432 時 2 自高雄國際機場（以下簡稱高雄機場）起飛，執行飛往花蓮機場之飛航任務，機上載有正、副駕駛員各 1 人、客艙組員 2 人、隨機機務 1 人、乘客 48 人，共計 53 人。該機於下降過程中發生客艙失壓情形，經飛航組員處置後，於 1528 時降落在花蓮機場，人機均安。	The aircraft experienced an "Excess cabin altitude" warning during descending	Accept related report change in Chinese: …。該機於下降過程中「客艙高度過高」警告作動，…

1.18.2.1	ATR72-600 型機平日用於飛航國內航線時，最大飛行高度約為 1 萬 4,000 呎。	The maximum flight altitude for ATR72-600 aircraft On a normal domestic route is around 14,000, the flight altitude of a ATR 72-600 is usually around 14,000 ft in the Mandarin Airlines network.	Accept related report change in Chinese: 華信 ATR72-600 型機平日用於飛航國內航線時，最大巡航高度約為 1 萬 4,000 呎。
1.18.2.2	1 號油箱之油量較 2 號油箱少了 40 公斤，…	The amount of fuel used in No. 1 engine was 40kg less than that in No. 2 engine,	Not accept The sentence was extracted from FO's interview notes, the related draft corresponded to his statement.
2.2.1	事故機到達巡航高度（13,000 呎）後，發動機推力下降同時使空調系統進氣量下降，導致航機客艙高度上升（圖 2.2-1A 點以後），惟仍控制在約 8,000 呎；	When the occurrence aircraft reached cruising altitude (13,000ft), there is a sudden rise of cabin altitude (after Point A in Figure 2.2-1) probably due to the collapse of the air-conditioning distribution tube downstream the valve, which increases the external leakage, not compensated by the air conditioning system. The cabin altitude was finally maintained at approximately 8,000ft.	Not accept The air-conditioning distribution tube downstream the valve, though distorted, did not break, therefore, the external leakage would not be increased. The draft report will not be changed.

圖 2.2-1	巡航階段推力下降客艙高度升高	Cabin altitude increased as a probable result of the collapse of the air-conditioning distribution tube downstream the valve.	Not accept The air-conditioning distribution tube downstream the valve, though distorted, did not break, therefore, the external leakage would not be increased. The draft report will not be changed.
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