Federal Safety Investigation Authority

Written Preliminary Report

Accident with the aircraft Airbus A220-300,
on 23rd December 2024, at approx. 16:53 UTC,
at Graz Airport (LOWG), A-8073 Feldkirchen bei Graz, Styria, Austria
Ref.: 2025-0.190.968

Vienna, 2025

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Written Preliminary Report
This written preliminary report pursuant to Article 15 (4) of Regulation (EU) No. 996/2010 and Recommendation 5.4.6 of Annex 13 (13th Edition) to the Convention on International Civil Aviation was approved by the Head of the Federal Safety Investigation Authority.

This written preliminary report contains the facts ascertained up to the date of publication and is intended to provide information on the progress of the safety investigation. The information contained in the written preliminary report may be incomplete, may change in the course of the investigation or new relevant facts may become known that have not yet been taken into account.

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Foreword

The safety investigation is carried out in accordance with Regulation (EU) No. 996/2010 and the Accident Investigation Act [*Unfalluntersuchungsgesetz – UUG 2005*], Federal Law Gazette [*BGBI. I*] No. 123/2005 as amended.

The sole purpose of the safety investigation is the prevention of future accidents or incidents. The determination of the causes does not imply a finding of blame or administrative, civil, or criminal liability (Article 2 (4) of Regulation (EU) 996/2010).

The regulations cited in the written preliminary report always refer to the version applicable at the time of the occurrence, unless the written preliminary report expressly refers to other versions or to regulations that were not adopted until after the occurrence.

The extent of the safety investigation and the procedure to be followed in conducting the safety investigation shall be determined by the Federal Safety Investigation Authority, taking into account the lessons it expects to draw from the investigation for the improvement of aviation safety (Article 5 (3) of Regulation (EU) 996/2010).

In accordance with Recommendation 5.4.6. of Annex 13 to the Convention on International Civil Aviation, in the version of the 13th edition that entered into force on 28.11.2024, the responsible Investigation Authority should publish a preliminary report ("Written Preliminary Report") in the event of incidents that attract increased public interest, in which the facts ascertained and the progress of the investigation are to be presented. In accordance with this recommendation, the Federal Safety Investigation Authority publishes the present report pursuant to Article 15(4) of Regulation (EU) No 996/2010.

Unless stated otherwise, the safety recommendations are addressed to those bodies in a position to implement these safety recommendations in the form of suitable actions. The decision to implement these safety recommendations will be at the discretion of such bodies.

To protect the anonymity of all persons involved in the occurrence, the report is subject to content restrictions.

All times given in this report are stated in 24 hour format and UTC (at the time of the accident CET (standard time or "winter time") was valid, local time = UTC + 1 hour).

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Introduction

Aircraft operator:	Airline operator (EASA)
Mode of operation:	Commercial air transport operations
Aircraft manufacturer:	C Series Aircraft Limited Partnership (CSALP) - (now known as Airbus Canada Limited Partnership)
Type designation:	A220-300
Manufacturer designation:	BD-500-1A11
Aircraft type certification:	CS – 25 / Large Aeroplane
Nationality:	Switzerland
Accident location:	Graz Airport (LOWG)
Coordinates (WGS84):	N 46°59'35", E 015°26'21" (airport reference point)
Elevation above MSL:	About 341 m / 1 120 ft
Date and time:	December 23rd, 2024, approx. 16:53 UTC (time of landing)

Executive summary

On December 23rd, 2024, an Airbus A220-300 airline operated flight, departed from Bucharest Otopeni Airport (Romania) to Zurich International Airport (Switzerland) with 74 passengers and five crew members on board.

At 16:30 UTC, the flight crew established initial contact with WIEN RADAR while transitioning Austrian airspace. At 16:34 UTC, four minutes after the initial contact, the crew declared an emergency due to smoke in the cockpit at flight level 400, approximately 23 nm east-northeast of Graz Airport (LOWG). At 16:36 UTC, the crew requested an immediate diversion to Graz Airport.

Smoke entered the passenger cabin and cockpit area. The cabin crew members donned respiratory personal protective equipment (smoke hoods) as per their training, while the flight crew used full-face quick-donning oxygen masks in accordance with the abnormal procedures.

The aircraft landed uneventfully with one engine inoperative at 16:53 UTC on runway 34C, followed by an emergency evacuation at 16:55 UTC using four emergency exits. All passengers and crew successfully evacuated.

Several passengers and the entire crew were taken to a hospital for medical evaluation and treatment. One cabin crew member later succumbed to their condition on December 30th, 2024.

The standby service of the Austrian Federal Safety Investigation Authority-Civil Aviation Division (SUB) was informed of the incident by the Austro Control GmbH (ACG) Search and Rescue Center at approx. 17:15 UTC. In accordance with Article 5(1) of Regulation (EU) No 996/2010, a safety investigation into the accident was instituted.

In accordance with Article 9 (2) of Regulation (EU) No 996/2010, the following states concerned were informed of the accident:

State of manufacture (aircraft):	Canada
State of design (aircraft):	Canada
State of design (engine):	United States of America
State of manufacture (engine):	United States of America
State of the operator:	Switzerland
State of registry:	Switzerland

International Organisations:

International Civil Aviation Organization (ICAO)
European Union Aviation Safety Agency (EASA)

1 Factual information

1.1 Events and history of flight

The history of the flight and the sequence of events were reconstructed based on statements and reports from the flight crew, in conjunction with data retrieved from the flight data recorder (FDR), cockpit voice recorder (CVR), aircraft health management system (AHMS), radar data, and weather information provided by Austro Control GmbH, as well as investigations conducted by the Federal Safety Investigation Authority. The data presented provides a summarized excerpt for this preliminary report, offering a concise overview of the events.

At 16:30:19, the flight established initial contact with WIEN RADAR on 122.040 MHz while operating normally. One minute later, the aircraft entered Austrian Airspace. Shortly after, at 16:32:12, the cockpit crew detected initial signs of an engine abnormality, as indicated by an EICAS advisory message: L ENGINE FAULT and an INFO message: 79 L ENGINE FAULT - OIL DEBRIS ABOVE LIMIT.

At 16:33:46, a master caution was triggered with an EICAS message: ENG VIBRATION; close to this caution; the cabin crew recalled hearing a loud bang in the passenger cabin.

Subsequently, another master caution appeared on the EICAS, indicating L ENG OPER DEGRADED. At 16:34:12, the cockpit crew detected smoke and immediately donned their oxygen masks.

At 16:34:17, a master warning was issued on the EICAS with the alert LAV SMOKE, accompanied by an aural warning (“smoke” repeated four times). This was shortly followed by a new master warning: L ENG OIL PRESS. In response to these developments, at 16:34:51, CM1 declared a MAYDAY to ATC, reporting smoke in the cockpit and the initiation of a descent.

At 16:35:06, CM1 instructed the cabin crew: “Cabin crew at stations, cabin crew at stations” to prepare for a possible emergency landing. Thereafter, CM1 notified ATC of the decision to divert to Graz immediately. As the situation developed, at 16:37:28, the cockpit crew shut down the left engine according to abnormal procedures.

Efforts to coordinate with the cabin followed, with CM1 attempting to establish two-way communication at 16:39:30 using the cabin communication system. Shortly after, CM2 informed ATC of the lavatory smoke indication and confirmed that the left engine had been shut down.

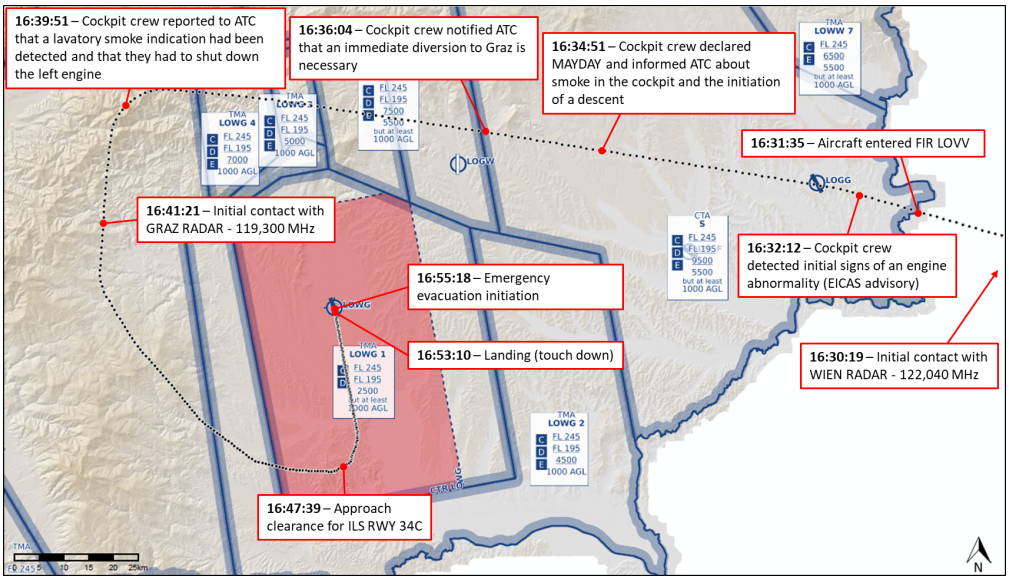
At 16:40:41, CM1 addressed the passengers via the PA system. The aircraft made initial contact with GRAZ RADAR at 16:41:21. The approach phase commenced, and at 16:47:39, approach clearance for ILS RWY 34C was received. Subsequently, ATC issued landing clearance for RWY 34C.

The aircraft touched down on RWY 34C at 16:53:10 and came to a complete stop on the runway.

At 16:53:41, CM1 instructed: “Cabin crew at stations, cabin crew at stations” to prepare for a potential evacuation. At 16:54:06, CM1 consulted Purser (CM3) regarding the situation in the cabin. Following this assessment, at 16:54:56, the cockpit crew shut down the right engine.

Based on the situation assessment, CM1 initiated an emergency evacuation via the PA system at 16:55:18. All passengers and crew evacuated using four emergency exits.

Figure 1 Sequence of events



Source: Austro Control GmbH, SUB

Figure 2 Flight path overview



Source: Google Earth, SUB

Table 1 Excerpt timeline of event

TIME in UTC	EVENT
16:30:19	Initial contact with WIEN RADAR – 122.040 MHz
16:31:35	Aircraft entered FIR LOVV
16:32:12	Cockpit crew detected initial signs of an engine abnormality EICAS advisory message: L ENGINE FAULT INFO message: 79 L ENGINE FAULT - OIL DEBRIS ABOVE LIMIT
16:33:46	Master caution – EICAS message: ENG VIBRATION
16:34:09	Master caution – EICAS message: L ENG OPER DEGRADED
16:34:12	Cockpit crew detected smoke and donned their masks
16:34:17	Master warning – EICAS message: LAV SMOKE and aural warning 4x “smoke”
16:34:30	Master warning – EICAS message: L ENG OIL PRESS
16:34:51	CM1 declared MAYDAY and informed ATC about smoke in the cockpit and the initiation of a descent
16:35:06	CM1 instruction to the cabin crew: “Cabin crew at stations, cabin crew at stations“
16:36:04	CM1 notified ATC that an immediate diversion to Graz is necessary

TIME in UTC	EVENT
16:36:51	Left engine thrust lever was reduced to IDLE
16:37:28	Shutdown of left engine by the cockpit crew
16:39:30	Attempt of CM1 to establish two-way communication with the cabin crew via the cabin communication system
16:39:51	CM2 reported to ATC that a lavatory smoke indication had been detected and that they had to shut down the left engine
16:40:41	Passenger announcement by CM1
16:41:21	Initial contact with GRAZ RADAR – 119.300 MHz
16:47:39	Approach clearance for ILS RWY 34C
16:48:57	Landing clearance for RWY 34C
16:53:10	Landing (touch down) on RWY 34C with full stop on the runway
16:53:41	CM1 instructed the cabin crew: “Cabin crew at stations, cabin crew at stations“
16:54:06	Consultation of CM1 with the Purser (CM3) regarding the situation in the cabin
16:54:56	Shutdown of right engine by the cockpit crew
16:55:18	Initiation of emergency evacuation by CM1 via the PA system

Source: SUB

1.2 Injuries to persons

Table 2 Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	1	-	-
Serious	1	-	-
Minor	3	3	-
None	-	71	

According to Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010, injuries are classified as follows: A fatal injury is defined in Article 2(5),

while a serious injury is specified in Article 2(17). The term minor and none injury is for informational purposes only and is not a classification under Regulation (EU) No 996/2010.

1.3 Damage to aircraft

The aircraft was undamaged in the accident. The left engine experienced an engine malfunction in flight and sustained damage (refer to section 1.9).

1.4 Personnel information

The crew consisted of two cockpit crew members and three cabin crew members. This composition met the required minimum number of cockpit and cabin crew members as per EASA Commercial Air Transport regulations, aircraft minimum crew requirements, and the operator's specified minimum crew requirements.

1.4.1 CM1 – Captain

Age:	41 years
Type of Civil Pilot Licence:	ATPL(A) (Airline Transport Pilot Licence)
Authorisations:	Multi-Pilot Operations Only
Type/Type Rating:	BD-500
Medical check:	Class 1
Validity:	License valid with a valid medical certificate

1.4.2 CM2 – First Officer

Age:	35 years
Type of Civil Pilot Licence:	ATPL(A) (Airline Transport Pilot Licence)
Authorisations:	Multi-Pilot Operations Only
Type/Type Rating:	BD-500
Medical check:	Class 1
Validity:	License valid with a valid medical certificate

1.4.3 CM3 – Purser

Age:	55 years
Cabin Crew Member (at flight):	S/C - CCM1

Seat Allocation (at flight):	Cabin Crew Station 1L - outboard
Door responsibilty:	Door 1L
Authorisations:	Certified Cabin Crew Member (A220)
Type/Type Rating:	Certified on Type
Medical Certificate Validity:	Valid
Duty Time on 23.12.2024:	Within legal limits
Safety Training:	Completed as per company standards
Recurrent Training:	Up to date
CRM Training:	Successfully completed

1.4.4 CM4 – Cabin Crew Member

Age:	23 years
Cabin Crew Member (at flight):	CCM – CCM2
Seat Allocation (at flight):	Cabin Crew Station 1L - inboard
Door responsibilty:	Door 1R
Authorisations:	Certified Cabin Crew Member (A220)
Type/Type Rating:	Certified on Type
Medical Certificate Validity:	Valid
Duty Time on 23.12.2024:	Within legal limits
Safety Training:	Completed as per company standards
Recurrent Training:	Up to date
CRM Training:	Successfully completed

1.4.5 CM5 – Cabin Crew Member

Age:	57 years
Cabin Crew Member (at flight):	CCM – CCM3
Seat Allocation (at flight):	Cabin Crew Station 2L - facing forward
Door responsibilty:	Doors 2L/R
Authorisations:	Certified Cabin Crew Member (A220)
Type/Type Rating:	Certified on Type
Medical Certificate Validity:	Valid
Duty Time on 23.12.2024:	Within legal limits
Safety Training:	Completed as per company standards
Recurrent Training:	Up to date
CRM Training:	Successfully completed

1.5 Aircraft information

Aircraft type:	CS – 25 / Large Aeroplane
Manufacturer:	C Series Aircraft Limited Partnership (CSALP)
Type designation:	A220-300
Manufacturer designation:	BD-500-1A11
Year of manufacture:	2017
Engine:	Turbofan
Engine manufacturer:	Pratt & Whitney
Engine manufacturer designation:	PW1524G-3

1.6 Meteorological information

1.6.1 METAR weather observations

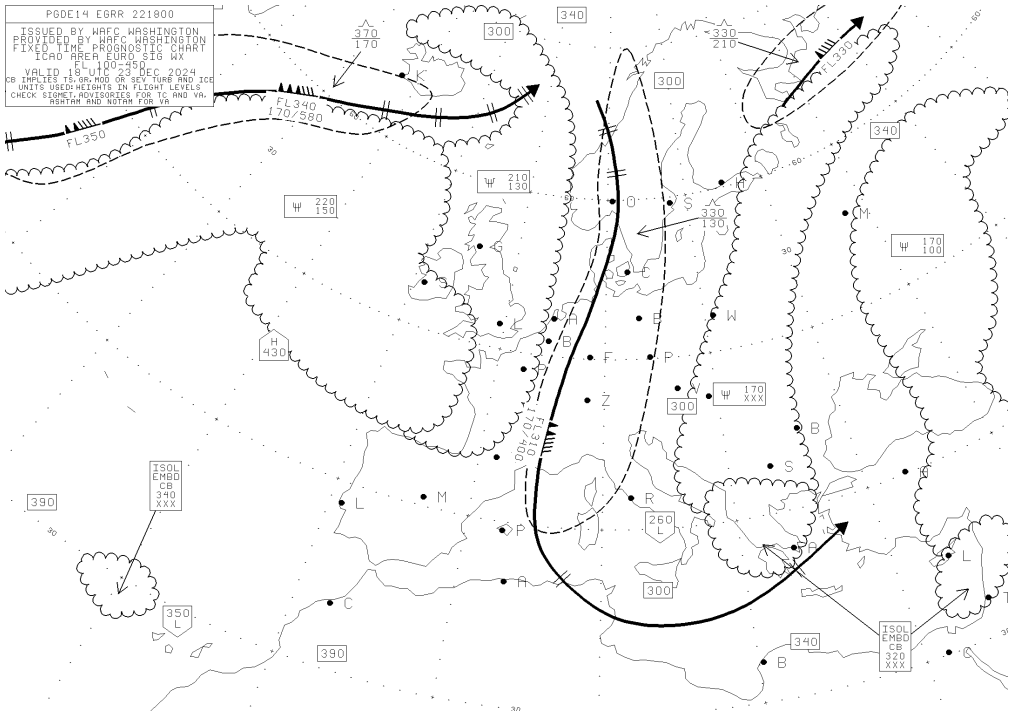
Table 3 Weather observation Graz airport (METAR LOWG)

SAOS55 LOWG
METAR LOWG 231750Z AUTO 34018KT 9999 NCD 04/M08 Q1007 NOSIG=
METAR LOWG 231720Z 34011KT CAVOK 03/M08 Q1007 NOSIG=
METAR LOWG 231650Z AUTO 34014KT 9999 NCD 04/M07 Q1007 NOSIG=
METAR LOWG 231620Z AUTO 35013KT 9999 NCD 03/M07 Q1007 NOSIG=
METAR LOWG 231550Z AUTO 35014KT 9999 NCD 04/M07 Q1006 NOSIG=

Source: Austro Control GmbH aviation weather service

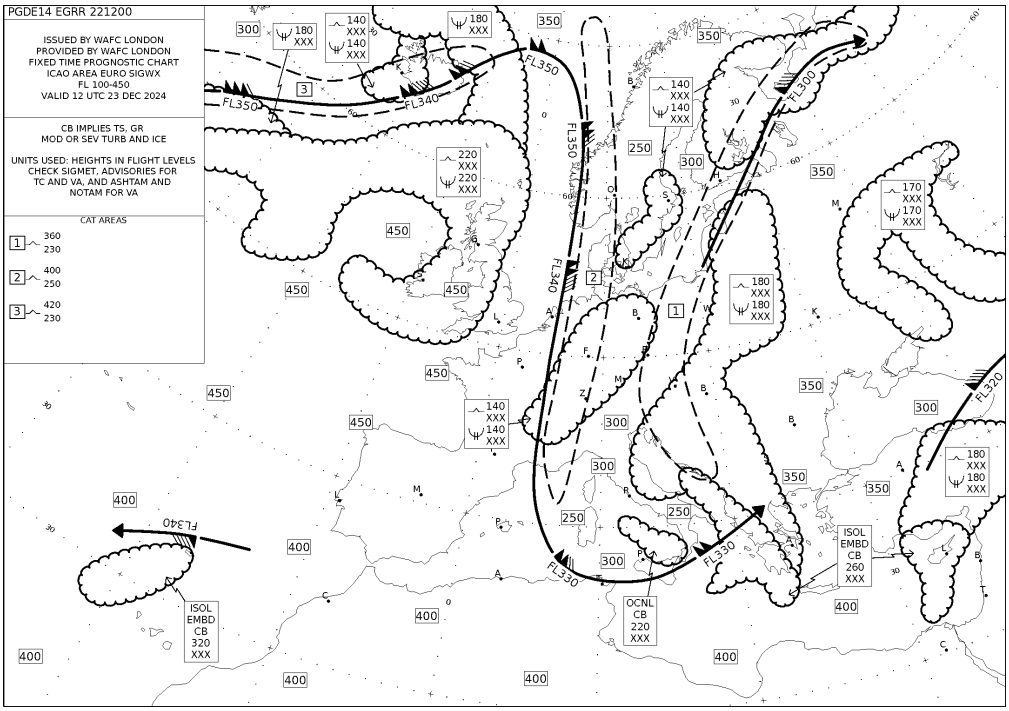
1.6.2 Weather charts

Figure 3 Significant Weather Chart, valid at 18:00, FL100-450



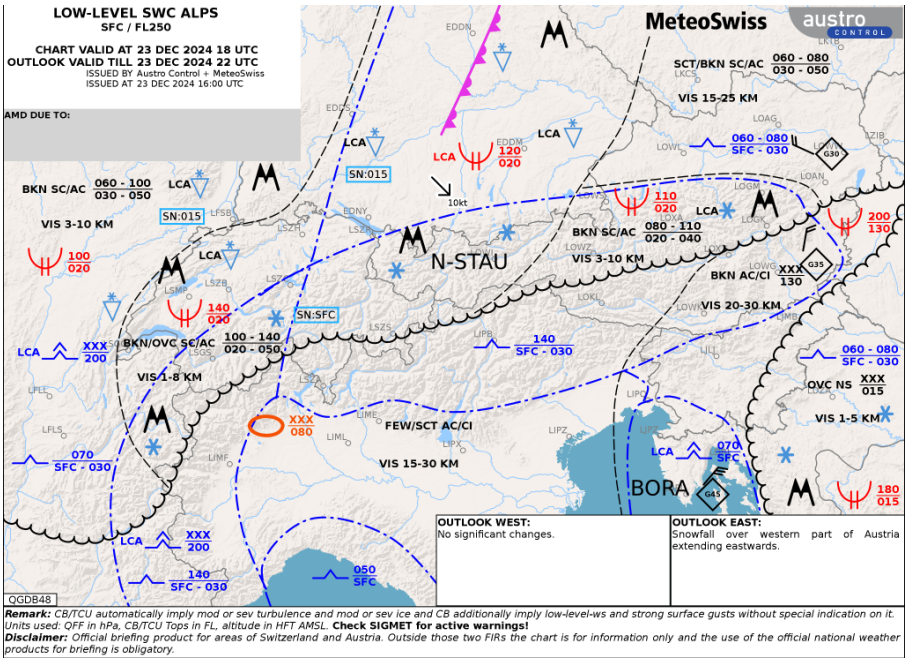
Source: Austro Control GmbH aviation weather service

Figure 4 Significant Weather Chart, valid at 12:00, FL100-450



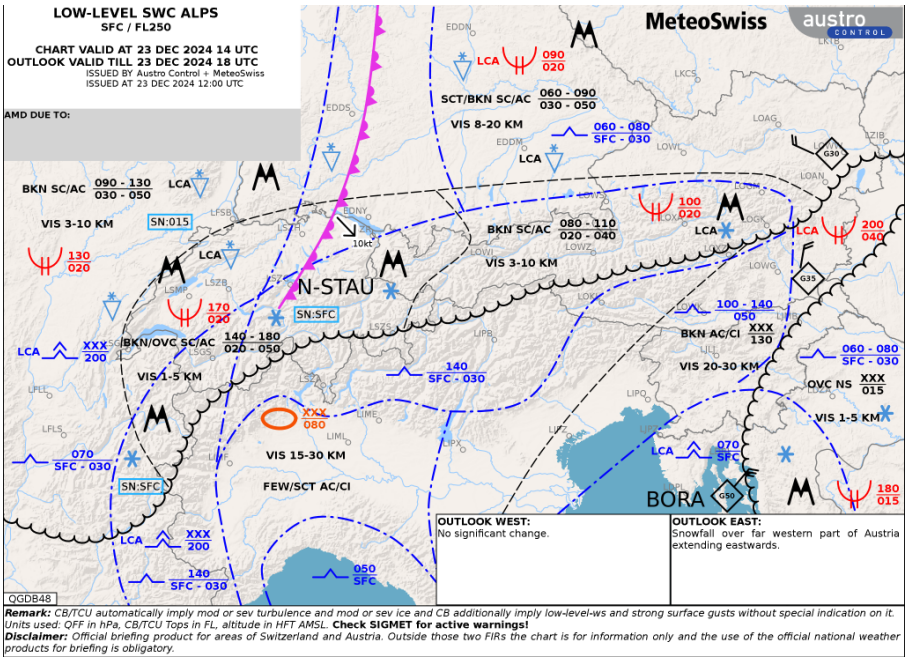
Source: Austro Control GmbH aviation weather service

Figure 5 Low-level SWC ALPS valid at 18:00, Outlook valid till 22:00



Source: Austro Control GmbH aviation weather service

Figure 6 Low-level SWC ALPS valid at 14:00, Outlook valid till 18:00



Source: Austro Control GmbH aviation weather service

1.7 Aeronautical telecommunications

The cockpit crew was in contact with the area control center (ACC) WIEN RADAR (122.040 MHz) upon entering FIR LOVV. The MAYDAY call was made on the ACC frequency. After being handed over from ACC, the cockpit crew remained in contact with approach control (APP) GRAZ RADAR (119.300 MHz) until the evacuation on the runway.

The Austrian air navigation service provider Austro Control GmbH supplied the SUB with complete transcripts of the radio communication. Furthermore, transcripts of all recorded verbal exchanges between the ATS units ACC and Graz APP, as well as with the emergency services at Graz Airport, were made available to the SUB.

1.8 Flight recorders

In accordance with international protocols and EU Regulation 996/2010, the data is subject to the provisions of the SUB.

1.8.1 FDR, CVR

The aircraft was equipped with both a flight data recorder (FDR) and a cockpit voice recorder (CVR), both of which were operational, undamaged, and recorded data. The CVR contained over five hours of audio recordings across four channels, all in good quality.

Under the supervision of the SUB, data acquisition was conducted in Switzerland using the infrastructure of the Swiss Transportation Safety Investigation Board (STSB).

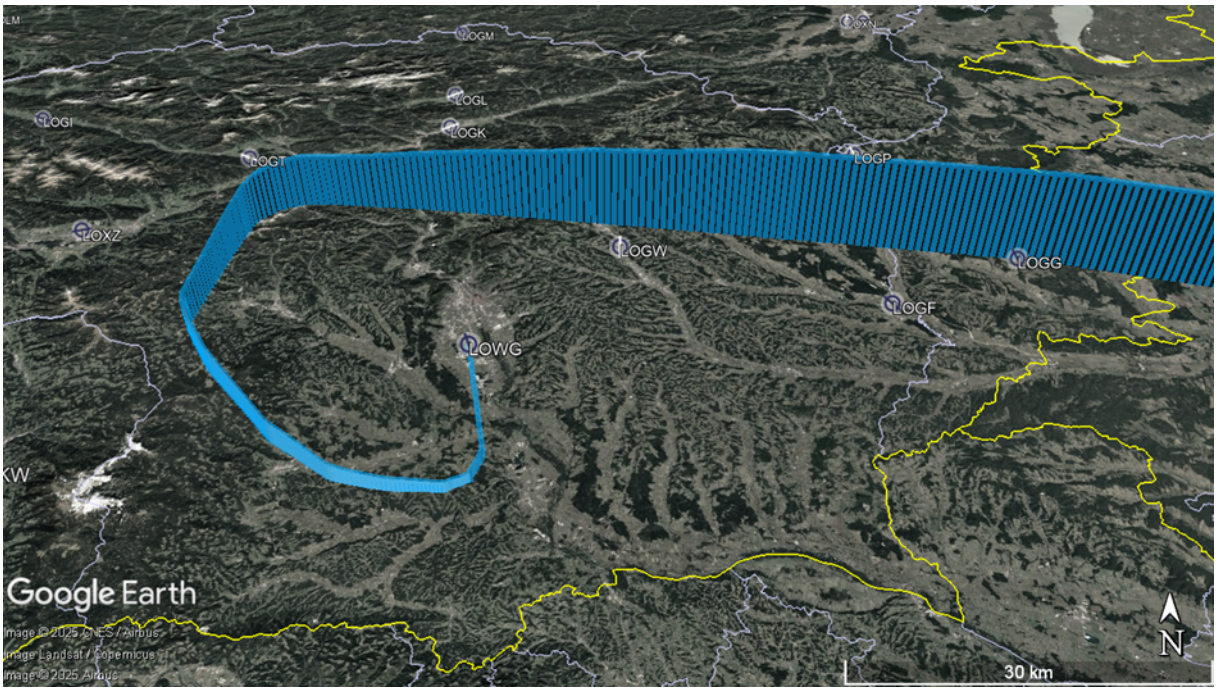
1.8.2 AHMS

The aircraft health management system (AHMS) recorded additional flight and engine parameters. The engine manufacturer provided selected parameters from the eFAST-HMU (enhanced flight data acquisition storage and transmission-health monitoring unit) related to the accident flight. Furthermore, the aircraft operator submitted data from the onboard maintenance system (OMS) covering both the accident flight and the preceding flight. Both eFAST-HMU and OMS are part of the AHMS.

1.8.3 Radar data

Data from the ATS surveillance system, in the form of ARTAS radar data for the affected aircraft, was transmitted by Austro Control GmbH. It covered the period from 21 nm before entering FIR LOVV until the evacuation at Graz Airport, with a temporal resolution of 4 seconds.

Figure 7 Radar data flight path



Source: Google Earth, Austro Control GmbH, SUB

1.9 Engine investigation

The aircraft was equipped with two Pratt & Whitney PW1524G-3 turbofan engines, which are high-bypass ratio, axial-airflow, dual-spool engines controlled by a Full Authority Digital Electronic Control (FADEC) system.

According to manufacturer records, the affected engine was manufactured on 30 July 2021 and initially delivered as a spare to the operator. On 08 July 2024, the engine was installed in the No. 1 (left) position on the aircraft. A review of maintenance records confirmed that all scheduled maintenance was performed in accordance with applicable procedures and timelines. Furthermore, all mandatory Airworthiness Directives (ADs) that were in effect at the time had been completed in accordance with regulatory requirements.

Following the occurrence, the No. 1 engine was removed from the aircraft by the operator's maintenance personnel and subsequently transported to a designated facility at Graz Airport for initial examination. A borescope inspection was conducted by specialists from the engine manufacturer in conjunction with the operator's technical staff under the

supervision of the Austrian Safety Investigation Authority (SUB). Subsequent to the inspection, the engine was shipped from Graz Airport to Columbus, GA, USA, and selected components were forwarded to the manufacturer's facility in Hartford, CT, USA, for further detailed analysis in accordance international protocols.

Examination revealed damage to the Front Drive Gear System (FDGS) as well as bearings No. 2 and No. 4. Further metallurgical testing and component analysis are ongoing as part of the investigation being conducted in both Austria and the United States of America.

1.10 Crew protective breathing equipment (PBE) investigation

The PBE is a hood or full face mask device that completely encloses the head of the wearer and seals around the neck with a thin, elastic membrane. The chemical air regeneration system is based on the use of potassium superoxide (KO2). Operation of the PBE is powered by the exhalation of the wearer into an oronasal mask cone located within the hood. The low moisture content of the oxygen gas generated by the KO2 bed in the canister reduces the wet bulb temperature, improving wearer comfort, and controlling misting or fogging of the visor, side windows, and/or glasses. The complete device is secured to the head to minimize restrictions of mobility. A neck shield extends downward from the back of the hood to protect the collar and upper shoulder area of the user from direct flame contact. A speaking diaphragm is installed in the oronasal mask cone to facilitate communication. The unit is vacuum sealed in a bag and installed in a protective stowage box within the aircraft cabin. The PBE on board are specifically intended to protect crew members from the effects of smoke, carbon dioxide or other harmful gases and oxygen deficiency caused by other than an aircraft depressurization, while attempting to locate and/or extinguish (combating) an inflight fire on board an aircraft. The PBEs have a limited life and are dependent on their correct use. Cabin crews receive initial and recurrent training on their use.

Each of the four PBE units (three were worn by crew member) involved in the accident were collected and examined per a special PBE Examination plan in close collaboration with the PBE manufacturer. The plan includes visual examination of the hood, non-destructive and destructive inspection of special parts. Some parts of the hoods are under analysis as part of laboratory testing that is ongoing and not finished at the moment. Within the investigation, the use of the PBE will be evaluated. This will also include how crews are trained on their correct use and how to identify any malfunction with the PBE and its end of operation.

1.11 Emergency evacuation investigation

1.11.1 Emergency evacuation equipment

The provided diagram in Figure 8 illustrates the cabin layout of the aircraft, highlighting the designated **cabin crew seating positions** and **exit door locations**.

Cabin crew seating positions and door naming

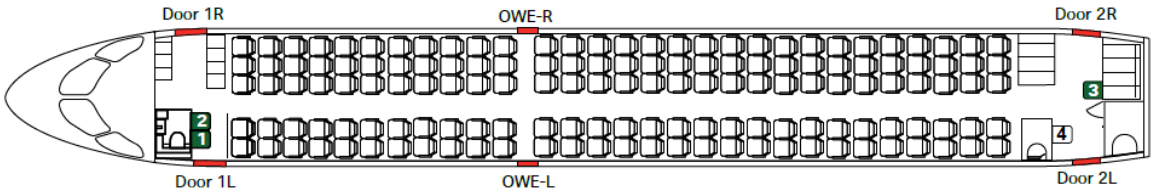
The aircraft is equipped with **four main doors** and **two overwing exits (OWE)**, which are named as follows:

- **Door 1L and Door 1R** – Forward exits located at the front of the aircraft.
- **Door 2L and Door 2R** – Aft exits are located at the rear of the aircraft.
- **OWE-L and OWE-R** – Overwing exits, positioned over the wings.

The cabin crew seating positions are also indicated:

- **Crew seat 1 and 2** are located near **Door 1L**, at the front galley.
- **Crew seat 3** is located near **Door 2R**, at the rear galley.
- **Crew seat 4** is positioned at the rear galley area near Door 2L.

Figure 8 Cabin crew seating positions and door naming



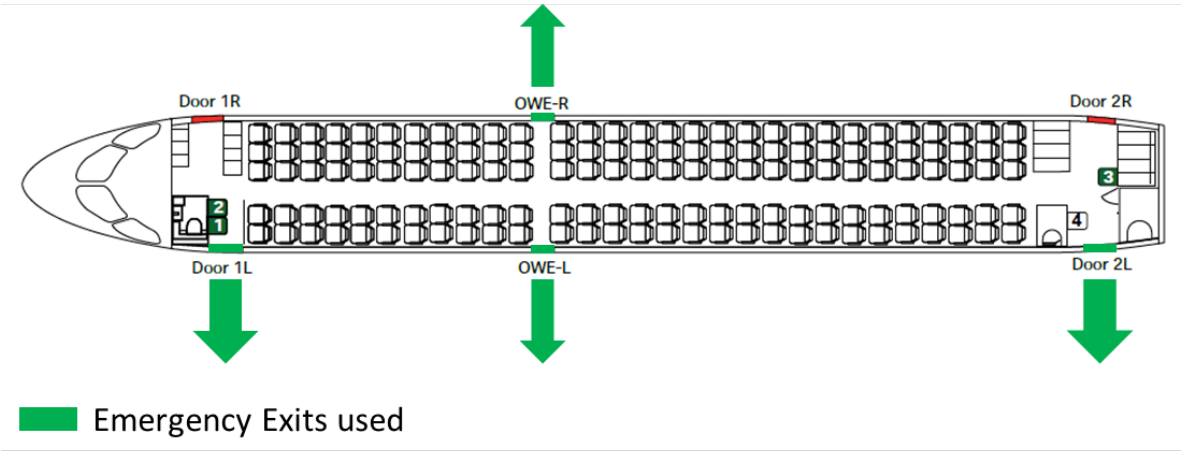
Source: Crew Safety Procedures Manual (CSPM) of the operator

1.11.2 Emergency exits used in the evacuation

As illustrated in Figure 9 during the evacuation:

- **Door 1L** (front left)
- **Overwing exit OWE-L** (left side)
- **Overwing exit OWE-R** (right side)
- **Door 2L** (rear left)
- **Doors 1R and 2R were not utilized during the evacuation.**

Figure 9 Emergency exits used in the evacuation



Source: CSPM of the operator, SUB

Investigation into the unused doors is ongoing.

Figure 10 Door 1L (front left) after evacuation



Source: SUB

Figure 11 Aft view, showing overwing exit OWE-L (left side), overwing exit OWE-R (right side), door 2L (rear left) after evacuation



Source: SUB

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List of Regulations

Federal Aviation Act of 2 December 1957 (**Aviation Act** [***Luftfahrtgesetz – LFG***]), Federal Law Gazette [*BGBl. I*] No. 253/1957 as amended by Federal Law Gazette [*BGBl. I*] No. 151/2021

Federal Act on the Independent Safety Investigation of Accidents and Incidents (**Accident Investigation Act** [***Unfalluntersuchungsgesetz – UUG 2005***]), Federal Law Gazette [*BGBl. I*] No. 123/2005 as amended by Federal Law Gazette [*BGBl. I*] No. 231/2021

Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and the repeal of Directive 94/56/EC.

Abbreviations

ACC	Area Control Center
ACG	Austro Control GmbH
AD	Airworthiness Directive
AHMS	Aircraft Health Management System
APP	Approach Control
ARTAS	ATM Surveillance Tracker and Server
ATC	Air Traffic Control
ATM	Air Traffic Management
ATPL(A)	Airline Transport Pilot Licence, Aeroplane
ATS	Air Traffic Service
BGBl	Bundesgesetzblatt (Federal Law Gazette of Austria)
CCM	Cabin Crew Member
CET	Central European Time
CM	Crew Member
CS	Certification Specification
CSALP	C Series Aircraft Limited Partnership
CSPM	Crew Safety Procedures Manual
CVR	Cockpit Voice Recorder
EASA	European Union Aviation Safety Agency
EC	European European Commission
eFAST	Enhanced Flight Data Acquisition Storage and Transmission
EICAS	Engine Indication and Crew Alerting System
EU	European Union
FADEC	Full Authority Digital Electronic Control
FDGS	Front Drive Gear System
FDR	Flight Data Recorder
FIR	Flight Information Region
FL	Flight Level

HMU	Health Monitoring Unit
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
KO2	Potassium Superoxide
LFG	Luftfahrtgesetz (Aviation Act)
LOVV	Designation of the Flight Information Region (FIR) Vienna
LOWG	ICAO designation of Graz airport
METAR	Meteorological Aviation Routine Weather Report
MSL	Mean Sea Level
OMS	Onboard Maintenance System
OWE	Overwing Exits
PA	Passenger Adress
PBE	Protective Breathing Equipment
RWY	Runway
S/C	Senior Cabin Crew
STSB	Swiss Transportation Safety Investigation Board
SUB	Sicherheitsuntersuchungsstelle des Bundes (Federal Safety Investigation Authority)
SWC	Significant Weather Chart
UTC	Coordinated Universal Time
UUG	Unfalluntersuchungsgesetz (Accident Investigation Act)
WGS84	World Geodetic System 1984
WMO	World Meteorological Organization

ft	Feet (1 ft = 0.3048 m)
MHz	Megahertz (1 MHz = 10^6 Hz)
nm	Nautical mile (1 nm = 1852 m)

Abbreviations related to weather charts and weather reports can be found in the WMO Manual "Aerodrome Reports and Forecasts," WMO-No. 782:

https://library.wmo.int/records/item/30224-aerodrome-reports-and-forecasts

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