Technical report
IN-014/2022

Incident involving a Cessna 560 XL aircraft, registration D-CNOC, on 24 March 2022 at Seville Airport (Seville, Spain)

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GOBIERNO DE ESPAÑA
MINISTERIO DE TRANSPORTES, MOVILIDAD Y AGENDA URBANA
UNDERSECRETARIAT
CIVIL AVIATION
ACCIDENT AND INCIDENT
INVESTIGATION COMMISSION

Notice

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission regarding the circumstances of the accident that is the object of the investigation, its probable causes, and its consequences.

In accordance with the provisions of Article 5.4.1 of Annex 13 of the International Civil Aviation Convention, Article 5.6 of Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010; Article 15 of Law 21/2003 on Air Safety; and Articles 1 and 21.2 of RD 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent their recurrence. The investigation is not intended to attribute any blame or liability, nor to prejudge any decisions that may be taken by the judicial authorities. Therefore, and according to the laws specified above, the investigation was carried out using procedures not necessarily subject to the guarantees and rights by which evidence should be governed in a judicial process.

As a result, the use of this report for any purpose other than the prevention of future accidents may lead to erroneous conclusions or interpretations.

CONTENTS

ABBREVIATIONS

° ‘ “	Sexagesimal degrees, minutes and seconds
%	Per cent
°C	Degrees Celsius
AEMET	State Meteorological Agency
AESA	Spain’s National Aviation Safety Agency
AOC	Air operator certificate
AOD	Aerosol optical depth
AOG	Aircraft on the ground
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATPL	Airline transport pilot licence
ATS	Air traffic service
CAT	Commercial air transport
CRS	Certificate of release to service
DU	Dust
E	East
EASA	European Aviation Safety Agency
ECCAIRS	European Co-ordination centre for Accident and Incident Reporting Systems
FAR	Federal Aviation Regulations
FOD	Foreign object damage
ft	Feet
h	Hours
hPa	Hectopascals
HZ	Haze
IFR.	Instrument flight rules
ILS	Instrument Landing System
IR	Instrument rating
kg	Kilograms
km	Kilometres
Kt	Knot(s)
l	Litres
lb	Pounds
LEAM	ICAO code for Almería Airport
LEZL	ICAO code for Seville Airport
LPFR	ICAO code for Faro Airport
m	Metres
MMEL	Master minimum equipment list
MP	Multi-pilot aircraft rating
METAR	Aviation routine weather report (in aeronautical meteorological code)

Min	Minutes
NCC	Non-commercial operations with complex motor-powered aircraft
NCO	Non-commercial operations with non-complex motor-powered aircraft
ICAO	International Civil Aviation Organisation
PF	Pilot flying
PIC	Pilot-in-command
PM	Pilot monitoring
QNH	Altimeter setting to obtain elevation above sea level when on the ground
S	South
SE	Southeast
SNS	Event notification system
SW	Southwest
TAF	Terminal aerodrome forecast
UTC	Coordinated universal time
V_{S1}	Stall speed (“clean” configuration)
WMO	World Meteorological Organisation
$\mu g/m^3$	Micrograms per metre cubed

Technical report

IN-014/2022

Owner	Vertical Inc
Operator	OHLAIR Chaterflug GmbH&Co. Kommanditgesellschaft[1]
Aircraft:	Cessna 560 XL, registration D-CNOC (Germany)
Date and time of the incident:	24 March 2022, 12:52 h[2]
Site of incident:	Seville Airport (Seville)
Persons on board:	2 (crew)
Type of flight:	Commercial air transport – Non-commercial operation – Ferry/positioning
Phase of flight:	En route
Type of operation:	**I**FR
Date of approval:	**25 January 2023**

Synopsis

Summary:

At 11:33 h on Wednesday, 24 March 2022, the Cessna 560 XL aircraft with registration D-CNOC took off from Almería Airport (LEAM) in Spain for a ferry flight to Faro Airport (LPFR) in Portugal[3].

As the aircraft approached runway 10 at Faro airport, it was raining heavily. On reaching the decision altitude, the visibility through the windshield was diminished to the extent that the flight crew did not have a clear view of the runway. After making two missed approaches, they decided to divert to their alternate aerodrome, Seville (LEZL). At that moment, according to their account, they had more fuel remaining than the minimum required to proceed to Seville (LEZL).

[1] The operator's commercial name is Excellent Air

[2] All times referenced in this report are local time in Spain. UTC is 1 hour less. The aircraft's second missed approach at Faro airport took place at approximately 12:52 local time in Spain.

[3] A ferry flight is a non-commercial operation. The European regulations allow the holder of an AOC to operate for non-commercial purposes, in accordance with Annex VI (Part NCC) or Annex VII (Part NCO), the aircraft included in the operations specifications of its AOC or its operations manual. Despite this, during the investigation, the aircraft operator clarified that the flight was conducted under Part CAT.

The runway in use at Seville Airport was runway 27. As the ATIS was reporting variable winds, the flight crew requested clearance to land on runway 09 to shorten the flight time. The controller informed them that to land on runway 09, they would have to declare an emergency (MAYDAY). At 13:03 h, the flight crew declared an emergency, alleging lack of fuel, and the aircraft landed on runway 09 at Seville Airport at 13:20 h without further incident.

The investigation has determined that the incident was caused by the poor condition of the windshield coating, which had not been previously detected by the aircraft operator. However, the investigation has been unable to determine when the coating deteriorated or what caused it to do so. The possibility that the haze over the Iberian Peninsula at the time of the incident may have contributed to its deterioration has not been ruled out, nor has it been definitively confirmed as the trigger for this event.

The issue of a safety recommendation to the aircraft manufacturer has been deemed necessary.

1. THE FACTS OF THE INCIDENT

1.1. Summary of the incident

At 11:33 h on Wednesday, 24 March 2022, the Cessna 560 XL aircraft with registration D-CNOC took off from Almería Airport (LEAM) in Spain, bound for Faro Airport (LPFR) in Portugal.

It was a positioning flight with no passengers, the only occupants on board the aircraft being the captain (PF) and the co-pilot (PM).

The south of the Iberian Peninsula was affected by an episode of haze[4], and the weather forecast for the destination airport predicted that rainfall could temporarily reduce visibility to 4,000 m.

There were no relevant entries in the list of deferred items in the aircraft's technical log.

As the aircraft approached runway 10 at Faro airport, it was raining heavily. According to the pilots, when they reached the decision altitude, the rain on the cockpit windows was obscuring their view of the runway, which led to two missed approaches, the last of which took place at 12:52 h.

After the second missed approach, they decided to divert to Seville Airport (LEZL). At that point, the aircraft was carrying 300 pounds more fuel than the minimum required to proceed to the alternate aerodrome.

As the ATIS for Seville Airport was reporting variable winds, the flight crew asked to land on runway 09 to shorten the flight time and save fuel. ATC informed them that the runway in use was runway 27 and that in order to use runway 09, they would have to declare an emergency. After a brief FORDEC[5], they declared a fuel emergency at 13:03 h. ATC cleared the aircraft for the ILS runway 09 approach to Seville, where it landed at 13:20 h without further incident and with its fuel level above the final reserve.

The aircraft's flight path, extracted from the Flightradar24 tool, is shown below:

[4] See section 1.7

[5] FORDEC is a tool that helps pilots make decisions.

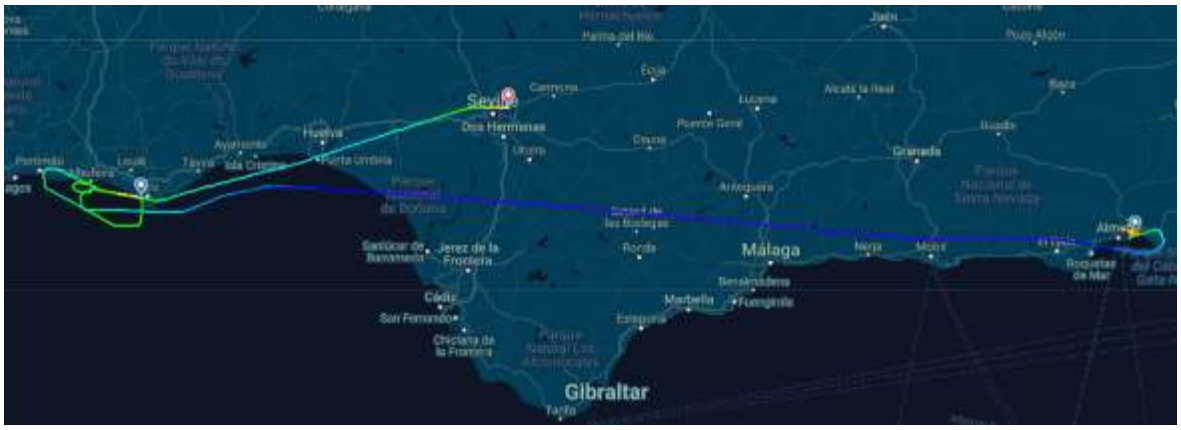

Image 1: The aircraft's flight path, extracted from the Flightradar24 tool.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal				
Serious				
Minor				
Unharmed	2		2	
TOTAL	2		2	

1.3. Damage to the aircraft

The aircraft did not sustain any damage.

1.4. Other damages

There was no further damage.

1.5. Information about the personnel

1.5.1. Information about the captain

The 55-year-old German captain held an airline transport pilot licence -ATPL(A)- first issued on 8 July 2013, with ratings including: C560XL/XLS for PIC (pilot-in-command) and IR (instrument rating) valid until 30 September 2022 and C525 for PIC and IR, MP (multi-pilot) operations valid until 31 January 2023.

His Class 1 medical certificate was valid until 18 July 2022.

He had 12,098 h of flight experience, of which 3,973 h were on the C560XL/XLS.

1.5.2. Information about the co-pilot

The 39-year-old German co-pilot held an airline transport pilot licence -ATPL(A)- first issued on 19 August 2014, with the following ratings: C560XL/XLS for PIC valid until 30 November 2022 and C525 for PIC and IR, MP operations, valid until 31 August 2022.

His Class 1 medical certificate was valid until 25 April 2022.

He had 4,739 h of flight experience, of which 819 h were on the C560XL/XLS.

1.6. Information about the aircraft

- Make: Cessna
- Model: 560 XL Citation
- Year of manufacture: 2008
- Serial number: 560-05814
- Registration number: D-CNOC
- Maximum take-off weight: 20,000 lb (9,072 kg)
- Number of engines: 2
- Type of engines: PW545A Turbofans made by Pratt&Whitney
- Information about the owner and operator: The aircraft is registered in the German Aircraft Registry in the name of Vertical Inc. as owner, and its operator is listed as OHLAIR Chaterflug GmbH&Co. Kommanditgesellschaft.

The aircraft had an Airworthiness Certificate and an Airworthiness Review Certificate, the latter being valid at the time of the event. The Airworthiness Review Certificate was issued on 30 September 2021 when the aircraft had 5,857 h of flight time.

The following photographs show the aircraft involved in the incident:

Image 2: Aircraft involved in the incident

Image 3: Cockpit and instruments onboard the aircraft involved in the incident

1.6.1. Rain removal system: Windshield coating

According to the aircraft's Type Certificate, the basis for certification is FAR Part 25, effective from 1 February 1965, as amended by Amendments 25-1 to 25-82. Requirement 25.773 governs vision in the pilot compartment. It states that the aircraft must have a means to maintain a clear portion of the windshield sufficient for both pilots to have an extensive view along the flight path in normal flight attitudes. This means must be designed to function, without continuous attention on the part of the crew, in heavy rain at speeds up to $1{,}6V_{S1}$ with lift and drag devices retracted, among other situations.

Cessna 560 XL Citation aircraft have a rain removal system[6] consisting of a hydrophobic sealant windshield coating developed by PPG Industries Inc.; specifically, the aircraft involved in the incident had the Surface Seal® Gen II version. The coating, which is applied to the windshield's exterior, causes raindrops to form into beads and roll off, allowing the flight crew to see through with little distortion.

The coating offers hydrophobic properties for a certain period of time. When the effectiveness of the coating decreases (e.g. due to scratches from rain, hail or dust), it has to be re-applied[7]. The aircraft manufacturer indicated during the investigation that there is no set time interval for re-applying the coating as it varies depending on the condition or state of the aircraft.

Chapter 56-11-00 of the Cessna 560 XL Maintenance Manual includes a functional test to check the condition of the coating using a fog spray. The condition of the coating must be inspected or checked every 12 months[8]. Basically, checking the windshield coating involves removing the dirt from the windshield with the recommended cleaner or with a mixture of water and isopropyl alcohol, spraying it with distilled or deionised water and then comparing the visibility with the reference standard, using the following photographs:

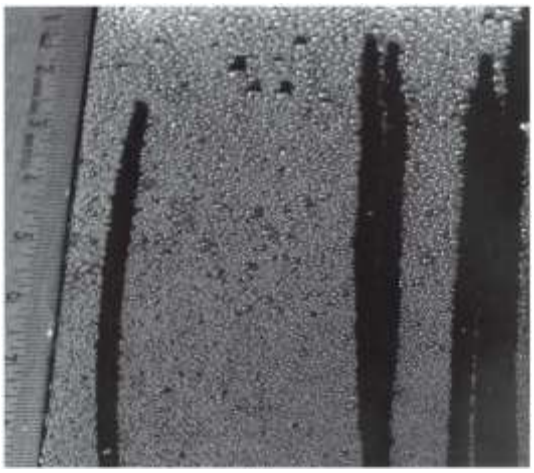

Image 3: New coating

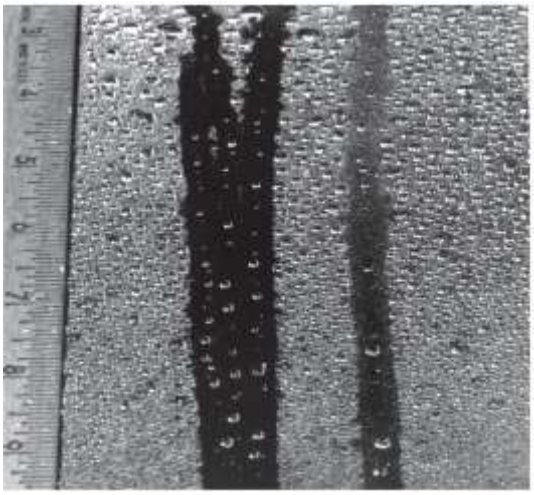

Image 4: Acceptable coating

[6] Rain removal systems afford the pilot a clear view of the airport while taxiing and of the approach and departure paths and the runway environment when taking off and landing in the rain.

[7] In terms of the useful life of the coating, the Cessna 560 XL Aircraft Maintenance Manual states in chapter 56-11-00 that it depends on its application method, whereby:

(1) Using a thermal blanket to cure the coating may be omitted; however, its useful life will be reduced to approximately 60% of the projected useful life of a fully cured coating.

(2) If the coating is applied but not immediately cured, so long as it is thermally cured within four days, the useful life of the coating will be almost as long as if it had been cured immediately.

(3) If the coating is applied and cured immediately for 2 h, the useful life will be reduced to approximately 80% of the projected useful life of a fully cured coating.

[8] The initial interval is 12 months, and the subsequent intervals, unless otherwise stated, are also 12 months.

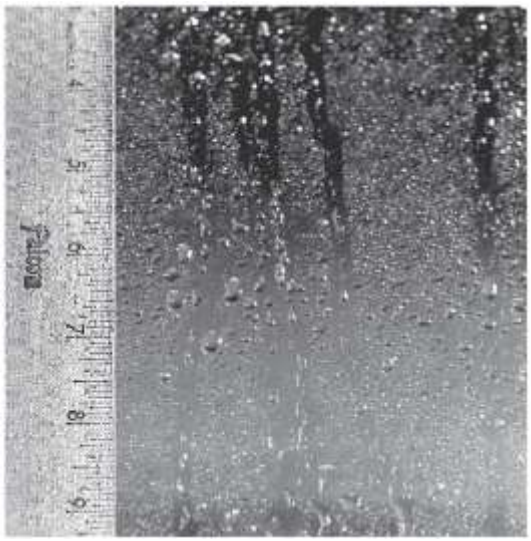

Image 5: Coating in "condition"

Image 6: Unacceptable coating

A coating classified as in "condition" (see illustration 5) should be subjected to an additional test that measures the contact angle of water droplets to determine the remaining permissible operating hours before renewal.

Furthermore, the aircraft manufacturer's MMEL, states that the coating could be inoperative if the aircraft is not flown in wet weather conditions within 5 nautical miles of the intended take-off or landing airport.

1.6.2. Inspection of the condition of the windshield coating

On 27 November 2020, the maintenance organisation Rijmond Air Services carried out the annual inspection of the windshield and re-applied the coating to both the left and right windscreens, as per the aircraft manufacturer's Maintenance Manual and the document produced by the manufacturer of the windshield coating (*PPG Surface Seal Coating System DSS 1042*).

The aircraft then remained parked inside the maintenance organisation's hangar until 13 August 2021 (approximately 8.5 months) due to a delay in the supply of a landing gear part. The certificate of release to service (CRS) was issued on that date.

However, on 27 November 2021, three months later and 12 months after the windshield coating was last re-applied, the functional test that should have been carried out to check its condition was not performed. During the investigation, the aircraft manufacturer and the operator indicated that the test was due to be carried out on 13 August 2022, i.e. 12 months after the certificate of release to service (CRS) was issued[9].

[9] According to EASA (see https://www.easa.europa.eu/en/faq/19102), in a normal scenario, the date of signing the certificate of release to service (CRS) should be considered the date of the accomplishment. Therefore, the next due date should be calculated based on that date.

After the incident, on 30 March 2022, the maintenance organisation Rheinland Air Service again re-applied the coating on both the left and right windscreens[10]. On this occasion, they used a coating called Surface Seal® Gen III.

1.7. Meteorological information

The aircraft took off from Almería Airport (LEAM) in Spain, bound for Faro Airport (LPFR) in Portugal. Due to the poor condition of the windshield coating, as revealed by the weather conditions at Faro Airport, the crew decided to divert to Seville Airport (LEZL) in Spain.

The information below describes the meteorological conditions in the following locations:

- The south of the Iberian Peninsula, in which most of the flight took place.
- The departure airport (LEAM), the destination airport (LPFR) and the alternate airport (LEZL).
- The airports used by the aircraft in the days prior to the incident.

1.7.1. Meteorological conditions in the south of the Iberian Peninsula.

According to AEMET's technical summary[11] for 24 March 2022, the meteorological conditions in the south of the Iberian Peninsula were marked by the presence of low pressure to the south of the peninsula with two centres, one in Morocco and the other to the SW of the Gulf of Cádiz, and an associated frontal system passing through the extreme SW of the peninsula.

Haze[12] began to appear in points to the S and SE, and the moist airflow from the E gave rise to more frequent and intense rainfall in the S of Andalusia. However, the downpours weren't as heavy as the previous night, when they were locally heavy and persistent.

However, in cases where the duration of a maintenance overhaul/visit is significant, there may be a significant difference between the date of accomplishment and the date of release to service (CRS).

For example, a 2-month long overhaul/visit for one task that has an inspection interval of 3 months. In this case, either the task is carried out on the last days of the maintenance overhaul/visit, and the next due date is calculated from the CRS, or the task is carried out at the beginning of the visit and the next due date should be calculated from the date of accomplishment.

[10] During the investigation, it was noted that there was no mention of this defect in the aircraft's technical log.

[11] https://aemetblog.es/2022/04/04/el-tiempo-de-la-semana-del-21-al-27-de-marzo-de-2022-resumen-tecnico/

[12] Haze is defined as the suspension of microscopic non-aqueous solid particles in the atmosphere (ranging in size from sub-micron units to tens of microns), invisible to the human eye but sufficiently numerous to give the sky an opalescent appearance. Its origin can vary. In the Canary Islands and the Spanish mainland, haze episodes are usually due to the intrusion of Saharan dust.
Haze is reported when low visibility (5,000 m or less) coincides with relative humidity below 70 %.

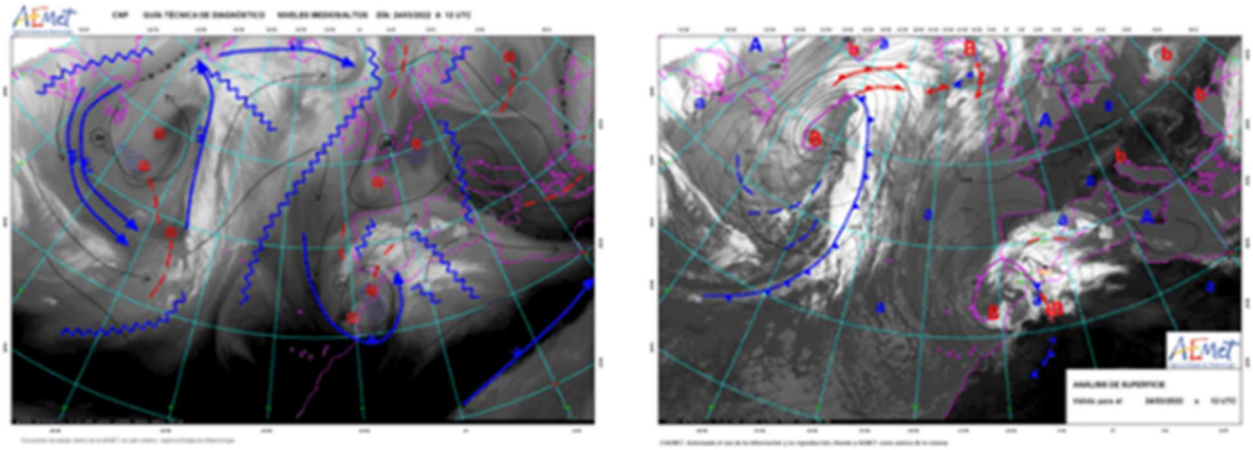

Image 7: High-Level Technical Guide and Surface Analysis for the 24th at 12 UTC.

1.7.2. Meteorological conditions at Almería Airport, the departure aerodrome

The aircraft took off from Almería Airport at 10:33 UTC (or 11:33 local time) on 24 March. The METARs were as follows:

LEAM 241100Z 05026G39KT 9999 BKN035 OVC090 18/09 Q1014[13]
LEAM 241000Z 04029G41KT 9999 SCT030 BKN040 OVC080 17/10 Q1014[14]

It had landed at Almería the day before, on 23 March at 13:55 UTC (or 14:55 local time). The METAR was as follows:

LEAM 231400Z 05012KT 9999 FEW015 BKN080 17/13 Q1014[15]

During the investigation, we also asked the manager of Almería Aerodrome about the meteorological conditions on 23 and 24 March, the days on which the aircraft was there. The manager replied that no haze (HZ) or dust (DU) was reported in the METARs issued on those days.

[13] The METAR at 11:00 UTC reported a wind speed of 26 knots with gusts of 39 kt and a wind direction of 50°. Visibility was greater than 10 km. The cloud cover was broken starting at 3,500 ft and overcast starting at 9,000 ft. The temperature was 18 °C and the dew point was 9 °C. The QNH was 1014 hPa

[14] The METAR at 10:00 UTC reported a wind speed of 29 knots with gusts of 41 kt and a wind direction of 40°. Visibility was greater than 10 km. The cloud cover was scattered starting at 3,000 ft; broken starting at 4,000 ft and overcast starting at 8,000 ft. The temperature was 17 °C and the dew point was 10 °C. The QNH was 1014 hPa.

[15] The METAR at 14:00 UTC reported a wind speed of 12 knots and a wind direction of 50°. Visibility was greater than 10 km. The cloud cover was few clouds starting at 1,500 ft and broken clouds starting at 8,000 ft. The temperature was 17 °C and the dew point was 13 °C. The QNH was 1014 hPa.

However, as haze, caused by the Saharan dust intrusion, was present on the dates of the event and is one of the agents responsible for reducing the effectiveness of the coating, Annex I contains the predicted atmospheric dust particle concentrations for 23 and 24 March at Almería Airport, as reported by the World Meteorological Organisation's Regional Climate Centre, as well as the images provided by the EUMETSAT satellite.

1.7.3. Meteorological conditions at Faro Airport, the destination aerodrome

The METARs covering the period during which the aircraft made the two missed approaches at Faro airport are provided below:

METAR LPFR 241130Z 08007KT 3000 -RA SCT005 BKN010 13/11 Q1012=[16]
METAR LPFR 241200Z 08004KT 040V120 3500 SHRA FEW005 BKN010 12/11 Q1011=[17]

The TAF issued for Faro airport at 10:34 UTC was:

TAF AMD LPFR 241034Z 2410/2506 06010KT 9999 SCT012 SCT025 TEMPO 2410/2421 4000 -RA SCT008 BKN012 BECMG 2500/2503 VRB05KT=[18]

1.7.4. Meteorological conditions at Seville Airport, the alternate aerodrome

Upon flight dispatch, the airport's 08:00 UTC TAF was:

TAF LEZL 240800Z 2409/2509 VRB03KT 9999 SCT020 BKN030 TX17/2415Z TN11/2507Z TEMPO 2409/2412 4000 RA BR BKN010 PROB40 TEMPO 2412/2501 3000 SHRA SCT040CB=[19]

[16] The METAR at 11:30 UTC reported a wind speed of 7 knots and a wind direction of 80°. Visibility was 3 km with rain. The cloud cover was scattered cloud starting at 500 ft and broken cloud starting at 1,000 ft. The temperature was 13 °C and the dew point was 11 °C. The QNH was 1012 hPa. No significant changes were expected.

[17] The METAR at 12:00 UTC reported a wind speed of 4 knots and a wind direction of 80°. Visibility was 3,500 m with rain showers. The cloud cover was few clouds starting at 500 ft and broken cloud starting at 1,000 ft. The temperature was 12 °C and the dew point was 11 °C. The QNH was 1011 hPa. No significant changes were expected.

[18] The TAF was valid from 10:00 UTC on 24 March until 06:00 UTC on 25 March. It reported a wind speed of 10 knots and a wind direction of 60°. Visibility was greater than 10 km. The cloud cover was scattered cloud starting at 1,200 ft and 2,500 ft. With temporal fluctuations between 10:00 UTC and 21:00 UTC on 24 March: visibility 4 km with rain, scattered cloud starting at 800 ft and broken cloud starting at 1,200 ft. With the wind expected to change to 5 knots from a variable direction between 00:00 UTC and 03:00 UTC on 25 March.

[19] The TAF was valid from 09:00 UTC on 24 to 09:00 UTC on 25 March. It reported a wind speed of 3 knots from a variable direction. Visibility was greater than 10 km. The cloud cover was scattered cloud starting at 2,000 ft and broken cloud starting at 3,000 ft. With temporal fluctuations between 9:00 UTC and 12:00 UTC on 24 March: visibility 4km with rain and low light conditions, broken cloud starting at 1,000 ft. With temporal

The crew decided to divert to Seville Airport, where they landed at 12:20 UTC (or 13:20 h) without further incident. The ATIS issued at 12:20 UTC was as follows:

> *255 LEZL INFO P TIME 1220 RWY IN USE 27 09 R C R 5 / 5 / 5 WET WET WET TRL 75 WIND TDZ VRB 3 KT VRB BTN 260 AND 040 DEG VIS 10 KM OR MORE RVR TDZ ABV 2000 M CLD FEW 1000 FT SCT 4500 FT T 13 DP 11 QNH 1013 QFE 1009 NOSIG FIRST CONTACT 118.1 47*[20]

1.7.5. Meteorological conditions at the airports the aircraft operated in the days prior to the incident

As one of the agents that diminish the effectiveness of the coating is dust, and given that an unusually prolonged Saharan dust intrusion had been affecting much of Europe, and the Iberian Peninsula in particular, since 15 March 2022, we consulted the meteorological conditions on the routes flown and at the airports used by the aircraft between that date and the day of the event.

During the relevant period, the METAR reports from the airports visited by the aircraft did not include any obscuration descriptors such as HZ or DU. However, the maps showing the predicted aerosol optical depth (AOD) and surface concentrations did confirm the presence of dust in the atmosphere from the Sahara.[21]

Even so, there were no reports from the flight crews or entries in the aircraft's maintenance records to indicate any adverse effects from operating in these conditions.

1.8. Aids to navigation

N/A.

1.9. Communications

The most relevant communications between the crew and the controllers at the Seville Airport control tower and the Seville control centre are detailed below [22] . The communications between the air traffic control units are also provided. In addition, the aircraft's radar trace at various points during the flight have been integrated into this section.

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fluctuations between 12:00 UTC on 24 March and 01:00 UTC on 25 March: visibility 3 km with rain showers and scattered cumulonimbus cloud starting at 4,000 ft.

[20] The ATIS indicated variable wind at 3 kt, visibility greater than 10 km, few clouds starting at 1,000 ft, and scattered clouds starting at 4,500 ft, temperature 13 °C, dew point 11 °C and QNH 1013hPa.

[21] These maps can be consulted at https://dust.aemet.es/products/daily-dust-products

[22] During the investigation, the communications between the crew and the controllers in the control tower at Faro airport were requested but have not been provided.

At 12:01:49 UTC, the crew contacted the controller at the Seville control centre to report that they had made two missed approaches and been unable to land at Faro Airport due to heavy rain showers and requested to fly direct to TENDU[23] and land on runway 09 instead of runway 27 due to the fuel situation.

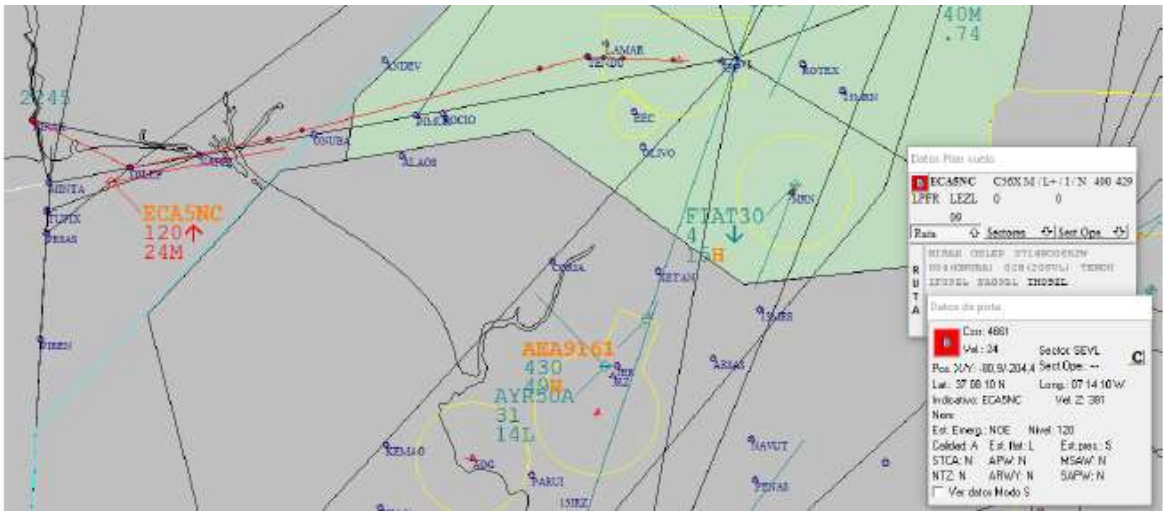


Image 8: Aircraft position at 12:01:51 UTC

At 12:02:31 UTC, the control centre controller contacted the Seville control tower controller to inform him of the traffic situation. The control tower controller replied that he would have to declare an emergency to clear the traffic for landing on the opposite runway.

At 12:03:07 UTC, the control centre controller contacted the crew to explain that they would need to declare an emergency to land on runway 09. The aircraft's crew agreed to declare an emergency.

Subsequently, the control centre controller contacted the control tower controller again to indicate that traffic had declared an emergency in order to land on runway 09.

At 12:06:17 UTC, the crew contacted the Seville Airport control tower controller to explain their situation and asked if it was raining there at the time. The controller replied that it was not raining and that they had few clouds at 1,000 ft and scattered clouds at 5,400 ft. The crew again requested to land on runway 09 and added that they had fuel remaining for approximately 50 minutes. The controller asked them to confirm that they had declared MAYDAY, which they affirmed.

[23] TENDU is the initial approach fix (IAF) for the ILS approach to runway 09 at Seville

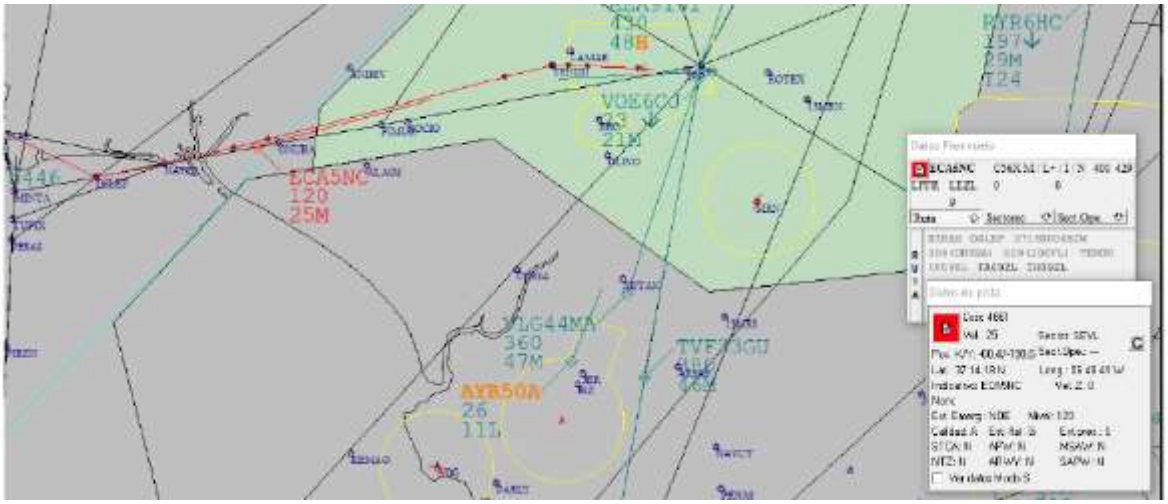


Image 9: Aircraft position at 12:07:08 UTC

At 12:15:38 UTC, the crew contacted the controller again to inform him that they were established on the Z-locator for runway 09, 12 miles away. The controller cleared them to land.

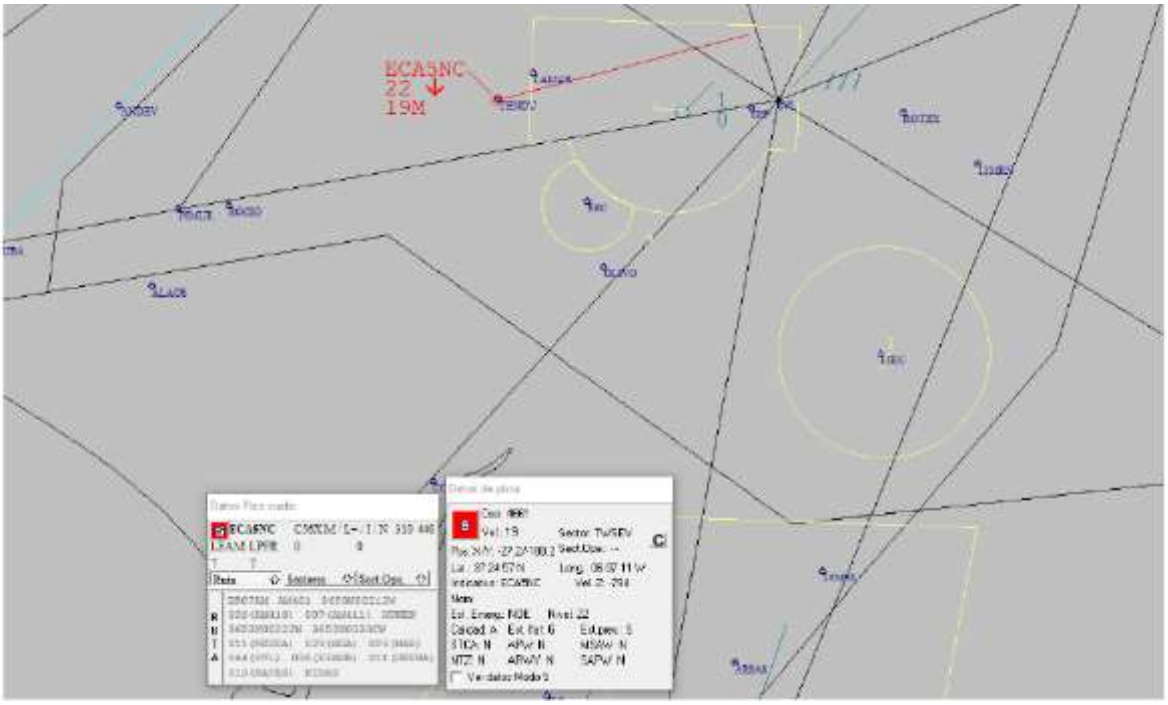


Image 10: Aircraft position at 12:16:42 UTC

At 12:21:06 UTC, the control tower controller informed the control centre controller that the aircraft had landed safely and that they were going to check the runway. The runway was declared operational again at 12:25:22 UTC.

1.10. Information about the aerodrome

1.10.1. Information about Faro Aerodrome, the destination airport

The aircraft was scheduled to land at Faro Airport, whose ICAO code is LPFR. The airport is located 4 km from Alto de Faro. Its elevation is 7 m and it has one runway, 2490 m long by 45 m wide, designated 10/28.

1.10.2. Information about Seville Aerodrome, the alternate airport

The aircraft landed at Seville Airport, whose ICAO code is LEZL. The airport is located 10 km northeast of the city. Its elevation is 34 m and it has one runway, 3364 m long by 45 m wide, designated 09/27.

1.11. Flight recorders

Neither the flight data recorder nor the cockpit voice recorder were used during the investigation into the incident.

1.12. Aircraft wreckage and impact information

N/A.

1.13. Medical and pathological information

We have found no evidence to suggest the flight crew were affected by any physiological or disabling factors.

1.14. Fire

N/A.

1.15. Survival aspects

N/A.

1.16. Tests and research

1.16.1. Fuel planning in the flight dispatch

The applicable European Regulation states in requirement *CAT.OP.MPA.150 Fuel Policy*, section c, that the operator shall include in the calculation of the fuel required:

1. taxi fuel;
2. trip fuel;
3. reserve fuel, consisting of:
   i) contingency fuel,

ii) alternate fuel, if a destination alternate aerodrome is required,
iii) final reserve fuel, and
iv) additional fuel, if required by the type of operation, and

4. extra fuel if required by the commander.

In accordance with CAT.OP.MPA.150, the operator made the following fuel calculation during the flight dispatch:

	TIME	FUEL (lb)
TRIP (Fuel for the flight)	0:48	1381
ALTN1 (Fuel for an alternate aerodrome)	0:24	711
CNTFMCF (Fuel for contingencies)[24]	0:05	105
HOLD (Final reserve fuel)	0:30	625
TAXI (Fuel for the taxi)		200
COMPF[25]	0:00	0
RAMP MIN	**01:47:00**	**3022**
EXTRA (Extra fuel required by the commander)	0:25	528
RAMP ACT	**02:12:00**	**3550**

The flight crew added 528 lbs of extra fuel, sufficient for an additional 25 minutes of flight time.

1.16.2. Fuel remaining after landing at Seville Airport

According to the aircraft's technical log, the chock time was 2 h, and the flight time was 1:47 h. The flight used 2,500 lb of fuel; therefore, the fuel remaining after landing was 1,000 lb (454 kg) more than the final reserve fuel amount.

Moreover, at 12:06:17 UTC, i.e. 14 minutes before landing, the crew indicated to the control tower controller at Seville Airport that they had fuel remaining for approximately 50 minutes.

1.17. Organisational and management information

Excellent Air, whose air operator name is OHLAIR Chaterflug GmbH&Co. Kommanditgesellschaft, holds an Air Operator's Certificate (AOC) issued by the German Civil Aviation Authority, LBA. It currently operates Cessna 525A and Cessna 560 XL aircraft. The company is licensed to carry out the commercial air transport of passengers and cargo.

1.18. Additional information

[24] Contingency fuel is the fuel required to cope with unforeseen factors that may influence the fuel consumed en route to the destination aerodrome. The operator calculated it as the greater of 5% of the trip fuel or the fuel required for a 5-minute wait at 1,500 ft above the destination aerodrome elevation based on the calculated weight on arrival.

[25] Fuel internally defined by the operator. Rarely added.

1.18.1. Consultation with the aircraft manufacturer Textron Aviation

As mentioned earlier in the report, when the incident occurred, the Iberian Peninsula and much of Europe were affected by a Saharan dust intrusion. This dust is one of the agents known to diminish the effectiveness of the coating. As a result, the aircraft manufacturer Textron Aviation was contacted for information during the investigation. The manufacturer provided a document that detailed its recommendations in the event of volcanic ash[26], indicating that the procedures would also apply to haze.

The document sets out, among other things, how to protect parked aircraft from volcanic ash. For windscreens, it recommends fitting the windshield cover, if available.

In addition, the document explains how to inspect the condition of an aircraft affected by volcanic ash in flight or while parked. For windows and windscreens:

- Visually inspect windows and windscreens for contamination or erosion.
- For aircraft with electrically heated windscreens, check the condition of the rain repellent and coating following the procedures in Chapter 56 of the Aircraft Maintenance Manual.

The aircraft manufacturer added that with regard to sand/dust or ash, there is an (unscheduled) inspection in section 5-50-00 of the Maintenance Manual to check for FOD damage to the windscreens. Furthermore, in their opinion, if the weather conditions include sand/dust, ash or another phenomenon, the crew should consult a mechanic and check the aircraft for damage, including to the windshield.

1.18.2. Consultation with the manufacturer of the windshield coating, PPG Industries

As part of the investigation we also contacted PPG Industries, the developer of the hydrophobic windshield sealant coating on Cessna 560 XL Citation aircraft, to establish how it might be affected by haze. PPG Industries stated that, although it depends on the severity of the dust storm, coating deterioration is to be expected in the event of volcanic ash or dust storms, and the deterioration can be rapid in the most extreme cases. They suggest inspecting the condition of the coating after these types of events.

[26] The volcanic ash document is a customer service note published on the aircraft manufacturer's website: www.txtavsupport.com.

1.18.3. Similar events

During the investigation into this incident, we searched for other events logged in AESA's occurrence reporting system (SNS) or the European database (ECCAIRS) to establish how the different episodes of haze that affected the Iberian Peninsula in March had impacted flights.

In addition to the incident that occurred on 15 March 2022 at Málaga Airport, which prompted a CIAIAC investigation (IN-016-2022), five other events were reported, all on 24 March at Málaga airport. The primary issue was a decrease in visibility due to the deposits of airborne sand or dust on the windscreens of the aircraft involved.

The only event involving an aircraft similar to the one in this incident is detailed. Two hours after the D-CNOC aircraft landed at Seville Airport, following the missed approaches at Faro, a Cessna 510 Mustang aircraft descended and approached Málaga Airport. The flight crew reported that, during the descent, they passed through clouds of dust/sand, which settled on their windshield and obscured their view. The visibility on the right side of the windshield was better and allowed them to complete the landing at Málaga. Once on the ground, the aircraft was placed under precautionary AOG to inspect for damage caused by flying through the dust clouds, but no damage to the windshield coating was detected.

1.19. Special investigation techniques

N/A

2. ANALYSIS

Various aspects related to this incident were analysed, including the following:

- The fuel on board the aircraft.
- The condition of the windshield coating.
- The manufacturer's documentation on flights in dust environments.

2.1. Analysis of the fuel on board the aircraft

During the flight dispatch, the aircraft operator calculated the amount of fuel required for the flight in accordance with the applicable European regulations, specifically *CAT.OP.MPA.150 Fuel Policy*, section c. In addition, it should be noted that the flight crew added 528 lbs as extra fuel, which was sufficient for an additional 25 minutes of flight time. According to the aircraft's technical log, the fuel remaining after landing was 1,000 lb, i.e. more than the final reserve fuel of 625 lb.

Therefore, the fuel calculation made by the operator and flight crew was appropriate for the intended flight.

The extra fuel added at the pilot's discretion allowed them to carry out the two missed approaches and divert to the alternate with more than the minimum fuel required to initiate the diversion. However, after assessing the situation, to shorten the flight time, the flight crew declared MAYDAY in order to land on runway 09 instead of runway 27, which was the runway in use at Seville Airport at the time.

2.2. Analysis of the condition of the windshield coating

The aircraft involved in this incident had a hydrophobic sealant coating on its windshield. This coating was damaged, impeding the flight crew’s view of the approach path and runway environment when attempting to land in wet conditions.

Inspections to check the condition of the coating

The Aircraft Maintenance Manual provides information on the inspection to check the condition of the coating, establishing an inspection interval of 12 months unless specified otherwise. The aircraft operator had last inspected the coating on 27 November 2020. As the result of the test was "in condition", the coating was re-applied. The event occurred on 24 March 2022; therefore, 16 months had passed since the last inspection and re-application.

According to the information provided to the investigation, the aircraft remained in the hangar for a prolonged period of time, during which it underwent maintenance, awaiting the arrival of landing gear parts. Under these circumstances, once all the maintenance work had been completed, the operator did not consider it necessary to repeat the functional test on the windshield coating, despite the fact that eight and a half months had passed since it was last re-applied, nor did it schedule an inspection for 12 months after the re-application.

Even though it seemed the aircraft had not been exposed to conditions that would cause deterioration to occur, eight and a half months had passed between the re-application and the issue of the certificate of release to service (CRS). Therefore, if the functional test had been carried out 12 months after the re-application in November 2021 (three and a half months after the issue of the CRS), it might have helped to detect a hypothetical deterioration of the coating.

Possible causes of the deterioration of the coating

Neither the aircraft manufacturer nor PPG, the manufacturer of the windshield coating, specify its useful life. However, both mention that its useful life may be reduced, depending on the curing process.

The investigation has been unable to determine when and why the deterioration of the windshield coating occurred. There are two hypotheses: either the coating application was inadequate, reducing its useful life to 16 months, or the coating deteriorated due to improper care or environmental factors.

At the time of the incident, the Iberian Peninsula and much of Europe were affected by a Saharan dust intrusion, one of the agents known to diminish the effectiveness of the coating. In fact, the coating manufacturer, PPG, explained during the investigation that some deterioration is to be expected after flights that pass through clouds of volcanic ash or dust storms. Furthermore, it pointed out that the deterioration can be remarkably rapid in the most extreme cases.

The METAR reports from the airports used by the aircraft during the dust intrusion did not contain any obscuration descriptors to indicate the presence of dust, such as HZ or DU. Furthermore, according to the aircraft operator, no flight operation issues were detected during the Saharan dust episode, and no additional measures were deemed necessary to protect or inspect the aircraft.

However, the maps showing the predicted aerosol optical depth (AOD) did confirm the presence of dust in the atmosphere from the Sahara. Moreover, on 24 March 2022, 5 events involving decreased visibility in flight due to sand or dust deposits on aircraft windshields were reported in Málaga. Although, according to the entries in the AESA occurrence reporting system and the European ECCAIRS database, the situation did not deteriorate the windshield coatings.

2.3. Analysis of the manufacturer's documentation on flights in dust environments.

During the investigation, the aircraft manufacturer, Textron Aviation, stated that the measures to be taken in dust events are similar to those prescribed for volcanic ash and that if an aircraft has been flown during dust events, the condition of the coating should be checked as per the procedures included in Chapter 56 of the aircraft's Maintenance Manual.

However, the aircraft operator did not deem the Saharan dust intrusion to be similar to a volcanic ash event, nor did it assess the circumstances as necessitating additional protective measures. Therefore, before the flight, the crew simply performed a visual check of the windshield for contamination. As a result, the issue of a safety recommendation to the aircraft manufacturer, suggesting it consider extending its recommendations for operating in dust/sand environments, is deemed necessary.

3. CONCLUSIONS

3.1. Findings

- The fuel calculation made by the operator and flight crew was appropriate for the intended flight.
- It was raining heavily at Faro Airport, the destination aerodrome.
- The condition of the aircraft's windshield coating prevented the crew from having an adequate view of the runway.
- The crew made two missed approaches before diverting to Seville Airport, their alternate aerodrome.
- The crew declared MAYDAY in order to land on runway 09 instead of runway 27, the runway in use at Seville Airport at the time.
- The fuel remaining after landing was more than the amount stipulated as final reserve fuel.
- The flight crew did not note the deterioration of the windshield coating in the technical flight log.

3.2. Causes/contributing factors

The investigation has determined that the incident was caused by the poor condition of the windshield coating, which had not been previously detected by the aircraft operator. However, the investigation has been unable to determine when the coating deteriorated or what caused it to do so. The possibility that the haze over the Iberian Peninsula at the time of the incident may have contributed to its deterioration has not been ruled out, nor has it been definitively confirmed as the trigger for this event.

4. OPERATIONAL SAFETY RECOMMENDATIONS

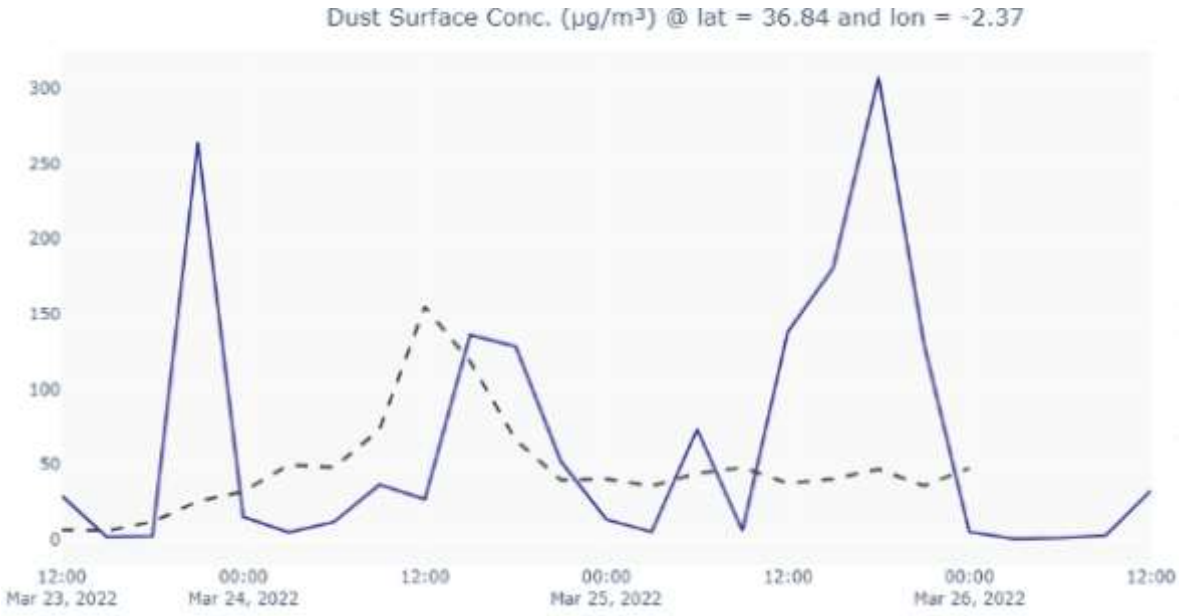
During the investigation into this incident, Textron Aviation provided a document containing its recommendations in the event of volcanic ash, which, according to the manufacturer, also applied to a haze event such as the one affecting Spanish airports at that time. It was therefore considered appropriate to issue the following recommendation:

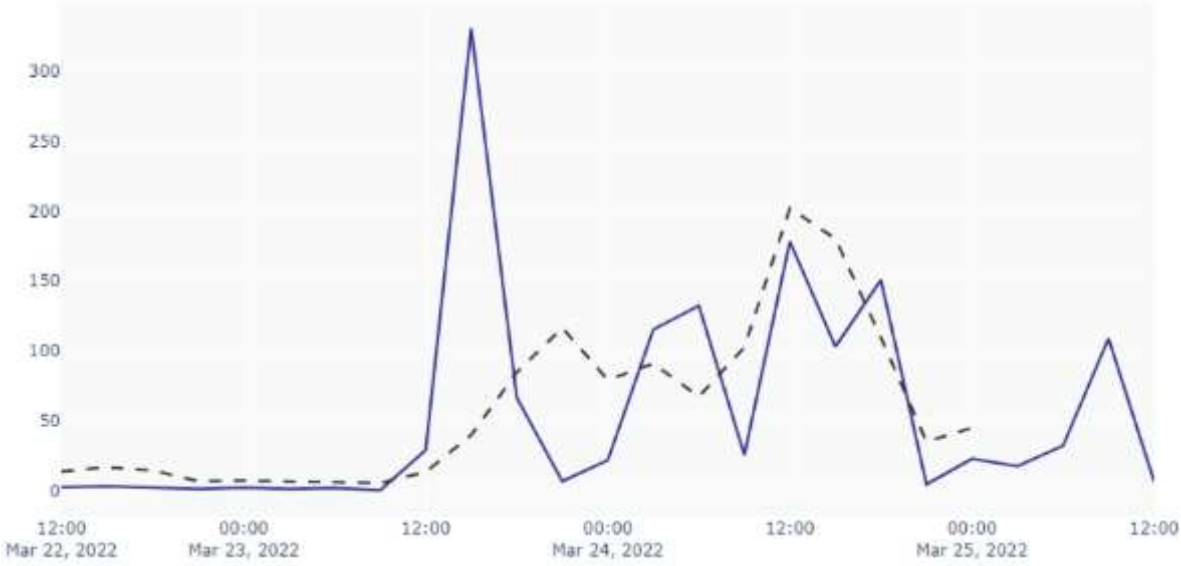
REC 03/23: It is recommended that the aircraft manufacturer consider extending its recommendations for volcanic ash events to other types of weather conditions that may deteriorate the condition of the windshield coating.

ANNEX I: METEOROLOGICAL CONDITIONS ON THE 23 AND 24 MARCH AT ALMERÍA AIRPORT:

The WMO Barcelona Dust Regional Centre coordinates the World Meteorological Organisation's activities in regard to dust and sand storms in North Africa, the Middle East and Europe.

The following graphs show the predicted concentration of dust particles in the atmosphere for 23 and 24 March at Almería Airport using two models: Monarch, which is the Centre's reference model, and Multi-model, which is an average of all the models used at the Centre. A solid line depicts the concentration values obtained using Monarch, and a dashed line represents those obtained using Multi-model:





Between 12:00 h on 23 March and 0:00 h on 24 March, the Monarch model predicts a peak in the concentration of dust particles, reaching 250 µg/m^3. Subsequently, between 0:00 h and 12:00 h on 24 March, the concentration does not exceed 50 µg/m^3.

The Multi-model places the peak concentration of dust particles at 12:00 h on 24 March, with a value of 150 µg/m^3.

Given that the aircraft landed at Almería Airport on 23 March at 13:55 UTC and remained there until the following day, 24 March, when it took off at 10:33 UTC, according to the Multi-model, it would not have been affected by high concentrations of dust particles, but according to the Monarch model, it would have been.

The EUMETSAT satellite provides images in RGB (red, green and blue) taken on 23 and 24 March, showing the evolution of the dust intrusion. The presence of dust is associated with the colour pink/magenta. On 24 March at 0 h, the Iberian Peninsula (marked with a white circle) is affected by a dust intrusion.

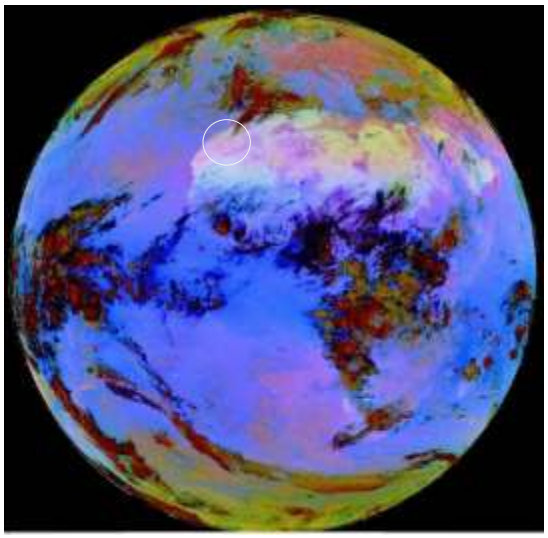


Image 11: 23 March at 0 h

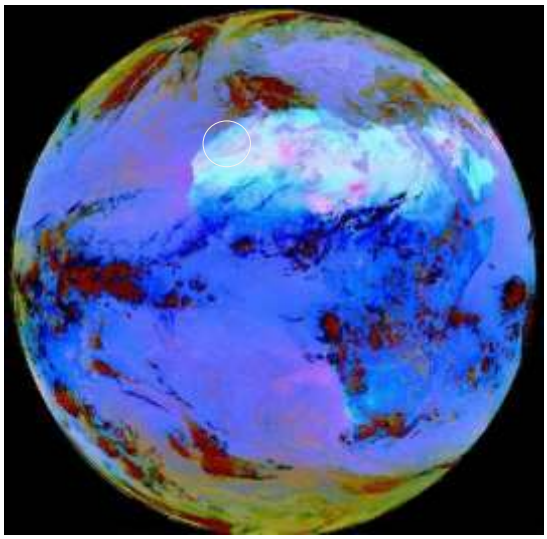


Image 12: 23 March at 12 h

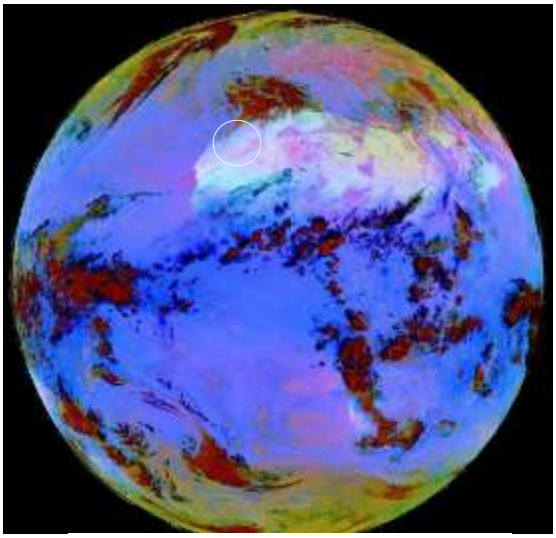


Image 13: 23 March at 18 h

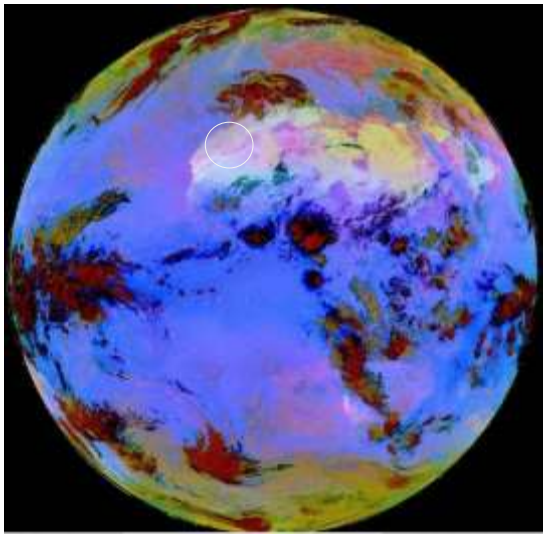


Image 14: 24 March at 0 h

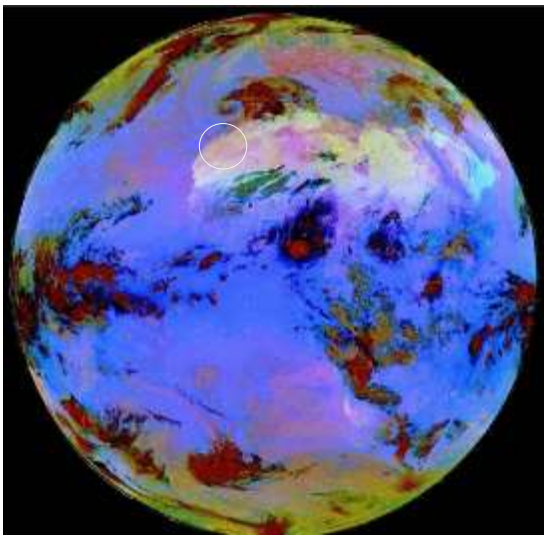


Image 15: 24 March at 6 h

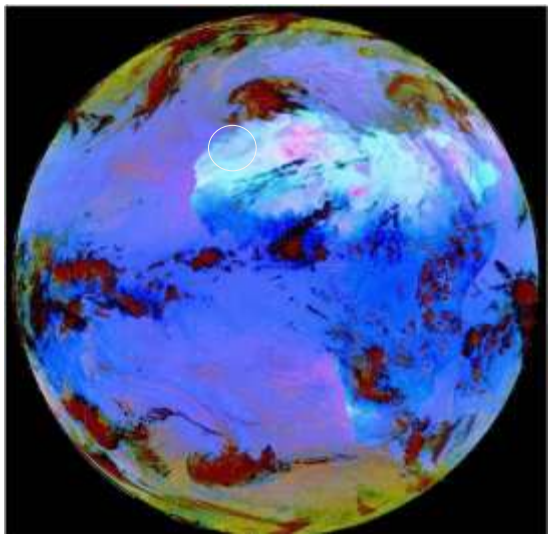


Image 16: 24 March at 12 h