

SERIOUS INCIDENT

Aircraft Type and Registration:	Airbus A319-111, G-EZNM	
No & Type of Engines:	2 CFM56-5B5/P turbofan engines	
Year of Manufacture:	2005 (Serial no: 2402)	
Date & Time (UTC):	11 May 2019 at 0630 hrs	
Location:	En route to Bristol Airport	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 6	Passengers - 107
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	41 years	
Commander's Flying Experience:	9,159 hours (of which 5,737 were on type) Last 90 days - 54 hours Last 28 days - 26 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The lenses of both pilots' oxygen masks misted when donned during a smoke and fumes event, obscuring their vision. The commander removed his mask so he could see the flight instruments. The aircraft diverted to Birmingham and landed without further event.

The investigation found that the masks misted up due to a combination of the environment in which they were stowed and the condition of the lenses. The source of the smoke was probably an accumulation of dust in the transformer rectifier unit (TRU).

The aircraft manufacturer has added a cleaning procedure for the TRU in the Aircraft Maintenance Manual. The operator has added a practical demonstration on the use of the mask and its selectors during its recurrent training cycle.

History of the flight

The aircraft was on a scheduled flight from Newcastle International Airport to Bristol Airport. The co-pilot was PF for the sector and the commander was PM.

About 30 minutes after takeoff, while in the cruise at FL290 and about 80 nm north-north-west of Bristol, the co-pilot noticed an acrid burning smell. Upon looking to the rear of the flight deck both crew members observed smoke in front of the flight deck door and rising to shoulder height behind their seats. They donned their oxygen masks, and the commander took control of the aircraft and continued to communicate with ATC; the co-pilot actioned

the 'SMOKE/FUMES/AVNCS [avionics] SMOKE' checklist in the quick reference handbook (QRH). The commander transmitted MAYDAY to ATC, selected the emergency transponder code, and the crew started an emergency descent towards the final approach for Runway 27 at Bristol Airport.

About 90 seconds after the pilots donned them, their oxygen masks misted up, obscuring their vision. The co-pilot was able to read the checklist by holding it close to the mask, but could not read his flight instruments. The commander removed his oxygen mask so he could see the flight instruments, having first informed the co-pilot that he would do so and agreeing this was the least risk option.

Upon removing his mask the commander noticed the smoke had dissipated. He then gave the senior cabin crew member a NITS¹ briefing over the interphone, informing her of their intent to continue to Bristol. Upon looking at the aircraft's navigation display, which was now visible, it was noted that Birmingham was a closer option. The pilots decided to divert to Birmingham, and informed ATC and the cabin crew of their revised plan.

During the descent the crew made an announcement to passengers informing them of the situation. After this the smoke became perceptible in the cockpit again. The commander then informed the co-pilot that he felt "A LITTLE BIT WOBBLY" but well enough to continue. As his oxygen mask had cleared he refitted it, and it did not mist up again.

The aircraft subsequently landed at Birmingham and stopped on the runway, without further event and with the RFFS in attendance. After a review of the situation, the commander removed his mask and discovered no perceptible smoke or fumes in the cockpit. The aircraft was then taxied onto a stand and shutdown.

Pilots' comment

The commander believed the condensation formed on the lenses because they were stowed in a compartment that was relatively cold compared to the flight deck. After he removed the oxygen mask from his head, he placed it on his lap, when it probably warmed towards ambient temperature. He reported that his breathing rate was high when he first donned the mask, because of the stress of the situation.

The commander commented that he was proficient in operation of the mask, but while he was aware of the emergency pressure selector² on the mask, his knowledge on the use of it was probably incomplete. He added that he could not be certain if he had selected it during the event. The co-pilot did not select the emergency setting.

Footnote

¹ A standard form of briefing that considers the Nature of the situation, Intentions, Timings and Special instructions (NITS).

² See *Crew oxygen masks* section for a description of the masks and the oxygen regulator controls.

Crew oxygen masks

Description

The mask type fitted to G-EZNM was a 'MF10' full-face mask-regulator that provides protection during depressurisation and smoke events, while allowing the pilots to communicate with each other. The window has two lenses with an air gap between them. The internal lens has an anti-fogging coating (Figure 1).

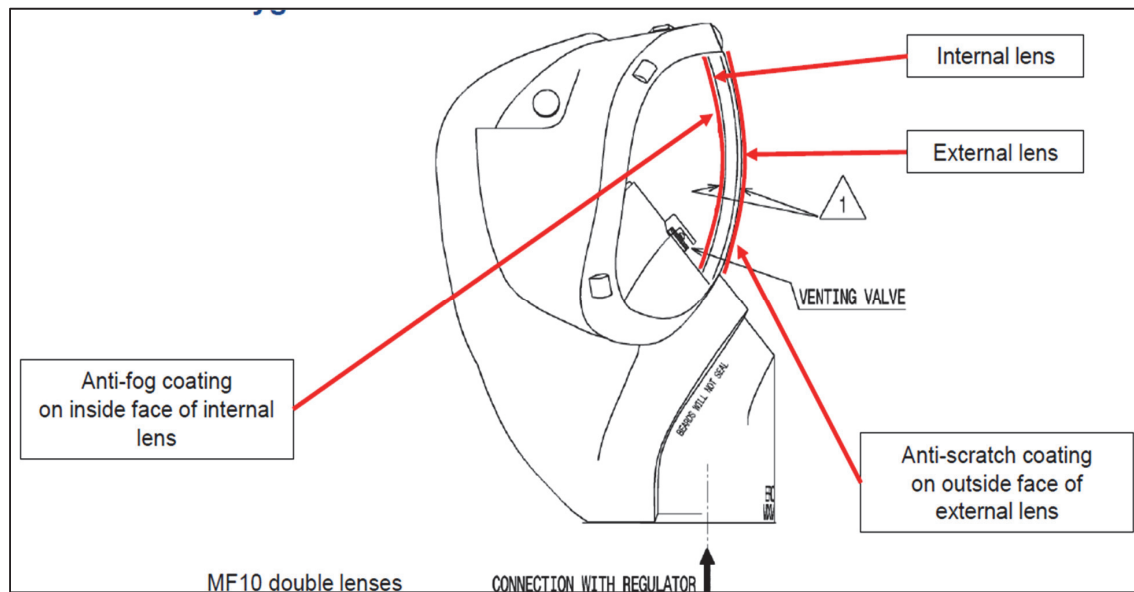


Figure 1
Mask lens arrangement

Pushing the N/100% (N - normal flow) selector into the 100% position, on the regulator control, supplies 100% oxygen (item 3 in Figure 2). After pushing the N/100% rocker into 100% position, rotating the emergency pressure selector in the direction of the arrow to the EMERGENCY position provides 100% oxygen with an overpressure (item 2 on Figure 2). The overpressure eliminates condensation or fogging of the mask, and prevents smoke, smell or ashes from entering the mask.

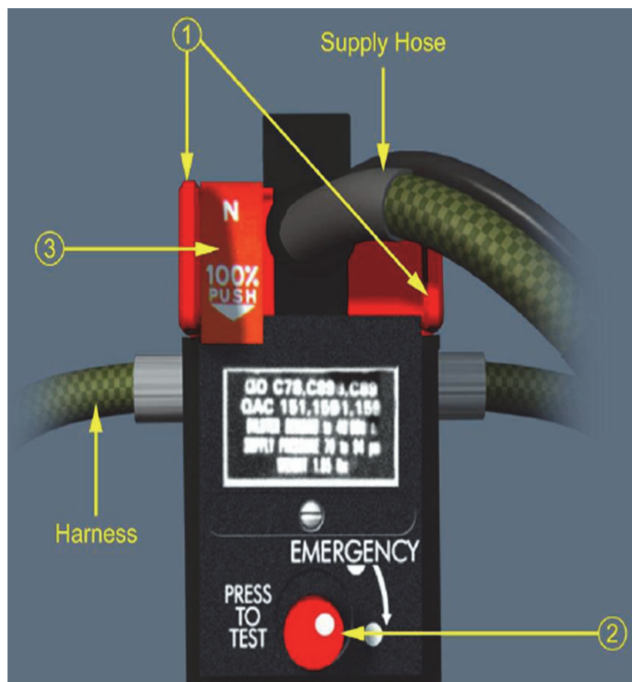


Figure 2
Oxygen regulator controls

SMOKE/FUMES/AVNCS SMOKE checklist

The QRH checklist for ‘SMOKE/FUMES/AVNCS SMOKE’ was as follows:

SMOKE / FUMES / AVNCS SMOKE	
<small>Applicable to: ALL</small>	
LAND ASAP	
IF PERCEPTIBLE SMOKE APPLY IMMEDIATELY:	
CREW OXY MASKS (if required) ... USE/100%/EMERG	
VENTILATION BLOWER.....	OVRD
VENTILATION EXTRACT.....	OVRD
CAB FANS.....	OFF
GALY & CAB.....	OFF
SIGNS.....	ON
CKPT / CAB COM.....	ESTABLISH
● If smoke source immediately obvious, accessible, and extinguishable:	
FAULTY EQPT.....	ISOLATE
● If smoke source not immediately isolated:	
DIVERSION	INITIATE
DESCENT TO FL 100 / MEA-MORA	INITIATE

Additionally, the aircraft's Flight Crew Operating Manual, which is a support document for crews, contained additional information. It stated, under the heading 'CREW OXY MASK...':

'Turn the emergency knob to remove condensation or smoke from the mask.'

Oxygen masks examination

The crew's masks were examined by the manufacturer under AAIB supervision.

Visual inspection

Both masks were in a generally good condition.

The commander's external and internal lenses were reported to be in a "good condition". The inner surface of the internal lens was sensitive to fogging (uniform blurring), and fogging remained for a few seconds on the inner surface of the internal lens after exhaling on it.

The co-pilot's external and internal lenses were reported to be in a "bad condition", with scratches present. The inner surface of the internal lens was sensitive to fogging (with non-uniform blurring reported), and fogging remained for a few seconds on the inner surface of the internal lens after exhaling on it. When fogging appeared on the inner surface of the internal lens, elongated shapes were visible that looked as though the surface had been wiped (Figure 3).



Figure 3

Co-pilot's mask showing fogging and marks on internal lens

Both masks had 100% selected and the emergency pressure selector had not been rotated in the direction of the arrow; a state in which no overpressure was provided.

An exemplar mask was also tested. Its internal lens was not sensitive to fogging, and fogging disappeared instantly after exhaling on it.

A test of the emergency mode pressure was performed on a universal test bench. Values for the emergency pressure demand was within the acceptable range for both masks.

Fogging test

A fogging test was performed in the manufacturer's cockpit simulator room. This reproduced an aircraft cockpit and supplied pressurised oxygen to a mask via a stowage box. It did not replicate the relative temperature environment of the stowage or the cockpit.

The fogging test simulated the masks being worn for 10 minutes and breathing in different configurations of oxygen flow. The objective was to determine in which configuration it was possible to reproduce the fogging described during the incident on the visor.

Neither mask exhibited any fogging in either N, 100% or EMERGENCY oxygen flows.

Recurrent pilot training

Some of the operator's type rating examiners reported that some crews were unfamiliar with the correct use of the oxygen masks, particularly in the selection of the various oxygen flows. Accordingly, the operator has added a practical demonstration on the use of the mask and its selectors during its next recurrent training cycle.

Aircraft Maintenance Manual

A detailed inspection of the masks is required every 24 months. The Aircraft Maintenance Manual (AMM) contains the process to be followed if they require cleaning.

The extant AMM stated in its Subtask 35-12-41-160-050-A, '*Cleaning of the Full-Face/Quick-Donning Oxygen Mask on Aircraft*':

'(1) Clean the mask of the Inter technique MF10 series as follows:

...

(b) ...

Do not let the Disinfectant and cleaner-Oxygen Mask- (Material No. 11CKA1) touch the surfaces of the visor of the mask.

...'

At the operator's request, the aircraft manufacturer has moved the above warning to the beginning of the procedure and highlighted it as follows:

'CAUTION: BE CAREFUL NOT TO PUT DETERGENT SOLUTION, DISINFECTANT OR WATER ON THE MASK VISOR. IF YOU DO, DAMAGE TO THE ANTI-MIST LAYER OF THE MASK VISOR CAN OCCUR.'

This was incorporated into the February 2020 revision of the AMM.

Source of the smoke and fumes

Initially the operator's maintenance control remotely diagnosed the source of the smoke as a faulty recirculation fan but, upon inspection, both fans were found to be in a "very good condition".

As the source of the smoke was not positively identified, and based on previous experience with burnt smells in the cockpit, the transformer rectifier units (TRU) were suspected as being the source. In previous cases of electrical burnt smells in the cockpit, dust contamination of the TRUs was identified as the cause.

G-EZNM's records showed neither TRU had been replaced since the aircraft was manufactured, since when it had accumulated more than 40,000 flying hours. Upon inspection, the TRU ventilation grids and hot air exhaust ducts showed light dust accumulation and no other abnormal findings. They were cleaned and reinstalled.

As a result, the aircraft manufacturer has introduced a cleaning procedure for the TRUs in the AMM. This was incorporated into the May 2019 revision of the AMM revision.

Analysis

The crew experienced a smoke and fumes event in the cockpit and subsequently initiated and completed a successful diversion to Birmingham.

About 90 seconds after donning their masks both of the crew's masks became obscured by condensation. The misting obscured the flight instruments leading the commander to remove his mask. While this decision was judged to achieve the greatest overall aircraft safety in the circumstances, it exposed the commander to potentially hazardous fumes.

Both emergency pressure selectors were found not to have been rotated to the EMERGENCY position. The commander was unable to recall if he had selected EMERGENCY. However, if they both had, even for a short period, it is likely the condensation would have been removed, enabling the commander to keep his mask on and breath 100% oxygen during the remainder of the flight. This would probably have improved the physiological condition he reported, which may have been caused by inhaling fumes. Removing the condensation in this way would also have allowed the co-pilot to properly monitor the aircraft's flight path. The option to select EMERGENCY was stated in the QRH checklist. The Flight Crew Operating Manual (though not as readily accessible) contained the additional information that this selection would remove condensation.

The results of the fogging test conducted after the event were inconclusive because the simulator did not replicate the cockpit environment and the testers were not exposed to the stress and increased breathing rate probably experienced during the incident.

The masks are likely to have misted up during the event due to a combination of the cold stowage compartment, a relatively warm cockpit, damage to the anti-fog coating and the crews' higher breathing rate.

This incident highlights the importance of fully understanding mask operation, including what selections are available and how to use them.

Conclusion

The aircraft had a smoke and fumes event that was probably a result of dust accumulation on its TRUs. The pilot's oxygen masks misted up shortly after donning, due to a combination of the environment in which they were stowed, the crews' breathing rate and the condition of the lenses. This left them unable to see the flight instruments, resulting in the commander removing his mask. Selecting the emergency pressure setting helps clear a mask and reduced exposure to any remaining smoke and fumes.

Safety actions

The operator has taken safety actions in the following areas as a result of this incident:

The operator has added a practical demonstration on the use of the mask and its selectors during its recurrent training cycle.

The aircraft manufacturer has taken safety actions in the following areas as a result of this incident:

At the operator's request, the aircraft manufacturer has moved the relevant warning to the beginning of the procedure and highlighted it as follows:

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Published: 21 May 2020.