



A safety investigation report for an A320-214 aircraft, Reg. No. 9H-AHS

This investigation has been conducted in accordance with
*Annex 13 to the ICAO Convention on International Civil
Aviation, EU Regulation No 996/2010 and
The Civil Aviation (Investigation of Air Accidents and Incidents) Regulation; Legal
Notice 16 of 2013.*

Under these Regulations, the sole objective of the investigation of an accident or incident is the prevention of accidents and incidents in the future. It is not the purpose of this investigation to assign fault or blame and the reporting process should not be used to determine liability.

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A safety investigation report for the A320 aircraft,
Reg. No. 9H-AHS; incident involving fumes in the cabin.

1. General Information.

Location: Malta International Airport	Accident Number: BAAI/SIR- 171122
Date & Time: 17 th November 2022, approximately 07:44 LT	Registration: Air Malta, Reg. No. 9H-AHS.
Aircraft: A 320-214, Reg. No. 9H-AHS	Aircraft Damage: No aircraft damage was reported at the time of landing.
Defining Event: Aircraft returned to Malta shortly after take-off due to fumes/vapour in the cockpit and forward passenger cabin.	Injuries: No injuries Reported

2. Synopsis

Shortly after take-off from RWY 23, the flight crew and passengers sitting in the midsection of the aircraft, noticed a burnt oil odour. The cabin crew, who were sitting in the forward part of the aircraft, adjacent to the forward galley, were alerted by the passengers to the fumes and pungent smell. The cockpit-crew was informed, and the crew decided to return back to the departure airport. Rescue and Fire Fighting Services (RFFS) personnel reported no signs of fire or obvious damage in and around the aircraft. The aircraft then taxied to the apron on its own power. Passengers and crew disembarked normally, with no damages or injuries reported. All passengers and crew were tested for possible fume inhalation at the arrival's terminal, and all on board tested negative.

The BAAI was notified and conducted a visual inspection of the aircraft. The Cockpit Voice Recorder (CVR) and the Quick Access Recorder (QAR) data stored in the PCMCIA card were retrieved by the BAAI for further investigation. The operator's aircraft maintenance section carried out the necessary troubleshooting as per procedures. Interviews were conducted with the flight and cabin crew.



Fig 1. Image of the A320-214 following the incident.

3. Factual Information

Aircraft and Owner/Operator Information

Aircraft

Aircraft Manufacturer: Airbus

Model/Series: A320 – 214

Year built: 2011

Aircraft Category: Twin jet engine airplane

Landing Gear Type: Tricycle

Seats: 151-159 (adjustable depending on business class seats)

Certified Max Take-off Wt.: 70,535 kg

Registration: 9H-AHS

Registered Owner: N/A

Operator: Air Malta

Meteorological Information

Conditions at Accident Site: VFR

Condition of Light: Day

Note: No significant weather conditions were reported that could have contributed to the incident.

Airport Information

Airport: Malta International Airport

Geographical coordinates: N 35°51' E 014°28'

Airport Elevation: 297ft (Threshold Runway 05)

Runway Used: RWY 23

Runway Heading: 232°

Runway Surface Type: Asphalt

Runway conditions: Dry

Runway Length/Width: 2377m/45m

4. Findings

The findings presented in this report are derived from an extensive series of interviews conducted with both the cockpit-crew and the cabin crew, in conjunction with a comprehensive technical investigation. For this reason, this section will be divided into two distinct parts: the first part will detail the results and insights gained from the interviews with the crew members, while the second part will provide an in-depth examination of the various aspects uncovered during the technical investigation.

4.1 Interviews

Incident Overview:

The flight crew and cabin crew were invited to attend an interview following the incident. At the time of the event, the flight crew was under a routine route check, and consequently, a flight instructor was present in the cockpit.

Flight Crew Account:

The flight crew reported that all pre-flight checks and taxi procedures were performed without any issues. Engine start, taxiing, and take-off proceeded smoothly, with no unusual indications or odours detected in any part of the aircraft.

During rotation, a strong odour similar to "burnt oil" penetrated the cockpit. The crew promptly followed the recall items of the emergency procedures and donned their oxygen masks. As documented in the CVR data, the flight crew conversed about putting on their masks 47 seconds after initiating full thrust and 15 seconds after the landing gear squat switches were no longer compressed. There were no ECAM warnings, all engine parameters were normal and all other systems operating normally. At 07:44, the crew declared a "PAN PAN" to ATC, signalling their request for priority and assistance.

Note: Where an unexpected circumstance necessitates a return to the take-off runway or a nearby alternative runway, it is advisable to maintain the lowest safe altitude or circuit height if staying in the circuit, follow ATC instructions, and select the quickest safe route for landing.

In situations involving smoke/fumes/fire, timing is critical. Investigations have shown that a fire can escalate out of control in just 8 minutes, leaving the flight crew with approximately 15 minutes to safely land the aircraft. The SMOKE/FUMES/AVNCS SMOKE ECAM procedure as

well as the relevant QRH procedure stress the importance of landing the aircraft as soon as possible (LAND ASAP)

Airbus recommends that if smoke is detected without an ECAM warning, the crew should immediately consult the Quick Reference Handbook (QRH).

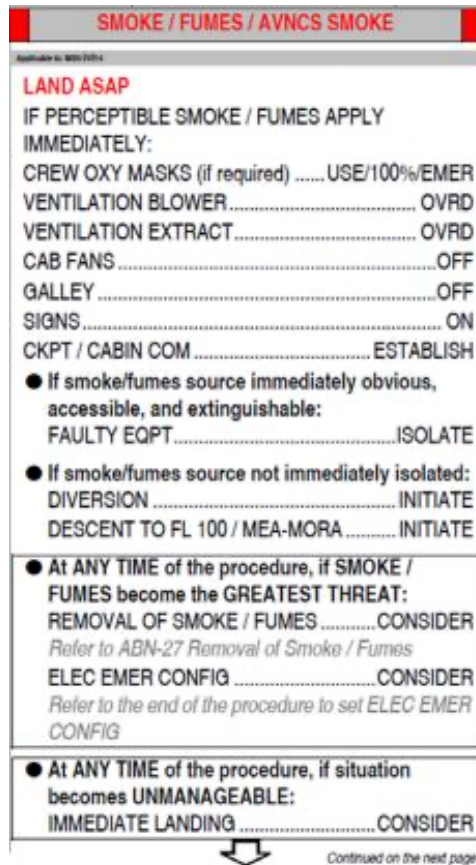


Fig 2. Airbus QRH

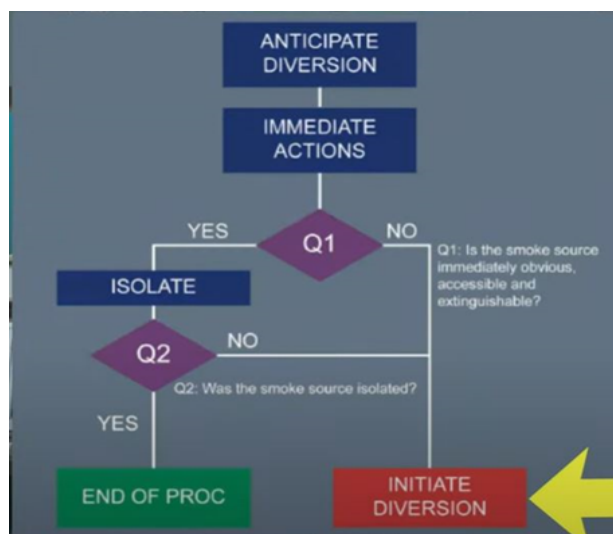


Fig 3. An Airbus suggested logical strategy for dealing with smoke and fumes problems.

Initially, the crew consulted the SMOKE/FUMES/AVNCS SMOKE checklist in the absence of ECAM warnings. As the fumes dissipated and considering the checklist was deemed too time-consuming, their focus turned towards landing the aircraft promptly. As a result, the crew focused on executing an overweight landing in order to minimize their time in the air.

ATC informed the crew that all runways were available, and at the crew's request, cleared them to land on RWY 31. Rescue and Fire Fighting Services (RFFS) were alerted and prepared to assist if necessary.

Cabin Crew Account:

Note: In unusual situations, it is essential for the cabin crew to follow their training and adhere to established protocols and procedures. Opening the cockpit door in these scenarios can compromise safety and should be avoided when possible.

Cabin crew members stationed at the front of the aircraft reported being alerted to a disturbance near the mid-section, where passengers were complaining about a noxious odour described as "burnt plastic." The Cabin Service Manager promptly informed the flight crew of what was happening. Cabin crew located at the aft of the passenger cabin observed what appeared to be a mist near the over-wing emergency exit area; however, the pungent smell did not reach the aft section. Despite one passenger exhibiting panic, cabin order was maintained throughout the incident.

Interviews analysis

The testimony given by the crew was compared to the recordings on the CVR and found to be consistent with the evidence given. An anonymous tip submitted via the BAAI website was also investigated. Although the individual appeared knowledgeable about the aviation industry, this person seemed unfamiliar with the cabin procedures during such events. Unfortunately, because the tip was submitted anonymously, the BAAI could not contact the person for further investigation.

As previously mentioned, the flight crew was undergoing a routine route check for this flight. During the interviews, it emerged that while it is standard practice for the check captain to halt the check and join the operating crew in the event of an unusual situation, the crew reported that there is no specific procedure or standard callout to indicate this transition. This lack of clarity may have created some initial uncertainty regarding the third crew member's new role.

(A recommendation has been proposed in this report; please refer to the recommendation section for further details.)

Another critical aspect requiring careful attention is handling incidents at low altitudes or shortly after take-off, which may necessitate an immediate landing. In these situations, completing a full checklist for the specific malfunction or event could unnecessarily extend the flight. *(A recommendation has been proposed in this report; please refer to the recommendation section for further details.)*

Outcome:

The aircraft landed successfully on RWY 31 at 08:06 Lt. The aircraft then taxied on its own power to the apron, where cabin crew facilitated an orderly and uneventful disembarkation of passengers and crew. No damages or injuries were reported. Upon arrival at the terminal, all passengers and crew underwent testing for possible fume inhalation, with all results returning negative.

4.2 Technical Investigation

4.2.1 On-site evidence

At 09:00 LT, personnel from BAAI (Bureau of Air Accident Investigation) were present on site. The team boarded the aircraft and conducted a visual inspection. An initial consultation with the cabin and flight crew was conducted to gain a primary understanding of the incident.

To identify potential sources, multiple inspections were carried out:

- Inspection of the electrical fuse boxes located at the front and rear of the cabin. No anomalies were detected, allowing for the exclusion of electrical sources from further consideration.
- A visual examination of the engines was performed. During this inspection, a pool of liquid was observed in the bypass duct of Engine 1, whereas Engine 2 showed no such evidence. Figure 2 illustrates a photograph of the liquid pool within the bypass duct of Engine 1, and Figure 3 displays a photograph showing liquid traces along the bypass stator blade.

These observations led to the preliminary hypothesis that oil traces might have infiltrated the bleed air system, warranting further investigation. In addition, data from the Cockpit Voice Recorder (CVR) and the Quick Access Recorder (QAR), stored on a PCMCIA card, were retrieved by BAAI for detailed analysis.



Fig 4: Excess pool of liquid sitting in the bypass duct, as seen from the aft

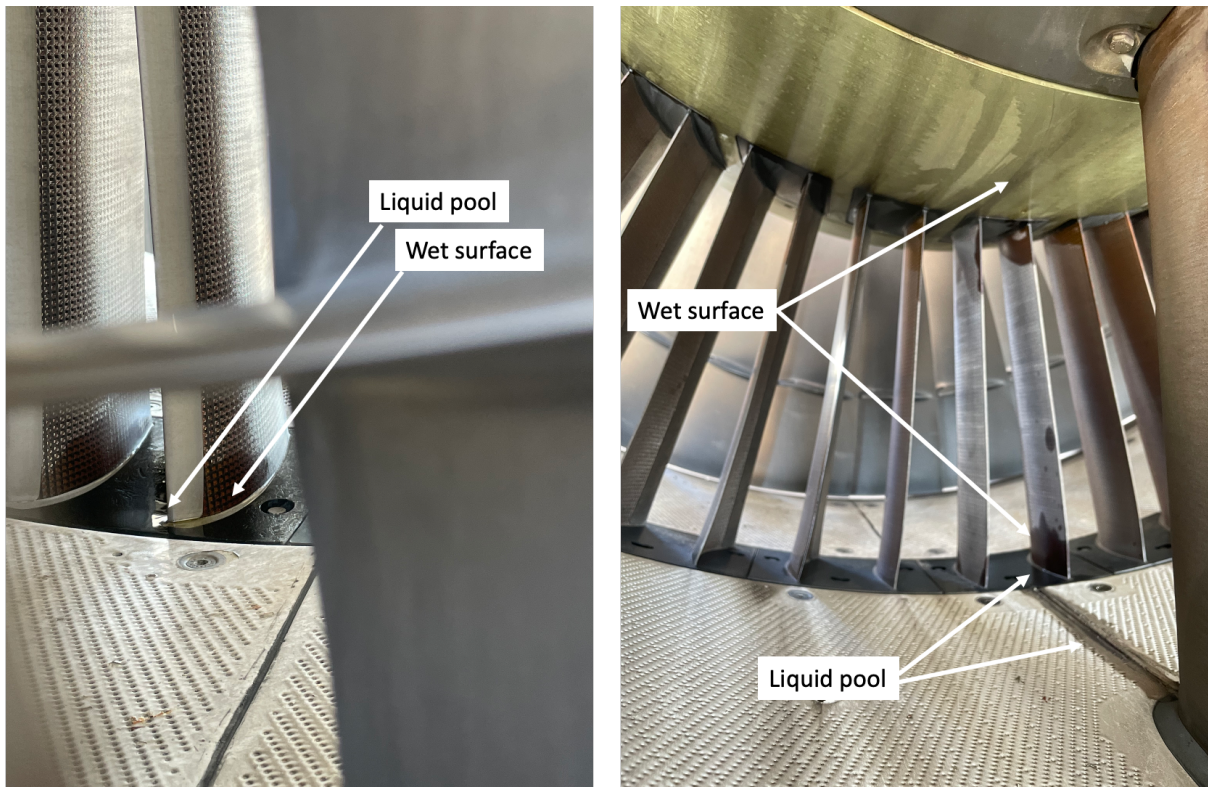


Fig 5: Traces of liquid along the bypass stator blade.

4.2.2 Trouble shooting

The operator indicated that Engine 1 was installed on the aircraft following a 6-month storage and the incident flight was its first operation flight post-storage. Upon installation, an engine test run was executed according to standard procedures, during which no burnt oil odour was detected. Given the constraints of the BAAI's resources, the maintenance division of the aircraft operator was authorized to undertake further troubleshooting activities while maintaining communication with the BAAI. The detailed troubleshooting report is included in Annex 1. For the sake of continuity, key findings are reiterated in this section.

Following BAAI's approval, the oil accumulation on the acoustic panel of Engine 1, located behind the OGVs, was cleaned, and both engines were subjected to an idle run. There were no burnt oil odours detected within the cabin, nor were there any reports of oil droplets in the engine bypass duct. A subsequent borescope inspection of both engines revealed oil wetting on the casing screws of Engine 1, as well as in the area forward of the bleed valves, specifically between the case and the splitter fairing. Additional traces of wetting were observed in the booster, though no wetting was identified in the high-pressure compressor stages 1 and 2. Fluid wetting was also detected within the forward sump pressurizing tube.

The investigation was concentrated on Engine 1 based on these findings. After thoroughly cleaning the area, another engine run was conducted at an operational setting of 72.5%. During this run, a burnt oil odour was perceptible for a few minutes before dissipating. Post-test inspection revealed an oil accumulation behind the OGVs, thereby confirming Engine 1 as the source of the mist and fumes reported in the cabin during the incident.

The aircraft operator consulted CFM-International, the engine manufacturer, and LHT (Lufthansa Technik) , the engine repair facility, for further diagnostic recommendations to pinpoint the exact source within the engine. Following additional guidance from these entities, a new borescope inspection was performed, which narrowed down the issue to the area immediately preceding the high-pressure compressor. Oil wetting was localized around the aft seal of bearing No. 3. Figure 4 provides a schematic of the engine, illustrating the primary components and the identified problematic bearing. The maintenance team's analysis traced the pathway of oil from bearing No. 3 through the engine components, culminating in the bypass cowling. This trace analysis corroborated the link between bearing No. 3 and the oil pool detected as evidence. Figure 5 presents a schematic visualizing the connection between bearing No. 3 and the observed oil pooling.

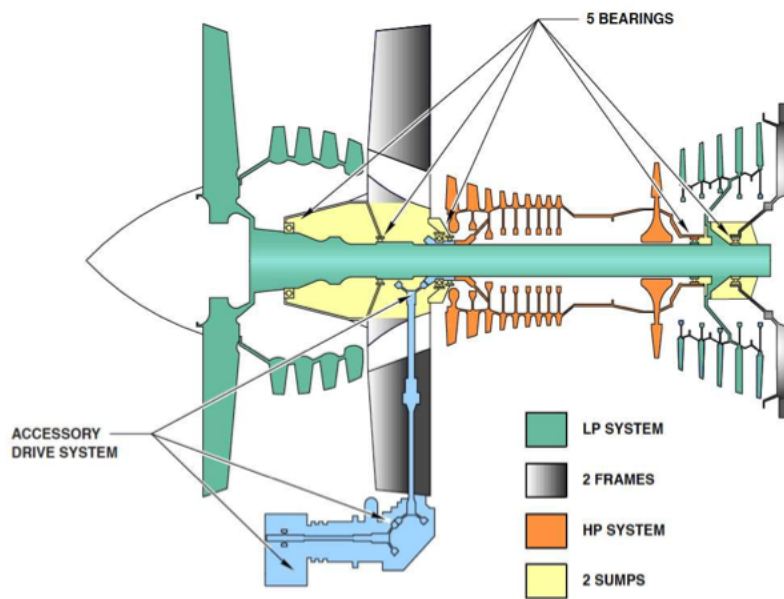


Fig 6. General schematic of the engine, highlighting the main components and bearings.

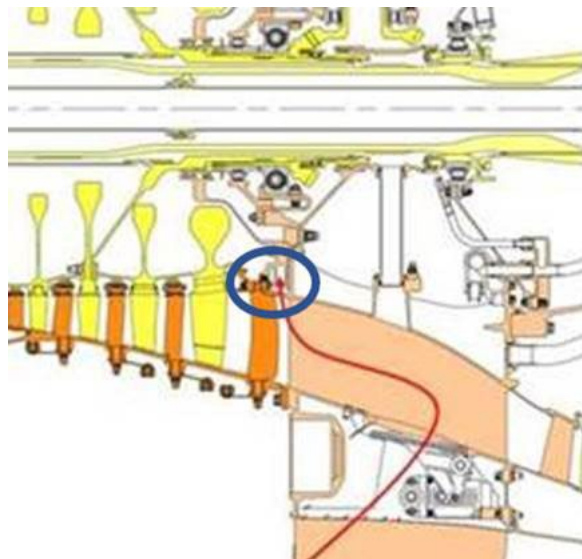


Figure 7. Trace showing how oil from Bearing No. 3 could seep through the components and settle in the bypass cowling. (reference Appendix1)

The investigation conclusively determined that the failure of the seal in bearing No. 3 resulted in oil traces from Engine 1 entering the engine core air stream. The air system utilizes bleed air supplied directly to the cockpit and cabin, where the contaminated oil traces, appearing as mist, were introduced into the cabin air supply. Operating under high temperatures within the

engine compressor, the oil experienced thermal degradation, which produced a distinctive "burnt oil" odour.

Figure 6 illustrates the pathway through which bleed air from Engines 1 and 2 is directed towards the environmental control system (ECS) packs. These packs subsequently channel the air into a mixer unit, which combines the air streams and distributes them to the cockpit, forward cabin, and aft cabin. Notably, the bleed air from Engine 1 follows a shorter trajectory to the cockpit and forward cabin, elucidating why these sections were impacted first by the contamination.

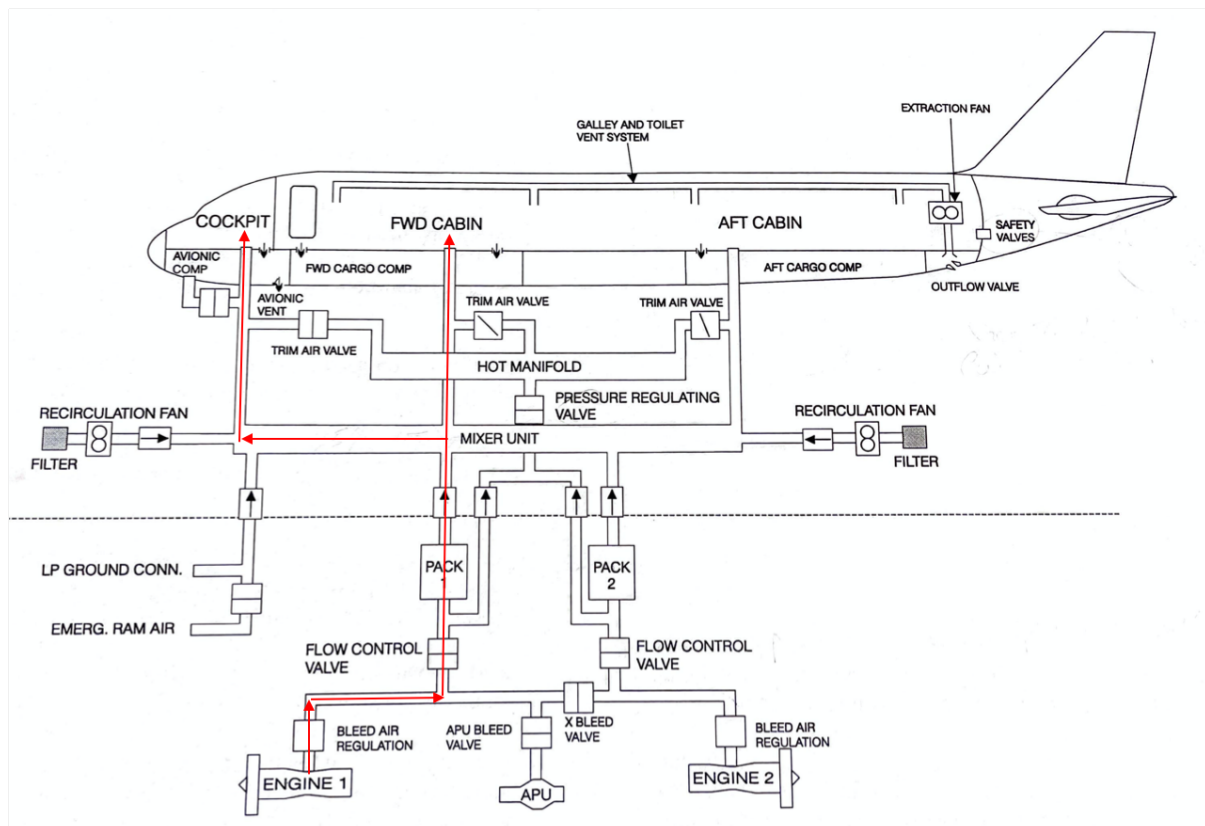


Fig 8: Schematic of the bleed air for the aircraft, highlighting (in red) the route of the bleed air from engine 1 to the cockpit and the forward cabin.

4.2.3 Other investigations

As part of the technical investigation, the BAAI team explored additional factors that could have contributed to the oil mist and the smell of burnt oil. Although these potential causes were ultimately ruled out, they are presented here for the sake of thoroughness in this report.

Engine Preservation Process:

The BAAI looked into the theory that the burnt oil smell might have originated from engine preservation oil, typically applied before storage. It was considered that this oil could have burned, creating the burnt oil odour. However, the presence of oil residues post-flight refuted this theory. Instead, attention was directed towards a potential defect within the engine.

Engine Motoring Process:

During installation, the engine undergoes a motoring process, where it is rotated using a motoring device. This rotation increases oil pressure, but if the engine is not generating pressure, the seals may not function properly. In cases of prolonged motoring, oil pressure could rise and leak through ineffective seals. BAAI examined this scenario but concluded that the discovery of oil during the borescope inspection, along with recurring issues during high-power engine runs, suggested that the oil leakage was not a result of the motoring process but indicated a flaw in the engine seal.

4.2.4 Cause of Failure.

The fact that the engine had just come out of storage makes determining the cause of failure even more challenging. As a result, the cause of the bearing seal failure remains unknown.

4.2.5 Analysis of the CVR and QAR

Concurrently with the technical investigation conducted by the aircraft operator, the BAAI reached out to the BEA (Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile), for assistance in retrieving and analysing data from the Cockpit Voice Recorder (CVR) and Quick Access Recorder (QAR) stored on a PCMCIA card. The BEA's findings can be located in Annex 2. *For consistency, excerpts from the report are being reproduced in this section.*

According to the CVR data, the flight crew communicated to each other about donning masks 47 seconds after applying full thrust for take-off and 15 seconds after the landing gear squat switches were no longer compressed. This aligns with the crew's statements during interviews and illustrates the progression of the issue during take-off thrust application. It is further supported by tests carried out by the aircraft operator, which indicated no presence of smoke odour at idle settings but did detect a smell of smoke at 72% power setting. This suggests that at this elevated power level, there is a natural increase in oil pressure leading to a failure in the bearing No. 3 seal.

On the other hand, the QAR data revealed no irregularities that could be linked to a drop in engine oil pressure, rise in oil pressure, or malfunctions in engine performance. This indicates

that the quantity of oil leaked during the flight was not substantial enough to trigger any alerts and did not pose a risk to the engine's operation.

4.3 Summary

The Bureau of Air Accidents Investigations (BAAI Malta) has established that the cause of the fumes in the cockpit and forward galley with a pungent odour of burnt oil was a result of a broken engine seal. It was shown that engine No. 1 suffered a failure in the seal of bearing No.3. This resulted with oil mixing with the mainstream air, with a portion of it finding its way through the bleed air, through pack 1 and into the cockpit and forward galley.

The same fumes and pungent odour were felt by the cabin crew at the forward galley to the over-wing emergency exit.

5 Recommendations

The necessity of adhering to the manufacturer's checklist in emergency situations is totally accepted within the aviation industry. While emergency checklists are typically structured for use in scenarios where there is ample time to methodically complete all required steps safely, circumstances may arise where an immediate landing after take-off or from low altitude is unavoidable. In such cases, time constraints may prevent the completion of the entire emergency checklist or even complete just one long and complicated checklist, leading to doubts for pilots regarding the adequacy of measures taken to ensure a safe landing.

Similar accidents where time is critical occurred on other occasions. For example, on 18 April, 2018, an Airbus 330-300 operated by Delta Airlines from Atlanta to London, returned for an overweight landing after developing a right engine fire which occurred shortly after take-off. The aircraft touched down 26 minutes after take-off. However, an NTSB report highlights that it would have been possible for the crew to have landed back 12 minutes after take-off had the crew decided not to extend the flight time in order to attempt to resolve the issue.

A different approach was taken by the crew of the Airbus A320-200 on February 10, 2007. The passenger flight took off from New York JFK to Nassau and was climbing through 7000 feet when it experienced a fire in the overhead passenger compartments. The NTSB investigation determined that the probable cause was a result of a catastrophic failure of a 9-Volt lithium battery. The crew levelled at 7600 feet. The captain disengaged the autopilot and took over flight controls with the airplane landing approximately 6 minutes later. Evidently the crew prioritized landing the aircraft immediately and safely.

The accident experience by Saudia Flight 163 of August 1980 is also a reminder of the consequences of a crew spending precious time trying to confirm the warnings and diagnose the problem while fire spread from the cargo compartment through the cabin.

There are other examples of reported incidents which occurred where time for landing is critical. In such situations, the dilemma of following the checklists places unwarranted stress on the crew during a critical phase where their focus should be solely on executing a safe landing. A simplified yet comprehensive checklist concentrating only on essential tasks, will support the crew precisely when they need it most, enabling them to confidently and effectively manage emergencies and ensure the safe landing of the aircraft. This approach not only

enhances safety by making sure that essential tasks are completed, but also assists in alleviating undue stress on the crew, allowing them to concentrate on the critical task at hand.

To address this challenge, the recommendation of developing a more general (Generic) checklist has been made to provide crews with a streamlined set of essential actions to guide them in high-pressure situations with very limited time available.

Recommendation 1: To the Aircraft Manufacturer.

It is recommended that the manufacturer explores the possibility of creating a general (generic) checklist specifically tailored to efficiently handle essential tasks during emergency return scenarios or situations with time constraints. This checklist should be employed at lower altitudes, specifically when it is imperative to return to the departure airport or a nearby alternative. While focusing solely on critical elements pertinent to the situation at hand, this checklist aims to facilitate a safe landing promptly and without compromising safety measures.

Recommendation 2. To the operator.

It is widely recognized that a crew undergoing evaluation may experience heightened stress levels due to the assessment process. Following CRM best practices, it is recommended to improve the current procedure by having the operating Captain to declare the end of the evaluation and the integration of the check captain into the operating crew. This aligns with standard CRM procedures, wherein in such situations, the check captain is considered as an additional cockpit resource.

To address this issue, it is recommended that the operator establish a standard callout to be announced by the operating captain, thus also ensuring a clear chain of command.

Recommendation 3. To the operator.

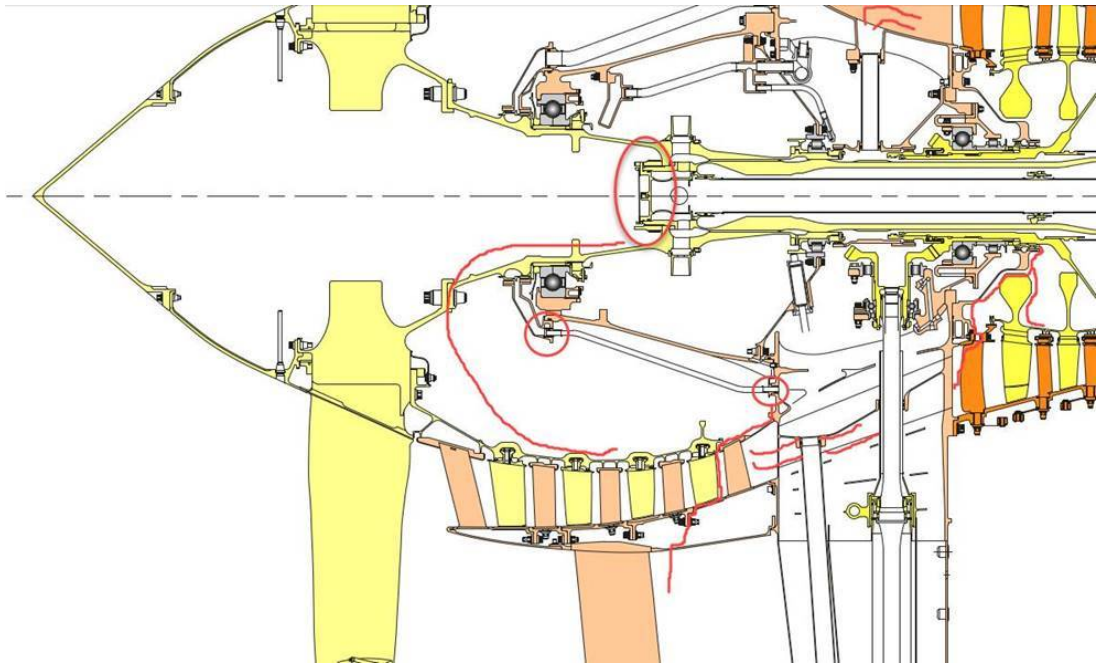
It is recommended that the operator establish a procedure to be used when an emergency situation necessitates an immediate return to the departure airport or its alternative. This measure will help avoid interruptions to the flight crew from the cabin crew. Additionally, the pre-flight briefing should outline the steps to be followed for an immediate landing, particularly in cases where the aircraft's weight requires an overweight landing procedure.

ABBREVIATIONS

ATC	-	Air Traffic Control
ATIS	-	Automatic Terminal Information Service
BEA	-	Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile,
CVR	-	Cockpit Voice Recorder
ECS	-	Environmental control system
ICAO	-	International Civil Aviation Organization
LHT	-	Lufthansa Technik
LMML	-	Malta International Airport ICAO Code
MATS	-	Malta Air Traffic Services
MTOW	-	Maximum Take-off Weight
NOSIG	-	No Significant Weather
PPL(A)	-	Private Pilot Licence (Airplane)
QAR	-	Quick Access Recorder
QNH	-	Atmospheric Pressure adjusted to Mean Sea Level
RFFS	-	Rescue and Fire Fighting Services
SEP(Land)	-	Single Engine Piston (Land)
VFR	-	Visual Flight Rules
WGS84		World Geodetic System 1984

SPARE ENGINE CFM56-5B4/3 ESN 643943 BSI DUE TO CABIN OIL SMELL

1. Remove Front Spinner and inspect Fan Shaft inner area for obvious oil traces.



2. Remove a Fan Disk bolt and inspect Bearing No.1 Stationary Seal body and seal area for obvious oil traces. Inspect inner Booster Spool area for fresh oil. Inspect the Fwd. Sump Scavenge / and Drain Tube for Oil drops/traces.

Notes:

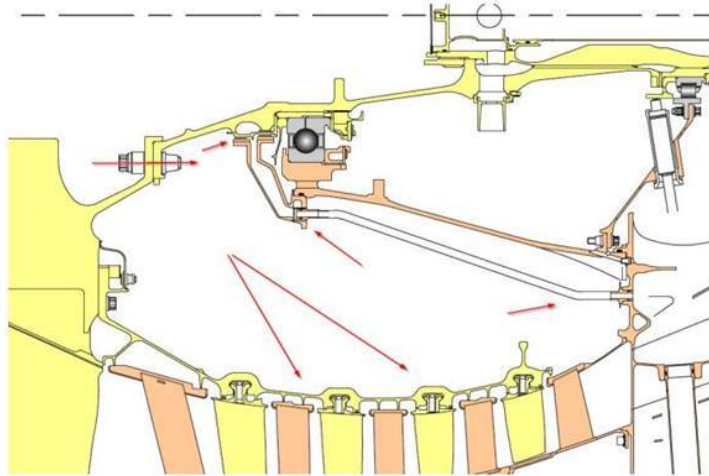
Both parts (seal and/or scavenge tube) might be the origin of the defect. The BSI is either to be recorded by video or take good photos from the areas inspected.

The scavenge tube is located at the 6 o'clock position and is sealed by O-Rings to the Bearing No.1 Stationary Seal body and to the Fan Frame which might be worn (not unusual).

The Air/Oil Seal of the Bearing No.1 Stationary Seal is not expected to be the source of the problem, but the Seal body in the oil scavenge area might have a crack potentially, even though it is of low probability. This is to be inspected as well.

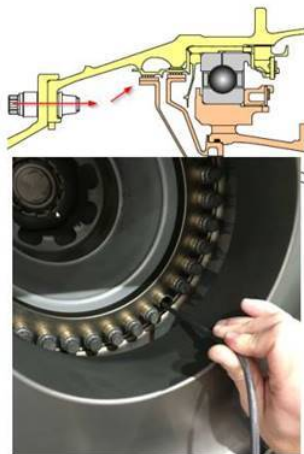
Bearing #1 seal and booster spool

- 1ea fan disk bolt must be removed



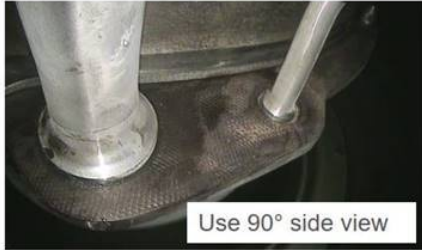
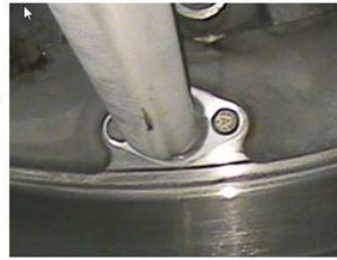
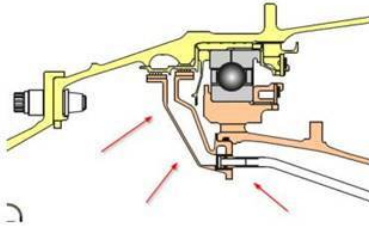
Bearing #1 seal

- Put the BSI (6mm flex / straight view) through the removed fan disk bolt to the fwd side of the bearing #1 seal area (No.1 Stationary Air/oil Seal) abrasible material.
- Turn the fan disk 360° to see the whole abrasible area. Take a video!



Bearing #1 seal

- #1 seal body, oil scavenge and #1 seal drain tube area.



Booster Spool area and examples

- Use straight view.
- Oil fatter film is normal condition from the operation.
- Fresh oil is an oil leak indication from the #1 seal or oil tubes.



- The Bearing No. 3 Fwd Seal was already inspected as part of AMM 71-00-00-810-802-A and showed oil wetness, which is not unusual in a limited quantity.

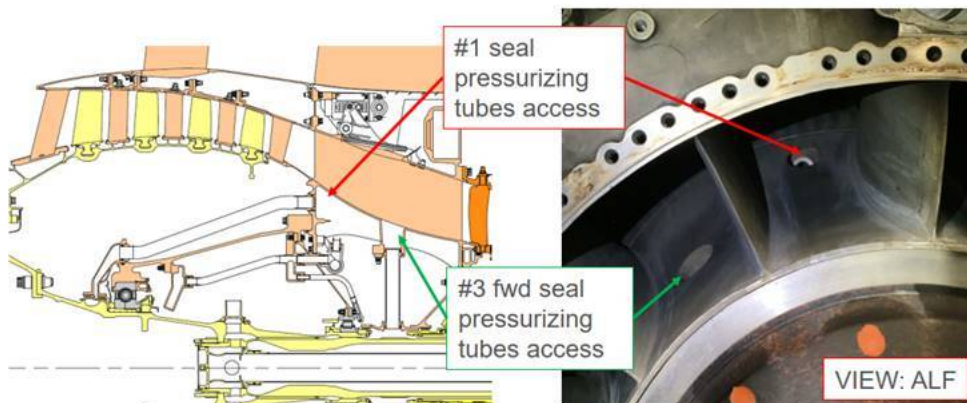
Notes:

Re-inspect the Bearing No. 3 Fwd Seal pressurizing tubes, especially 2ea lower positions (see below) to enable a comprehensive assessment.

Go through the tubes and try to watch the tube walls and the Teflon seal area as good as possible as well for possible Teflon delamination.

Fan Frame area locations

- The pressurizing tubes are located on the 1:30, 4:30, 7:30 and 10:30 o'clock position in the fan frame (Aft looking forward).
- Note: Also the #1 seal pressurizing tubes have there ports in the fan frame but in different locations and with different shapes
- Refer to next slides.

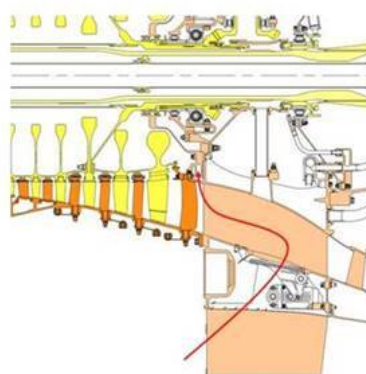


The #3 aft seal inspection (shown below) is not required again as it was already inspected and no oil wetness was found.

#3 Aft Seal Inspection

- Insert BSI trough VBV doors in 6 o'clock area and go trough the flowpath to the gap between the fan frame and the IGV shroud.
- Access is only possible if a composite #3 aft seal is installed.

Access area:
Picture taken during a
topcase event



Technical document

QAR and CVR examination

**Restricted release to the safety investigation members
Technical assistance for the Maltese BAAI**

Serious incident on **17th November 2022**
at **Malta AD (Malta)**
to the **Fixed Wing AIRBUS - A320 - 214**
registered **9H-AHS**
operated by **Air Malta Co. Ltd.**

Foreword

This document and the photographs and technical information contained herein are subject to the laws relating to communication and confidentiality embodied in European Regulation 996 of 20 October 2010.

The conclusions of this document are based on the work undertaken by the BEA (Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile). They should not be used to prejudge the final conclusions of the safety investigation.


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Glossary

ADLP	Audio and Data Link Player
APU	Auxiliary Power Unit
ARINC429	Data transfer standard for aircraft avionics
CAM	Cockpit Area Microphone
CVR	Cockpit Voice Recorder
ECAM	Electronic Centralized Aircraft Monitor
F/O	First Officer
FDR	Flight Data Recorder
FSK	Frequency Shift Keying
IIC	Investigator In Charge
PCMCIA	Personal Computer Memory Card International Association
PFR	Post Flight Report
QAR	Quick Access Recorder
ROSE	Read-Out Support Equipment
SHA256	Digital fingerprints made of 64 hexadecimal digits
UTC	Coordinated Universal Time

1 - EQUIPEMENT AND DATA EXAMINED

	QAR data	CVR
	-	
Manufacturer	-	L3Harris
Part number	-	2100-1026-02
Serial number	-	000844603

QAR data: 14 raw files (.dat) were received via our secured FTS server (Linshare) on the 13th of December 2022, provided by the IIC. The list of 14 .dat files SHA256 fingerprints is provided in Appendix 4.

2 - WORK PERFORMED

2.1. CVR download

The CVR was downloaded using L3Harris official means (ROC7).
The readout provided one raw file labelled *9H-AHS_CVR.cvr* (108 MB).

The CVR data raw file was decompressed with ROSE decompression function. That process provided the following audio files and associated administrative files:

- *9H-AHS_CVR_H1.wav* (Captain or F/O channel) / Duration: 02:04:14 (113 MB)
- *9H-AHS_CVR_H2.wav* (Captain or F/O channel) / Duration: 02:04:14 (113 MB)
- *9H-AHS_CVR_H3.wav* (observer channel) / Duration: 02:04:14 (113 MB)
- *9H-AHS_CVR_H4.wav* (CAM channel) / Duration: 02:04:14 (227 MB)
- *9H-AHS_CVR_SP.dat* / time-data synchronization file (1.77 MB)
- *9H-AHS_CVR_SP.log* / human readable time-data synchronization file (1.11 MB)

The CVR data raw file was decompressed with ADLP decompression function to extract recorded datalink activity. That process provided the following datalink log files and raw datalink file:

- *9H-AHS_datalink.log* (476 MB)
- *9H-AHS_datalink2.log* (476 MB)
- *9H-AHS_datalink3.log* (476 MB)
- *9H-AHS_datalink4.log* (376 MB)
- *pn2100-1026-02 sn844603.dlr* (32 MB)

The list of SHA256 fingerprints is provided in Appendix 1.

2.2. QAR data

The dataframe used for the QAR analysis was provided by Airbus and was referenced *f1024facf01*.

The 14 files (.dat) were concatenated into a file named *9H-AHS_All_Flights.bin* and synchronized in the BEA analysis software. It contained 70,591 seconds (approx.19h36min) of synchronized data, recorded at the rate of 1024 wps. The data contains 11 flights, including the event flight that was identified as the last recorded flight. The flight of event was confirmed by following parameters: (Parameter labels are written in *Arial*)

- UTC time and date parameters (*Hours Minutes, Date*);
- Heading at take-off and landing (*Heading*);
- Latitude and Longitude parameters (*CAPT LONGITUDE/LATITUDE POSITION ELAB WITH HIGH RESOLUTION*).

2.2.1. UTC time

The UTC time was determined using the following QAR recorded parameters:

- *Hours*
- *Minutes*
- *Seconds*

2.2.2. Specific computation

The standard altitude (*ALTITUDE ELAB* parameter set to 29.92 inHg, i.e. pressure altitude) was set to the QNH 1009 (QNH of the day of the accident): the parameter “-*C-ALTITUDE QNH*” was created.

3 - RESULTS

3.1. CVR

3.1.1. Time synchronization

The FSK bursts have been used to timestamp the data.

The CVR recorded three power OFF/ON before the flight of the event.

The last power ON of the CVR before the flight of the event occurred at 06:19:35.5 UTC.

The full thrust for the take-off of the event started at 06:50:57 UTC.

The verbal announcement from the crew to say that he will wear his mask was recorded at 06:51:44 UTC.

An overview of the multitrack audio project is shown in Appendix 2.

The synchronization of UTC time in FDR and CVR data was confirmed by the VHF keying and by the three landing squat switches.

3.1.2. Recorded datalink

Recorded datalink activity has been decompressed from the raw data file. Four log files have been created. Only label 350 of ARINC 429 bus, corresponding to the status messages, have been recorded.

3.1.3. Chronology

A chronology of the sound and warnings enhanced with the summary of the crew's conversations has been made to the profit of the analysis on the PCMCIA's data. The sound and warnings chronology starts at 6:19:35 UTC time to the end of recording. This document is shown in Appendix 3.

3.2. Sequence of events

The chronology of the event was established based on QAR data analysis. Some CVR inputs (*Italic front table*) were inserted when it should be relevant. Times are indicated in UTC. During this flight, the Pilot Flying was the captain as noticed by the parameter “*Captain pitch command position*” indicated the inputs on the captain’s sidestick (Ref to Appendix 5 “GENERAL OVERVIEW”).

The aircraft took off on runway 23 and landed on runway 31 as both runways are available at Malta airport.

3.2.1. Phase 1: Ground

The aircraft was on apron before taxi.

Time	Ground speed (kt)	Altitude (QNH)(ft)	Heading(°)	Event	Comments
06:40:45	0	244	359	APU bleed is selected ON and bleed valve is open	
06:40:46	-	-	-	APU GEN is recorded ON	The APU generator is online.
06:40:59	-	-	-	APU Bleed is switched OFF.	
06:41:04	-	-	-	Crew set the flaps at position 3 for take-off.	
06:41:05	-	-	-	APU bleed is closed	
06:41:13	-	-	-	Flap actual position changed to 20°	This angle corresponds to position 3 selected above.
06:42:02	-	-	-	The crew shut down the APU.	
06:47:14	-	-	-	N1 of both engines increase.	Aircraft starts taxi from its stand position N°5, apron 8.
06:48:05	7	244	360		

3.2.2. Phase 2 : Flight

Time	CAS (kt)	Altitude (QNH)(ft)	Heading (°)	Event	Comments
INITIAL CLIMB					
06:50:50		240	232	N1 of both engines increased to 88% within 11 seconds	Take-off power set on runway 23
06:51:31	152	268	233	Altitude starts increasing	The aircraft took off. Gear squat switches position confirmed aircraft was airborne
				Normal acceleration increases from 0.9 to 1.2g for 5 seconds	
				Squat switches of the gear are not anymore compressed	
06:51:44	158	748	233	<i>Crew announced the wearing of the oxygen mask</i>	
06:52:18	167	1937	234	Flaps position 2 are selected	
06:52:20	171	1969	234	Flaps position 1 are selected	
06:52:21				Flap actual changed to 10°	Flaps are in position 1
06:52:40	198	2200	234	Aircraft stops climbing at altitude 2200 ft, on runway heading	
06:52:42	202	2214	235	Flaps position 0 are selected	
06:52:49				Flap actual changed to 0°	Clean configuration
DOWN WIND FOR RUNWAY 31					
06:54:25	250	2218	135		Aircraft turned onto downwind leg for runway 31
06:55:29	224	2222	125	Crew announces: "SMOKE/FUMES/AV NCS SMOKE" C/L	The "SMOKE/FUMES/AVNCS SMOKE" check list requests to override the "VENTILATION BLOWER" & "VENTILATION EXTRACT" items, among others
06:56:11	216	2210	125	<i>Single chime</i>	
06:56:13	216	2206	125	<i>Single chime</i>	

Time	CAS (kt)	Altitude (QNH)(ft)	Heading (°)	Event	Comments
				Captain & first officer Master caution triggered	
06:56:15	216	2206	125	Pressurisation page popped up on ECAM	
06:56:30	215	2218	125	Crew announced: «Blower fault, extract fault»	The post flight report mentions [VENT BLOWER FAULT] & [VENT EXTRACT FAULT] at 06:56
06:56:34	215	2218	125	The Status page was selected by the crew	
06:57:09	215	2218	126	Crew announced "OVERWEIGHT LANDING"	The "OVERWEIGHT LANDING" check list requests to switch the APU on, among others items
06:57:36	216	2206	103	APU page popped up on the ECAM	
06:57:45	216	2210	082	FLAP position 1 were selected	
06:57:48	215	2210	076	APU page disappeared from the ECAM	
BASE LEG FOR RUNWAY 31					
06:58:04	202	2222	040		Aircraft was on base leg
06:58:16	198	2222	036	FLAP position 2 were selected	
06:58:24	187	2242	037	APU page popped up on the ECAM	
06:58:27	183	2254	037	APU Bleed was selected ON	Crew switched the APU bleed on as requested by the "OVERWEIGHT LANDING" check list
06:58:29	181	2258	037	Flap actual position changed to 15°	Flaps were in position 2.
06:58:41	169	2226	039	APU Bleed valve was OPEN	
06:58:42	168	2222	039	APU GEN is ON	The APU generator is online
06:58:52	158	2218	039	APU page disappeared	
FINAL RUNWAY 31					
07:00:31	149	2222	310		Aircraft turned onto final
07:03:22	151	2129	309	Landing gear lever was selected down	
07:03:35	146	1965	310	The nose gear was recorded down and locked	
07:03:37	145	1945	310	The main gear was down and locked	

Time	CAS (kt)	Altitude (QNH)(ft)	Heading (°)	Event	Comments
07:03:52	147	1773	310	Flaps position 3 were selected	
07:03:55	147	1737	310	Flap actual position changed to 20°	Flaps were in position 3
07:03:56	148	1729	310	Flaps position full were selected	Crew selected this final flaps configuration, for landing
07:04:00	148	1681	310	Flap actual position changed to 35°	Flaps were in position full
07:04:51	142	1061	309	The Autopilot is disconnected	<i>Cavalry charge</i>
07:04:52	143	1045	310	Master Warning triggers	Disconnection of Autopilot
07:06:04	129	180	310	Left & Right landing squat switches are compressed	Main gear touched the runway
07:06:05	126	180	311	All spoilers (n°1 to n°5) deploys	
07:06:06	122	180	310	Eng 1 reverser fully deploys	
07:06:07	118	176	313	Eng 2 reverser fully deploys LDG squat switch-nose is compressed	Nose gear touched the runway
07:07:30		236	312	Master caution triggers during 1 min Both packs are closed	The post flight report mentions [AIR PACK 1 2 FAULT] at 07:07

4 - CONCLUSION

The FDR parameters read-out does not give any information regarding the origin of the smoke in the cabin and in the cockpit.

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Appendix 1: A320-200 – 9H-AHS SSCVR data – SHA256 fingerprints list

Name: 9H-AHS_CVR.cvr
Size: 113682050 bytes (108 MB)
SHA256: 428AE0C73AA18B60445CCAE4E67DF69BD69D9B8D8182E851D4CB45A63AC82408

Name: 9H-AHS_CVR_H1.wav
Size: 119272364 bytes (113 MB)
SHA256: 97F4387A8F2AD72E9808119A9884A7DA8EB040AB37281FC3CC9304864CD62B1E

Name: 9H-AHS_CVR_H2.wav
Size: 119272364 bytes (113 MB)
SHA256: 5BEAAC7E1D217AF3A0F7D366F91368242A087566E44D100F02723E02A142151B

Name: 9H-AHS_CVR_H3.wav
Size: 119272364 bytes (113 MB)
SHA256: 4CE0D0A74DA637ED69F9D798070EF35D9E9CB9285CF84D64A790FCD10BE66759

Name: 9H-AHS_CVR_H4.wav
Size: 238544684 bytes (227 MB)
SHA256:
697BC9BC1E36C700FD0D01D6BB5FFBCC0B9BF0ABCFA14BA2C90C286AA2C8BAFA

Name: 9H-AHS_CVR_SP.dat
Size: 1863648 bytes (1819 KB)
SHA256: 939341DF03E6D852E948D7B1CE9B0F2900D64CAE8262B453B7F076D79E5B043C

Name: 9H-AHS_CVR_SP.log
Size: 1164881 bytes (1137 KB)
SHA256: 86BD51D230805965A03A39181C1770ACB5A341C950BF44A5439A6756785F8F68

Name: 9H-AHS_datalink.log
Size: 500000130 bytes (476 MB)
SHA256: F7439D3739D43644FFB28A21695EF442B4B8A5DC1ED4170F8F7D13D3F695F8EA

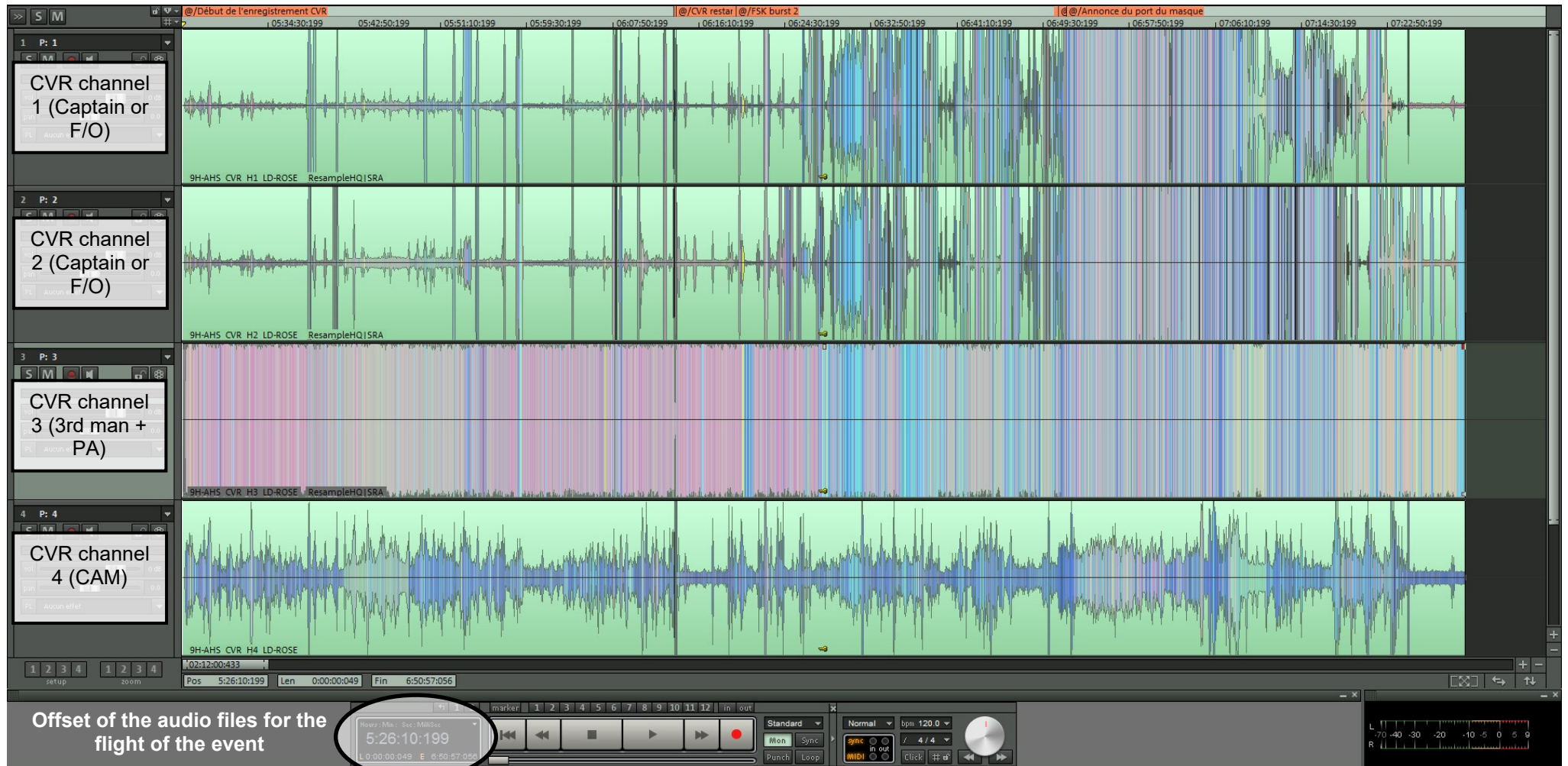
Name: 9H-AHS_datalink2.log
Size: 500000227 bytes (476 MB)
SHA256: 293B4A093ED07875172CC77FEB9FC92F7D10C4AFA20B8C47DEDE9E2763E94C4E

Name: 9H-AHS_datalink3.log
Size: 500000104 bytes (476 MB)
SHA256: 5484EABB1EFAAA1A95DB74BFD11300CD669411A420EC3B43B8137F4714C3B7D7

Name: 9H-AHS_datalink4.log
Size: 394914424 bytes (376 MB)
SHA256: 6E9AA3709D1AE78F523C720A5DFA7A38923D5A9F921CD3B511B29201A7C16817

Name: pn2100-1026-02 sn844603.dlr
Size: 33554594 bytes (32 MB)
SHA256: 0896DB7B27396E117240E574D78EC5587290CB24B9AB8A47C8A9FEAB61E8B8B5

Appendix 2: A320-200 – 9H-AHS SSCVR data / Audio project – Overview of the multitrack audio project



Appendix 3: A320-200 – 9H-AHS SSCVR data / Sound and warnings chronology enhanced with the crew conversations summary

UTC	Sounds
05:26:10	[@]: Start of the recording
06:13:44	[@]: CVR restart
06:14:00	[@]: CVR restart
06:19:35	[@]: CVR restart
06:48:12	[@]: Seat movement
06:49:16	[@]: Seat movement
06:49:21	[@]: Seat movement
06:49:25	[@]: Seat movement
06:49:30	[@]: Seat movement
06:50:03	[@]: Unidentified sound
06:50:39	[@]: Seat movement
06:50:51	[@]: Seat movement
06:50:57	[@]: Increase of the thrust
06:51:41	[@]: Seat movement
06:51:44	[@]: The crew announced the wearing of the oxygen mask
06:51:47	[@]: Doorbell (duration: 3s)
06:51:57	[@]: Doorbell (duration: 3s)
06:52:03	[@]: May be door noise
06:52:17	[@]: May be door noise
06:52:59	[@]: Announce of PAN PAN on radio
06:54:21	[@]: Doorbell (duration: 3s)
06:55:29	[@]: Start of the SMOKE/FUMES/AVNCS SMOKE checklist
06:56:11	[@]: Single chime
06:56:13	[@]: Single chime
06:56:30	[@]: The crew noticed the blower and extract faults
06:56:34	[@]: The crew cleared the faults
06:57:08	[@]: Overweight landing checklist
06:58:18	[@]: The crew removed the status
06:58:22	[@]: The crew announced the status removed

UTC **Sounds**

07:04:50	[@]: Cavalry charge
07:04:53	[@]: Triple click
07:04:57	[@]: SV: 1000ft
07:05:35	[@]: SV: 100ft above
07:05:38	[@]: SV: 400ft
07:05:44	[@]: SV: minimums
07:05:56	[@]: SV: 50ft
07:05:57	[@]: SV: 40ft
07:05:58	[@]: SV: 30ft
07:05:59	[@]: SV: 20ft
07:05:59	[@]: SV: retard
07:06:01	[@]: SV: retard
07:06:02	[@]: Sound similar to the touch of the landing gears
07:06:06	[@]: Sound similar to the reverses
07:06:28	[@]: Seat movement
07:07:29	[@]: Single chime
07:07:44	[@]: Doorbell (duration: 2,3s)
07:07:46	[@]: Sound of the door opening
07:10:16	[@]: Seat movement
07:11:38	[@]: Seat movement
07:11:43	[@]: Seat movement
07:18:23	[@]: Doorbell

Appendix 4: A320-200 – 9H-AHS QAR data – SHA256 fingerprints list

Nom: REC01883.DAT

Taille: 11051008 octets (10 MiB)

SHA256: C50D08848EA43FB5845253FF0FD23A41C595875DBF14FBBFF3C209793D22E2C5

Nom: REC01884.DAT

Taille: 11083776 octets (10 MiB)

SHA256: A1665966E69E191D324B771D027993217D8A605DA5CC981A1522D715D89B7DCA

Nom: REC01885.DAT

Taille: 13295616 octets (12 MiB)

SHA256: 8706F9FC0014E792DA7D0C0756582001A29829E380FD5FCCF9A253CAFD0113E3

Nom: REC01886.DAT

Taille: 13516800 octets (12 MiB)

SHA256: 7562125F653832CA98E66CFA4DDE6A57C2932574534236085AB89F8F0868D31A

Nom: REC01887.DAT

Taille: 10125312 octets (9888 KiB)

SHA256: D332CD4A0D5B893992E3698DD528EE7A0DE6BD3A15D13D75349A19637C190F0B

Nom: REC01888.DAT

Taille: 9732096 octets (9504 KiB)

SHA256: 80D9CCE8364818CA34541D5686B730EDA97DD944EC73B670C6E4737A8C83BC33

Nom: REC01889.DAT

Taille: 19578880 octets (18 MiB)

SHA256: 72181970ECC986980F4AAD7DBA6E6D15950A72A5BF9D59FDFD065D51E02BA724

Nom: REC01890.DAT

Taille: 15540224 octets (14 MiB)

SHA256: 47858965DF883560D3B721C60926BD7F62D91A932CF187D3667B2CD82ED7EF08

Nom: REC01891.DAT

Taille: 20250624 octets (19 MiB)

SHA256: 59549890BC6278B5F821DFC2F3F877D0D5F906A0EFF378057E10792AC148316F

Nom: REC01892.DAT

Taille: 17678336 octets (16 MiB)

SHA256: 1709C8C4782494F5AE83048F719F74BA7DF7BEC1E472ECE46CCCC2A1526BC450

Nom: REC01893.DAT

Taille: 286720 octets (280 KiB)

SHA256: 940F9AA31A07F91EAA1F0325FBCB0B9D2197A338CE544668901B4799EA0B76C4

Nom: REC01894.DAT

Taille: 1925120 octets (1880 KiB)

SHA256: 9CAE9D40876E5C4E394E3C75BF408127574F5578669D0EA666CEFED9F97AAB09

Nom: REC01895.DAT

Taille: 532480 octets (520 KiB)

SHA256: A62E52BEF286E3B2BBD6520C1D3BEAB8FB591AC52E87CC63D45AC43D4ABF1A4E

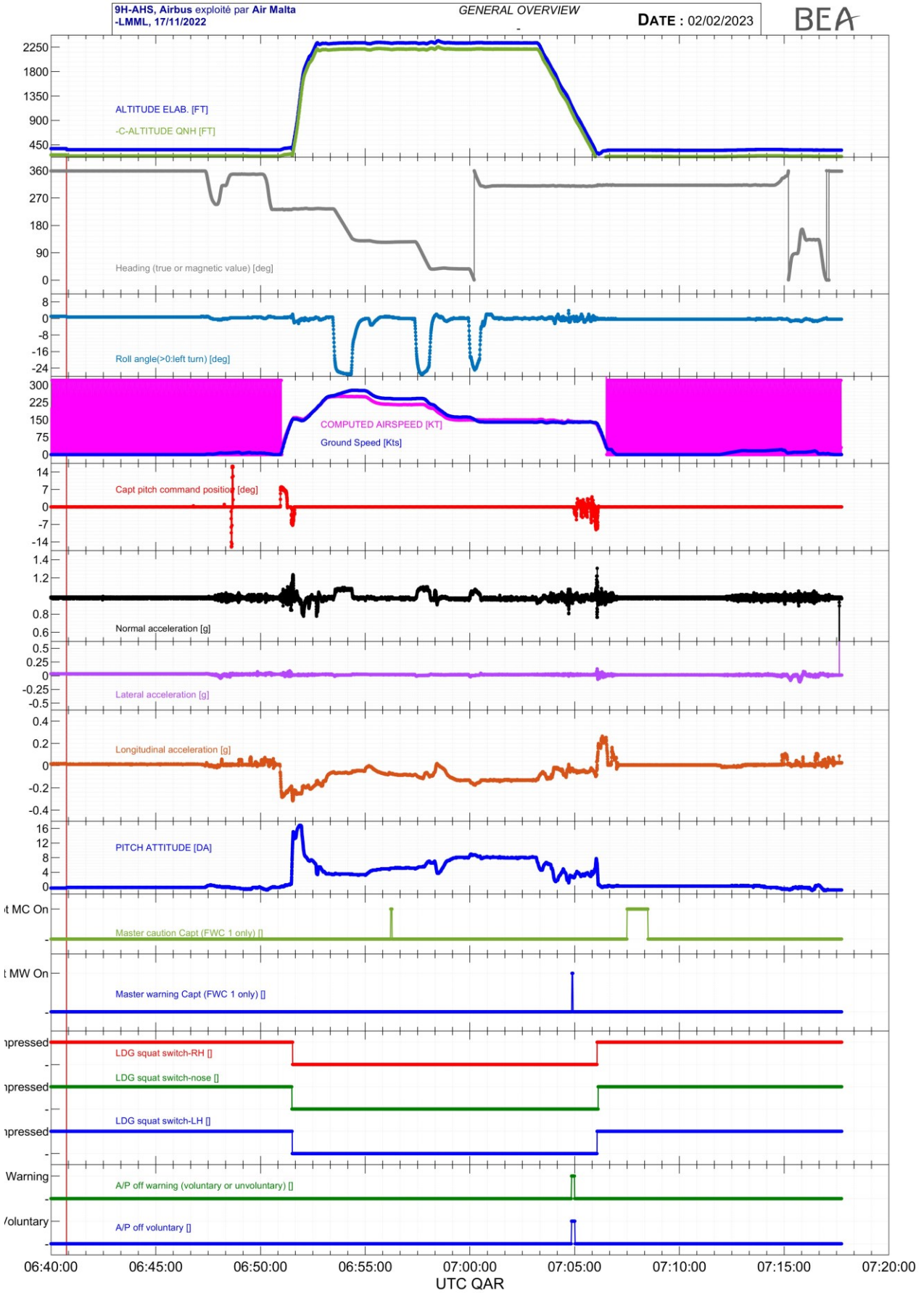
Nom: REC01896.DAT

Taille: 4546560 octets (4440 KiB)

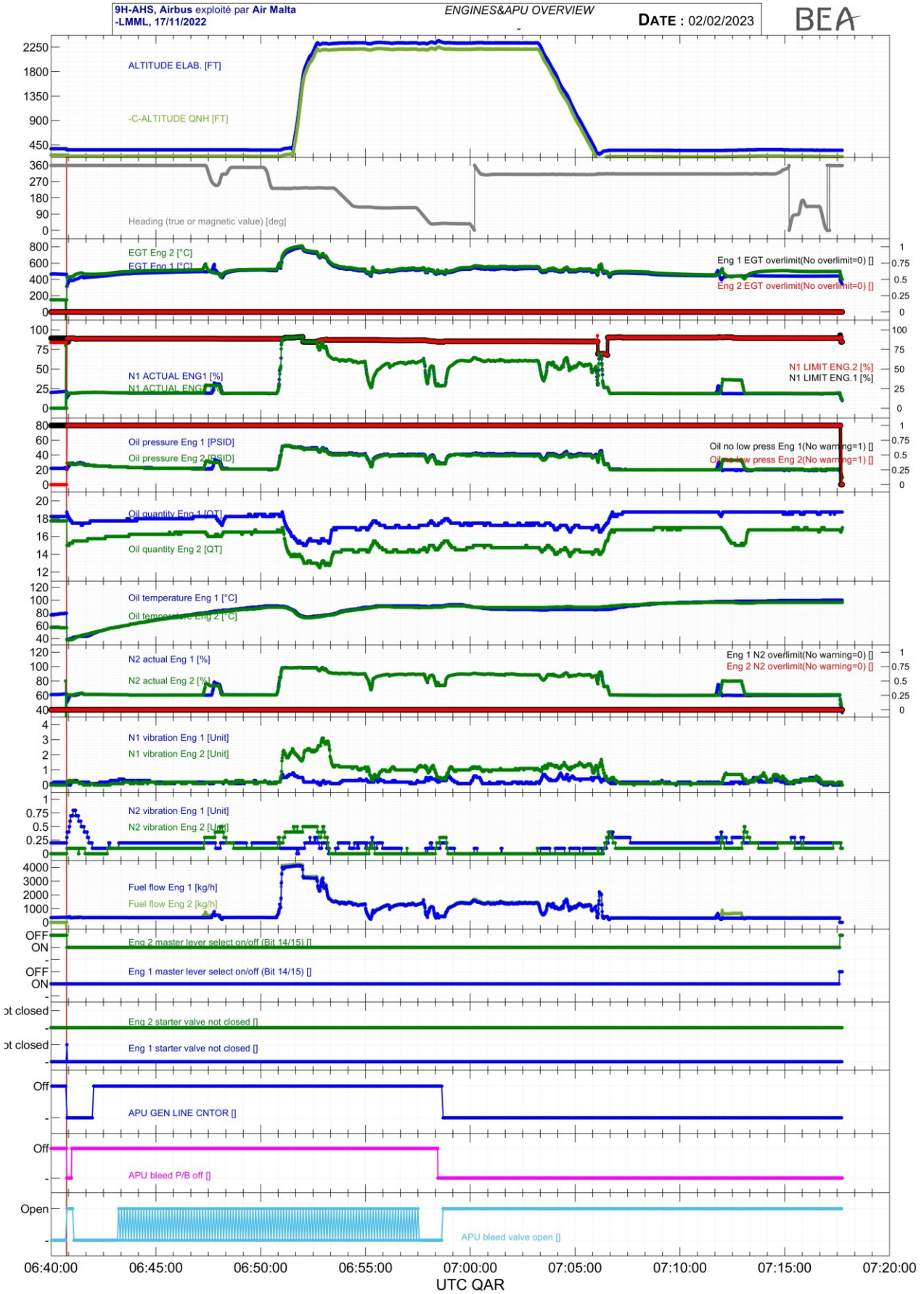
SHA256:

B5B7A5D5BCB6DBD4514D5D1DE4D9BF58DBFCA67E0E6C03FE31A661BEE0E4BA7A

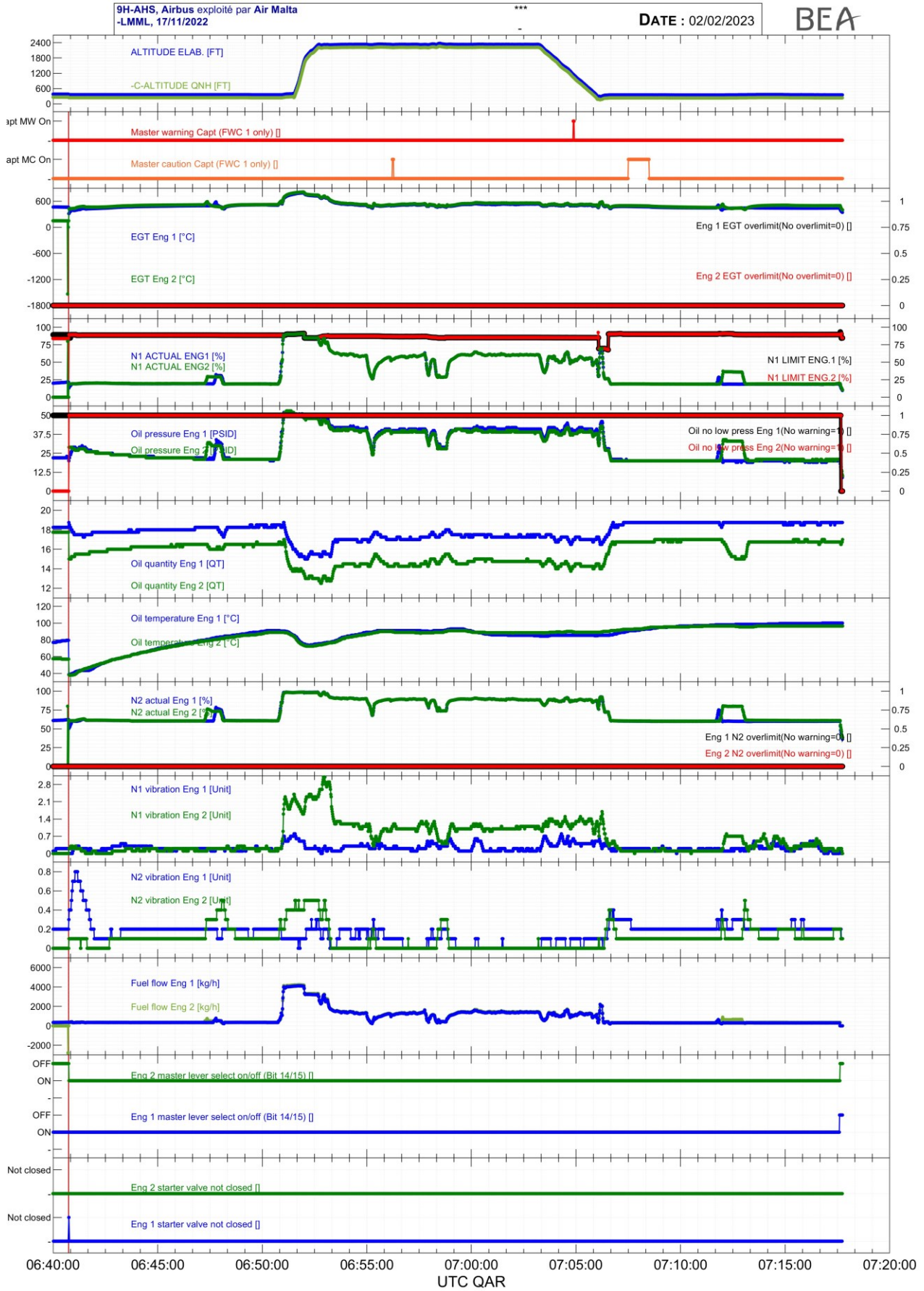
Appendix 5: GENERAL OVERVIEW



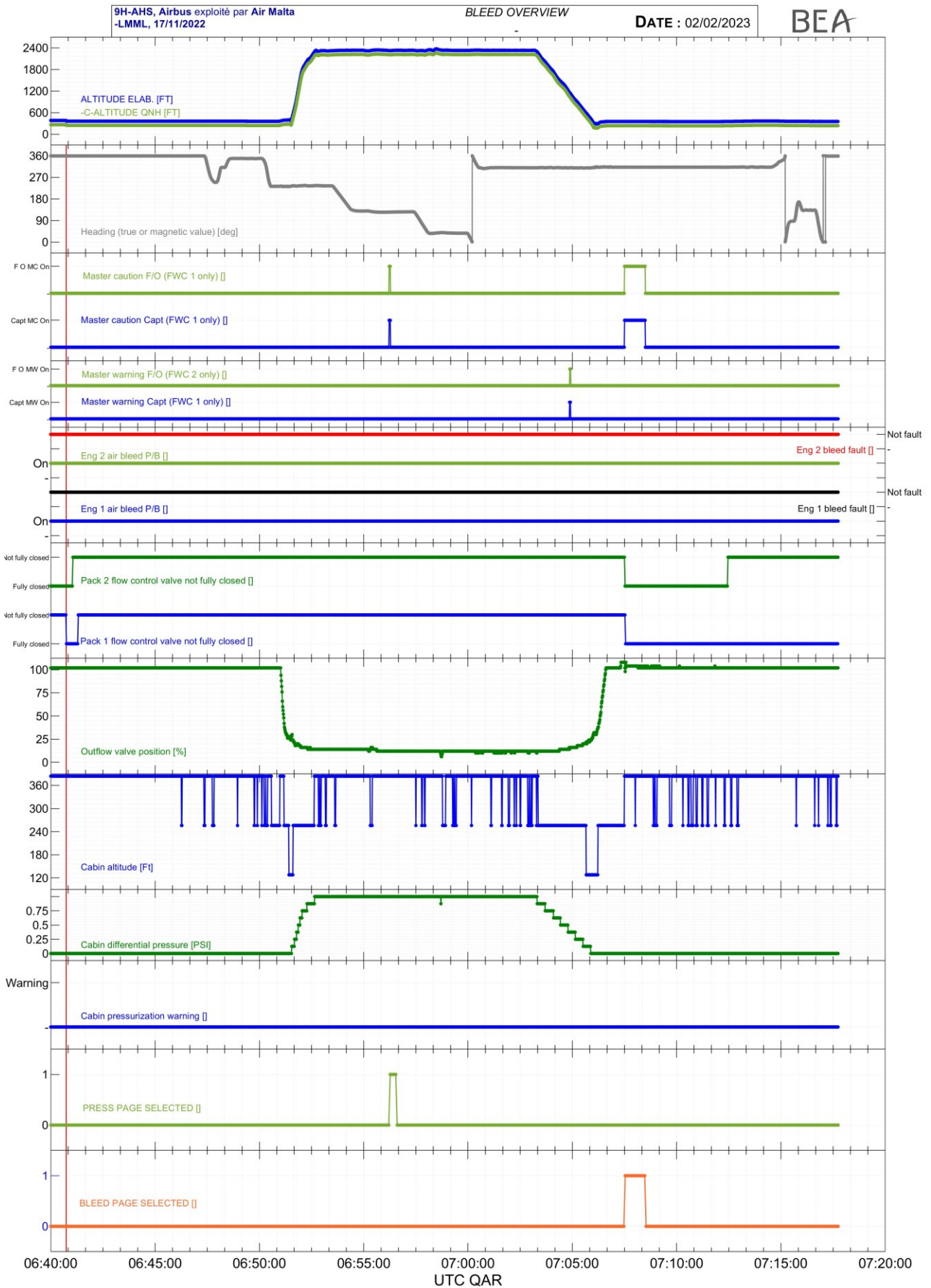
Appendix 6: ENGINES & APU OVERVIEW



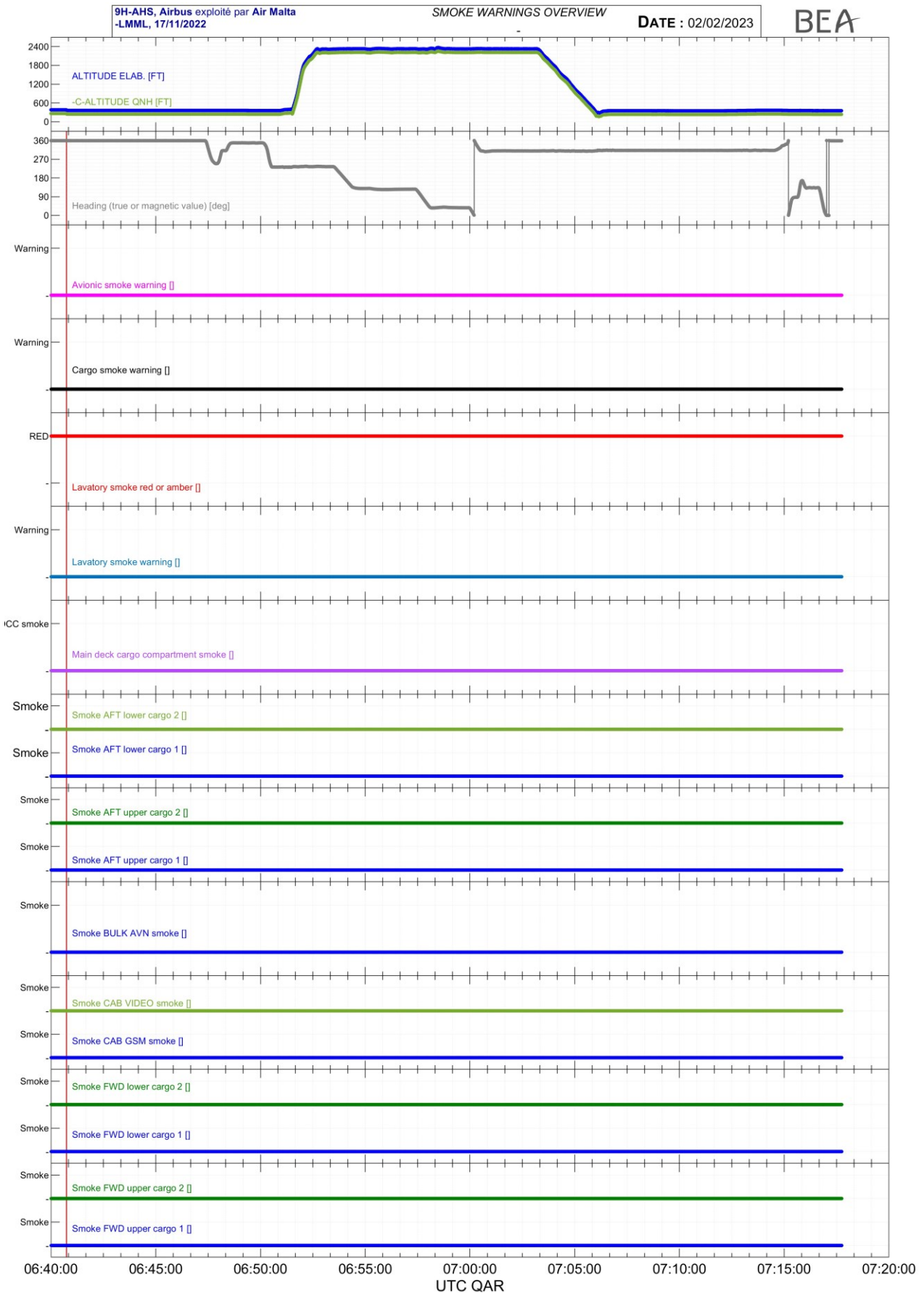
Appendix 7: ENGINES& NO APU OVERVIEW



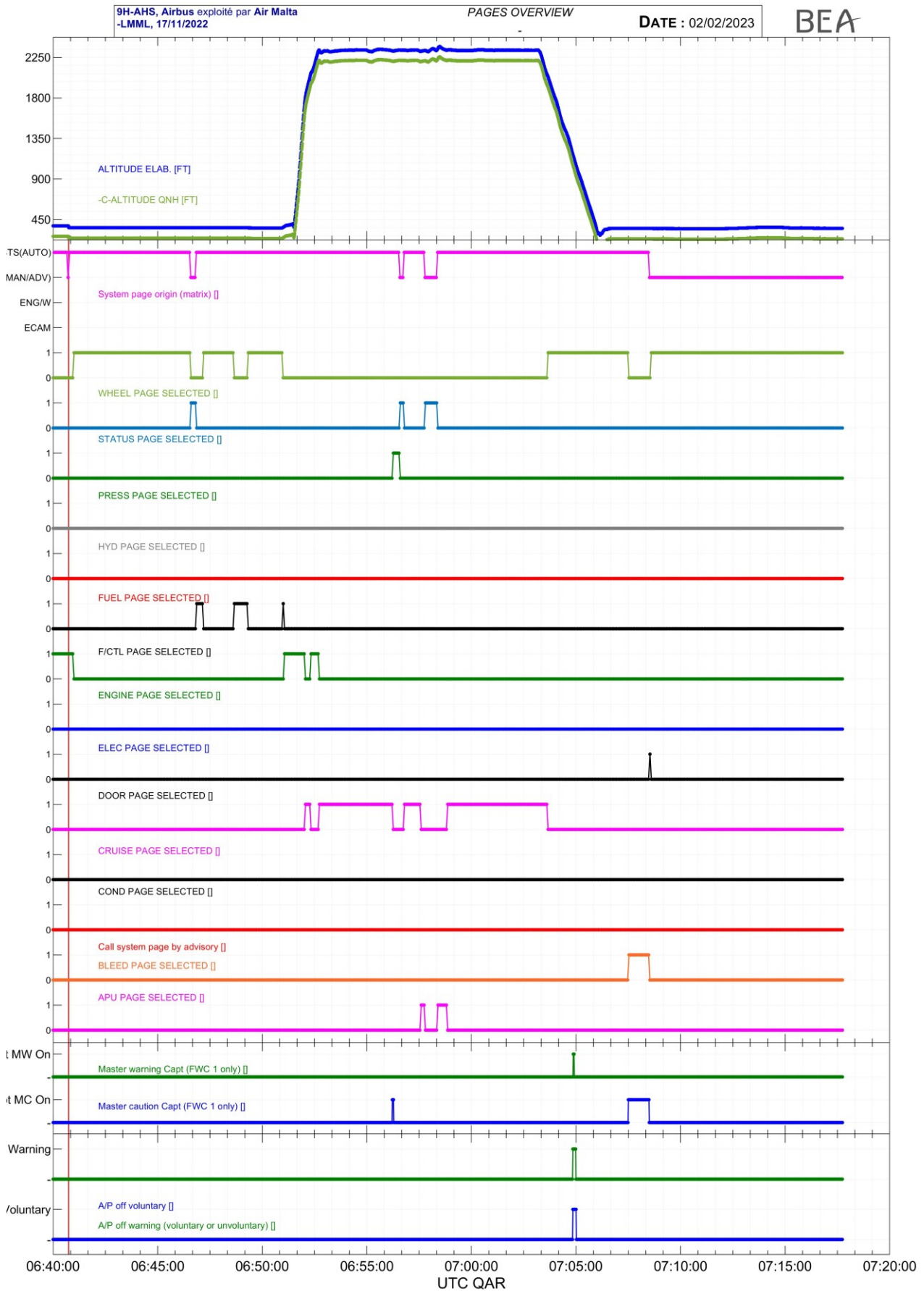
Appendix 8: BLEED OVERVIEW



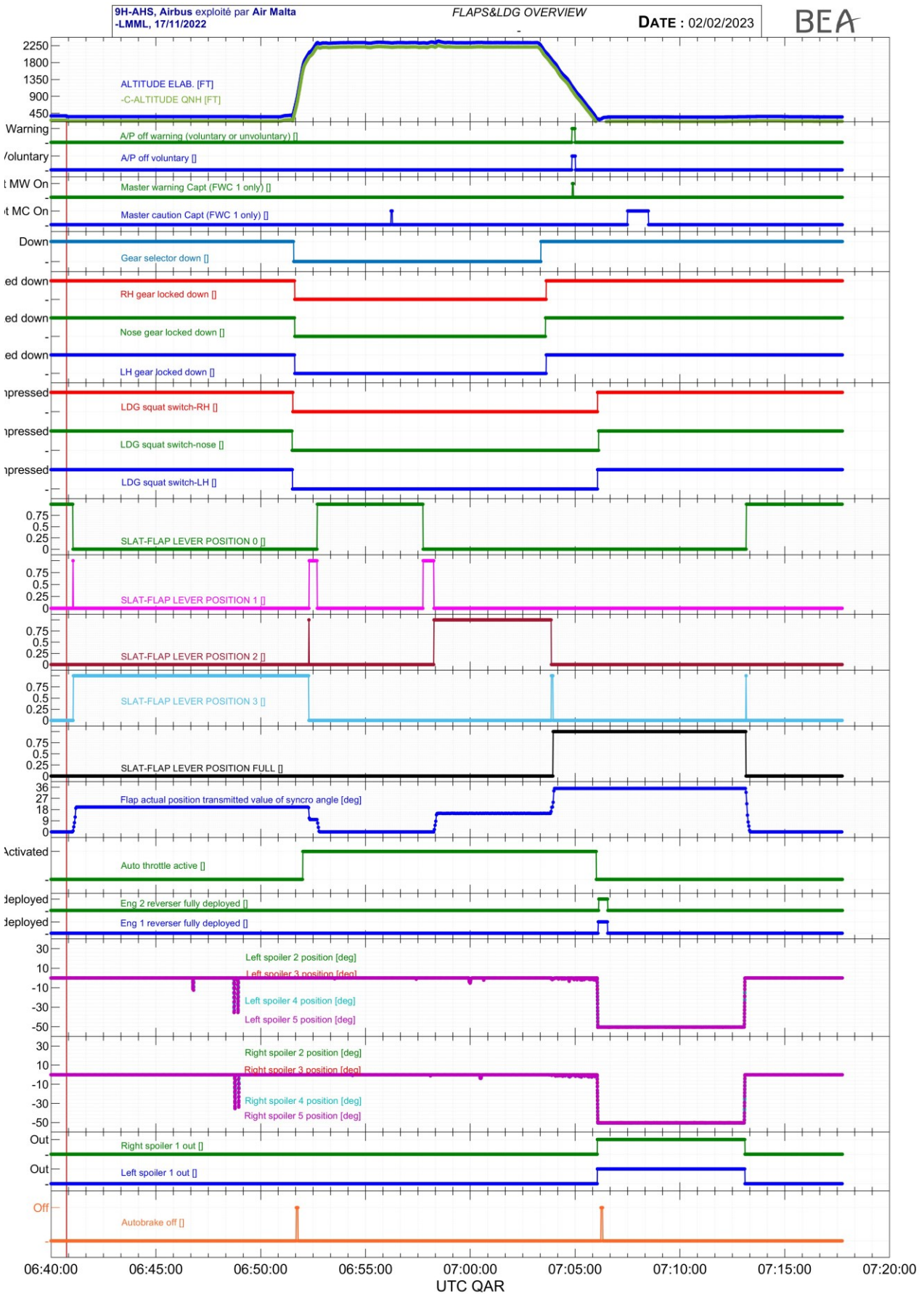
Appendix 9: SMOKE OVERVIEW



Appendix 10: PAGES OVERVIEW



Appendix 11: FLAPS&LDG OVERVIEW



Appendix 12: Post Flight Reports

Printed: 28/11/2022

Title: Flight Details

Leg	-44	Flight Number	KM514	A/C ID	9H-AHS
From	MLA	First Event Date	17 Nov 22 - 06:42		
To	VIE	Last Event Date	17 Nov 22 - 07:08		

CMS:CFR_TAB

Fault Tracking	Phase	Date Time	ATA	Source	Title	Occurrence History	Priority	Work	Note
	06-CRUISE	17 Nov 22 - 06:56	2126		[VENT BLOWER FAULT]X			
	06-CRUISE	17 Nov 22 - 06:56	2126		[VENT EXTRACT FAULT]X			
					[null]				
	09-80 KTS	17 Nov 22 - 07:07	2161		[AIR PACK 1 2 FAULT]X			
					[null]				

BEA

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