



TRANSPORTATION SAFETY
BUREAU OF HUNGARY

FINAL REPORT

**2014-093-4P
Serious Incident**

**Budapest
22 March 2014**

**Airbus A320-232
G-EUUE**

The sole objective of the technical investigation is to reveal the causes and circumstances of aviation accidents or incidents or irregularities and to initiate the necessary technical measures and make recommendations in order to prevent similar cases in the future. It is not the purpose of this activity to investigate or apportion blame or liability.

INTRODUCTION

This investigation was carried out by the Transportation Safety Bureau of Hungary on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII of 1995 on aviation,
- Annex 13 identified in the Appendix of Act XLVI. of 2007 on the declaration of the annexes of the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as Kbvt.),
- MET (Ministry of Economy and Transport) Decree 123/2005 (XII. 29.) on the regulations of the technical investigation of aviation accidents, incidents and irregularities,
- In absence of other related regulation of the Kbvt., in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service.

The Kbvt. and the MET Decree 123/2005 (XII. 29.) jointly serve compliance with Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation.

The competence of the Transportation Safety Bureau of Hungary is based on Government Decree 278/2006 (XII. 23.).

Under the aforementioned regulations

- The Transportation Safety Bureau of Hungary shall investigate aviation accidents and serious aviation incidents.
- The Transportation Safety Bureau of Hungary may investigate aviation incidents and irregularities which – in its judgement – would have resulted in accidents under other circumstances.
- The technical investigation is independent of any administrative, infringement or criminal procedures initiated in connection with a transport accident or incident.
- In addition to the aforementioned laws, throughout the technical investigation ICAO Doc 9756 and Doc 6920 Manual of Aircraft Accident and Incident Investigation are applicable.
- This final report shall not be binding, nor shall an appeal be lodged against it.

No conflict of interest has arisen in connection with any member of the investigating committee. Persons participating in the technical investigation shall not act as experts in other procedures concerning the same case.

The IC shall safe keep the data having come to their knowledge in the course of the technical investigation. Furthermore the IC shall not be obliged to make the data – regarding which its owner could have refused the disclosure of the data pursuant to the relevant act – available to other authorities.

DEFINITIONS AND ABBREVIATIONS

AAIB	Air Accident Investigation Branch
ACC	Area Control Center
ACE	Aeroplex of Central Europe Ltd.
AMM	Aircraft Maintenance Manual
ATR	Aircraft Technical Report
BA	British Airways
BEA	Bureau of Enquiry and Analysis for Civil Aviation Safety / Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile
BUD/LHBP	The IATA/ICAO code of Budapest Liszt Ferenc International Airport
CAA	Civil Aviation Authority (UK)
EASA	European Aviation Safety Agency
ELAC	Elevator Aileron Computer
ELAC1 PB Switch	ELAC1 Push Button Switch
FDR	Flight Data Recorder
FL	Flight Level
GLA/EGPF	The IATA/ICAO code of Glasgow International Airport
IAS	Indicated Airspeed
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IC	Investigating Committee
Kbvt.	Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents
knot	unit of speed (1 knot = 1 nautical mile/ hour = 1,852 kilometre/hour)
kg	kilogram
LHR/EGLL	The IATA/ICAO code of London Heathrow International Airport
LT	Local Time

MEL	Minimum Equipment List
MMEL	Master Minimum Equipment List
MET	Ministry of Economy and Transport
MTOM	Maximum Take Off Mass
NTA AA	National Transport Authority Aviation Authority (Hungary)
OSL/ENGM	The IATA/ICAO code of Oslo International Airport
PFR	Post Flight Report
QNH	Query: Nautical Height (barometric pressure adjusted to sea level)
SEC	Spoiler Elevator Computer
Side Stick	joystick (small electronic control stick)
TSB	Transportation Safety Bureau of Hungary/ Közlekedésbiztonsági Szervezet
UTC	Coordinated Universal Time

SUMMARY OF THE OCCURRENCE

Occurrence category		serious incident
Aircraft	Class	fixed wing aircraft
	Manufacturer	Airbus
	Type	A320-232
	Registration mark	G-EUUE
	Operator	British Airways
Occurrence	Date and time (UTC)	22 March 2014, 20:26 hours
	Location	Budapest (BUD), Hungary

Reports and notifications

The occurrence was reported as “anticipated air traffic occurrence” to the duty service of TSB by HungaroControl Pte. Ltd. Co. on 22 March 2014, at 20:16 hours (hereinafter referred to as HC Ltd.).

Every reference to time in this report will be according to UTC (Universal Time Coordinated); winter time was in effect at the date of the event, and thus, Local Time (LT) = (UTC) + 1 hour.

The duty service of TSB

–informed the person on duty of NTA AA on 20 March 2014, at 20:20 hours.

–notified the investigating organisation of the country of the operator (AAIB), the investigating organisation of the country of the manufacturer (BEA), as well as EASA and ICAO.

Investigating Committee

On 24 March 2014, the Director-General of TSB assigned the following investigating committee (hereinafter referred to as “the IC”) to investigate the occurrence:

Investigator in Charge	Endre Szilágyi	Investigator
Member	Ferenc Kamasz	Investigator
Member	Pál Burda	On-site investigation technician

Overview of the investigation process

The on-site investigation technician of TSB took photos of the on-board documents and the aircraft after it landed.



Figure 1: The airplane with Registration mark G-EUUE in Budapest after landing

On 24 March 2014, the IC inspected the aircraft, and viewed and photographed the technical and troubleshooting documentation of the aircraft.

The IC contacted the European Aviation Safety Agency (EASA), from which the valid Airbus A318/A319/A320/A321 Master Minimum Equipment List (MMEL) document was received on 08 May 2014.

The IC contacted the British Airways airline with the assistance of the Air Accident Investigation Branch (AAIB), and the IC received from BA the data recorded by the FDR of the flight involved in the incident. Upon request from the IC, AAIB converted the FDR records to Excel-compatible format and sent it to the IC.

The IC reviewed the data from the FDR records, and made diagrams of the parameters found relevant to the occurrence.

The IC sent the Draft Report to AAIB, BEA, and EASA on 28 January 2016. The IC has received a response from each competent organisation. Those comments to the Draft Report which have not yet been integrated into the Final Report by the IC are added, with explanations, in Annexes 4 and 5.

After closing the investigation, the IC will issue a safety recommendation to the manufacturer of the Airbus relevant to the 10-day time interval relevant to the MMEL aileron servo controls.

A short summary of the occurrence

The type Airbus A320-232 aircraft with registration mark G-EUUE took off from London Heathrow International Airport (LHR/EGLL) on 22 March 2014 at 18:28:32 to perform the Flight No. BA870 for the British Airways airline.

The take off as well as the flight was in order until 19:24:32 (the aircraft was cruising at an altitude of FL370 and speed of 250 knots at that time), when the crew received “Right Aileron Fault & ELAC1 fault” messages.

In the subsequent phase of the flight, the deflection of the right aileron increased with the decrease of altitude.

At Budapest Liszt Ferenc International Airport (BUD/LHBP), the pilot in the left seat (Captain) performed the final approach segment and landing in Manual flight, and the aircraft landed normally on Runway 13L at 20:25:57, and taxied to stand No. 32 at 20:35.



Figures 2 and 3: Position of the right aileron with pressurized hydraulic systems after landing

1. FACTUAL INFORMATION

1.1 History of the flight

The type Airbus A320-232 aircraft with registration mark G-EUUE took off from London Heathrow International Airport (LHR/EGLL) on 22 March 2014 at 18:28:32 to perform the Flight No. BA870 for the British Airways airline.

The take off as well as the flight was in order until 19:24:32 (the aircraft was cruising at an altitude of FL370 and speed of 250 knots according to the instrument at that time), when the crew received "Right Aileron Fault & ELAC1 fault" messages, however, the "Fault" light on the "ELAC1 PB Switch" was not illuminate.

As observed by the pilots, the right aileron deflected upward by half of the scale on the display. The autopilot remained ON, but the trim deflected to position 3 to 6, so that the aircraft should maintain its horizontal linear motion.

The flight crew reported technical fault to Bratislava ACC due to the fault of the right aileron; however, they did not report Mayday, and continued the flight to the original destination (BUD/LHBP).

In a subsequent phase of the flight, the deflection of the right aileron increased with the decrease of altitude.

Data recorded by the FDR revealed that the deflection of the right aileron reached 15° (maximum possible deflection: $\pm 25^\circ$) during flight, approach, and landing.

"Anticipated air traffic occurrence" (local standby) alert was declared at Budapest Liszt Ferenc International Airport (BUD/LHBP) due to the BA870 flight arriving with a right aileron fault.

At Budapest Liszt Ferenc International Airport (BUD/LHBP), the pilot in the left seat (Captain) performed the final approach segment and landing in Manual flight, and the aircraft landed normally on Runway 13L at 20:25:57. Then, escorted by fire fighting vehicles on standby, the airplane taxied to Stand No. 32 at 20:35. No intervention by the fire service was needed.

The emergency was terminated at 20:36. The ICAO Rescue Fire Fighting (RFF) Category was 9 for both runways at the airport.

1.2 Personal injuries

Injuries	Crew		Passengers	Other people
	Flight	Cabin		
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	2	5	137	

1.3 Damage to aircraft

There was no damage to the affected aircraft in relation to the event.

1.4 Other damage

The IC received no information on other damage during the period of the technical investigation.

1.5 Crew information

1.5.1 Data of the Pilot in Command

The IC makes no finding about the aircraft captain's activity during the event therefore it needs not be discussed in detail.

1.5.2 Data of the Copilot

The IC makes no finding about the copilot's activity during the event therefore it needs not be discussed in detail.

1.5.3 Data of the Air Traffic Controller

The IC makes no finding about the air traffic controller's activity during the event therefore it needs not be discussed in detail.

1.5.4 Data of the technical staff

The IC makes no finding about the certifying staff activity previous to the event therefore it needs not be discussed in detail.

1.6 Aircraft data

1.6.1. General

Class	fixed wing aircraft
Manufacturer	Airbus
Type/subtype (type number)	Airbus A320-232
Date of manufacturing	2002
Serial number	1782
Registration mark	G-EUUE
State of registry	United Kingdom
Owner	British Airways Plc.
Operator	British Airways
Airline	British Airways
Call sign during the affected flight	BA870
Maximum Take Off Mass (MTOM)	73 500kg

1.6.2. Airworthiness

Airworthiness Review Certificate	Reference No.	G-EUUE/UK.MG.0037/21052014
	Expiry	29 May 2015
	Limitations	None

The aircraft had a valid certificate of airworthiness (EASA Form 25) and airworthiness review certificate (EASA Form 15) at the time of the event.

The aircraft showed the following malfunctions during the days previous to the incident:

- on 19 March 2014, en route GLA/EGPF-LHR/EGLL (ATR Log, page AJ690781): “ELAC2 fault & Aileron servo fault”,
 - on 21 March 2014, en route LHR/EGLL-OSL/ENGM (ATR, page AJ690793): “ELAC2 fault & Aileron servo fault”,
 - on 21 March 2014, en route OSL/ENGM-LHR/EGLL (ATR, page AJ690794): “ELAC2 fault & Aileron servo fault”.
- Then, on 21 March 2014, the mechanics staff deactivated the right aileron blue hydraulics system’s servocontrol for an interval of 10 calendar days, in accordance with Section 27-14-04A of the MEL.

1.6.3. Aircraft engine data (type 2x IAE V2527-A5 engine)

The aircraft engines had no effect on the course of events, and thus require no detailed analysis.

1.6.4. Propeller data

The affected engines have no propellers.

1.6.5 Loading data

During the investigation, the IC found no sign of any effect of the mass or position of the gravity centre of the aircraft on the occurrence, and thus these parameters require no detailed analysis.

1.6.6 Description of the defective system

Figure 4 shows a schematic diagram of the roll control channel of the Airbus A320 family aircraft.

The roll (turning around the longitudinal axis) of the aircraft can be controlled using 1 aileron and 4 spoilers (No. 2, 3, 4, and 5) for each wing.

The ailerons can be deflected by max. $\pm 25^\circ$ using the Side Stick (manual flight) or under control of the autopilot (automatic flight).

Each aileron can be actuated by two servocontrols independent of each other. During normal operation, 1 servocontrol works in active mode for each aileron, while the other works in damping mode.

The servocontrols are controlled by two independent computers (ELAC1 and ELAC2).

When the ELAC1 computer is active the left aileron is operated by the blue servocontrol, and the right aileron is operated by the green servocontrol.

When the ELAC2 computer is active the left aileron is operated by the green servocontrol, and the right aileron is operated by the blue servocontrol.

In the case of any single part failure, the control of the ailerons is automatically transferred to the other servocontrol.

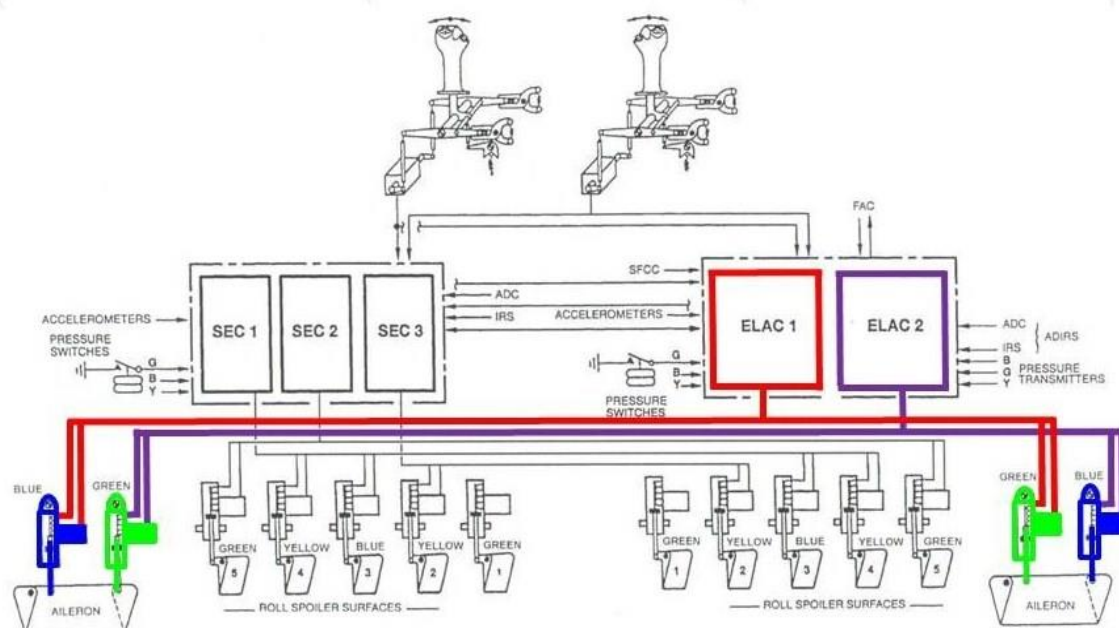


Figure 4: Schematic diagram of the operation of the roll control channel of the A320 aircraft
(source: Maintenance Training Manual of the A320 family)

On 21 March 2014, previous to this event, the right aileron blue servocontrol was deactivated in accordance with Section 27-14-04A of the MEL.

In this event, the roll control channel of the ELAC1 computer malfunctioned during the flight, and as a result, the left aileron blue servocontrol and the right aileron green servocontrol also became inoperative.

The mechanics staff of ACE performed troubleshooting and repair works on the aircraft after this event, during which both the ELAC1 computer and the left (Cpt) Side Stick were replaced.

Following the repairs, the aircraft was released to service, with a hold item in accordance with Section 27-14-04A of the MEL.

1.6.7 Onboard warning systems

The warning systems had no effect on the course of the event therefore they need not be discussed in detail.

1.7 Meteorological data

The weather conditions had no effect on the course of the event therefore they need not be discussed in detail.

1.8 Aids to navigation

The aids to navigation had no effect on the course of the event therefore they need not be discussed in detail.

1.9 Communication

Communication had no effect on the course of the event therefore it need not be discussed in detail.

1.10 Airport information

The aircraft took off from London Heathrow International Airport (LHR/EGLL) at 18:28:32 on 22 March 2014.

The scheduled destination was Budapest Liszt Ferenc International Airport (BUD/LHBP).

Actual landing at the scheduled destination airport (on Runway 13L) took place normally at 20:25:57, and then the airplane taxied to Stand No.32 at 20:35.

The parameters of the departure and destination airports had no effect on the event, therefore such information requires no detailed analysis.

1.11 Flight recorders

The required onboard flight data recorder (FDR) was operative at the time of the event, and the recorded data was evaluable.

Figure 5 shows the position of the right and left ailerons depends on altitude and speed of the aircraft, during the complete period of the flight.

According to FDR data, take off was performed at 18:28:32, and landing at 20:25:57.

According to the FDR channel „ELAC1 fault”, the ELAC1 computer was operative throughout the complete period of the flight.

The ELAC1 roll and pitch channels of the FDR failed at 19:24:32, and the green hydraulic system of the right aileron and the blue hydraulic system of the left aileron became inoperative also at that time.

The deflection of the right aileron by 8.8° upward took place at the same moment in time and this aileron remained in deflected position for the rest of the flight, and with decrease of the altitude the deflection of the right aileron further increased to 15.9°.

According to data from the FDR, the roll channel and the pitch channel of the Flight Control operated in “Normal Law” mode, during the complete period of the flight.

The Post Flight Report (PFR) showed the following fault message: “ELAC1 OR INPUT OF CAPT ROLL CTL SSTU 4CE1”.

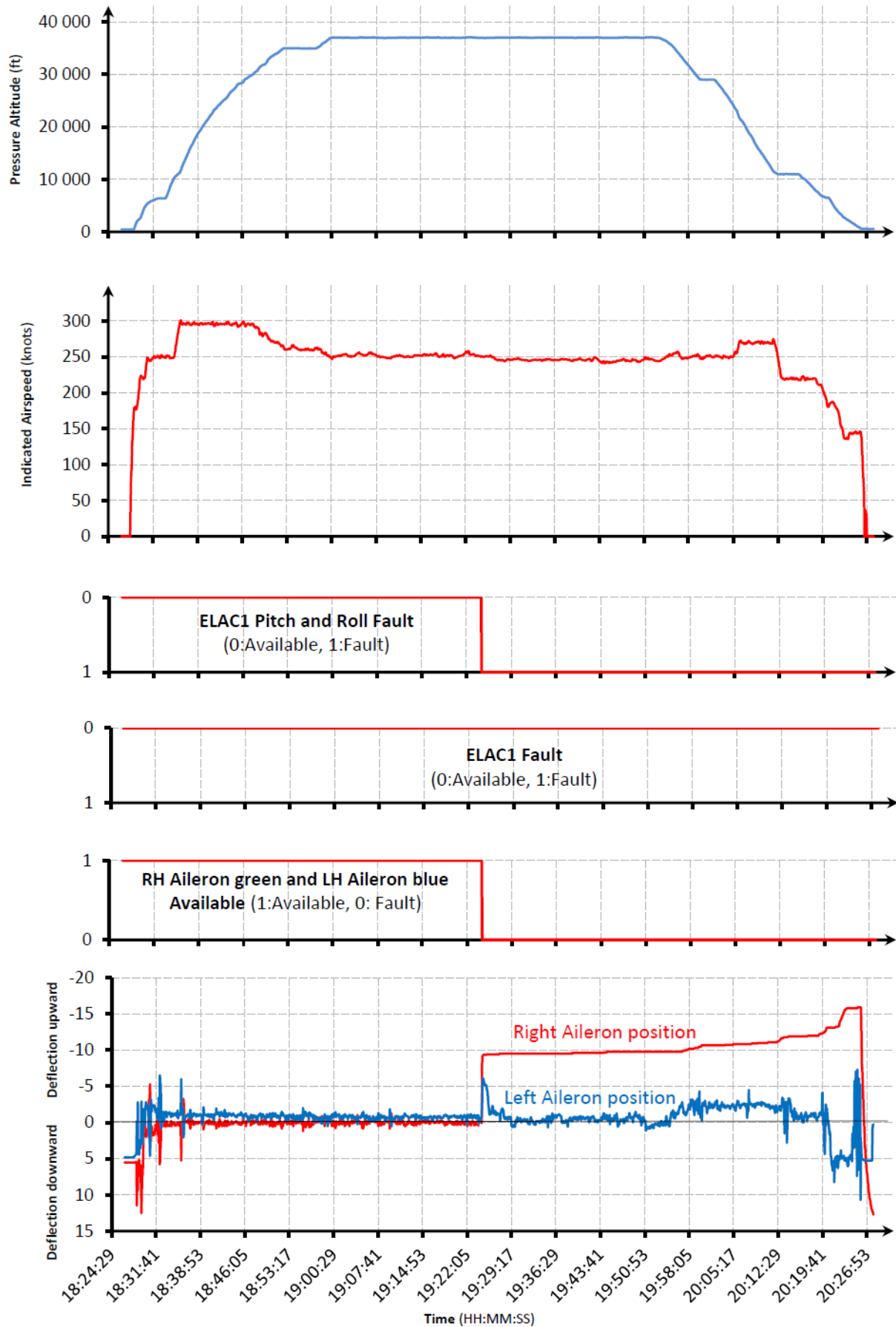


Figure 5: Changes in the parameters during the complete flight based on the FDR readout

The time of landing may be determined on the basis of FDR data, namely the speed of the main landing gear wheels. For the sake of clarity, Figure 6 only shows the speed of the wheel No. 4 of the main landing gear, but the speed of the wheels No. 1, 2, and 3 are nearly equal with it. According to data, landing took place at 20:25:57.

After landing, with the decrease of speed, the deflection of the right aileron decreased, and then it deflected downward, reaching a value as high as 13°.

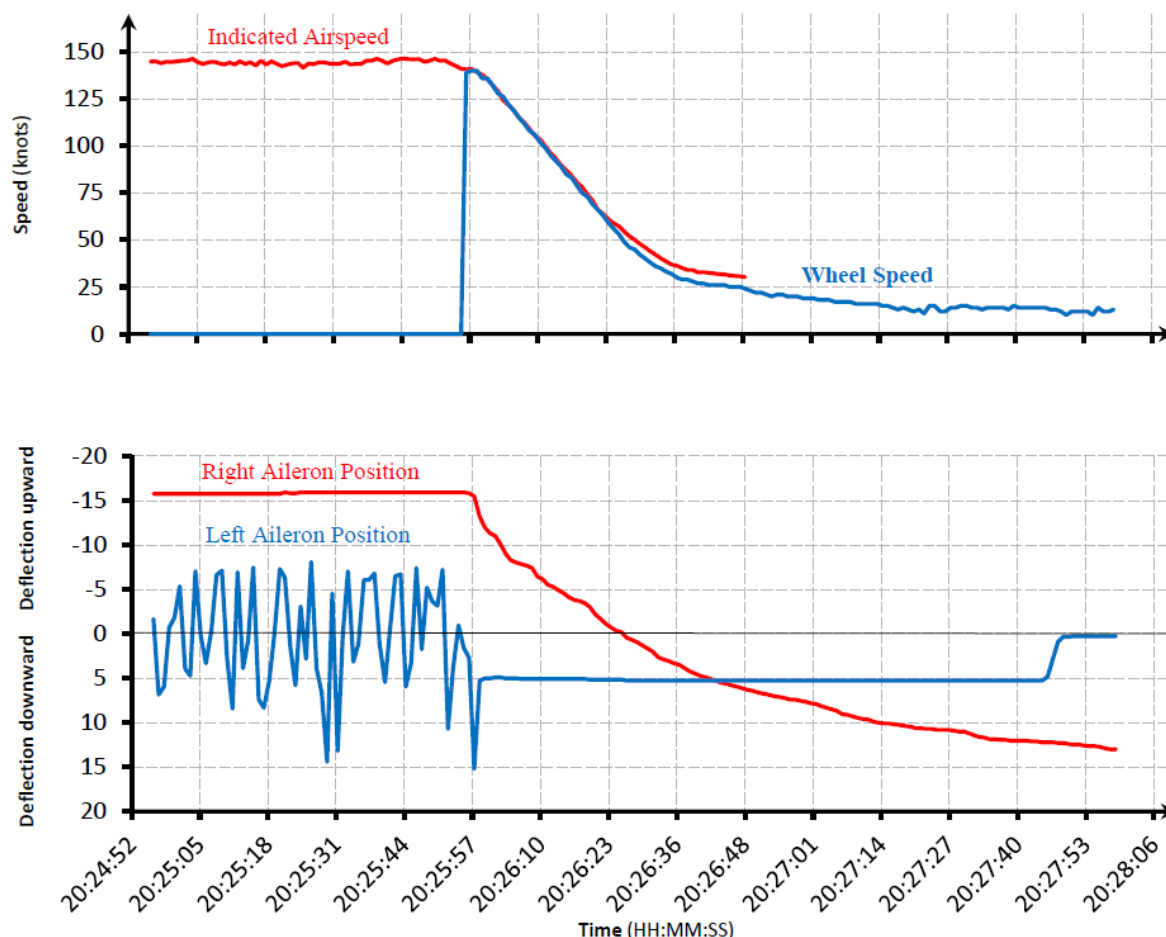


Figure 6: Changes in the parameters in the last 3 minutes of the flight based on the FDR readout

1.12 Wreckage and impact information

The incident generated no wreckage.

1.13 Data of the medical investigations

The IC found it unnecessary to initiate medical investigation in relation to the incident.

1.14 Fire

There was no fire in relation to this event.

1.15 Chances of survival

Nobody was injured in relation to this event.

1.16 Tests and research

Tests or research were not performed or initiated by the IC.

1.17 Organisational and management information

The parameters of the competent organizations had no effect on the event therefore they need not be discussed in detail.

1.18 Additional information

The role of MEL prior to the beginning of the flights:

The Minimum Equipment List (MEL) lists those items of equipment, parts and components the malfunction of which does not render the aircraft unserviceable, i.e. in the case of malfunction of such items, the aircraft may commence a flight task.

The approval process of the modification of the MEL

1. At certain intervals, (the operator determines the MMEL revision cycle on the Page HOW P4/24 of MMEL), on the basis of operation experiences with the A320 aircraft family and flight safety aspects, the aircraft manufacturer (Airbus) revises the Master Minimum Equipment List (MMEL) relevant to the aircraft types A318/A319/A320/A321, and where necessary it limits or extends the number of items of equipment and devices listed, and specifies an interval of time for each item until which it may be inoperative on airworthy aircraft.
2. The authority supervising the aircraft manufacturer (EASA) approves the revised A318/A319/A320/A321 MMEL document according to its own procedure of approval.
3. Within 90 days of the approval of the revised MMEL, the operator of the aircraft (British Airways) prepares the modified A320 MEL document on the basis of the A318/A319/A320/A321 MMEL and taking into account the configurations and operation circumstances of the airplanes it operates.
4. The aviation authority supervising the operator of the aircraft (CAA) approves the modified A320 MEL document according to its own procedure of approval.
5. The operator of the aircraft (BA) updates the approved A320 MEL modifications in the onboard MEL copies (according to its own procedure) of the airplanes it operates.

Determining the repair interval category C in the MEL

Items in the category C shall be rectified within ten (10) consecutive calendar days, excluding the day of discovery.

(For example, if it is recorded at 13:00 on 26 of January, then the 10-day interval begins at 00:01 on 27 of January, and ends at 23:59 on 05 February.)

1.19 Useful or effective investigation techniques

The investigation did not require techniques differing from the standard procedures.

2. ANALYSIS

The type Airbus A320-232 aircraft with registration mark G-EUUE took off from London Heathrow International Airport (LHR/EGLL) on 22 March 2014 at 18:28:32.

At 19:24:32, when the airplane was cruising at an altitude of 36 950 ft and speed of 250 knots, the crew perceived the indication “Right Aileron Fault & ELAC1 fault”, but the “Fault” light on the “ELAC1 PB Switch” was not illuminate. Figure 7 shows the position of the pushbutton switch.

The evaluated flight data (recorded by the FDR) fully confirm the pilots’ reports; Figures 5 and 6 show the diagrams made by the IC from the data regarded relevant to the event according to the IC. Based on FDR data, the IC established that, at 19:24:32, malfunction occurred in roll control channel and pitch control channel of the ELAC1, and the green hydraulic system of the right aileron, as well as the blue hydraulic system of the left aileron had been unavailable (coded FDR data: Fault) from the same moment in time; however, according to data from the “ELAC1 Fault” channel, the ELAC1 computer was available (coded FDR data: Available) throughout the complete period of flight, and that was the reason why the fault signal on the ELAC1 pushbutton switch did not illuminate.

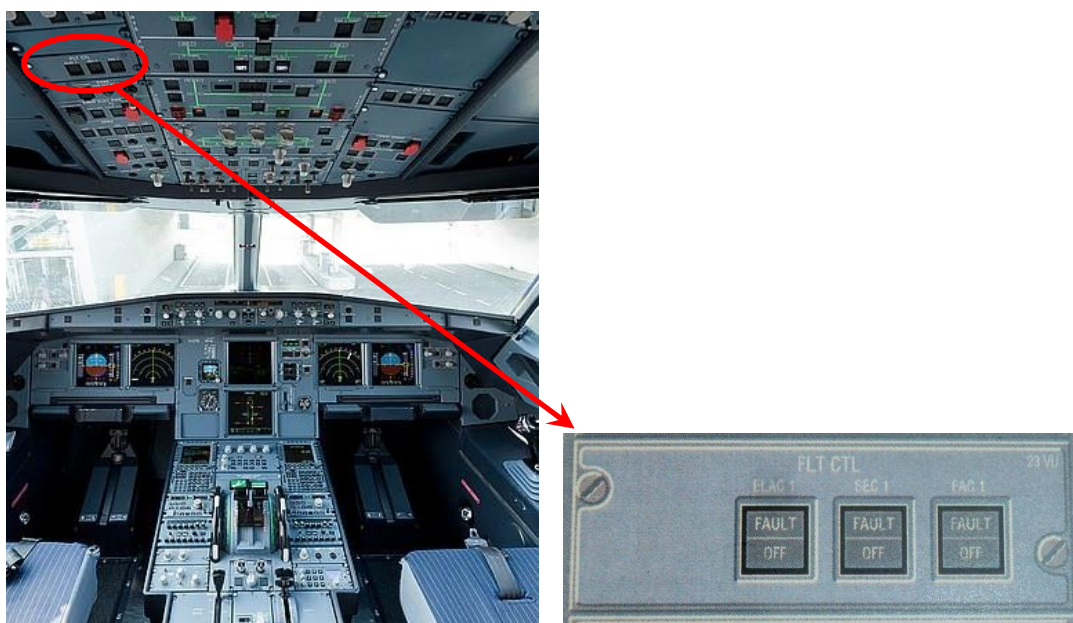


Figure 7: Position of the ELAC1 pushbutton switch on the Overhead Panel (illustration)

At that time, the right aileron deflected upward halfway the scale on the display, as observed by the pilots. The autopilot remained ON, the trim deflected to positions 3 to 6, thus ensuring that the aircraft could continue its horizontal motion in a straight line.

In the subsequent phase of the flight, the deflection of the right aileron increased with the decrease of altitude.

According to FDR data, at that time the right aileron deflected upward by 8.8°, and remained in that position for the rest of the flight, except that its deflection even increased further, up to 15.9°, (maximum possible deflection: $\pm 25^\circ$) with the decrease of altitude.

The time of landing may be determined on the basis of FDR data, namely the speed of the main landing gear wheels. For the sake of clarity, Figure 6 only shows the speed of the wheel No. 4 of the main landing gear, but the speed values of the other 3 wheels are nearly equal with it. According to data, landing took place at 20:25:57.

After landing, with the decrease of speed, the deflection of the right aileron decreased, and then it deflected downward, reaching a value as high as 13° (Figure 6).

On the basis of the movement of the right aileron after landing, the IC concluded that, after the malfunction of the ELAC1, the right aileron was not operated by the hydraulic system but it was moved by the aerodynamic force acting upward.

With the decrease of altitude, and without change of the speed of flight, this aerodynamic force increased further, which then increased further the deflection of the aileron to 15.9°.

The speed of the aircraft continuously decreased after landing, and the aerodynamic force on the aileron also decreased due to decrease of the airspeed, and thus, at 20:26:25, the aerodynamic force also decreased to the value corresponding to the force of the weight of the aileron, and accordingly, the aileron moved to neutral position. Due to further decrease in the speed of the aircraft, the aerodynamic force on the aileron also decreased further, and thus the force of the weight of the aileron was already able to deflect the aileron downward, reaching a deflection value as high as 13°.

The certifying staff of ACE performed troubleshooting and repair works on the aircraft after the event, replaced the ELAC1 computer, and then performed operational test of the Flight Control system in accordance with AMM 27-93-00, which showed that the system remained inoperative, with "ELAC1 pitch fault" message.

Then the certifying staff of ACE replaced the ELAC1 computer again, and also replaced the Side Stick at the captain's side in accordance with AMM 22-97-00-710-001-A and AMM 27-92-41-710-001-A. Following the repairs, the operational test was OK, the aircraft was released to service.

The Post Flight Report (PFR) showed the following fault message: "ELAC1 OR INPUT OF CAPT ROLL CTL SSTU 4CE1". It cannot clearly be decided on the basis of this message either which of the two defects was the real cause of the fault.

In the opinion of the IC, the possible fault of the left (Cpt.) Side Stick may have been a contributing factor or cause the malfunction of the ELAC1 computer, but the IC think that the two defects may also have occurred independently of each other.

Previous to this flight, ELAC 2 fault and aileron servocontrol fault occurred on the aircraft with registration mark G-EUUE en route GLA/EGPF-LHR/EGLL on 19 March 2014, and en route LHR/EGLL-OSL/ENGM and OSL/ENGM-LHR/EGLL, after which the certifying staff deactivated the right aileron blue servocontrol for an interval of 10 calendar days, in accordance with Section 27-14-04A of the MEL, on 21 March 2014.

The IC reviewed the CAA-approved MEL copy available onboard, and found that the said servocontrol deactivation had been performed in compliance with MEL 27-14-04A.

On 08 May 2014, the IC received from EASA the Airbus A318/A319/ A320/A321 MMEL document, with the acceptance date 04 February 2014. (The approved onboard copy of the MEL was made on the basis of the previous revision of the

MMEL, because the operator has 90 days after the approval of the modified MMEL to prepare the modified MEL copy and obtain approval of it from the competent authority.)

The IC reviewed the MMEL document approved on 04 February 2014 and found that, according to Section 27-14-04 of the MMEL, the actuator of the right aileron blue servocontrol may be inoperative for 10 days. On the basis of Sections 27-14-01 to 27-14-04 of the MMEL (Annexes 2 and 3), the same interval of time applies to the blue and green servocontrols of the right and left ailerons.

According to information available to the IC, the type Airbus A320 aeroplanes operated by national airlines perform 6 flights per day on average, while those operated by discount airlines perform 8 flights per day on average.

This implies 60 to 80 flights for a 10-day period which the airplanes may perform continuously with only one operative servocontrol on one or both ailerons. (The left aileron green servocontrol (according to MMEL 27-14-02) and the right aileron blue servocontrol (according to MMEL 27-14-04) may be inoperative concurrently for an interval of 10 days.)

With regard to the fact that the incident occurred due to malfunction of the flight control system, which is one of the most critical systems from the aspect of flight safety (especially in the case of fly-by-wire type aircraft) the IC proposes a safety recommendation to the manufacturer relevant to the 10-day interval of the aileron servocontrol chapters of the MMEL.

3. CONCLUSIONS

3.1 Factual findings

At the time of the event, the flight crew had the required certificates, authorizations and ratings as well as necessary experience for the actual flight. The flight was performed in accordance with the relevant regulations in effect.

The aircraft was suitable for the flight, and it had a valid certificate of airworthiness and airworthiness review certificate. According to its documentation, the aircraft had been equipped and maintained in compliance with the effective regulations and accepted procedures.

The mass and balance of the aircraft, was within the specified limits. The aircraft had fuel of appropriate quantity and quality on board for the flight.

The flight took place according to the flight plan, in good visibility conditions (night-time conditions).

No objection was raised about the air traffic controllers, the parameters of the airport or the activity of the ground handling staff, so these factors cannot be related to the event.

3.2 Causes of the event

During the technical investigation, the IC concluded that the following provable causes had led to the event:

- On 21 March 2014, previous to the flight, the right aileron blue servo control was deactivated on the airplane in accordance with Section 27-14-04A of the MEL.
- In according to FDR data the roll and pitch control channels of the ELAC1 computer malfunctioned during the flight.

In addition to those above, the IC supposes the following probable cause:

- possible fault of the left (Captain) Side Stick may have been a contributing factor to or cause of the malfunction of the ELAC1 (and earlier the ELAC2) computer.

4. SAFETY RECOMMENDATION

4.1 Action taken by the operators/ authorities during the investigation

The IC has no information on any specific action taken by the operator or the competent authority in connexion with the event.

4.2 Safety recommendation issued during the investigation

The TSB issued no safety recommendation during the investigation.

4.3 Safety recommendation issued after the investigation

Transportation Safety Bureau of Hungary (KBSZ) issues the following safety recommendation as conclusion of the investigation:

BA2014-093-4P-1:

The Investigating Committee of TSB of Hungary concluded during the investigation that the causes of the right aileron fault which then caused the incident were as follows:

- *previous to the examined flight, the right aileron blue servocontrol was deactivated according to Section 27-14-04A of the MEL.*
- *The ELAC1 computer, which was responsible for the operation of the ailerons, malfunctioned during the flight.*

Depending on the type of operation, the airplanes in the Airbus A320 family perform 6 to 8 flights per day on average (i.e. 60 to 80 flights within a 10-day interval), and, according to relevant sections of the MEL, the operability of only one servocontrol is required on any or both of the ailerons. (The left aileron green servocontrol (according to MMEL 27-14-02) and the right aileron blue servocontrol (according to MMEL 27-14-04) may be inoperative concurrently for an interval of 10 days.)

The Transportation Safety Bureau of Hungary recommends Airbus Industrie to revise and, if possible reduce, the 10-day interval relevant to unserviceable aileron servocontrols listed in pages MMEL27-14-01 to MMEL27-14-04 in the Airbus A318/A319/A320/A321 Master Minimum Equipment List document.

The Investigating Committee considers that in the case of accepting and implementing the above recommendation, the number of those flights within the Airbus A320 family of aircraft may be reduced significantly where the fly-by-wire type Flight Control system operates in single-channel mode. This would reduce the risk of an aileron fault caused by a computer (ELAC1 or ELAC2) fault alone.

Budapest, 16 June 2016.



Endre Szilágyi
Investigator in Charge



Ferenc Kamasz
Member of IC



Pál Burda
Member of IC

NOTE:

This document is the translation of the Hungarian version of the Final Report. Although efforts have been made to translate it as accurately as possible, discrepancies may occur. In this case, the Hungarian is the authentic, official version.

APPENDICES:

Annex 1: MMEL How to Use (1/24, 4/24)


Annex 2: MMEL 00-05 Repair Interval (1/2)

Annex 3: MMEL 27-14 Aileron and Hydraulic Actuation (1/8-8/8)

Annex 4: Comments shared by BEA/AIRBUS

Annex 5: Comment by EASA

ANNEX 1:

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	HOW TO USE
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FOREWORD

Ident.: HOW-00012802.0001001 / 29 JUN 11

Applicable to: ALL

This Master Minimum Equipment List (MMEL) is a reference manual published in English. It is approved by the European Aviation Safety Agency (EASA). This MMEL must be used as a reference by the Operator to develop its MEL.

This MMEL takes into account the specific configuration of each aircraft of the Operator's fleet. The aircraft validity is managed at Documentary Unit (DU) level. *Refer to HOW Documentary Unit (DU)*

This MMEL is produced in XML format and can be published in PDF format and in electronic format for electronic consultation on EFB.

Airbus also proposes a set of tools to create and publish the Operator's MEL based on this MMEL.

QUESTIONS AND SUGGESTIONS

Ident.: HOW-00012803.0001001 / 26 NOV 13

Applicable to: ALL

For any questions or comments related to this manual, the Operator's Flight Operations Management may contact the Airbus Flight Operations & Training support department.

MMEL CONTENTS


Ident.: HOW-00012804.0001001 / 29 JUN 11

Applicable to: ALL

This MMEL has four sections:

- How to Use (HOW): This section contains general information and describes the organization of the manual.
- MMEL Entries (ME): This section lists all the ECAM alerts and indicates the associated MMEL item (if any) to apply for dispatching the aircraft. This section is a user-friendly entry point for the flight crew and the maintenance personnel when an ECAM alert reports a system failure.
- MMEL Items (MI) : This section is approved by the EASA and lists all the MMEL items with the associated dispatch conditions.
- MMEL Operational : This section gives the operational procedures that are associated with the Procedures (MO) MMEL items.

Note: The MMEL Maintenance Procedures are published in the AMM.

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	HOW TO USE
MMEL REVISION MANAGEMENT	
Ident.: HOW-00012807.0001001 / 29 JUN 11 Applicable to: ALL	

MMEL REVISION CYCLE

The MMEL revision adds, updates, or deletes information. The Operator determines the revision cycle. For urgent update, Airbus issues an immediate revision regardless of the revision cycle.

MMEL ISSUE DATE

An issue date identifies each MMEL revision.

The issue date appears:

- In the Transmittal Letter for the PDF format, and
- In the LIBRARY panel of the OPS LIBRARY Browser for the electronic consultation.

***Note:** The issue date is different from the EASA approval date. The EASA approval date appears in the MMEL Approval Reference of the MMEL Preamble. The applicability date of this MMEL is based on the issue date and not on the EASA approval date (Refer to MI-00-01 MMEL Approval Reference).*

MMEL REVISION CONTENTS

Each MMEL revision contains the following information that is useful to update the MMEL and to identify the changes that the revision has inserted:

- The Transmittal Letter (in PDF format only),
- The List of Effective Sections/Subsections (LESS) (in PDF format only),
- The Filling Instructions (in PDF format only),
- The List of Effective Documentary Units (LEDU),
- The Summary of Highlights (SOH).

Each MMEL revision also contains:

- An Aircraft Allocation Table (AAT),
- A List of Modifications (LOM).


When there is a change within a DU, the MMEL revision updates the whole subsection that contains the DU.

TRANSMITTAL LETTER

The Transmittal Letter is a way of communication between Airbus and the Operators. The Transmittal Letter also specifies the issue date of the MMEL revision.

The Transmittal Letter only exists in the PDF format.

ANNEX 2:

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 00 - PREAMBLE 00-05 - Repair Interval
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REPAIR INTERVAL

Ident.: MI-00-05-00012620.0001001 / 15 SEP 10

Applicable to: ALL

Inoperative items, deferred in accordance with the MEL, must be rectified at or before the expiration of the repair interval that is established by the following letter designators given in the "Repair Interval" column.

- | | |
|-------------------|---|
| Repair Interval A | : No standard interval is specified, however, items in this category shall be rectified in accordance with the dispatch conditions stated in the MEL.
Where a time period is specified in calendar days, it shall start at 00:01 on the calendar day following the day of discovery.
Where a time period is specified in number of flights or flight hours, it shall start at the beginning of the first flight following the discovery of the failure. |
| Repair Interval B | : Items in this category shall be rectified within three (3) consecutive calendar days, excluding the day of discovery.
For example, if it were recorded at 13:00 on January 26th, the 3-day interval begins at 00:01 on January 27th and ends at 23:59 on January 29th. |
| Repair Interval C | : Items in this category shall be rectified within ten (10) consecutive calendar days, excluding the day of discovery.
For example, if it were recorded at 13:00 on January 26th, the 10-day interval begins at 00:01 on January 27th and ends at 23:59 on February 5th. |
| Repair Interval D | : Items in this category shall be rectified within one hundred and twenty (120) consecutive calendar days, excluding the day of discovery. |

ENV A318/A319/A320/A321 FLEET

MMEL

A

MI-00-05 P 1/2

27 NOV 13

ANNEX 3:

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
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27-14-01	Left Aileron Blue Servo-Control (Controlled by ELAC 1)
-----------------	---

Ident.: MI-27-14-00008312.0001001 / 22 MAR 10

¹ Applicable to: MSN 0029-0051, 0057-0059, 0069-0072, 0074-0075, 0078-0080, 0083, 0085-0096, 0104-0111, 0113-0114, 0116-0117, 0135-0137, 0140, 0142-0147, 0149-0150, 0157-0158, 0161-0162, 0165-0166, 0172-0173, 0176-0178, 0181-0182, 0185-0190, 0194-0195, 0198-0202, 0207, 0209, 0211, 0216-0218, 0223-0229, 0231, 0234-0235, 0240-0249, 0252-0256, 0259-0261, 0264-0269, 0274-0277, 0279, 0284, 0289-0292, 0295-0296, 0302-0303, 0308-0316, 0320-0325, 0330-0333, 0341-0347, 0350-0354, 0356-0357, 0359, 0361, 0366, 0368, 0371, 0373-0378, 0382, 0384, 0386, 0393-0398, 0401, 0403-0407, 0409, 0414-0416, 0419, 0421-0423, 0426-0428, 0430-0432, 0435-0439, 0441-0443, 0445-0447, 0450-0454, 0456-0457, 0459-0466, 0469-0470, 0472, 0475, 0479-0480, 0483, 0485-0487, 0489-0490, 0492, 0496-0497, 0499-0500, 0503-0504, 0506, 0508, 0510, 0512, 0523, 0525, 0528, 0537, 0539, 0542, 0568-0569, 0571, 0579, 0587, 0589, 0592, 0594, 0605, 0607, 0611, 0613, 0617, 0619, 0622, 0630, 0638, 0640, 0645, 0648, 0650, 0653, 0655, 0657, 0662, 0676, 0678, 0683, 0702, 0706-0707, 0714, 0724, 0726

27-14-01A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No


(o) (m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) The left aileron green servo-control (controlled by ELAC 2) is operative, and
- 4) The right aileron blue servo-control (controlled by ELAC 2) is operative, and
- 5) All roll spoilers are operative, and
- 6) The TR 1 and TR 2 are operative, and
- 7) The DC TIE contactor 1PC1 is checked closed, and
- 8) The Normal LAF law is considered inoperative.

Refer to Item 27-64-06 Load Alleviation Function (LAF)

Reference(s)

(o) *Refer to OpsProc 27-14-01A Left Aileron Blue Servo-Control (Controlled by ELAC 1)*(m) *Refer to AMM 27-14-00-040-001*

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
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27-14-01	Left Aileron Blue Servo-Control (Controlled by ELAC 1)
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Ident.: MI-27-14-00008312.0002001 / 22 MAR 10

² Applicable to: MSN 0052-0056, 0061-0068, 0073, 0076-0077, 0081-0082, 0084, 0099, 0112, 0115, 0118-0127, 0138, 0141, 0148, 0152-0155, 0159-0160, 0164, 0167-0171, 0174-0175, 0179, 0183, 0192, 0197, 0203-0206, 0208, 0210, 0212-0214, 0220, 0230, 0232-0233, 0237-0239, 0250, 0258, 0262-0263, 0270-0273, 0278, 0281-0282, 0285-0287, 0293, 0297-0301, 0306-0307, 0317-0319, 0328-0329, 0334-0340, 0349, 0355, 0358, 0360, 0362-0364, 0367, 0370, 0372, 0380-0381, 0383, 0385, 0387-0390, 0399-0400, 0402, 0408, 0410-0413, 0417-0418, 0420, 0424, 0429, 0434, 0440, 0444, 0448-0449, 0455, 0458, 0468, 0471, 0473-0474, 0476-0477, 0482, 0484, 0488, 0491, 0493-0495, 0498, 0501-0502, 0505, 0507, 0509, 0511, 0513-0522, 0524, 0526-0527, 0529-0535, 0538, 0540-0541, 0543-0567, 0570, 0572-0578, 0580-0586, 0588, 0591, 0593, 0595-0604, 0606, 0608-0610, 0612, 0614-0616, 0618, 0620-0621, 0623-0629, 0631-0637, 0639, 0641-0644, 0646-0647, 0649, 0651-0652, 0654, 0656, 0658-0661, 0663-0675, 0677, 0679-0682, 0684-0701, 0703-0705, 0709-0713, 0715-0723, 0725, 0727-9780

27-14-01A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No

(o) (m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) The left aileron green servo-control (controlled by ELAC 2) is operative, and
- 4) The right aileron blue servo-control (controlled by ELAC 2) is operative, and
- 5) All roll spoilers are operative, and
- 6) The TR 1 and TR 2 are operative, and
- 7) The DC TIE contactor 1PC1 is checked closed.

_____ Reference(s) _____

(o) Refer to OpsProc 27-14-01A Left Aileron Blue Servo-Control (Controlled by ELAC 1)

(m) Refer to AMM 27-14-00-040-001



A318/A319/A320/A321
MASTER MINIMUM
EQUIPMENT LIST

MMEL ITEMS

27 - FLIGHT CONTROLS

27-14 - Aileron and Hydraulic Actuation

27-14-02

Left Aileron Green Servo-Control (Controlled by ELAC 2)

Ident.: MI-27-14-00008314.0001001 / 22 MAR 10

³ Applicable to: MSN 0029-0051, 0057-0059, 0069-0072, 0074-0075, 0078-0080, 0083, 0085-0096, 0104-0111, 0113-0114, 0116-0117, 0135-0137, 0140, 0142-0147, 0149-0150, 0157-0158, 0161-0162, 0165-0166, 0172-0173, 0176-0178, 0181-0182, 0185-0190, 0194-0195, 0198-0202, 0207, 0209, 0211, 0216-0218, 0223-0229, 0231, 0234-0235, 0240-0249, 0252-0256, 0259-0261, 0264-0269, 0274-0277, 0279, 0284, 0289-0292, 0295-0296, 0302-0303, 0308-0316, 0320-0325, 0330-0333, 0341-0347, 0350-0354, 0356-0357, 0359, 0361, 0366, 0368, 0371, 0373-0378, 0382, 0384, 0386, 0393-0398, 0401, 0403-0407, 0409, 0414-0416, 0419, 0421-0423, 0426-0428, 0430-0432, 0435-0439, 0441-0443, 0445-0447, 0450-0454, 0456-0457, 0459-0466, 0469-0470, 0472, 0475, 0479-0480, 0483, 0485-0487, 0489-0490, 0492, 0496-0497, 0499-0500, 0503-0504, 0506, 0508, 0510, 0512, 0523, 0525, 0528, 0537, 0539, 0542, 0568-0569, 0571, 0579, 0587, 0589, 0592, 0594, 0605, 0607, 0611, 0613, 0617, 0619, 0622, 0630, 0638, 0640, 0645, 0648, 0650, 0653, 0655, 0657, 0662, 0676, 0678, 0683, 0702, 0706-0707, 0714, 0724, 0726

27-14-02A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No


(m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) All roll spoilers are operative, and
- 4) The Normal LAF law is considered inoperative.

Refer to Item 27-64-06 Load Alleviation Function (LAF)

Reference(s)

(m) *Refer to AMM 27-14-00-040-001*

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	M MEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
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27-14-02	Left Aileron Green Servo-Control (Controlled by ELAC 2)
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Ident.: MI-27-14-00008314.0002001 / 22 MAR 10

⁴ Applicable to: MSN 0052-0056, 0061-0068, 0073, 0076-0077, 0081-0082, 0084, 0099, 0112, 0115, 0118-0127, 0138, 0141, 0148, 0152-0155, 0159-0160, 0164, 0167-0171, 0174-0175, 0179, 0183, 0192, 0197, 0203-0206, 0208, 0210, 0212-0214, 0220, 0230, 0232-0233, 0237-0239, 0250, 0258, 0262-0263, 0270-0273, 0278, 0281-0282, 0285-0287, 0293, 0297-0301, 0306-0307, 0317-0319, 0328-0329, 0334-0340, 0349, 0355, 0358, 0360, 0362-0364, 0367, 0370, 0372, 0380-0381, 0383, 0385, 0387-0390, 0399-0400, 0402, 0408, 0410-0413, 0417-0418, 0420, 0424, 0429, 0434, 0440, 0444, 0448-0449, 0455, 0458, 0468, 0471, 0473-0474, 0476-0477, 0482, 0484, 0488, 0491, 0493-0495, 0498, 0501-0502, 0505, 0507, 0509, 0511, 0513-0522, 0524, 0526-0527, 0529-0535, 0538, 0540-0541, 0543-0567, 0570, 0572-0578, 0580-0586, 0588, 0591, 0593, 0595-0604, 0606, 0608-0610, 0612, 0614-0616, 0618, 0620-0621, 0623-0629, 0631-0637, 0639, 0641-0644, 0646-0647, 0649, 0651-0652, 0654, 0656, 0658-0661, 0663-0675, 0677, 0679-0682, 0684-0701, 0703-0705, 0709-0713, 0715-0723, 0725, 0727-0780

27-14-02A


Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No

(m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) All roll spoilers are operative.

Reference(s)

(m) Refer to AMM 27-14-00-040-001

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
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27-14-03	Right Aileron Green Servo-Control (Controlled by ELAC 1)
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Ident.: MI-27-14-00008316.0001001 / 22 MAR 10

5 Applicable to: MSN 0029-0051, 0057-0059, 0069-0072, 0074-0075, 0078-0080, 0083, 0085-0096, 0104-0111, 0113-0114, 0116-0117, 0135-0137, 0140, 0142-0147, 0149-0150, 0157-0158, 0161-0162, 0165-0166, 0172-0173, 0176-0178, 0181-0182, 0185-0190, 0194-0195, 0198-0202, 0207, 0209, 0211, 0216-0218, 0223-0229, 0231, 0234-0235, 0240-0249, 0252-0256, 0259-0261, 0264-0269, 0274-0277, 0279, 0284, 0289-0292, 0295-0296, 0302-0303, 0308-0316, 0320-0325, 0330-0333, 0341-0347, 0350-0354, 0356-0357, 0359, 0361, 0366, 0368, 0371, 0373-0378, 0382, 0384, 0386, 0393-0398, 0401, 0403-0407, 0409, 0414-0416, 0419, 0421-0423, 0426-0428, 0430-0432, 0435-0439, 0441-0443, 0445-0447, 0450-0454, 0456-0457, 0459-0466, 0469-0470, 0472, 0475, 0479-0480, 0483, 0485-0487, 0489-0490, 0492, 0496-0497, 0499-0500, 0503-0504, 0506, 0508, 0510, 0512, 0523, 0525, 0528, 0537, 0539, 0542, 0568-0569, 0571, 0579, 0587, 0589, 0592, 0594, 0605, 0607, 0611, 0613, 0617, 0619, 0622, 0630, 0638, 0640, 0645, 0648, 0650, 0653, 0655, 0657, 0662, 0676, 0678, 0683, 0702, 0706-0707, 0714, 0724, 0726

27-14-03A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No


(o) (m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) The right aileron blue servo-control (controlled by ELAC 2) is operative, and
- 4) The left aileron green servo-control (controlled by ELAC 2) is operative, and
- 5) All roll spoilers are operative, and
- 6) The TR 1 and TR 2 are operative, and
- 7) The DC TIE contactor 1PC1 is checked closed, and
- 8) The Normal LAF law is considered inoperative.

Refer to Item 27-64-06 Load Alleviation Function (LAF)

Reference(s)

(o) *Refer to OpsProc 27-14-03A Right Aileron Green Servo-Control (Controlled by ELAC 1)*(m) *Refer to AMM 27-14-00-040-001*

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
---	---

27-14-03	Right Aileron Green Servo-Control (Controlled by ELAC 1)
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Ident.: MI-27-14-00008316.0002001 / 22 MAR 10

⁶ Applicable to: MSN 0052-0056, 0061-0068, 0073, 0076-0077, 0081-0082, 0084, 0099, 0112, 0115, 0118-0127, 0138, 0141, 0148, 0152-0155, 0159-0160, 0164, 0167-0171, 0174-0175, 0179, 0183, 0192, 0197, 0203-0206, 0208, 0210, 0212-0214, 0220, 0230, 0232-0233, 0237-0239, 0250, 0258, 0262-0263, 0270-0273, 0278, 0281-0282, 0285-0287, 0293, 0297-0301, 0306-0307, 0317-0319, 0328-0329, 0334-0340, 0349, 0355, 0358, 0360, 0362-0364, 0367, 0370, 0372, 0380-0381, 0383, 0385, 0387-0390, 0399-0400, 0402, 0408, 0410-0413, 0417-0418, 0420, 0424, 0429, 0434, 0440, 0444, 0448-0449, 0455, 0458, 0468, 0471, 0473-0474, 0476-0477, 0482, 0484, 0488, 0491, 0493-0495, 0498, 0501-0502, 0505, 0507, 0509, 0511, 0513-0522, 0524, 0526-0527, 0529-0535, 0538, 0540-0541, 0543-0567, 0570, 0572-0578, 0580-0586, 0588, 0591, 0593, 0595-0604, 0606, 0608-0610, 0612, 0614-0616, 0618, 0620-0621, 0623-0629, 0631-0637, 0639, 0641-0644, 0646-0647, 0649, 0651-0652, 0654, 0656, 0658-0661, 0663-0675, 0677, 0679-0682, 0684-0701, 0703-0705, 0709-0713, 0715-0723, 0725, 0727-0780

27-14-03A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No


(o) (m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) The right aileron blue servo-control (controlled by ELAC 2) is operative, and
- 4) The left aileron green servo-control (controlled by ELAC 2) is operative, and
- 5) All roll spoilers are operative, and
- 6) The TR 1 and TR 2 are operative, and
- 7) The DC TIE contactor 1PC1 is checked closed.

Reference(s)

(o) Refer to OpsProc 27-14-03A Right Aileron Green Servo-Control (Controlled by ELAC 1)

(m) Refer to AMM 27-14-00-040-001

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
---	---

27-14-04	Right Aileron Blue Servo-Control (Controlled by ELAC 2)
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Ident.: MI-27-14-00008318.0001001 / 22 MAR 10

7 Applicable to: MSN 0029-0051, 0057-0059, 0069-0072, 0074-0075, 0078-0080, 0083, 0085-0096, 0104-0111, 0113-0114, 0116-0117, 0135-0137, 0140, 0142-0147, 0149-0150, 0157-0158, 0161-0162, 0165-0166, 0172-0173, 0176-0178, 0181-0182, 0185-0190, 0194-0195, 0198-0202, 0207, 0209, 0211, 0216-0218, 0223-0229, 0231, 0234-0235, 0240-0249, 0252-0256, 0259-0261, 0264-0269, 0274-0277, 0279, 0284, 0289-0292, 0295-0296, 0302-0303, 0308-0316, 0320-0325, 0330-0333, 0341-0347, 0350-0354, 0356-0357, 0359, 0361, 0366, 0368, 0371, 0373-0378, 0382, 0384, 0386, 0393-0398, 0401, 0403-0407, 0409, 0414-0416, 0419, 0421-0423, 0426-0428, 0430-0432, 0435-0439, 0441-0443, 0445-0447, 0450-0454, 0456-0457, 0459-0466, 0469-0470, 0472, 0475, 0479-0480, 0483, 0485-0487, 0489-0490, 0492, 0496-0497, 0499-0500, 0503-0504, 0506, 0508, 0510, 0512, 0523, 0525, 0528, 0537, 0539, 0542, 0568-0569, 0571, 0579, 0587, 0589, 0592, 0594, 0605, 0607, 0611, 0613, 0617, 0619, 0622, 0630, 0638, 0640, 0645, 0648, 0650, 0653, 0655, 0657, 0662, 0676, 0678, 0683, 0702, 0706-0707, 0714, 0724, 0726

27-14-04A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No

(m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) All roll spoilers are operative, and
- 4) The Normal LAF law is considered inoperative.

Refer to Item 27-64-06 Load Alleviation Function (LAF)

Reference(s)

(m) *Refer to AMM 27-14-00-040-001*

 A318/A319/A320/A321 MASTER MINIMUM EQUIPMENT LIST	MMEL ITEMS 27 - FLIGHT CONTROLS 27-14 - Aileron and Hydraulic Actuation
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27-14-04	Right Aileron Blue Servo-Control (Controlled by ELAC 2)
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Ident.: MI-27-14-00008318.0002001 / 22 MAR 10

⁸ Applicable to: MSN 0052-0056, 0061-0068, 0073, 0076-0077, 0081-0082, 0084, 0099, 0112, 0115, 0118-0127, 0138, 0141, 0148, 0152-0155, 0159-0160, 0164, 0167-0171, 0174-0175, 0179, 0183, 0192, 0197, 0203-0206, 0208, 0210, 0212-0214, 0220, 0230, 0232-0233, 0237-0239, 0250, 0258, 0262-0263, 0270-0273, 0278, 0281-0282, 0285-0287, 0293, 0297-0301, 0306-0307, 0317-0319, 0328-0329, 0334-0340, 0349, 0355, 0358, 0360, 0362-0364, 0367, 0370, 0372, 0380-0381, 0383, 0385, 0387-0390, 0399-0400, 0402, 0408, 0410-0413, 0417-0418, 0420, 0424, 0429, 0434, 0440, 0444, 0448-0449, 0455, 0458, 0468, 0471, 0473-0474, 0476-0477, 0482, 0484, 0488, 0491, 0493-0495, 0498, 0501-0502, 0505, 0507, 0509, 0511, 0513-0522, 0524, 0526-0527, 0529-0535, 0538, 0540-0541, 0543-0567, 0570, 0572-0578, 0580-0586, 0588, 0591, 0593, 0595-0604, 0606, 0608-0610, 0612, 0614-0616, 0618, 0620-0621, 0623-0629, 0631-0637, 0639, 0641-0644, 0646-0647, 0649, 0651-0652, 0654, 0656, 0658-0661, 0663-0675, 0677, 0679-0682, 0684-0701, 0703-0705, 0709-0713, 0715-0723, 0725, 0727-9780

27-14-04A

Repair interval	Nbr installed	Nbr required	Placard
C	1	0	No

(m) May be inoperative provided that:

- 1) It is electrically disconnected, and
- 2) It remains mechanically connected and hydraulically supplied (damping function is not affected), and
- 3) All roll spoilers are operative.

_____ Reference(s) _____

(m) Refer to AMM 27-14-00-040-001

ANNEX 4: Comments shared by BEA/AIRBUS

Comment No.1:

Draft Report paragraph: Page 1- Title
"Serious incident"

Proposed amendment:
"~~Serious incident~~ Event or incident"

Reason for comment:
"What happened during the subject flight is minor and had no consequences on the flight. The flight control systems stayed in Normal law and the Auto-pilot remained engaged, meaning that there had no changes on the intended flight path"

Explanation by TSB:

The IC will not decide about the event category on the basis of whether or not the Autopilot was disengaged.

The event must be categorised as 'incident', 'serious incident' or 'accident' on the basis of the guidelines in Regulation (EU) No. 996/2010.

In its Annex, the Regulation lists a few examples of serious incidents:

- "multiple malfunctions of one or more aircraft systems seriously affecting the operation of the aircraft"
- "failure of more than one system in a redundancy system mandatory for flight guidance and navigation"

In the case under investigation, none of the servocontrols was able to move the right aileron, and so the aileron became unserviceable.

Comment No.2:

Draft Report paragraph:
Page 6- Figures 2&3

Proposed amendment:
"We propose to suppress these photos, or to mention that the ailerons position (downward) is normal on ground with the hydraulic cutoff."

Reason for comment:
"On ground, with the hydraulic cut-off, the ailerons are not pressurized. Consequently they are automatically downward. These two photos are misleading and could let the reader assume that there is something abnormal with this configuration."

Explanation by TSB:

The caption to Figures 2 and 3 in the Draft Report has been corrected, and reads: "...with pressurized hydraulic systems".

In the case under investigation, the right aileron moved to the lower position due to gravity force after landing. Then, after the aircraft stopped, neither the deactivated servocontrol, nor the servocontrol receiving no control signal from the ELAC1 was able to move the aileron to its neutral position.

Comment No.3:

Draft Report paragraph: Page 15- §2 ANALYSIS

"At 19:24:32, when the airplane was cruising at an altitude of 36 950 ft and speed of 250 knots, the crew perceived the indication "Right Aileron Fault & ELAC1 fault", but the "Fault" light on the "ELAC1 PB Switch" was not illuminated. Figure 7 shows the position of the pushbutton switch. "

Proposed amendment:

"At 19:24:32, when the airplane was cruising at an altitude of 36 950 ft and speed of 250 knots, the crew perceived the indication "Right Aileron Fault & ELAC1 fault", but The "Fault" light on the "ELAC1 PB Switch" was not illuminated because the ELAC1 fault was caused by a peripheral system (Captain side-stick) and not the ELAC1 itself . Figure 7 shows the position of the pushbutton switch "

Reason for comment:

"The ELAC Fault light illuminates when the ELAC computer self-detects faulty. For the subject event the ELAC1 fault triggered because it was not longer able to work on pitch and roll due to the misbehavior of the Captain side-stick. Indeed when an ELAC detects a side-stick misbehavior it rejects the information from both side-stick (Cpt & F/O)"

Explanation by TSB:

The email of 22 March 2016 received by the IC from the AIRBUS Factory contained the information that, after the fault, "The shop-finding of the ELAC and Side-Stick are No Fault Found". (The IC did not receive the Shop Report from AIRBUS, so the IC has no evidence in this aspect).

As the IC has no evidence which would clearly support that the ELAC1 computer was serviceable when the event occurred, the IC invariably thinks that the fault of the aileron may have been caused either by the fault of the ELAC1 computer in itself or in combination with the fault of the Captain Side-Stick.

Paragraph 2, Analysis section in page 15 presents what the pilots experienced; Paragraph 3 discusses FDR data. The causes are presented in Paragraphs 8 and 9 in the Analysis chapter in page 16, and in the "3.2 Causes of the event" chapter, page 18. The part following the second hyphen (-) in Chapter 3.2 has now the addition "In accordance with FDR data".

Comment No.4:

Draft Report paragraph: Page 15§3- ANALYSIS

"Based on FDR data, the IC established that, at 19:24:32, malfunction occurred in roll control channel and pitch control channel of the ELAC1, and the green hydraulic system of the right aileron, as well as the blue hydraulic system of the left aileron had been inoperative from the same moment in time; however, according to data from the "ELAC1 Fault" channel, the ELAC1 computer was operative throughout the complete period of flight, and that was the reason why the fault signal on the ELAC1 pushbutton switch did not illuminated. "

Proposed amendment:

~~"Based on FDR data, the IC established that, at 19:24:32, malfunction occurred in roll control channel and pitch control channel of the ELAC1, and the green hydraulic system of the right aileron, as well as the blue hydraulic system of the left aileron had been inoperative from the same moment in time; however, according to data from the "ELAC1 Fault" channel, the ELAC1 computer was operative throughout the complete period of flight, and that was the reason why the fault signal on the ELAC1 pushbutton switch did not illuminated.~~

We suggest using the explanation given on the email dated 22 march 2016. "

Reason for comment:

"This paragraph is not totally correct as it suggests that several failures occurred in flight which is not the case. To summarize:

-Aircraft dispatched with right aileron able to be controlled by ELAC1 and green hydraulic only

-In flight misbehavior of the Cpt side-stick made the ELAC1 to reject both side-sticks, with for consequence no ELAC able to control the right aileron.

Consequently only one failure occurred in flight."

Explanation by TSB:

Paragraph 3 in Page 15 (Analysis chapter) was clarified in order to fit to the terminology used with FDR data.

The IC takes the FDR data as evidence, and on the basis of such data, "ELAC1 pitch fault" and "ELAC1 roll fault" occurred during the malfunction (see Figure 5 page 12). The IC does not exclude the malfunction of the Captain Side-Stick during the event under investigation; this is indicated in paragraph 9, page 16 of the Final Report. The e-mail of 22 March 2016 sent by the AIRBUS Factory contained the information that "Shop Findings of the ELAC and Side-Stick are No Fault Found", so the IC has no evidence to establish whether it was the fault of the ELAC1 or the fault of the Captain Side-Stick that actually caused the fault of the right aileron. The fault code from the Post Flight Report reads "ELAC1 OR INPUT OF CAPT ROLL CTL SSTU 4CE1", on the basis of which it cannot be unambiguously proved that any or both of the malfunction acted as the actual fault.

This information has been added to paragraph 8, page 16 of the Final Report.

Comment No.5:

Draft Report paragraph: Page 17-§3 ANALYSIS

"With regard to the fact that the incident occurred due to malfunction of the flight control system, which is one of the most critical systems from the aspect of flight safety (especially in the case of fly-by-wire type aircraft) the IC proposes a safety recommendation to the manufacturer relevant to the 10-day interval of the aileron servocontrol chapters of the MMEL."

Proposed amendment:

~~"With regard to the fact that the incident occurred due to malfunction of the flight control system, which is one of the most critical systems from the aspect of flight safety (especially in the case of fly-by-wire type aircraft) the IC proposes a safety recommendation to the manufacturer relevant to the 10-day interval of the aileron servocontrol chapters of the MMEL."~~

Reason for comment:

"We cannot say that there had an incident caused by the flight control. In this flight there are

-No flight control law reversion (no consequences on the envelop protection),

-No auto pilot disconnection,

-No deviation of the intended flight path,

-A failure totally compensated by the remaining systems (redundancy).

We thus propose removing this paragraph. "

Explanation by TSB:

During this event, the right aileron became unserviceable with both of its channels, and one of the channels of the left aileron malfunctioned. The IC thinks that full malfunction of the right aileron and partial malfunction of the left aileron should be classified as serious incident pursuant to Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010.

Regarding the investigation as a whole, the opinion of the IC is that it stands to reason to treat the event at a higher risk level than indicated in No.5: Reason for comment.

Comment No.6:

Draft Report paragraph: Page 18-§3.2 Causes of the event

“During the technical investigation, the IC concluded that the following provable causes had led to the event:

-On 21 March 2014, previous to the flight, the right aileron blue servo-control was deactivated on the airplane in accordance with Section 27-14-04A of the MEL.

–The roll and pitch control channels of the ELAC1 computer malfunctioned during the flight.

-In addition to those above, the IC supposes the following probable cause:

–possible fault of the left (Captain) Side Stick may have been a contributing factor to or cause of the malfunction of the ELAC1 (and earlier the ELAC2) computer. ”

Proposed amendment:

“During the technical investigation, the IC concluded that the following ~~provable~~ probable causes had led to the event:

–On 21 March 2014, previous to the flight, the right aileron blue servo control was eactivated on the airplane in accordance with Section 27-14-04A of the MEL.

~~–The roll and pitch control channels of the ELAC1 computer malfunctioned during the flight.~~
The ELAC1 was no longer able to control the pitch and roll axis.

In addition to those above, the IC supposes the following probable cause:

–possible fault of the left (Captain) Side Stick may have been a contributing factor to or cause of the malfunction of the ELAC1 ~~(and earlier the ELAC2)~~ computer. ”

Reason for comment:

“According to the PFR there had no ELAC2 fault during this flight.”

Explanation by TSB:

The IC takes the FDR data as evidence, and on the basis of such data, “ELAC1 pitch fault” and “ELAC1 roll fault” occurred during the flight (see Figure 5 page 12).

It is irrelevant from the perspective of the movement of the aileron whether the failure of the ELAC1 computer to send control signals to the servo-control was due to inner malfunction of the ELAC1 computer or to malfunction of its peripheral system. The fact is that no control signal came from the ELAC1 computer.

The e-mail of 22 March 2016 sent by the Airbus factory to the IC contained the information that the Shop Finding of the Side-Stick was No Fault Found.

As the IC has no evidence to support that the Captain Side-Stick was defective and that the ELAC1 was serviceable despite its fault message, the IC maintains its position worded in the Draft Report.

The part following the second hyphen (-) in Chapter 3.2, in page 18, has now the addition “In accordance with FDR data”.

The IC agree that “the ELAC1 was no longer able to control the pitch and roll axis”, but think this was not the cause but the consequence of the fault.

The ELAC2 computer malfunctioned in the course of earlier flights, which was detailed in chapter 1.6.2, page 9 of the Draft Report.

Comment No.7:

Draft Report paragraph: Page 19-§4.3 Safety recommendation issued after the investigation

Proposed amendment and Reason for comment:

“As per regulations (JAR-MMEL/MEL .10 or CS-MMEL.140), “the MMEL is a document that lists the equipment which may be temporarily inoperative, subject to certain conditions, while maintaining an acceptable level of safety. In order to ensure this acceptable level of safety, any MMEL candidate is analyzed in accordance with a Safety methodology agreed with the Airworthiness authorities.

The first step of the analysis consists in checking that the consequence of the failure is no more than minor (as per CS 25.1309). For failures with consequences more than minor, the introduction of a specific procedure can be used to alleviate the consequences and come back to minor consequences.

The second step consists in identifying the consequence of an additional failure in flight combined with the initial MMEL failure. This additional failure in flight shall not lead to a failure condition with consequence more than major. As for the first step, a specific procedure can be used to alleviate the consequences and come back to major consequences.

The third step consists in reviewing all the failure conditions that involve the considered item and that have strong safety implications (i.e. failure conditions classified hazardous or catastrophic). The purpose of this last step is to demonstrate that, even with a failed item, all the safety objectives are still met or if exposure time needs to be reduced.

Coming back on the aileron event experienced by BAW:

- The consequence of the LH Blue aileron servo-control failure is classified MINOR since the aileron is still fully operable with the remaining LH Green servo-controlled by the ELAC 2.

- The consequence of the additional failure in flight is the total loss of the affected aileron which is classified MINOR. Even the loss of both ailerons remains MINOR since it can be compensated using the roll spoilers. Therefore, the consequence of the next critical failure is not more than MAJOR provided that the roll spoilers are operative which is requested by the dispatch conditions.

- The quantitative analysis that reviewed all the failure conditions that involve the loss of an aileron servo-control showed that all the safety objectives are met with no specific additional restrictions.

Consequently the above explanation shows that such a failure was anticipated and thus totally compensated by the remaining systems, with no consequences on the envelop protection and aircraft flight path. Based on this analysis it was not necessary to impose a reduced repair interval. For that reason, the item 27-14-01 was accepted by the airworthiness authorities with a repair interval “C” for 10 days.

Therefore BEA and Airbus does not consider this draft of Safety Recommendation suitable. ”

Explanation by TSB:

please see: CS-MMEL BOOK1 Subpart C

„CS MMEL.140 Level of safety

(see GM1 MMEL.140 and GM2 MMEL.140)

The MMEL items are prepared to ensure that an acceptable level of safety as intended by the applicable requirements is maintained taking into account the following factors:

(a) reduction of aircraft functional capabilities and/or safety margins;

(b) change in crew workload and/or degradation in crew efficiency;

(c) consequence(s) to the aircraft and its occupants of the next failure(s) having the worst safety-related impact on the aircraft's take-off, continued flight and landing when dispatching in a known degraded configuration;

(d) consequence(s) to the aircraft and its occupants of the next external event(s) for which the item was designed to protect against, if applicable."

The MMEL is approved by EASA, the Airworthiness authorities do not approve it.

It is the MEL document that needs approval from the competent aviation authority. The IC described in detail the processes of approval of the MMEL and MEL in chapter 1.18, page 14 of the Draft (and Final) Report.

Although the IC is not obliged to take into account the economic aspects of aircraft operation, the IC can accept that the aircraft should be allowed to fly a couple of flight in the case of an aileron servocontrol malfunction, so that the aircraft could return to its home base where the defective part can be replaced.

With regard to safety aspects, however, the IC still does not find it a considered decision to let an aircraft perform 60 to 80 flights with 1 (or 2) deactivated servocontrol, during which flights an ELAC1 or ELAC2 computer malfunction may occur with a higher probability, which in turn may render one (or both) aileron unserviceable.

Additional AIRBUS Comment No.8:

Draft Report paragraph: Page 16-§2 ANALYSIS

"Description of the aileron deflection"

Reason for comment:

"Why such a long description on the aileron deflection which could confuse the reader? The aileron being no longer pressurized by the hydraulic its deflection depends on the aerodynamic forces."

Explanation by TSB:

The IC needs to explain in the Analysis chapter whether the aileron deflection was caused by the servocontrol due to an erroneous control signal or by lack of effective servocontrol due to aerodynamic forces.

ANNEX 5: Comment by EASA**Comment:**

With respect to the Safety Recommendation we would like to highlight that the manufacturer assigns a rectification interval C when the effects of the next critical failure associated to the inoperative item are no more than MAJOR. To ask just for a review of the rectification interval due to the high number of flights doesn't seem a justification robust enough to take an action.

For this reason, it is believed that it would be better to ask for a review of the effects of the next critical failure with the MMEL item 27-14-02 and/or 27-14-04 applied, and, if needed, to think about a reduction of the rectification interval.

Explanation by TSB:

The mission of the TSB is to initiate the necessary technical measures and issue Recommendations in order to prevent similar cases in the future.

The Investigating Committee's opinion is remained the same as the probable reduction of the 10 days interval of the MMEL item between 27-14-01 and 27-14-04 should prevent similar incidents or mitigate of the recurrence probability in the future.

As all four aileron servo-control intervals are exactly the same in the MMEL, the Investigation Committee considers important the Safety Recommendation which does not just applies to the servo-control which was deactivated before this incident, rather to be extended to all four aileron servo-controls.

In a case where such similar event will happen within our competency in the future where the cause of the incident could be the: "next critical failure with the MMEL item 27-14-02 and/or 27-14-04 applied" then we will issue a Safety Recommendation about your suggestion indicated with quotation marks.

A possible Safety Recommendation by your suggestion we could not be able to justify at this particular incident.