DUTCH
SAFETY BOARD

MH17

Appendices
MH17 Crash

Appendices to report Crash of Malaysia Airlines flight MH17

The Hague, October 2015

The reports issued by the Dutch Safety Board are open to the public.
All reports are available on the Safety Board's website www.safetyboard.nl.

Source photo cover: DCA Malaysia

Dutch Safety Board

The aim in the Netherlands is to limit the risk of accidents and incidents as much as possible. If accidents or near accidents nevertheless occur, a thorough investigation into the causes, irrespective of who are to blame, may help to prevent similar problems from occurring in the future. It is important to ensure that the investigation is carried out independently from the parties involved. This is why the Dutch Safety Board itself selects the issues it wishes to investigate, mindful of citizens' position of dependence with respect to authorities and businesses. In some cases the Dutch Safety Board is required by law to conduct an investigation.

Dutch Safety Board

Chairman: T.H.J. Joustra
E.R. Muller
M.B.A. van Asselt

Associate members of the Board: B.J.A.M. Welten
A.P.J.M. Rutten

General Secretary: M. Visser

Visiting address: Anna van Saksenlaan 50
2593 HT The Hague
The Netherlands

Postal address: PO Box 95404
2509 CK The Hague
The Netherlands

Telephone: +31 (0)70 333 7000
Fax: +31 (0)70 333 7077

Website: www.safetyboard.nl

NB: This report is published in the English and Dutch languages. If there is a difference in interpretation between the English and Dutch versions, the English text will prevail.

CONTENTS

MH17

Appendices part A: Causes of the crash

APPENDICES PART A: CAUSES OF THE CRASH

INVESTIGATION ACTIVITIES AND PARTICIPANTS (PART A)

This Appendix provides an overview of the activities performed in relation to the investigation and the parties, persons, and organisations involved. It also gives an explanation about a number of information sources that were used.

List of activities

The following activities were performed in 2014 and 2015 with regard to the investigation into the crash of flight MH17:

2014	
18 July:	Deployment of team of investigators to Kyiv, Ukraine.
22 July:	Recorders were received.
23 July - 24 July:	Delegation of the Annex 13 MH17 investigation: signing of Memorandum of Understanding between Ukraine and the Netherlands, signing of Agreement between NBAAI and Dutch Safety Board. Due to the security situation, investigators could not travel to the crash sites.
23 - 27 July:	Read out of Cockpit Voice Recorder and Flight Data Recorder at AAIB, Farnborough, UK.
28 July:	Informal meeting ICAO observer with Dutch Safety Board chairman, vice-chairman and project manager.
27 July - 7 August:	Team of Dutch Safety Board investigators standby in Kharkiv, Ukraine for deployment to crash site.
4 - 6 August:	Dutch Safety Board investigators on standby in Soledar, Ukraine for deployment to crash site.
2 - 15 August:	Dutch Safety Board Investigation Manager liaisons present in Kyiv.
4 August:	Handover of small wreckage material from Malaysian investigators at Dutch Safety Board office.
4 - 6 August:	Meeting with investigator ATSB at Dutch Safety Board office.
5 - 8 August:	Meeting with investigators AAIB UK at Dutch Safety Board office.
11 August:	Dutch Safety Board investigators back at Dutch Safety Board office.
25 - 28 August:	Meeting with investigators NBAAI at Dutch Safety Board office regarding radar data.

26 August:	Vice-chairman Dutch Safety Board informs relatives of the MH17 passengers about the investigation process, Nieuwegein, the Netherlands.
27 - 28 August:	Meeting with investigators from the Russian Federation regarding radar data.
29 August:	Draft Preliminary Report MH17 Crash sent to Accredited Representatives for their comments.
9 September:	Publication of the Preliminary Report MH17 Crash.
11 September:	Chairman Dutch Safety Board, Vice-chairman, Project Manager and Investigator in Charge present the Preliminary Report to the relatives of the MH17 passengers in Nieuwegein.
24 September:	Dutch Safety Board investigators attend forensic investigation meeting of the Joint Investigation Team.
9 - 11 October	Deployment and preparations of Coordinator Recovery Operations Dutch Safety Board in Kyiv.
22 - 25 October:	Preparations of Coordinator Recovery Operations Dutch Safety Board in Kharkiv.
28 Oct. - 13 Nov.:	Preparations for recovery in Kyiv, Kharkiv, and Donetsk, Ukraine and reconnaissance of wreckage site near Hrabove, Ukraine by Coordinator Recovery Operations Dutch Safety Board.
14 November:	Agreement between Dutch Safety Board and SES for recovery of wreckage.
14 - 16 November:	Dutch Safety Board Investigation Manager liaison present in Kyiv.
16 - 22 November:	Recovery of wreckage parts with assistance of OSCE, SES and local habitants and transport to railway station Torez, Ukraine.
17 Nov. - 9 Dec.:	Dutch Safety Board Investigation Manager liaison present in Kharkiv.
23 November:	Wreckage transported by 12 train wagons and 2 trucks from Torez to Kharkiv.
1 - 8 December:	Transfer of wreckage parts and preparation for transport to the Netherlands in Kharkiv from the 12 trains and 2 trucks into 16 trucks.
3 December:	Dutch Safety Board present at meeting in Nieuwegein with the relatives of the MH17 passengers.
8 - 12 December:	Transfer of the wreckage by road from Kharkiv to Gilze-Rijen Air Force Base, the Netherlands.
10 December:	Unloading, sorting, forensic investigation and photographing of the wreckage started at Gilze-Rijen Air Force Base.

2015	
10 - 16 January:	Investigations performed in Malaysia at Malaysia Airlines.
30 January:	Dutch Safety Board present at meeting in Nieuwegein with the relatives of the MH17 passengers.
4 - 7 February:	Observation of wreckage parts recovered by local inhabitants in Kharkiv by Coordinator Recovery Operations Dutch Safety Board.

9 - 13 February:	Meeting Investigator in Charge and Coordinator Reconstruction Operations with NTSB in Washington and Boeing in Seattle, USA.
17 - 20 February:	1st progress meeting of the Annex 13 investigation participants at Gilze-Rijen Air Force Base.
27 February:	Meeting for preparations with family liaison officers of the Dutch National Police and victim support personnel about relatives' wreckage visits.
3 - 7 March:	Visits to wreckage by relatives at Gilze-Rijen Air Force Base.
9 March:	Transfer of Flight Data Recorder data to Public Prosecutor.
	Planning and start of detailed forensic investigation and preparation of retrieved high-energy objects and associated wreckage parts.
9 -10 March:	Meeting Investigator in Charge and Coordinator Reconstruction Operations with AAIB UK at Farnborough.
20 - 28 March:	Observation of wreckage parts recovered by local habitants near Petropavlivka, Ukraine by Coordinator Recovery Operations Dutch Safety Board. Preparations for transport to the Netherlands.
30 March - 2 April:	Special Envoy Dutch Safety Board and Investigator in Charge have several meetings in Kyiv to retrieve investigation data.
19 April - 2 May:	Recovery of wreckage parts and preparations for transport of eight 40-feet containers to the Netherlands.
6 - 7 May:	2nd progress meeting of the Annex 13 investigation participants at Gilze-Rijen Air Force Base.
12 May:	Forensic investigation and preparation of retrieved parts in containers from last recovery mission commenced.
26 May:	Start 3D reconstruction forward part of aeroplane wreckage at Gilze-Rijen Air Force Base.
2 June:	Draft Final Report sent to parties involved for review.
11-12 August:	Closing meeting of the Annex 13 investigation participants at Gilze-Rijen Air Force Base.

Other material made available to the investigation

The Dutch Safety Board received information from various sources, such as police, news organisations, social media and individuals regarding the crash. This material included eye-witness statements, articles, messages, films of the wreckage and films and photos from the sites in east Ukraine where the wreckage hit the ground. The Safety Board has used this material for as far as it was considered applicable to the investigation.

The Dutch Safety Board noted an amount of relevant, classified, information regarding the crash to flight MH17 that was in the possession of the Dutch intelligence services AIVD and MIVD. This is information from the AIVD and MIVD themselves and from the intelligence services of other countries. This classified information includes the results of the use of intelligence resources. The Dutch Safety Board has assessed its findings against this classified information. The classified information confirms the findings about the causes of the crash as contained in this report.

The classified information cannot be disclosed for reasons of national security.

Participating states and observer

Accredited Representatives and advisers from the following participating states were involved in the investigation:

- Ukraine (State of Occurrence);
- Malaysia (State of the Operator and State of Registry);
- United States of America (State of Design and Manufacture of the aeroplane);
- United Kingdom (State of Design and Manufacture of the engines);
- Australia (State that provided information on request - photographs of aeroplane wreckage parts on the crash site), and
- Russian Federation (State that provided information on request - radar- and communication data).

An observer from the International Civil Aviation Organization was available for support during the investigation.

Attendence to progress meetings

First Progress Meeting, 17 - 20 February 2015

State	Number of persons attending
Australia	1
Belgium	3*
Germany	2*
Malaysia	8
Russian Federation	7
United Kingdom	3
Ukraine	2
United States of America	4
Observer	**Number of persons attending**
ICAO	1

** Attended only on February 17.*

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Second Progress Meeting, 6 and 7 May 2015

State	Number of persons attending
Malaysia	2
Russian Federation	6
United Kingdom	2
Ukraine	1
United States of America	2

Third Progress Meeting, 11 and 12 August 2015

State	Number of persons attending
Malaysia	4
Russian Federation	6
United Kingdom	2
Ukraine	10
United States of America	2
Observer	**Number of persons attending**
ICAO	1

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Guidance committees

For the purpose of this investigation the Dutch Safety Board formed two guidance committees for Part A of the investigation. These committees consisted of external members with expert knowledge relevant to the investigation and was chaired by a Dutch Safety Board member. The external members served on the committees in a personal capacity. The committees had an advisory role in the investigation.

The composition of the guidance committee for the investigation to the cause of the crash was as follows:

E.R. Muller (chairman)	Vice-chairman of the Dutch Safety Board
H. Bijl	Delft University of Technology
C. Frostell*	Former Chief AIG Section, ICAO
Y. de Haan	Former Chief Pilot, KLM
G.H. Kroese	Former CEO, ATC the Netherlands
M.A.G. Peters	CEO, NLR
A. Rutten	Associate Member of the Dutch Safety Board [1]
A. Verberk	Former CEO, Martinair Holland
B.J.A.M. Welten	Associate Member of the Dutch Safety Board

** Consulted outside meetings.*

This guidance committee had four meetings.

1 As of 1 February 2015.

The guidance committee for the 'survival aspects' part of part A of the investigation was as follows:

E.R. Muller (chairman)	Vice-chairman of the Dutch Safety Board
P.L. Meurs	Associate Member of the Dutch Safety Board; chair of the Council for Public Health and Health Care
J.J. van Lieshout	Head of acute admissions department of internal medicine and Laboratory for Clinical Cardiovascular Physiology, Academic Medical Centre Amsterdam; professor of Cardiovascular Physiology, University of Nottingham, United Kingdom
B.P.R. Gersons	Professor emeritus of psychiatry at the Academic Medical Centre (AMC) and the University of Amsterdam; senior scientific adviser to the Arq Psychotrauma Expert Group
P.A. Boelen	Professor of Clinical and Health Psychology at the University of Utrecht
I.B. Schipper	Trauma surgeon, head of trauma surgery sub-department at the Leiden University Medical Centre
H.J. ten Duis	Professor emeritus of trauma surgery at the University Medical Centre Groningen and the University of Groningen

During the investigation, this guidance committee met three times.

Project team

The project team for the investigation into the crash of flight MH17 comprised the following persons:

M. Visser	MH17 Programme Manager
H. van Duijn	Investigation Manager[2]
K.E. Beumkes	Project Manager
C.J. van der Schors	Project Manager 'survival aspects'
G.J. Vogelaar	Investigator in Charge
R. Smits	Coordinator Recovery and Reconstruction Operations
E.M. Berends	Investigator
A.J. van der Kolk	Investigator
G.W. Medendorp	Investigator
M.L.M.M. Peters	Investigator
G.J. de Rover	Investigator
H. van Ruler	Investigator
A. Samplonius	Investigator
M.J. Schuurman	Investigator
Th.M.H. van der Velden	Investigator
W.F. Furster	Investigator
F. Gisolf	Investigator
L.G.L. Hoogduin	Investigator

2 Until March 2015.

The following individuals were added to the project team under the supervision and responsibility of the Dutch Safety Board:

H.G. van Galen	Ground Engineer Boeing 777
D. den Hartog	Trauma surgeon Erasmus Medical Centre and head of South-West Netherlands trauma centre
G. van Ingen	Pathologist
T. Meeuwsen	Flight physiologist, Senior aviation accident investigator, Deputy commander Centre for Man and Aviation (CML), Royal Netherlands Air Force
J.A. Melkert	Senior lecturer aeronautical engineering, Aerospace Engineering Faculty, Delft University of Technology
J.C. de Mol	Air traffic control expert
B. Mulder	Aircraft Ground Engineer B1 Boeing 777
J.G.W. van Ruitenbeek	Aircraft structures Expert
F. Schaefers	Cabin safety expert SGI Aviation
E.F. Thomassen	Aircraft Mechanic/sheet metal worker Boeing 777
A.J. van Utrecht	Technical Investigator
H.G.J.M. Vermetten	Psychiatrist, Head of Military Mental Health Research Centre and Arq Psychotrauma Expert group, professor of psychiatry at Leiden University Medical Centre (LUMC) and Leiden University
J. van der Vlist	Machinist/contributor reconstruction
A.P. Young	Investigator

Subsidiary investigations were performed by the following institutions at the instruction of the Dutch Safety Board:

- Academisch ziekenhuis Maastricht (azM);
- Element Materials Technology;
- National Aerospace Laboratory (NLR);
- Netherlands Forensic Institute (NFI);
- Netherlands Organisation for Applied Scientific Research (TNO);
- Delft University of Technology, Faculty of Aerospace Engineering - Structural Integrity & Composites, Fatigue, Damage Tolerance & Durability.

During the investigation of the Dutch Safety Board assistance was provided by the Dutch Ministry of Defence, in particular:

- Headquarters of the Ministry of Defence, the Hague;
- Inter Present Combined Joint Interagency Task Force;
- Commander and personnel of Gilze-Rijen Air Force Base;

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

- Gilze-Rijen Air Force Base Infrastructure Organisation;
- Gilze-Rijen Air Force Base Motor Transport Squadron;
- Dutch Defence Salvage team;
- Dutch Defence Catering Service;
- Dutch Defence Guards and Security Organisation;
- Dutch Defence Transportation Organisation.

The following companies and organisations provided specialist services at the request of the Dutch Safety Board:

- Dutch Association for Aircraft Maintenance Technicians (Experts);
- Voortman Steel Group (Body aircraft reconstruction);
- Van der Vlist speciaal- en zwaar transport B.V. (Transport);
- Loonbedrijf Hans Vogelaar (Internal transport).

REFERENCE INFORMATION (PART A)

Reference material

The following reference material was used in the investigation:

- Memorandum of understanding between the Minister of Foreign Affairs of the Kingdom of the Netherlands and the Minister for Foreign Affairs of Ukraine concerning the investigations regarding the accident of the downing of civilian aircraft, Malaysia Airlines Flight MH17 on July 17, 2014;
- Agreement between the National Bureau of Air Accident and Incidents Investigation with Civil Aircraft (NBAAI) of Ukraine and the Dutch Safety Board of the Netherlands on delegation of investigation in respect of aircraft accident involving Boeing 777-200, registration: 9M-MRD Malaysia Airlines Flight MH17;
- International regulations;
- Malaysia Airlines documentation.

International regulations

The international regulations relevant to this investigation include:

- The 'Standards and Recommended Practices' in the Appendices to the Chicago convention of the International Civil Aviation Organization (ICAO);
- Certification requirements of the Federal Aviation Administration (FAA);
- Certification requirements of the European Aviation Safety Agency (EASA);
- Department of Civil Aviation Malaysia regulations.

International Civil Aviation Organization

Six Appendices are of particular importance for the investigation. These are Appendices 2, 6, 8, 10, 11 and 13.

ICAO Annex 2 - Rules of the Air
The Standards in this document, together with the Standards and Recommended Practices of Annex 11, govern the application of the Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM) and the Regional Supplementary Procedures - Rules of the Air and Air Traffic Services, contained in Doc 7030. In the latter document subsidiary procedures of regional application are found.

ICAO Annex 6 - Operation of Aircraft, Part I - International Commercial Air Transport - Aeroplanes

The purpose of Annex 6 is to contribute to the safety of international air navigation by providing criteria of safe operating practice and to contribute to the efficiency and regularity of international air navigation by encouraging states to facilitate the passage over their territories of aeroplanes in international commercial air transport belonging to other states that operate in conform with such standards.

Annex 6 Part I contains the regulations for commercial air traffic using aircraft. Section 2 (Applicability) of this Annex states the following: *'The Standards and Recommended Practices contained in Annex 6, Part I, shall be applicable to the operation of aeroplanes by operators authorised to conduct international commercial air transport operations.'*

ICAO Annex 8 - Airworthiness of Aircraft

Annex 8 contains the Standards and Recommended Practices for the airworthiness of aircraft. This concerns type certification, design approval, certification of airworthiness and the so-called continuing airworthiness. Part III A of Annex 8 specifies the Standards and Recommended Practices with regard to airworthiness of large aircraft (more than 5700 kg) regarding which certification took place after 13 June 1960 and before 2 March 2004.

ICAO Annex 10 - Aeronautical Telecommunications

Annex 10 contains Standards and Recommended Practices with regard to aeronautical telecommunications. The Annex sets out the standards and practices that enable telecommunications and the radio aids to air navigation to contribute to the safety, regularity and efficiency of international air navigation.

ICAO Annex 11 - Air Traffic Services

Annex 11 contains Standards and Recommended Practices with regard to air traffic control. This Annex refers to the classification of airspaces and air traffic control services that have as their objective ensuring a safe, orderly and expeditious flow of air traffic.

ICAO Annex 13 - Aircraft Accident and Incident Investigation

Annex 13 contains Standards and Recommended Practices with regard to accident and incident investigation. This Annex sets out the basic requirements for the establishment of an accident investigation and how it should be reported. It was reviewed by the Dutch Safety Board with regard to its applicability to an accident where unlawful interference was suspected. The Annex makes no differentiation between sorts of accidents. The main principle of the investigation, regardless of cause is '*the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability*'. (See Annex 13, paragraph 3.1).

With regard to unlawful interference, Annex 13, paragraph 5.11 requires that *'If, in the course of an investigation it becomes known, or it is suspected, that an act of unlawful interference was involved, the investigator-in-charge shall immediately initiate action to ensure that the aviation security authorities of the State(s) concerned are so informed*'. This requirement was introduced into the Annex by Amendment 5 in 1976. Annex 17 to the Convention, entitled Security only refers to accident investigation is so far as the requirements of Annex 13 paragraph 5.11 are reproduced.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Other documents
In addition to Annex 11, ICAO Doc 4444 - *Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM)*, provides additional provisions with regard to air traffic control procedures. PANS-ATM is a supplement to Annex 11.

Furthermore Doc 8168 - *Procedures for Air Navigation Services - Aircraft Operations, Volume 1 Flight Procedures* prescribes among other things operational procedures, which are recommended for the guidance of flight operational personnel and flight crew members.

Lastly, ICAO Doc 9554 - *Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations*, provides guidance material which is meant to assist States in providing for the safe and orderly flow of international air traffic in the event that military activities, which constitute potential hazards to civil aircraft, are planned and conducted.

Federal Aviation Administration (FAA)

The aeroplane type Boeing 777 was certified on the basis of the certification requirements of FAA airworthiness standards for transport category airplanes: FAR Part 25.

The specification Technical Standard Order, TSO-C64, for oxygen masks.

European Aviation Safety Agency (EASA)

The aeroplane's engines were certified on the basis of EASA airworthiness standards for engines; EASA CS-E.

Department of Civil Aviation Malaysia

Malaysian Civil Aviation Regulations 1996.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Malaysia Airlines

The investigation made use of a number of documents that Malaysia Airlines used in the preparation and execution of the flight. Some of the documents were produced by Boeing. These documents included:

- Operations Manual Part A, and
- Boeing 777 Flight Crew Operations Manual.

Research reports

As part of the investigation, studies were performed with the cooperation of external institutions at the instruction of the Dutch Safety Board. The reports produced as a result of their studies are published on the Dutch Safety Board's website. These are:

National Aerospace Laboratory (NLR)	Impact damage due to high-energy objects on the wreckage of MH17
Netherlands Organisation for Applied Scientific Research (TNO)	Reconstruction of the damage pattern caused by the impact of high-energy objects on Malaysia Airlines flight MH17
Netherlands Organisation for Applied Scientific Research (TNO)	Numerical simulation of blast loading on Malaysia Airlines flight MH17 due to a warhead detonation

In addition, the NLR and Delft University of Technology (failure analyses), Element Materials Technology (forensic investigation of the high-energy objects found) and the Netherlands Forensic Institute (forensic investigation of the high-energy object found) contributed to the investigation.

APPENDIX C

AIR TRAFFIC CONTROL FLIGHT PLAN

Flight plan

A flight plan is a document that the pilot-in-command of an aircraft, or the operator, submits to the authorities prior to a flight. A flight plan provides the planned route of the proposed flight. The flight plan's format is established in ICAO Doc 4444.

In general, the compilers of a flight plan will opt for the most economic route, using the air routes that are available. The shortest route is represented by a straight line between the departure and arrival aerodromes, the so-called great circle. The preferred route is determined using the available air routes (airways) that are located closest to the great circle. The final route is established taking into account the operational limitations related to the aircraft and the weather. Examples of this would be avoiding areas with a lot of headwind, or looking for areas with a lot of tailwind.

The aeroplane's equipment may also present limitations. The systems on board with emergency oxygen for passengers and crew members may restrict the ability to fly over high terrain. With a twin-engine aeroplane, there must be a suitable diversion aerodrome at each point of the route within one, two or three hours flying time on one engine, depending on the equipment and certification. Another limitation when selecting a route is related to whether the operator in question has permission to fly over a certain area or country. The applicable NOTAMs are also examined to establish whether they impose any restrictions on the route.

Airways can be viewed as three-dimensional highways for aircraft. The flight plan includes the airways to be followed and reporting points or waypoints. The waypoints are important airway intersections or points where an airway passes the boundary of a flight information region (FIR).

During the flight, the crew can request permission from air traffic control to deviate from the flight plan. In addition, air traffic control can issue the crew with instructions to change course. In doing so, the pilot-in-command remains responsible for the safety of the flight operations.

Flight levels are used above the transition altitude, which varies from one country to another. These are used to facilitate the separation between aircraft. Above the transition altitude, a globally agreed standard altimeter setting applies, which means that all traffic uses the same altitude indication. Airways employ standard flight levels. Typically, magnetic tracks between 0 and 179 degrees have odd-numbered flight levels (FL290, FL310, etc.) and magnetic tracks between 180 and 359 degrees have even-numbered flight levels. A flight plan must also specify the flight levels for the proposed route.

FPL-MAS17-IS

-B772/H-SDFGHIJ3J5M1RWXY/LB1D1

-EHAM1000

-N0490F310 ARNEM UL620 SUVOX UZ713 OSN UL980 MOBSA DCT POVEL DCT SUI L980 UTOLU/N0490F330 L980 LDZ M70 BEMBI L980 PEKIT/N0480F350 L980 TAMAK/ N0480F350 A87 TIROM/N0490F350 A87 MAMED B449 RANAH L750 ZB G201 BI DCT MURLI DCT TIGER/N0490F370 L333 KKJ L759 PUT R325 VIH A464 DAKUS DCT

-WMKK1137 WMSA WMKP

-PBN/A1B1C1D1L1O1S2 DOF/140717 REG/9MMRD EET/EDGG0017 EDWW0023 EDUU0036 EPWW0052 UKLV0135 UKBV0153 UKDV0225 URRV0255 UATT0347 UTAK0411 UTAA0432 UTAV0507 OAKX0518 OPLR0601 OPKR0616 VIDF0631 VABF0725 VECF0747 VYYF0926 VOMF0930 VTBB1013 WMFC1051 SEL/QREJ

ORGN/KUL02MH RMK/ACASII EQUIPPED

Flight plan text	Explanation
FPL-MAS17-IS	Flight plan for flight MH17, a scheduled commercial flight operating under instrument flight rules.
B772/H-SDFGHIJ3J5M1RWXY/LB1D1	Aeroplane type (777-200) followed by code letters for relevant equipment on board and, where applicable, authorisation from the appropriate authority.
EHAM1000	Airport of departure and scheduled departure time in UTC.
N0490F310	Initial cruising speed in knots and first cruising level.
ARNEM UL620 SUVOX UZ713 OSN UL980 MOBSA DCT POVEL DCT SUI L980 UTOLU/ N0490F330 L980 LDZ M70 BEMBI L980 PEKIT/ N0480F350 L980 TAMAK/N0480F350 A87 TIROM/N0490F350 A87 MAMED B449 RANAH L750 ZB G201 BI DCT MURLI DCT TIGER/N0490F370 L333 KKJ L759 PUT R325 VIH A464 DAKUS DCT	Route details consisting of the names of air navigation waypoints and airway codes. Notes: DCT = direct to /N0490F350 after a waypoint name shows that the aeroplane will change speed and/or level. In the case of the change at waypoint TIROM: increase speed from 480 knots to 490 knots and remain at FL350.
WMKK1137 WMSA WMKP	Destination airport code, total time for flight (in this case, 11 hours and 37 minutes) and the airport codes for alternate airports.
PBN/A1B1C1D1L1O1S2	Codes relating to en-route navigation capability.
DOF/140717	Date of flight.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Flight plan text	Explanation
REG/9MMRD	Aircraft registration.
EET/EDGG0017 EDWW0023 EDUU0036 EPWW0052 UKLV0135 UKBV0153 UKDV0225 URRV0255 UATT0347 UTAK0411 UTAA0432 UTAV0507 OAKX0518 OPLR0601 OPKR0616 VIDF0631 VABF0725 VECF0747 VYYF0926 VOMF0930 VTBB1013 WMFC1051	EET = Estimated elapsed time to the boundaries between Flight Information Regions.
SEL/QREJ	Callsign for the selective-calling radio system.
ORGN/KUL02MH	Flight plan submitted by Malaysia Airlines.
RMK/ACASII EQUIPPED	Other information. In this case, the type of Airborne Collision Avoidance System installed.

Table 1: Explanation of air traffic control flight plan.

The flight plan starts with the aerodrome of departure (EHAM=Amsterdam Airport Schiphol) and the flight's departure time (10.00). It then indicates the planned cruise speed in knots and the altitude as a flight level (N0490 F310). This is followed by the first air navigation waypoint (ARNEM) and the airway (UL620) that the flight will take to the next waypoint (SUVOX). In this way, the flight plan describes the entire route, in which the airways are always referred to by using one or two letters followed by numbers and the air navigation waypoints by name. If a flight directly approaches an air navigation waypoint, the waypoint's designation is preceded by 'DCT' (direct). If the flight must fly at a different speed and/or altitude, this is also specified in the flight plan. Lastly, the aerodrome of arrival is mentioned in the flight plan (WMKK = Kuala Lumpur), the duration of the flight (11 hours and 37 minutes), and the diversion aerodromes (WMSA = Sultan Abdul Aziz Shah/ Subang and WMKP= Penang).

NOTAM INFORMATION

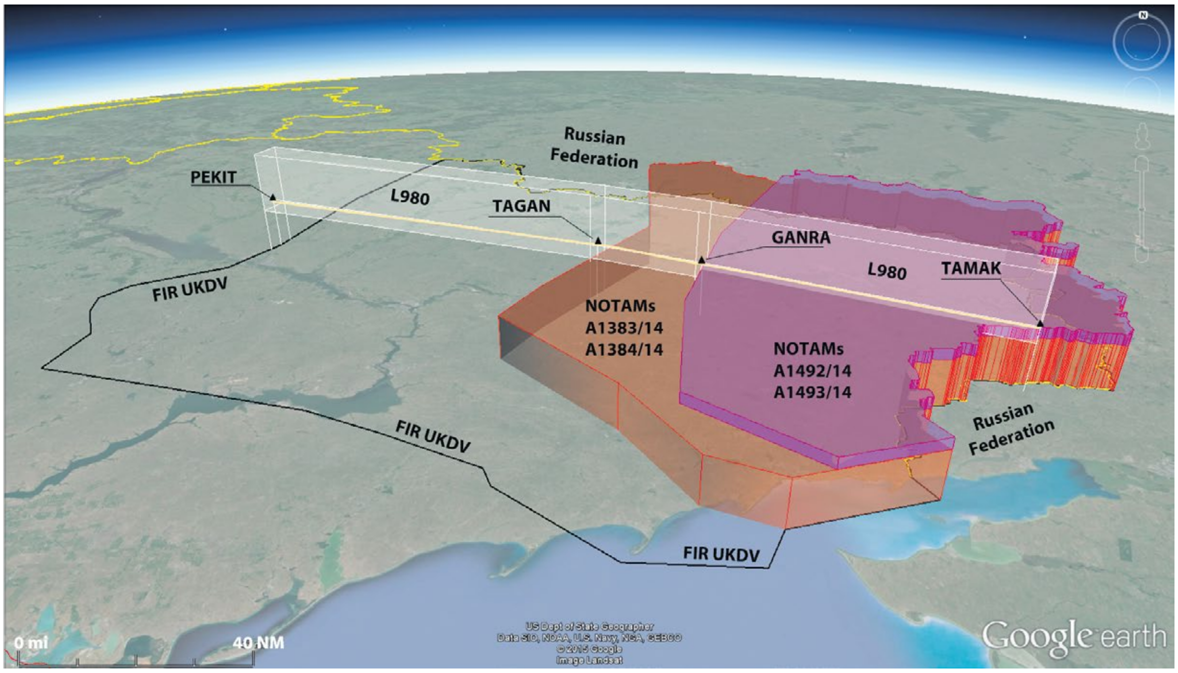


Figure 1: Ukrainian NOTAMs. (Source: Google, Landsat)

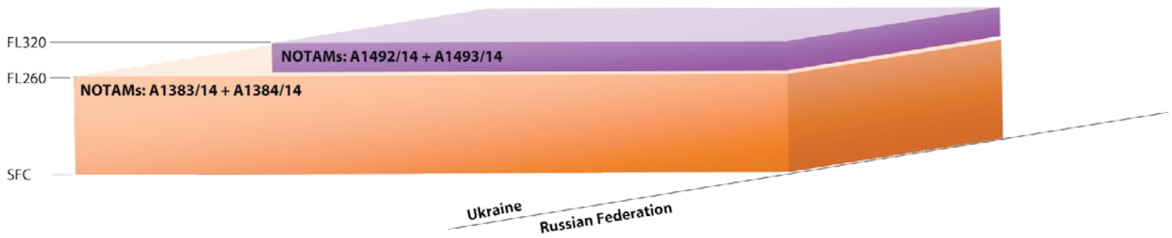


Figure 2: Side view of restricted airspace. (Source: Dutch Safety Board)

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

De-coding NOTAM data

The following material is provided so as to allow the reader to better understand the material in this report.

NOTAM text	Explanation
A1353/14 NOTAM	Reference number; the letter A followed by a numeric code and the year
Q) UKXX/QRTCA/IV/BO /W /000/050/4731N03254E196	Q-code: used by flight planning software to determine its applicability to a planned flight
A) UKDV UKOV UKFV	Flight Information Region or regions affected
B) 1406290000 C) 1407282359	Period of validity of NOTAM B) is date and time FROM, and C) is date and time TO in the format YYMMDDHHMM
E) TEMPO RESTRICTED AREA BOUNDED BY COORDINATES: 464700N 0373000E 455800N 0345000E THEN ALONG STATE BOUNDARY UNTIL POINT 481400N 0281700E CLOSED	Area of airspace that is restricted TEMPO = temporarily
THE PROHIBITION IS NOT APPLIED FOR FLIGHTS OF STATE ACFT OF UKRAINE. FLIGHTS OF CIVIL ACFT IN AREA IS AUTHORIZED UNDER CONDITIONS: - FPL SENDING IN THE DAY BEFORE UNTIL 1200(UTC)	Operational considerations associated with the restriction
F) SFC G) 1500M AMSL	F) Altitude from which the restriction applies, and G) Altitude or level to which the restriction applies

Table 2: Decoding NOTAM data.

The NOTAMs address airspace that is closed or restricted to air traffic. Two sorts of restriction were applied:

1. *Temporary Reserved Area*[3]
   Defined volume of airspace normally under the jurisdiction of one aviation authority and temporarily reserved, by common agreement, for the specific use by another aviation authority and through which other traffic may be allowed to transit, under air traffic control clearance.
2. *Temporary Restricted Area*
   Airspace of defined dimensions above the land areas or territorial waters of a state, within which the flight of aircraft is restricted in accordance with specific conditions.

All times in this Appendix are in UTC only.

3 EUROCONTROL, Airspace Management Handbook for Application of the Concept of the Flexible Use of Airspace, Ed. 3.0, 2010.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

NOTAMs - Ukraine

NOTAM number	Lower limit	Upper limit	Valid from	Valid to
1352/14	GND	1,500 m AMSL	29 June, 00.00	28 July, 23.59
1353/14	GND	1,500 m AMSL	29 June, 00.00	28 July, 23.59
1383/14	SFC	FL260	1 July, 00.00	28 July, 23.59
1384/14	SFC	FL260	1 July, 00.00	28 July, 23.59
1387/14	FL140	FL180	1 July, 00.00	28 July, 23.59
1389/14	FL210	FL260	1 July, 00.00	28 July, 23.59
1492/14	FL260	FL320	14 July, 18.00	14 August, 23.59[4]
1493/14	FL260	FL320	14 July, 18.00	14 August, 23.59[5]

Table 3: UkSATSE NOTAMs valid during the crash.

It is noted that NOTAMs 1383/14 and 1384/14 effectively covered the same area. NOTAM 1383/14 closed all airspace, whilst NOTAM 1384/14 closed the airways that passed through that airspace. NOTAMs 1492/14 and 1493/14 also closed both airspace and airways in the same way. This practice is common as it facilitates computerised flight planning by specifying exactly which portions of an airway are restricted.

The areas restricted by NOTAMs 1383/14, 1384/14, 1492/14 and 1493/14 were considered relevant to the investigation as they restricted parts of Ukrainian upper airspace closest to the planned route of flight MH17.

4 NOTAM end date no earlier than 14 August 2014.
5 NOTAM end date no earlier than 14 August 2014.

A1352/14 NOTAM
Q) UKXX/QRTCA/IV/BO /W /000/050/5015N03349E140
A) UKBV UKDV
B) 1406290000 C) 1407282359

E) TEMPO RESTRICTED AREA BOUNDED BY COORDINATES: 511600N 0303500E THEN ALONG STATE BOUNDARY UNTIL POINT 501900N 0364942E 490600N 0365000E 492300N 0352700E 512400N 0322000E 511600N 0303500E CLOSED.
THE PROHIBITION IS NOT APPLIED FOR FLIGHTS OF STATE ACFT OF UKRAINE.
FLIGHTS OF CIVIL ACFT IN AREA IS AUTHORIZED UNDER CONDITIONS:
- FPL SENDING IN UKRAEROCENTRE THE DAY BEFORE UNTIL 1200(UTC)
- NOT LATER THAN ONE HOUR BEFORE DEPARTURE RECEIVING PERMISSION OF AIR FORCES OF UKRAINE THROUGH UKRAEROCENTRE ON FLIGHT
- INFORMING AIR DEFENS UNIT OF AIR FORCES OF UKRAINE AND AIR TRAFFIC SERVICE ABOUT FLIGHT.

F) SFC G) 1500M AMSL

A1353/14 NOTAM
Q) UKXX/QRTCA/IV/BO /W /000/050/4731N03254E196
A) UKDV UKOV UKFV
B) 1406290000 C) 1407282359

E) TEMPO RESTRICTED AREA BOUNDED BY COORDINATES: 464700N 0373000E 455800N 0345000E 455242N 0323043E 460755N 0312733E 462300N 0312400E 462300N 0310700E 451200N 0294500E
THEN ALONG STATE BOUNDARY UNTIL POINT 481400N 0281700E 484900N 0292300E 481600N 0302700E 472500N 0304500E 472500N 0324400E 465800N 0325100E 470200N 0342700E 472442N 0351749E 473846N 0353706E 475542N 0355136E 472200N 0363900E 465400N 0370500E 464700N 0373000E CLOSED.
THE PROHIBITION IS NOT APPLIED FOR FLIGHTS OF STATE ACFT OF UKRAINE.
FLIGHTS OF CIVIL ACFT IN AREA IS AUTHORIZED UNDER CONDITIONS:
- FPL SENDING IN UKRAEROCENTRE THE DAY BEFORE UNTIL 1200(UTC)
- NOT LATER THAN ONE HOUR BEFORE DEPARTURE RECEIVING PERMISSION OF AIR FORCES OF UKRAINE THROUGH UKRAEROCENTRE ON FLIGHT
- INFORMING AIR DEFENS UNIT OF AIR FORCES OF UKRAINE AND AIR TRAFFIC SERVICE ABOUT FLIGHT.

F) SFC G) 1500M AMSL

A1383/14 NOTAM
Q) UKDV/QRAXX/IV/NBO/W /000/260/4833N03731E111
A) UKDV
B) 1407010000 C) 1407282359

E) TEMPORARY RESERVED AREA BOUNDED BY COORDINATES: 501900N 0364942E 490600N 0365000E 481520N 0360510E 475542N 0355136E 472200N 0363900E 465400N 0370500E 0464700N 0373000E 465900N 0382000E 470642N 0381324E

THEN ALONG STATE BOUNDARY UNTIL POINT 501900N 0364942E.
AUTHORIZED FLIGHTS OF STATE ACFT OF UKRAINE. FOR FLIGHTS OF CIVIL ACFT NEED HAVE PERMISSION HEADQUARTERS OF ARMED FORCES UKRAINE NOT LESS ONE DAY BEFORE FLIGHT.

F) SFC G) FL260

A1384/14 NOTAM
Q) UKXX/QARLC/IV/NBO/E /000/260/4829N03721E114
A) UKDV UKFV B) 1407010000 C) 1407282359

E) SEGMENTS ATS ROUTES CLOSED:
KHR-GOBUN A137 LS-TP A83
RUBES-FASAD B493 OLGIN-MASOL G476
KERTA-FASAD L140 LS-NALEM L32
DNP-GONED L69 PW-FASAD L984
DNP-TAMAK M70 KHR-KUBOK M987
LI-OLGIN M995 KHR-GUKOL M996
LS-LI P851 MASOL-LUGAT T242
PW-ELBAM W531 TOROS-KERTA W533
LI-FASAD W538 RUBES-KUBIR W546
ELBAM-OLGIN W617 GOBUN-LI W624
RUBES-LUGAT W633 DON-TAGAN W644.
FROM SFC TO FL260.)

A1387/14 NOTAM
Q) UKXX/QRTCA/IV/BO /W /140/180/4805N03533E197
A) UKBV UKDV UKFV UKOV
B) 1407010000 C) 1407282359

E) TEMPO RESTRICTED AREA BOUNDED BY COORDINATES: 511400N 0342700E 504942N 0341300E 502043N 0335720E 501000N 0335500E 491900N 0334000E 485800N 0332500E 484118N 0324431E 483620N 0324010E 483128N 0323605E 482300N 0323900E 480730N 0325324E 474600N 0325000E 474400N 0330300E 464600N 0325300E 460730N 0325430E 455700N 0331937E 454600N 0333000E 453840N 0344305E 452840N 0350317E 445612N 0363636E 450418N 0363418E 451218N 0363200E 451442N 0363542E 451824N 0363524E 452242N 0364100E 452700N 0364100E 463424N 0372206E 463930N 0372518E 464700N 0373000E 465400N 0370500E 472200N 0363900E 475542N 0355136E 473846N 0353706E 472442N 0351749E 473100N 0350455E 474943N 0345125E 474907N 0344411E 481312N 0340735E 482257N 0340608E 484200N 0341000E 485800N 0344500E 484000N 0353900E 481520N 0360510E 490600N 0365000E 494030N 0364948E 492000N 0361400E 492000N 0352200E 495600N 0353000E 502218N 0353848E
THEN ALONG STATE BOUNDARY UNTIL POINT 511400N 0342700E CLOSED.

F) FL140 G) FL180)

A1389/14 NOTAM
Q) UKXX/QRTCA/IV/BO /W /210/260/4805N03533E197
A) UKBV UK DV UKFV UKOV
B) 1407010000 C) 1407282359

E) TEMPO RESTRICTED AREA BOUNDED BY COORDINATES: 511400N 0342700E 504942N 0341300E 502043N 0335720E 501000N 0335500E 491900N 0334000E 485800N 0332500E 484118N 0324431E 483620N 0324010E 483128N 0323605E 482300N 0323900E 480730N 0325324E 474600N 0325000E 474400N 0330300E 464600N 0325300E 460730N 0325430E 455700N 0331937E 454600N 0333000E 453840N 0344305E 452840N 0350317E 445612N 0363636E 450418N 0363418E 451218N 0363200E 451442N 0363542E 451824N 0363524E 452242N 0364100E 452700N 0364100E 463424N 0372206E 463930N 0372518E 464700N 0373000E 465400N 0370500E 472200N 0363900E 475542N 0355136E 473846N 0353706E 472442N 0351749E 473100N 0350455E 474943N 0345125E 474907N 0344411E 481312N 0340735E 482257N 0340608E 484200N 0341000E 485800N 0344500E 484000N 0353900E 481520N 0360510E 490600N 0365000E 494030N 0364948E 492000N 0361400E 492000N 0352200E 495600N 0353000E 502218N 0353848E
THEN ALONG STATE BOUNDARY UNTIL POINT 511400N 0342700E CLOSED.

F) FL210 G) FL260

A1492/14 NOTAM
Q) UKDV/QRTCA/IV/BO /W /260/320/4822N03807E095
A) UKDV
B) 1407141800 C) 1408142359EST
E) TEMPO RESTRICTED AREA INSTALLED WITHIN FIR DNIPROPETROVSK BOUNDED BY COORDINATES : 495355N 0380155E 485213N 0372209E 480122N 0370253E 471352N 0365856E 465018N 0374325E 465900N 0382000E 470642N 0381324E
THEN ALONG STATE BOUNDARY UNTIL POINT 495355N 0380155E.
RESTRICTION NOT APPLIED FOR FLIGHTS OF STATE ACFT OF UKRAINE.

F) FL260 G) FL320)

A1493/14 NOTAM
Q) UKDV/QARLC/IV/NBO/E /260/320/4820N03716E119
A) UKDV
B) 1407141800 C) 1408142359EST

E) SEGMENTS OF ATS ROUTES CLOSED:
T242 NALEM MASOL M996 ABUGA GUKOL
G476 MASOL OLGIN W533 TOROS KUBIR
L32 NALEM KW P851 LS NESLO
A83 LS DIMAB L980 GANRA TAMAK
W538 GANRA FASAD W633 LUGAT MAKAK
L69 LAMIV GONED W644 DON GETBO
M70 BULIG TAMAK B493 PODOL FASAD

L984 BULIG FASAD W531 KOVIL PW
M136 MEBAM DON M995 OLGIN PENAK
L140 KOVIL FASAD.
FM FL260 UP TO FL320

NOTAM number	Lower limit	Upper limit	Valid from
1507/14	FL320	UNL	17 July, 15.00
1517/14	SFC	UNL	18 July, 00.05

Table 4: UkSATSE NOTAMs issued after the crash.

A1507/14 NOTAM
Q) UKDV/QRTCA/IV/BO /W /320/660/4822N03807E095
A) UKDV
B) 1407171500 C) 1408172359EST

E) TEMPO RESTRICTED AREA INSTALLED WITHIN FIR DNIPROPETROVSK
BOUNDED BY COORDINATES :
495355N 0380155E 485213N 0372209E 480122N 0370253E
471352N 0365856E 465018N 0374325E 465900N 0382000E
470642N 0381324E THEN ALONG STATE BOUNDARY UNTIL POINT 495355N 0380155E.
RESTRICTION NOT APPLIED FOR FLIGHTS OF STATE ACFT OF UKRAINE.

F) FL320 G) UNL

A1517/14 NOTAM
Q) UKXX/QRTCA/IV/BO /W /000/660/4801N03731E117
A) UKDV UKFV
B) 1407180005 C) 1408172359
E) TEMPO RESTRICTED AREA BOUNDED BY COORDINATES:
495428N 0380202E 490600N 0365000E
481520N 0360510E 475542N 0355136E
460809N 0370518E 464700N 0373000E
465900N 0382000E 470642N 0381324E
THEN ALONG STATE BOUNDARY UNTIL POINT 495428N 0380202E CLOSED.

F) SFC G) UNL

NOTAMs - Russian Federation

NOTAM number	Lower limit	Upper limit	Valid from	Valid to
6158/14	Various	Various to FL530	17 July, 00.00	January 2038
2681/14	SFC	FL330/FL340	17 July, 00.00	January 2038

Table 5: Russian Federation NOTAMs restricting airspace in force at the time of the crash.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

A6158/14 NOTAM
Q) Not reported
A) URRV
B) 1407170000 C) 3801010000

DUE TO COMBAT ACTIONS ON THE TERRITORY OF THE UKRAINE NEAR THE STATE BORDER WITH THE RUSSIAN FEDERATION AND THE FACTS OF FIRING FROM THE TERRITORY OF THE UKRAINE TOWARDS THE TERRITORY OF RUSSIAN FEDERATION, TO ENSURE INTL FLT SAFETY,
ATS RTE SEGMENTS CLSD AS FLW:
- A100 MIMRA - ROSTOV-NA-DONU VOR/DME (RND),
- B145 KANON - ASMIL,
- G247 MIMRA - BAGAYEVSKIY NDB (BA),
- A87 TAMAK - SARNA,
- A102 PENEG - NALEM,
- A225 GUKOL - ODETA,
- A712 TAMAK - SAMBEK NDB (SB),
- B493 FASAD - ROSTOV-NA-DONU VOR/DME (RND),
- B947 TAMAK - ROSTOV-NA-DONU VOR/DME (RND),
- G118 LATRI - BAGAYEVSKIY NDB (BA),
- G534 MIMRA - TOROS,
- G904 FASAD - SUTAG,
- R114 BAGAYEVSKIY NDB (BA)-NALEM.
SFC - FL320
DEP FM/ARR TO ROSTOV-NA-DONU AD TO/FM MOSCOW FIR CARRIED OUT ALONG ATS RTE G128 KONSTANTINOVSK NDB (KA) - MOROZOVSK VOR/DME (MOR) AND R11 MOROZOVSK VOR/DME (MOR) - BUTRI ON ASSIGNED FL.
DEP FM ROSTOV-NA-DONU AD TO DNIPROPETROVSK FIR CARRIED OUT ALONG ATS RTE A102 KONSTANTINOVSK NDB (KA) - NALEM ON FL340 AND ABOVE.
ARR TO ROSTOV-NA-DONU AD FM DNIPROPETROVSK FIR CARRIED OUT ALONG ATS RTE A712 TAMAK - SAMBEK NDB (SB) THEN DCT KONSTANTINOVSK NDB (KA) ON FL330 AND ABOVE.
SFC TO FL530

A2681/14 NOTAM
Q) Not reported
A) URRR
B) 1407170000 C) 3801010000

DUE TO COMBAT ACTIONS ON THE TERRITORY OF THE UKRAINE NEAR THE STATE BORDER WITH THE RUSSIAN FEDERATION AND THE FACTS OF FIRING FROM THE TERRITORY OF THE UKRAINE TOWARDS THE TERRITORY OF RUSSIAN FEDERATION, TO ENSURE INTL FLT SAFETY DEP FM/ARR TO ROSTOV-NA-DONU AD TO/FM MOSCOW FIR CARRIED OUT ALONG ATS RTE:
G128 KONSTANTINOVSK NDB (KA) - MOROZOVSK VOR/DME (MOR) AND R11 MOROZOVSK VOR/DME (MOR) - BUTRI ON ASSIGNED FL.

DEP FM ROSTOV-NA-DONU AD TO DNIPROPETROVSK FIR CARRIED OUT ALONG ATS RTE A102 KONSTANTINOVSK NDB (KA) - NALEM ON FL340 AND ABOVE.
ARR TO ROSTOV-NA-DONU AD FM DNIPROPETROVSK FIR CARRIED OUT ALONG ATS RTE A712 TAMAK - SAMBEK NDB (SB) THEN DCT KONSTANTINOVSK NDB (KA) ON FL330 AND ABOVE.

Malaysia Airlines briefing note - loss of GPS signals

The following company briefing note was issued by Malaysia Airlines to its crews on flights crossing Ukrainian airspace:

Official Dispatch Briefing
MAS017 17JUL14 9MMRD 777-2 EHAM 1000 WMKK 2210

Page 6/11
Trans ID: 2660858
Creation Time: 17.07.2014 07:05UTC

Overflight: 231135 EPWWZGZX DD 23Jan14.

UKDV / DNIPROPETROVS'K

GPS SIGNAL OUTAGE MAS 00083/14 (28 APR 14)

28 APR 2014 00:00-01 JAN 2038 00:00
GPS SIGNAL OUTAGE HAD BEEN REPORTED BY SEVERAL FLIGHTS WHEN OVER FLYING UKRAINE AIRSPACE, LOSING UP TO BOTH GPS SIGNAL. THE SIGNAL WAS RESTORED WHEN LEAVING UKRAINE FIRS.
PILOTS ARE REQUIRED TO EXERCISE VIGILANT WHEN TRANSITING THE AIRSPACE.
SHOULD YOUR FLIGHT ENCOUNTER GPS SIGNAL LOSS, PLEASE REPORT IN THE VR WITH THE FOLLOWING NOTES:
1. LOCATION (WAYPOINTS) OR
2. LAT/LONG
3. ALTITUDE
4. LOCATION WHEN SIGNAL RECOVERS

Authority:
Captain Wee YC
Chief Pilot Technical and Development

Figure 3: Company briefing note regarding loss of GPS signal. (Source: Malaysia Airlines)

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

APPENDIX E

LOAD INFORMATION

The flight's load sheet, showing the information about the loading of the aeroplane is reproduced here.

```
 ÇDVC-67003 1013 17JUL14

MALAYSIA AIRLINES

L O A D S H E E T              CHECKED BY           APPROVED      EDNO
ALL WEIGHTS IN KG             MHOEBEE                               02

FROM/TO FLIGHT            A/C REG VERSION         CREW      DATE     TIME
AMS KUL MH0017/17         9M-MRD  J33Y245         4/11      17JUL14 1013
                            WEIGHT             DISTRIBUTION
LOAD IN COMPARTMENTS         17751 1/4780 2/6450 3/1066 4/4626 5/829
                                   0/0
PASSENGER/CABIN BAG          20225 257/23/3          TTL 283 CAB 0
                                   PAX 33/247
TOTAL TRAFFIC LOAD           37976
DRY OPERATING WEIGHT        145015
ZERO FUEL WEIGHT ACTUAL 182991 MAX 195044         ADJ
--------------------------------------------------
TAKE OFF FUEL                95700
TAKE OFF WEIGHT ACTUAL  278691 MAX  286897  L    ADJ
--------------------------------------------------
TRIP FUEL                    86900
LANDING WEIGHT    ACTUAL 191791 MAX 208652        ADJ
--------------------------------------------------
BALANCE AND SEATING CONDITIONS          LAST MINUTE CHANGES
DOI         59.40 DLI          45.66   DEST   SPEC     CL/CPT + - WEIGHT
LIZFW       52.17 MACZFW       26.06
LITOW       35.47 MACTOW       25.51


STAB TO  06.7 MID
SEATING
0A/33 0B/140 0C/105

UNDERLOAD BEFORE LMC        8206                LMC TOTAL + -

LOADMESSAGE AND CAPTAINS INFORMATION BEFORE LMC


PANTRY A                 6231/ 01.1



*** CONNECTED TO CHECK-IN APPLICATION ***

LOADSHEET BY MHOEBEE WBC S8-14 EXP 26JAN2016
NOTOC YES
PANTRY A


   NOTOC - YES

LDM
MH017/17.9M-MRD.J33Y245.4/11
-KUL.257/23/3.0.T17751.1/4780.2/6450.3/1066.4/4626
.5/829
.PAX/33/247.PAD/0/0.PEF/21P.PEF/22P.AVI/52
SI
KUL.B5625.C11910.MNIL.E216
```

Figure 4: Load sheet for flight MH17. (Source: Malaysia Airlines)

The flight's NOTOC, issued at Schiphol, is reproduced here.

Page 1 of 1

AVIAPARTNER CARGO SERVICES

SPECIAL LOAD - NOTIFICATION TO CAPTAIN

Station of Loading	Flight Number	Date	Aircraft Registration	Prepared by
AMS	MH-017	17. July 2014	9M-MRD	RIK

DANGEROUS GOODS

Station of Unloading	Air Waybill Number	Proper Shipping Name	Class or Division For Class 1 compat. grp.	UN or ID Number	Sub Risk	Number of Packages	Net quantity or Transp. Ind. per package	Radio-active Mat. Categ.	PG	IMP Code	ERG	CAO	Loaded ULD ID	POS

There is no evidence that any damaged or leaking packages containing dangerous goods have been loaded on the aircraft. (see mass and balance documentation)

OTHER SPECIAL LOAD

Station of Unloading	Air Waybill Number	Contents and Description	Number of Packages	Quantity	Supplementary Information	Code	Loaded ULD ID	POS
KUL	232-12805085	MEDICALS	1	91.6 kg	KEEO COOL AT 2 AND 20 C	PIL	PMC60869MH	11
KUL	232-12790330	FRESH FLOWERS	12	215 kg	KEEP COOL AT 3 AND 5 C	PEF	PMC61810MH PMC62422MH	32 31
KUL	232-12774134	LIVE PIGEONS	4	82 kg	80X60X30CM	AVI	BLK	H5
KUL	232-11342295	LIVE BIRDS	5	70 kg		AVI	BLK	H5
KUL	232-12809591	LIVE DOG	1	30 kg		AVI	BLK	H5
KUL	232-12809635	LIVE DOG	1	20 kg		AVI	BLK	H5

Other Information

Captain's signature:

LOADING CERTIFICATION
I certify that these articles have been loaded in accordance with all regulations and that there is no evidence of leaking or damaged packages. (to be signed by loadcontroller)

Loading supervisor's signature:

Figure 5: NOTOC for flight MH17. (Source: Malaysia Airlines)

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

The cargo and baggage was loaded as shown in Figure 6 and Table 6.

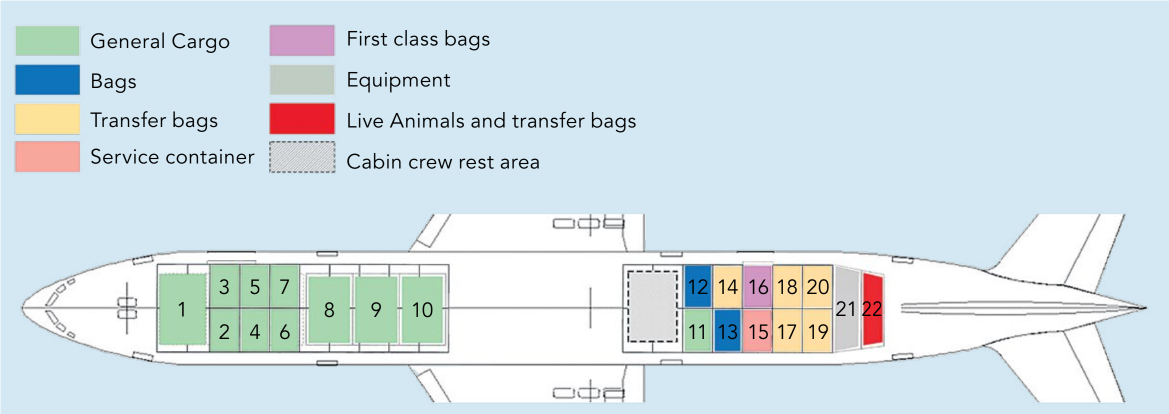


Figure 6: Distribution of cargo and baggage in the aircraft. (Source: Dutch Safety Board)

Position in Figure 6	Position number	Mass (kg)	Reference number
1	11P	1085	PMC60869MH
2	12L	515	AKE3951MH
3	12R	480	AKE6377MH
4	13L	625	AKE3540MH
5	13R	620	AKE90678MH
6	14L	655	AKE90446MH
7	14R	800	AKE90318MH
8	21P	1255	PMC62422MH
9	22P	1660	PMC61810MH
10	23P	3535	PMC6157MH
11	33L	410	AKE3664MH
12	33R	656	AKE3563MH
13	41L	416	AKE6032MH
14	41R	601	AKE3533MH
15	42L	91	AKE8522MH
16	42R	519	AKE3416MH
17	43L	708	AKE90655MH
18	43R	862	AKE3983MH
19	44L	811	AKE3417MH
20	44R	618	AKE90375MH
21	51L	559	#BULK
22	52R	270	#BULK

Table 6: Load information for flight MH17.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

WEATHER CHART AND WEATHER SATELLITE IMAGE

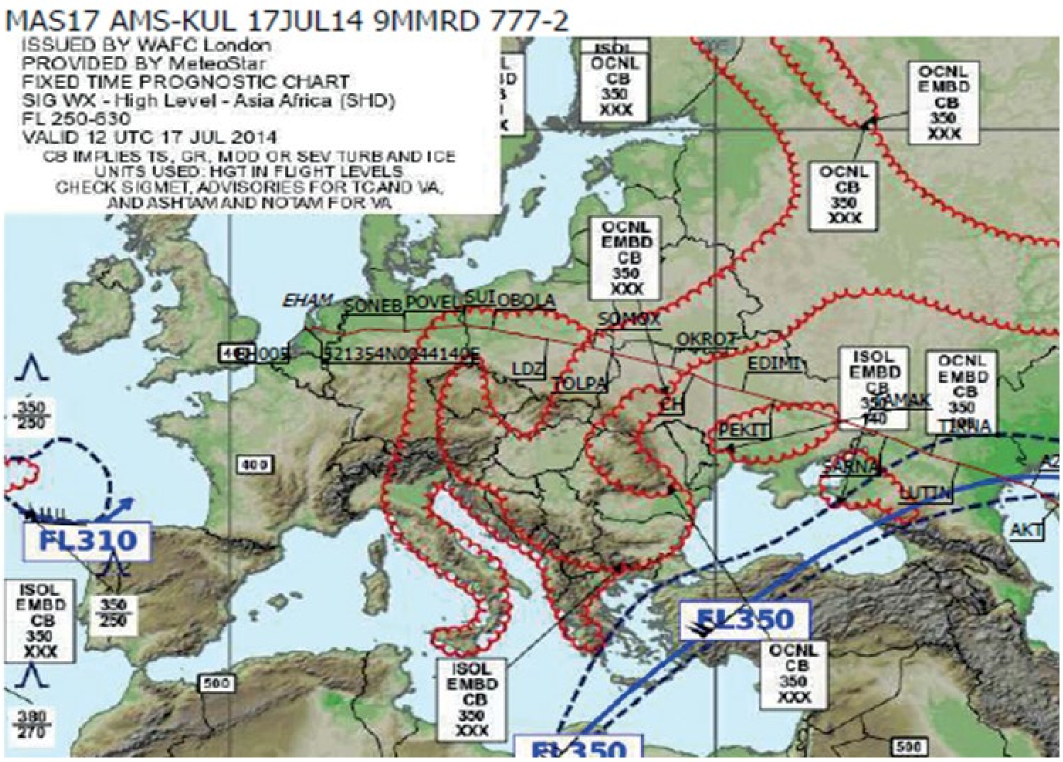


Figure 7: Synoptic weather for Europe, 17 July 2014. (Source: Meteostar via Aviapartner)

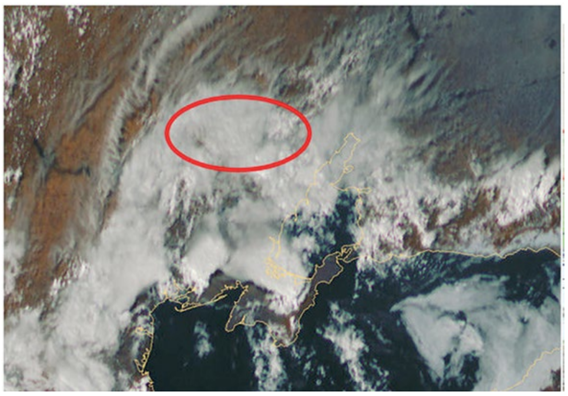


Figure 8: Weather satellite image, eastern part of Ukraine, 17 July 2014, 13.15 (15.15 CET). (Source: KNMI)

APPENDIX G

ATC TRANSCRIPT

This appendix contains relevant portions of communication between air traffic controllers and the aeroplane's crew and between different air traffic controllers as recorded by UkSATSE.

The codes used in this transcript are:

CALLSIGN

MH17 = Malaysia Airlines flight MH17
SIN351 = Singapore Airlines flight SIN351
AIRCRAFT = Aircraft, callsign unknown

DNP = Dnipro Radar, Ukraine
S2 = Sector 2
S4 = Sector 4
RST = Rostov Radar, Russian Federation

MEANS OF COMMUNICATION

RAD = VHF Radio

TEL = Telephone

Where a language other than English was used, a translation is given in the right hand column.

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
12.53:29	MH17	RAD	Hello, Dnipro, Malaysian one seven, flight level three three zero	
	DNP (S2)	RAD	Malaysian one seven, Dnipro Radar, hello, identified, advise ... able to climb flight level three five zero?	
	MH17	RAD	Malaysian one seven, negative, we are maintain three three zero	
	DNP (S2)	RAD	Malaysian one seven, roger	
13.00:02	MH17	RAD	Dnipro, Malaysian one seven, okay, start to two zero miles to the left of track due to weather?	

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	DNP (S2)	RAD	Malaysian one seven, roger, cleared avoid	
	MH17	RAD	Roger, cleared two zero miles left, Malaysian one seven	
13.00:52	MH17	RAD	Malaysian one seven, is level three four zero non-standard available?	
	DNP (S2)	RAD	Malaysian one seven, stand by	
13.01:20	DNP (S2)	RAD	Malaysian one seven, maintain flight level three three zero for a while, three four zero is not available for now	
	MH17	RAD	Roger, maintain three three zero, Malaysian one seven	
13.07:46	DNP (S2)	RAD	Malaysian one seven, contact Dnipro Radar, one three five decimal eight, bye	
	MH17	RAD	One three five eight, Malaysian one seven, good day	
13.08:00	MH17	RAD	Dnipro Radar, Malaysian one seven, flight level 330	
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar, good day, radar contact	
	MH17	RAD	Malaysian one seven	
13.19:21	DNP (S4)	TEL	Да.	Yes
	RST	TEL	Так. Днепр, Ростов один. Вы Малазийскому можете дать курс на Ростов, в точку RND, там у нас сходятся три штуки	So. Dniepr, Rostov one. Can you give a course (direction) for Malaysian to Rostov to the ROMEO NOVEMBER DELTA point, we have three converging traffic there
	DNP (S4)	TEL	Малазийскому семнадцатому?	To the Malaysian that is seventeen?
	RST	TEL	Да, потом мы его вернем на TIKNA	Yes, we will return it then to TIKNA
	DNP (S4)	TEL	Хорошо	Great (ok)
	RST	TEL	Да,точка RND	To point RND
	DNP (S4)	TEL	Хорошо	OK
	RST	TEL	Ага, спасибо	Yeah, thanks

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
13.19:49	DNP (S4)	RAD	Malaysian one seven, due traffic proceed direct to point ROMEO NOVEMBER DELTA	
13.19:56	MH17	RAD	ROMEO NOVEMBER DELTA, Malaysian one seven	
13.20:00	DNP (S4)	RAD	Malaysian one seven, and after point ROMEO NOVEMBER DELTA expect direct to TIKNA	
13.21:10	DNP (S4)	RAD	Malaysian one seven, how do you read me?	
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.21:36	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.22:02	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.22:05	RST	TEL	Слушаю, Ростов	Listening you, its Rostov
	DNP (S4)	TEL	Ростов, а вы малазийца семнадцатого наблюдаете по...по ответу?	Rostov, do you observe the Malaysian seventeen by… by the transponder?
	RST	TEL	Да нет. Что то начала разваливаться метка его.	No. It seems that its mark has started to break
	DNP (S4)	TEL	Ну у нас тоже. И на вызовы не отвечает	Well, we have the same. And it's not responding for our calls too
	RST	TEL	И не отвечает на вызовы, да?	He is not responding to the calls, is he?
	DNP (S4)	TEL	Да. И не видим пока его. То-есть ему дали отворот, он подтвердил и …	No. And we don't see it yet. So we gave him a turn, he confirmed and…
	RST	TEL	И все, да?	And that was all, yes?
	DNP (S4)	TEL	Да и исчез.	Yes, and it disappeared
	RST	TEL	Сейчас, подожди, я попрошу.	Wait now, I'll ask
	DNP (S4)	TEL	В пассиве там ничего у вас не наблюдается?	In primary don't you observe anything either?
	RST	TEL	Не не не ничего. Ничего не видим.	No, no, no, nothing. We see nothing.
	DNP (S4)	TEL	Ну хорошо, сейчас мы зовем их сюда.	Ok then, we are calling them here now

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.23:04	DNP (S4)	RAD	Singapore three five one, Dnipro Radar	
	SIN351	RAD	Singapore three five one, go ahead	
	DNP (S4)	RAD	Singapore three five one, please, report, are you observed traffic ahead of you at distance one six miles at flight level three three zero?	
	SIN351	RAD	Singapore three five one, copied, stand by	
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
	AIRCRAFT	RAD	Malaysian one seven, Dnipro Radar is calling you	
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar, how do you read me?	
	DNP (S4)	RAD	Singapore three five one, Dnipro Radar	
	SIN351	RAD	Singapore three five one, go ahead	
	DNP (S4)	RAD	Singapore three five one, do you have any traffic insight of you?	
	SIN351	RAD	Singapore three five one, negative, say again position of traffic	
	DNP (S4)	RAD	Singapore three five one, roger	
13.24:03	RST	TEL	Днепр, слушаю, Ростов один	Dniepr, listening, Rostov one
	DNP (S4)	TEL	Ну что не видно, не слышно?	So nothing is seen, nothing is heard?
	RST	TEL	Не видно... Слушай, «СИНГАПУРА» вижу три пять ноль, его вижу, а этого...	It is not seen. Listen, I do see three five zero "SINGAPORE", I see him but not your's...

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	DNP (S4)	TEL	А это ладно, ну мы тоже не видим. У нас пассив идет просто, синтетическая метка и все	Oh, fine with that. Well we don't see him either. Its just synthetic mark goes on, synthetic mark and that's all.
	RST	TEL	Где он хоть... синтетическая...где он хоть находится?	Where is it…by synthetic… where is it anyway?
	DNP (S4)	TEL	Ну по синтетике над точкой TAMAK. Но мы же дали отворот, а синтетика ведет его по плану, да. То есть мы не знаєм...	Well by synthetic over the TAMAK point. But we gave the turn, while synthetic shows it by plan, so we don't know….
	RST	TEL	Ну мы тогда сейчас скинем этого, три два ноль дадим ему.	Ok then we'll drop this one, we'll give him three two zero
	DNP (S4)	TEL	Ну давайте. Потому что крайняя была три три ноль, курс Ростов, все что он... дали на ROMEO NOVEMBER DELTA, да, и сказали после ROMEO NOVEMBER DELTA рассчитывать TIKNA	Ok let's do it. Because the last one was three three zero, direction to Rostov, everything he… gave to ROMEO NOVEMBER DELTA, yes, and told after ROMEO NOVEMBER DELTA expect TIKNA
13.25:22	DNP (S4)	RAD	Singapore three five one, check your TCAS please, report are you ... do you have any traffic ahead of you, at flight level three three zero?	
	SIN351	RAD	Singapore three five one, roger, looking a traffic and say again distance of traffic from us	
	DNP (S4)	RAD	Singapore three five one, below position, but approximately one five miles	
	SIN351	RAD	Singapore three five one, negative, no indication of traffic on TCAS though	
	DNP (S4)	RAD	Singapore three five one, roger, thanks, contact Rostov Control one three three decimal six	
	SIN351	RAD	One three three six, Singapore three five one, good day	
13.25:56	RST	TEL	Да, Днепр, слушаю Ростов	Yes Dniepr, listening to you, Its Rostov

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	DNP (S4)	TEL	Ростов, что то есть у вас?	Rostov, do you have anything?
	RST	TEL	Ничего нету, слушай.	We have nothing, listen.
	DNP (S4)	TEL	И у нас он не откликается. Он шел, крайнее было указание следовать на Ростов, после Ростова на TIKNA, на триста тридцатом эшелоне	It is not responding to us too, it flew, the latest instruction was to proceed to Rostov, after Rostov to TIKNA, at FL three hundred and thirty.
	RST	TEL	Да, да, да, я ж по просьбе моей, да не видим ребята, не видим. Вот три пять ноль «СИНГАПУР» зашел, сейчас «VIMAVIA» тогда подымем...	Yes, yes, yes I'm by my request, yes guys we don't see, don't see. Here three five zero "SINGAPORE" entered, now "VIMAVIA" then we'll give it to climb…
	DNP (S4)	TEL	«СИНГАПУР» сзади. И его не вижу...не наблюдает...мы просим, он все спрашивает 'Где позиция, не вижу не вижу!'. Ничего то есть нам не докладывает.	"SINGAPORE" is behind. And I don't see it… he is not observing… we are requesting, and he is continuously asking where is the position, he only repeats "we don't see, we don't see", so he is not reporting anything to us.
	RST	TEL	Ой, ой, ой, конечно. Ладно, хорошо.	Wow wow oww, sure, ok, fine
13.26:05	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.26:35	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.27:03	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.27:26	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.27:46	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.28:00	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.28:37	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.28:51	RST	TEL	Слушаю Днепр, Ростов один	Listening you, Dniepr, It's Rostov one
	DNP (S4)	TEL	Ну как? Никак у вас ни заявился?	What's up? Didn't show up at yours?

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	RST	TEL	Никак. Да и не видим. Уже тут доложили всем это, и не видим и ничего это и на аварийке да не отвечает он?	In no way. No, and we don't see. Already reported here to everyone about this, and can't see anything. He is not responding on the emergency (frequency) one too?
	DNP (S4)	TEL	Да ни на чем не отвечает. Он пропал после как это отдали на Ростов...	No, not responding by any means. He disappeared after instructions was given to proceed to Rostov…
	RST	TEL	Ну да да. Как я попросил дать на Ростов да. Мы уже этого подняли три четыре ноль, отвернули его там на Багаевский…	Well yes, yes. As I asked to give to Rostov, yes. We have already raised that one three four zero, turned him to Bagaevskiy then…
	DNP (S4)	TEL	Угу. Ну все. Сзади СИНГАПУР тоже ничего не видит, никто там, ну хотя он в районе Ростова должен быть, если он так…	Uh Huh. Ok then. "SINGAPORE" is behind it, sees nothing too, nobody there, but actually it has to be in the vicinity of Rostov, if he(it) is so…
	RST	TEL	Да, он сейчас САМБЕК у нас проходит, а EVA прошла FASAD, навряд ли что, ага	Yes, he is now passing SAMBEK and EVA passed FASAD, I doubt if something, uh huh
	DNP (S4)	TEL	Ну что б кто то...	Well that someone…
13.29:44	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.30:03	RST	TEL	Днепр слушаю, Ростов один	Dniepr, listening to you, It's Rostov one
	DNP (S4)	TEL	Ростовчик, а у вас никого там нет в радиусе..? Малазийского тоже, что бы он может на частоте компании или где-то там позвал	Rostovchik, may be you have someone other Malaysian in the area around there. You could ask him to call on their operator frequency.
	RST	TEL	В радиусе Малазийского?	In the area around the Malaysian, you mean?
	DNP (S4)	TEL	Ну да, что бы те...Там может Малазийца нигде нет на связи. Может, попросить чтоб им там где-то окликнули через компанию. Попробуйте, потому что у нас никого нету Малазийца чтобы....	Well yes. May be they don't have contact with him either. So ask that someone somewhere to call him via the company... Try, because we don't have any other Malaysians here...

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	RST	TEL	Да вот я и смотрю, сейчас я скажу там РП. Там мало сейчас...пока мы тут ничего не видим	Yes I'm looking too, now I'll tell the Shift Supervisor, there is small amount now.. we see here nothing yet.
	DNP (S4)	TEL	Ну хорошо. Все тогда	Alright then, that's all
13.31:20	RST	TEL	Да. Слушаю РП.	Yes, Listening you, its Shift Supervisor
	DNP (S4)	TEL	Алло, (name).	Hello, (name)
	RST	TEL	Да.	Yes
	DNP (S4)	TEL	Это (name). Ну. что нашелся, нет Малазиец? И нету. У меня тоже пропал.	This is (name). So what, was it found that Malaysian, no? I don't see him.
	RST	TEL	Нет, у меня не синтетика, бо я метку видел, потом пропала высота, потом он у меня с потерей пошел.	No, I have no synthetic. because I saw a mark, then altitude disappeared; After that I saw him going with loss
	DNP (S4)	TEL	Ну, а я синтетику только видел, и все.	So I saw only synthetic at all
	RST	TEL	Нет, у меня нету его	No, I don't see him
	DNP (S4)	TEL	И нету у меня тоже, пропал	I don't see him either, he's gone
	RST	TEL	Я его видел, он с потерей пошел	I saw him, he went with loss
	DNP (S4)	TEL	Да, ну синтетику-то я тоже вижу, до сих пор вижу	Yes, but, I also see synthetics, I still see it.
	RST	TEL	А ты в том районе хорошо видишь?	But can you see well in that area?
	DNP (S4)	TEL	Сейчас... Я вижу конечно, я вижу почти до AKERI, вот до этой точки.	At this moment I can see well, of course. I can almost see till AKERI, till this point.
	RST	TEL	Я понял. Ну пока никого нету у меня из Малазийцев чтобы через авиакомпанию позвать.	I understood. But there is none of Malaysians at mine to call through the company...
	DNP (S4)	TEL	Ну вот Сингапур триста пятьдесят первый за ним шел следом.	But there a Singapore three hundred and fifty one followed him.
	RST	TEL	Ну он видел... че, нет его ?	But Did he see something? Nothing?
	DNP (S4)	TEL	Нет и по TCASу не видел.	No, by TCAS didn't see too

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	RST	TEL	А куда он деться-то мог ?	Where could he go?
	DNP (S4)	TEL	Не знаю.	No idea
	RST	TEL	Ладно, сейчас я его… Хорошо.	Ok, I'll him… ok
	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.35:50	DNP (S4)	RAD	Malaysian one seven, Dnipro Radar	
13.36:07	RST	TEL	Да.	Yes
	DNP (S4)	TEL	Ну, что нету ?	So what. Is it there?
	RST	TEL	Сейчас я воспроизведение смотрю. Уменя пока не отвечает, молчит	Now I am watching the playback, it (he) is still not responding to me, keeps silence.
	DNP (S4)	TEL	Понятно. Я сейчас тоже пойду смотреть и слушать.	Understood, I'm going to go to watch (a playback) and listen too.
13.36:25	RST	TEL	Да, Днепр, Ростов один. Слушаю	Yes, Dniepr, Rostov one is listening.
	DNP (S4)	TEL	Ростовчик, что там у вас, нету его ?	Rostovchik, what do you have over there, he's still not there?
	RST	TEL	Да ничего. Сейчас тоже вот, как говорится, по всем сейчас каналам этим и частотам. Да, сейчас вот тоже подняли тут, как говорится. Дальше будем спрашивать. Не знаю. Ну не видим. Нету метки, ни синтетики, никак.	Well, nothing. So to say by any channels, frequencies now also подняли (Word means: all personnel in a rush trying to figure everything out by any means) (alert everyone), so to say. Then we'll ask, I don't know, we don't see, no mark, no synthetics, nothing…
	DNP (S4)	TEL	Понятно. Ну мы тоже в ту степь никого доворачивать не будем, чтоб посмотреть то есть…	Understood, but we are not going to send somebody there to have a look, so to speak.
	RST	TEL	Ну, да, да, да. Ну че известно, подскажим.	Well, yes, yes, yes. Well, if we get anything, we'll let you know.
	DNP (S4)	TEL	Все, давай.	Ok, bye
13.48:59	RST	TEL	Да, Днипро.	Yes, Dnipro

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

TIME (UTC)	CALLSIGN	MEANS	ORIGINAL DISCOURSE	TRANSLATION
	DNP (S4)	TEL	Да, здравствуйте. Что-то дозваться вас не могли. К вам Малазиец так и не вышел? Вы его не видите?	Yes, hello, we couldn't reach you for some reason. The Malaysian still didn't show up to you, you don't see him?
	RST	TEL	Нет, не видим, не слышим! Я был занят у меня тут движение идет	No, we don't see him, don't hear him. I was busy I have traffic here.
	DNP (S4)	TEL	Хорошо, спасибо	Ok, thanks

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

RECORDED DATA

General description work performed

The Cockpit Voice Recorder and Flight Data Recorder were not recovered from the wreckage site by investigators of the investigation team, but by individuals unknown to the team.

On 21 July 2014, the recorders were handed over to a Malaysian official in Donetsk by representatives of the armed group controlling the area. The recorders were transported by train from Donetsk to Kharkiv accompanied by Dutch and Malaysian officials and then transported to Kyiv accompanied by Dutch, Malaysian and ICAO officials.

On 22 July 2014 at 19.00 (21.00 CET) in Kyiv, Ukraine, the Flight Data and Cockpit Voice Recorders from the Malaysia Airlines flight MH17 were taken into custody by the Dutch ambassador and a team of international investigators led by an investigator of the Dutch Safety Board.

The Dutch Safety Board requested that the UK Air Accidents Investigation Branch (AAIB) perform the data download from both the recorders. The recorders were transported to the AAIB's laboratory at Farnborough, arriving 23 July in the early morning. There, an international team of air safety investigators carried out work to download data contained within them. Investigators from the following states / organisations were present:

- Germany;
- Interstate Aviation Committee;
- Malaysia;
- The Netherlands;
- Ukraine;
- United Kingdom, and
- United States of America.

ICAO was present as observer.

On 23 July the international team of investigators started at approximately at 09.00 (11.00 CET) a thorough examination of the Cockpit Voice Recorder. The Cockpit Voice Recorder was damaged but the memory module was intact. Furthermore, no evidence or indications of manipulation of the Cockpit Voice Recorder were found. Following the examination, the Cockpit Voice Recorder data was successfully downloaded and contained valid data from the flight.

On 24 July at 08.00 (10.00 CET) the international investigation team conducted a thorough examination of the Flight Data Recorder. The Flight Data Recorder was slightly damaged but the memory module was intact. Furthermore, no evidence or indications of manipulation of the recorder were found.

Following the examination, the data was successfully downloaded and the Flight Data Recorder contained valid data of the flight. Downloaded data from the flight was decoded using multiple software tools from different manufacturers. The data is consistent with other recorded information regarding the flight of Malaysia Airlines flight MH17. Furthermore the unique ICAO 24-bit aircraft address issued by the State of Registry (Malaysia) matched the recorded ICAO 24-bit aircraft address code on the Flight Data Recorder. The State of Registry registered the aeroplane as 9M-MRD.

Initial work started to verify shortlist parameters from about 1,300 parameters recorded on the Flight Data Recorder and identify possible areas and/or systems of interest to the investigation team. The creation of a shortlist is a means to ensure an effective investigation and to obtain an insight into possible causes.

On 25 July at 08.30 (10.30 CET) the international investigation team wrapped up the work. A small team continued to work to verify a shortlist of parameters. On 26 July the 'short list' of parameter verification was completed.

Cockpit Voice Recorder

Recorder Manufacturer:	Honeywell
Recorder Model:	980-6020-001
Recorder Serial Number:	not available as data plate was damaged and unreadable, but the underside of the recorder contained a printed serial number 1366 (97396ASSY 710-G310-005 REV G).

This model Cockpit Voice Recorder is a solid-state Cockpit Voice Recorder that records 30 minutes of 4-channel digital cockpit audio. The recording consists of three individual crew positions microphones, and a 4th channel, the cockpit area microphone (CAM), that records additional audio information.

Upon arrival at the AAIB UK, it was evident that the Cockpit Voice Recorder had sustained damage. The Underwater Locator Beacon, or 'pinger', was attached to the unit. The Cockpit Voice Recorder casing was bent over the protective memory module. The Cockpit Voice Recorder was disassembled to gain access to the protective memory module. Once this was achieved the memory module was opened to retrieve the memory board. The protective moulded plastic covering (Room Temperature Vulcanizing or RTV plastic) was removed to verify the memory board was not damaged. The data stored on the memory board was downloaded normally.

On 23 July, after downloading the Cockpit Voice Recorder audio, a first listening session was held in the presence of the Accredited Representatives[6] and two Dutch Safety Board investigators. A second listening session was held with a representative from the Interstate Aviation Committee on 24 July together with a Dutch Safety Board investigator.

On 24 July a Cockpit Voice Recorder transcript group was formed. The task of the Cockpit Voice Recorder group was to transcribe flight pertinent information of the 30 minutes of available audio. This work was completed at the end of the day. After the successful download a second download of the Cockpit Voice Recorder was performed. The reason for this was that one channel was found to contain poor/unusable audio. The recorder group decided to perform a second download of the audio data using different equipment than on the day before. A comparison of the second download to the first download did not yield any difference. The poor sound quality on the CAM channel noted during the investigation was most likely due to the missing microphone cap from the CAM.

Thereafter, in August 2014, the Accredited Representatives from Ukraine and the Russian Federation listened to the Cockpit Voice Recorder data during meetings in The Hague with the Dutch Safety Board. In August 2015 another check was performed by a captain of Malaysia Airlines.

Crew communication gave no indication that there was anything abnormal with the flight. At the very end of the recording, two peaks of sound were identified on the last 20 milliseconds of the recording. A graphic representation of the two peaks of sound for the four Cockpit Voice Recorder microphones are shown here.

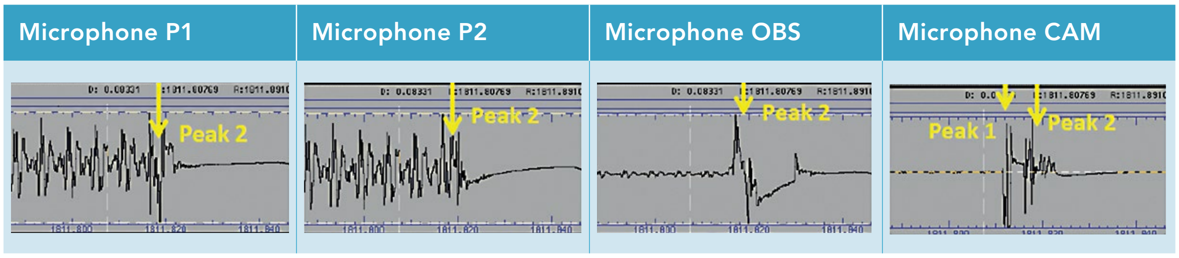


Figure 9: Sound peaks at end of recording. (Source: Dutch Safety Board)

The time period shown on each image is four hundredths of a second. It is noted that peak of sound ‘peak 1’ is only recorded on the CAM.

The Cockpit Voice Recorder investigation resulted in the following findings:

- The Cockpit Voice Recorder contained the event flight;
- No warnings were heard on the 30 minutes of audio on the Cockpit Voice Recorder;
- The Cockpit Voice Recorder audio ended abruptly;

6 The first listening session was attended by representatives from ICAO and from the following states: Germany, Malaysia, Ukraine, United Kingdom and the United States of America.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

- One of the four channels of audio was found to contain poor/unusable audio. The cockpit area microphone was not working as expected, and
- The Cockpit Voice Recorder did not contain additional flight operation information which was not already included in the air traffic control transcript.

Flight Data Recorder

Recorder Manufacturer:	Allied Signal (Honeywell)
Recorder Model:	980-4700-003
Recorder Serial Number:	2196

This solid-state Flight Data Recorder model accepts serial bit stream data in an ARINC 573/717 format at a rate of 128 12-bit words per second. The Flight Data Recorder uses solid-state flash memory technology as the recording medium. The recording is stored in a crash survivable memory unit. A minimum of the last 25 hours of operational data is retained on the recording medium. This output is a continuous sequence of four-second data frames. Each frame consists of four sub-frames of 128 separate 12-bit words, with the first word containing a unique 12-bit synchronisation word identifying it as sub-frame 1, 2, 3 or 4. The data stream is 'in sync' when successive synchronisation words appear at the proper 128-word intervals. If the data stream is interrupted, synchronisation words will not appear at the proper interval or sequence, and the time reference will be lost until the sub-frame pattern can be re-established.

Upon arrival at the AAIB, it was evident that the Flight Data Recorder had sustained little damage. The Underwater Locator Beacon was not attached to the unit and was missing, the bracket that holds the locator beacon to the Flight Data Recorder was however attached to the unit.

The protective memory module was accessible and opened by specialists. The memory board protective moulded plastic covering (RTV plastic) was removed and electrical continuity tests were performed to verify the memory board was not damaged. Next the memory board was downloaded from the unit normally using a 'surrogate download unit'.

From 24 July to 26 July, the Flight Data Recorder data was analyzed using decoding documentation provided to the Dutch Safety Board by the manufacturer under the provisions of ICAO Annex 13. Using a 'short list' of parameters the goal was to verify the Flight Data Recorder data and to determine if possible warnings of aeroplane systems were present at the end of the flight.

The Flight Data Recorder investigation concluded:

- The Flight Data Recorder data contains the event flight;
- No warnings have been detected in the data of flight MH17, and
- The Flight Data Recorder data ends abruptly and at the same time as the Cockpit Voice Recorder.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Three extracts of the Flight Data Recorder are shown for the final three minutes of the recorded data in the Figures 10 to 12.

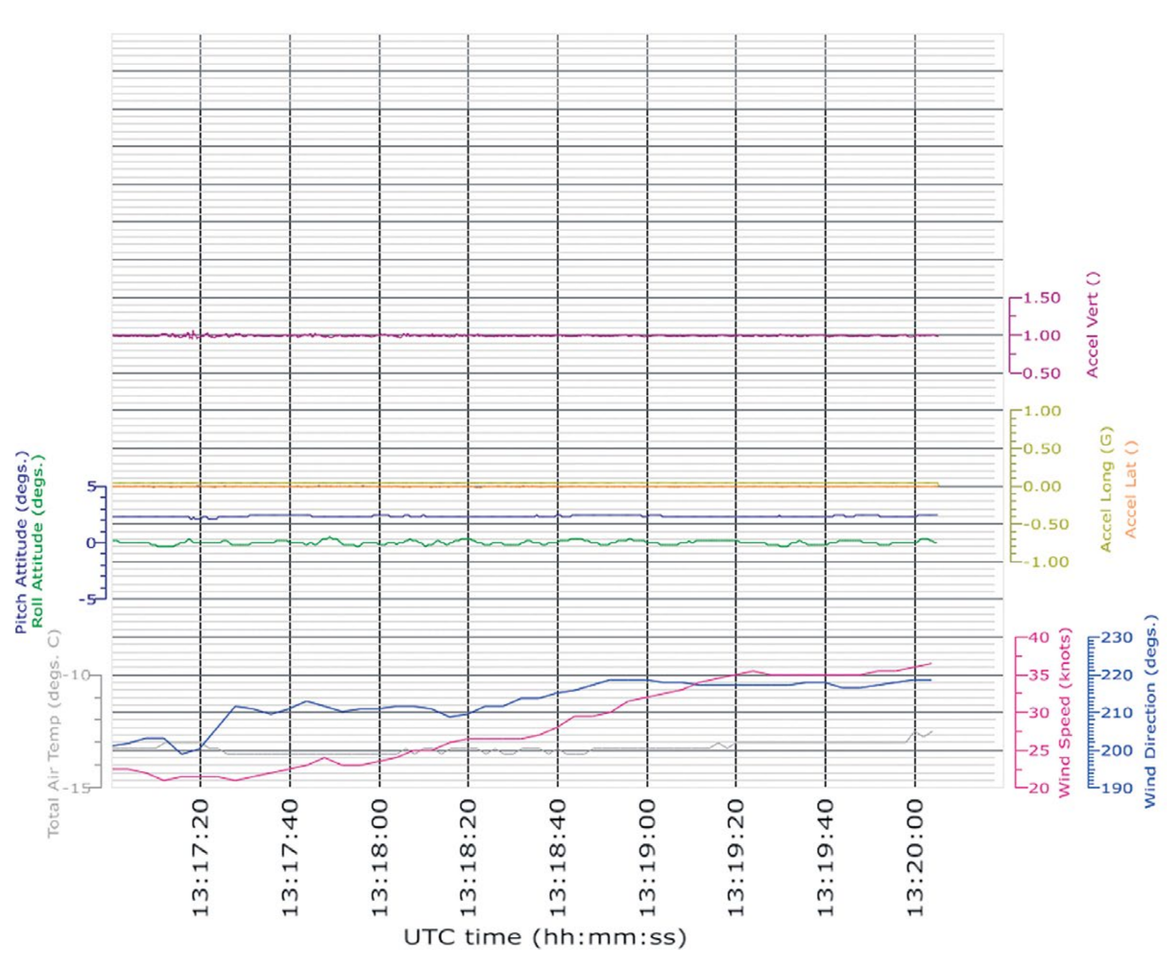


Figure 10: Flight Data Recorder data (image 1 of 3). (Source: Dutch Safety Board)

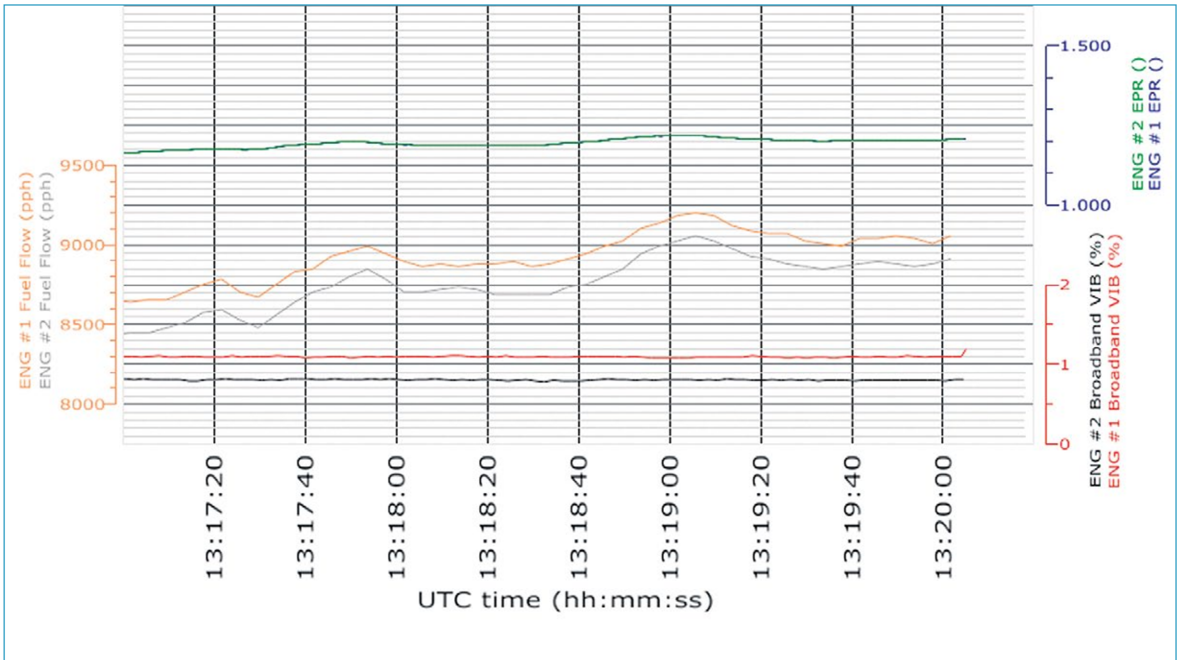


Figure 11: Flight Data Recorder data (image 2 of 3). (Source: Dutch Safety Board)

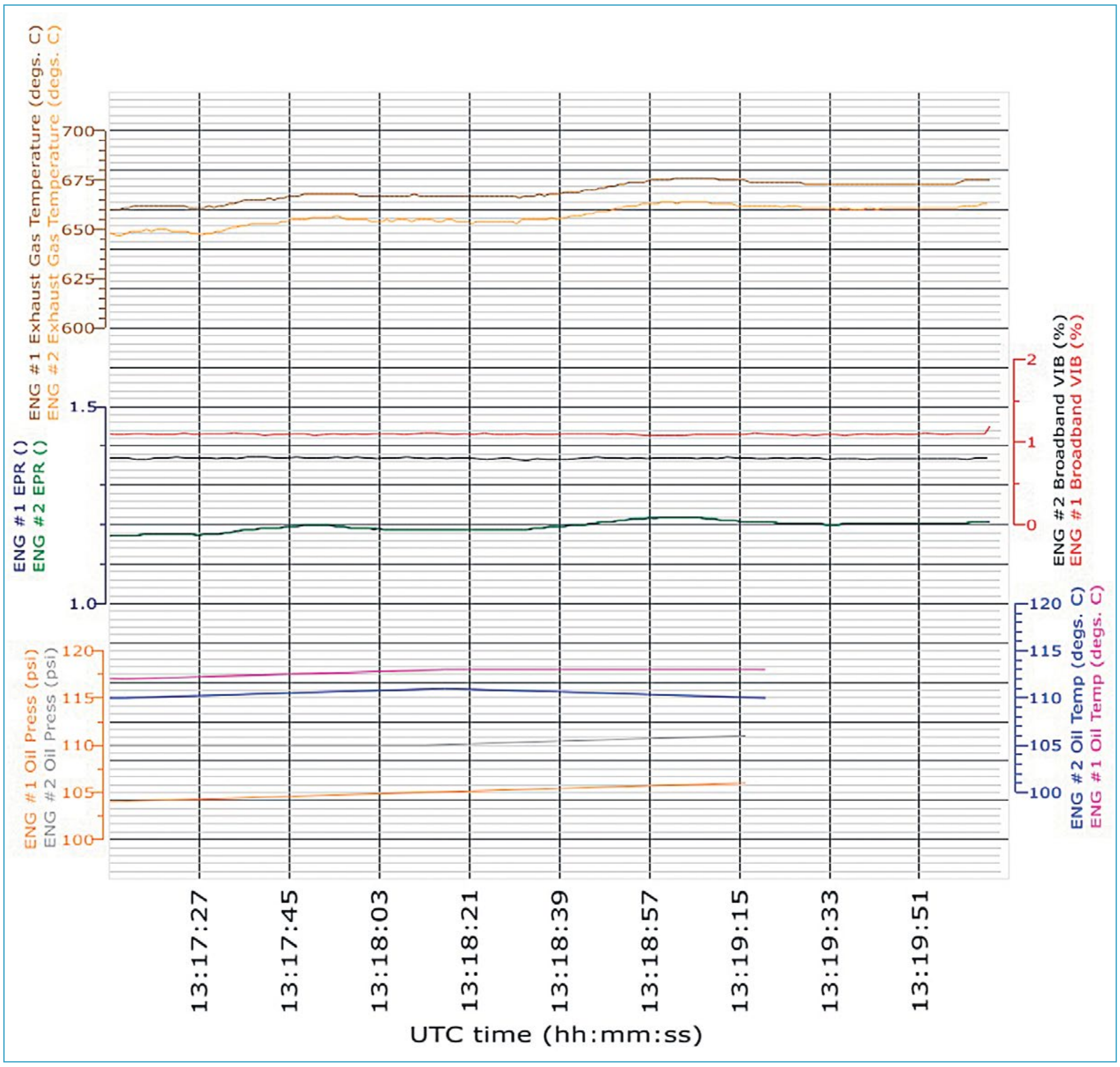


Figure 12: Flight Data Recorder data (image 3 of 3). (Source: Dutch Safety Board)

As can be seen in Figure 12, the reproduction of some engine parameters stops earlier than others. This is the result of the sampling rate (once per 64 seconds) for these parameters and is not related to a problem with the engines.

Emergency Locator Transmitters

Each Emergency Locator Transmitter was uniquely identifiable by a hexadecimal code embedded into the Emergency Locator Transmitter software. The fixed Emergency Locator Transmitter's code ended with the figures /0/1, whereas the portable Emergency Locator Transmitter ended /1/1. The code was for identification purposes and it was embedded in the data that was transmitted to a satellite when the Emergency Locator Transmitter was activated.

The unique codes for the two Emergency Locator Transmitters installed in the aeroplane were as follows:

Item	Fixed ELT	Portable ELT
Description	ELT ADT 406 AF	ELT ADT 406 AP
Customer	MALAYSIA AIRL	MALAYSIA AIRL
Aeroplane Type	Boeing 777	Boeing 777
Registration	9M-MRD	9M-MRD
Serial number	4340238	4340282
Unit code	533/1/9MMRD/0/1	533/1/9MMRD/1/1
Hex code	C2A439E7AB25CD1	C2A439E7AB25DD1

Table 7: Emergency Locator Transmitter coding.

The fixed Emergency Locator Transmitter, located in the aft section of the aeroplane, was connected to the cockpit remote control panel for manual activation. It has both a connector for the antenna on top of the fuselage and a back-up antenna.

The fixed Emergency Locator Transmitter was installed upside down, inside the fuselage in close proximity to the antenna. The fixed Emergency Locator Transmitter is located near the rear of the aeroplane at a point near Station 1880 (STA1880, See Section 12 - Abbreviations and Definitions); a part of the structure that normally remains together during an accident. The external antenna is located at STA1882.

The portable Emergency Locator Transmitter is located in a stowage area near the forward passenger door on the right hand side, door 1R. A placard is installed near the portable Emergency Locator Transmitter to inform the aeroplane's crew of its location. A portable Emergency Locator Transmitter has a 50 second time period between activation and the transmission of its signal. The portable Emergency Locator Transmitter, with only a manual system of activation, was not recovered. It was not activated; there was no data found to have been transmitted by the portable Emergency Locator Transmitter.

The ACARS traffic log file was received on 22 July 2014 by the AAIB. A preliminary analysis was performed on the data. Follow-up work was conducted on the data and a subsequent analysis was performed. Several questions were posed to the ACARS service provider and Malaysia Airlines to discuss the findings and verify received data and conclusions.

The log files of the Inmarsat system were received on 20 July 2014 for the investigation. A preliminary analysis was performed on the data. Follow-up work was conducted on the data and a subsequent analysis was performed. Several questions were posed to Inmarsat to discuss the findings and verify received data and conclusions.

Information was acquired on the specifications and the performance of the two Emergency Locator Transmitters installed in the aeroplane and to determine the Emergency Locator Transmitter's emergency signal time and position according to available information. In addition, the geographic location of the Emergency Locator Transmitter was analysed using COSPAS-SARSAT satellite and network data. Follow-up work was conducted on the COSPAS SARSAT data and a subsequent analysis was performed. Several questions were posed to COSPAS-SARSAT to discuss the findings and verify received data and conclusions.

It is noted that the fixed Emergency Locator Transmitter first transmitted a signal at around 13.20:36 (15.20:36 CET). This was relayed to ground station as follows:

Time (UTC)	Ground Station location
13.20:04.51	Algeria
13.20:35.70	Spain
13.20:36.01	Greece
13.20:36.02	France
13.20:36.09	Norway

Table 8: First time of Emergency Locator Transmitter signal receipt by ground stations.

The time of receipt of the message at the Algerian ground station was recorded as being at 13.20:04.51 (15.20:04.51 CET), 31 seconds earlier than the other messages. Verification against other messages received by the Algerian system on 17 July 2014 confirmed that there was an offset of just over 31 seconds in their recording system meaning that the message was actually recorded at 13.20:36 (15.20:36 CET); consistent with the other messages.

APPENDIX I

RADAR SCREEN IMAGES

Ukrainian air traffic control - radar data

The images in Table 9 show secondary surveillance data and are accompanied by text explaining the images and their symbols.

13.20:00	13.20:18
	
The secondary surveillance radar symbol for flight MH17 is shown in this image. The line displayed in brown is airway W633 with air navigation waypoint BELOL displayed.	An arrow appears on the display showing that the system has detected a loss of the secondary surveillance radar (Mode S) data link. According to information provided by UkSATSE, the arrow symbol is not expected to have been displayed at the actual time of the last data transmission.
13.20:36	**13.24:56**
	
The secondary radar data symbol for MH17 is replaced by a hashtag (#) symbol. This shows that the system has entered a 'synthetic' or extrapolated track mode known as 'coasting' (see below). This occurs from 13.20:36 until 13.24:56.	This image is taken from the data 4 seconds before it ends at 13.25:00. With the exception of other known and identified commercial traffic, no other aircraft are displayed near to the MH17 symbol between 13.20 and 13.25. The aeroplane is over the Russian Federation border on a predictive 'coasting' track.

Table 9: Ukraine air traffic control - radar screenshots. (Source: UkSATSE)

Notes
Times in Table 9 are in UTC only.

The symbols for flight MH17 are decoded as follows:

- The flight number MH17 is shown as 'MAS17';
- Its flight level, FL330, is shown as '330';
- The aeroplane type, Boeing 777-200, is shown as 'B772H' with the letter 'H' standing for 'heavy'; a term referring to the aeroplane's wake-turbulence category. The number '491' indicates the flight's groundspeed in knots;
- The word 'TAMAK' indicates the air navigation waypoint to which the aeroplane is currently cleared to.

The replay showed no other contacts in the direct vicinity of MH17.

A 'coasting' mode is one for which the radar returns have been (temporarily) interrupted and position and altitude are being predicted and displayed based on the previously received radar data and flight plan information. The phenomenon is comparable to the manner in which a car's navigation system continues to display vehicle movement when in a tunnel, without being able to receive a signal.

Russian Federation air traffic control - radar data

The film provided to the investigation by GKOVD depicted the Rostov air traffic controller's radar screen from 13.00 to 13.40 (15.00 to 15.40 CET) showing flight MH17 and other aircraft in the area. The scale of the screen was such that the distance shown from the symbol for flight MH17 is between about 30 and 60 km to the south, about 90 km plus to the north and east and about 200 km to the west. An image of the film, showing a small portion of the radar screen, is reproduced below.

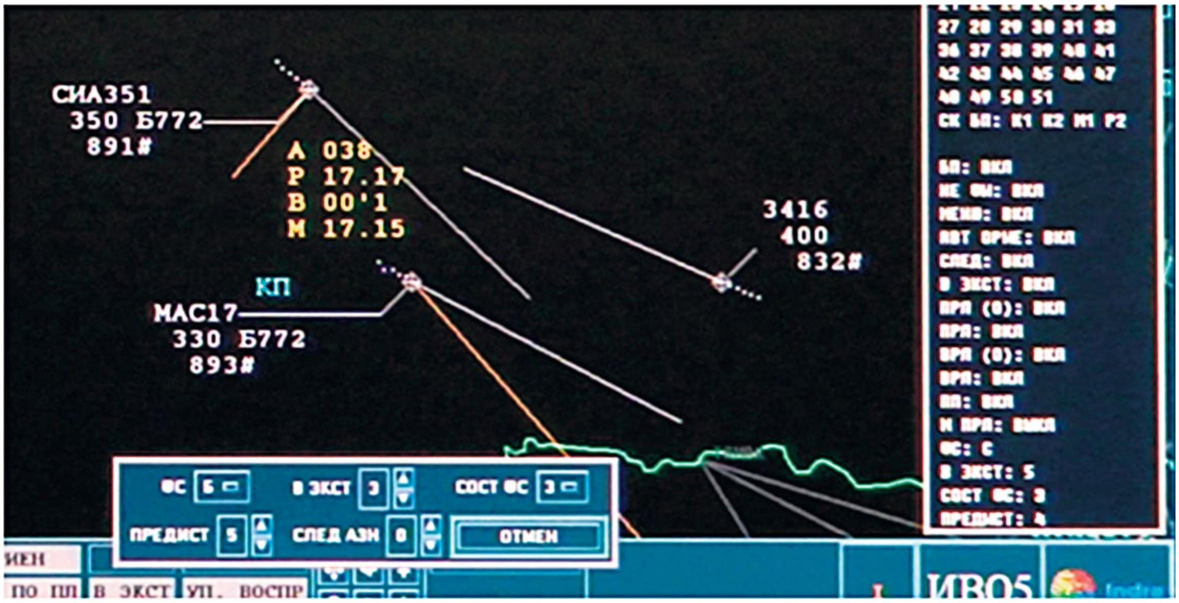


Figure 13: Russian Federation radar Basic image from film. (Source: GKOVD)

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

13.20:45

The combined primary and secondary surveillance radar symbols for flight MH17 are shown in this image. Data labels are in a Cyrillic script.

13.20:47

Data shows MH17 as a combined primary and secondary symbol and label. The symbol for MH17 shifts to the north-east with the speed vector turning to a north-easterly direction. A second primary return is displayed for the first time.

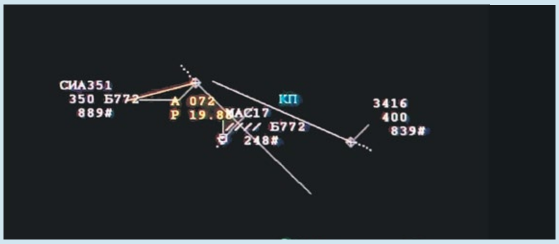
13.20:58

Data shows MH17 as a combined primary and secondary symbol, now labelled XXXX. This shows that the system has entered a 'synthetic' or extrapolated track mode known as 'coasting' (see below). The second primary return is no longer displayed.

13.21:18

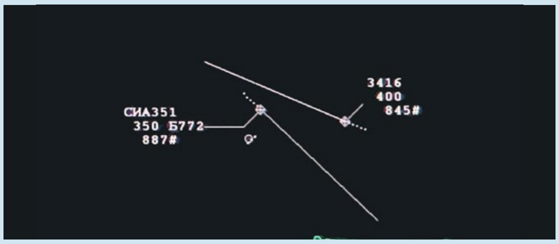
Data shows MH17 as a combined primary and secondary symbol, labelled XXXX.
A new primary return in the vicinity of the MH17 symbol appears.

13.21:28



MH17's primary symbol is shown as ////.
The second symbol remains as a primary return only.

13.22:18



The label for MH17 is no longer displayed. Primary returns are noted. These primary returns, first noted at 13.20:47, and others are analysed elsewhere in this report.

13.25:57

The label for MH17 is no longer displayed. Primary returns are noted. The second symbol, orginally near to MH17's position is no longer displayed.

Table 10: Russian Federation radar screenshots from film. (Source: GKOVD)

The images in Table 10 show stills from the video film of the Russian Federation radar display and they are intended to provide the reader with a summary of the final minutes of the display seen by the air traffic controller. The images below, comprising of primary and secondary surveillance data, are accompanied by an explanatory text regarding the image and its symbols.

Notes
Times in Table 10 are in UTC only.

The symbols for flight MH17 are decoded as follows:

- The flight number MH17 is shown as 'MAC17';
- Its flight level, FL330, is shown as '330';
- The aeroplane type, Boeing 777-200, is shown as 'Б772H' with the 'B' in Cyrillic script. The number '893' indicates the flight's groundspeed in km/h, and
- Data labels are in a Cyrillic script; MAC = MAS (Malaysia Airlines) and CHA = SIN (Singapore Airlines).

The aircraft identified as 3416 (Air India flight AIC 113) and CHA351 (Singapore Airlines SIN351) are not discussed in Table 10.

The replay showed no other contacts in the direct vicinity of MH17.

During the investigation it was confirmed by the Federal Air Transport Agency of the Russian Federation that the last known positions of MH17 was:

- *secondary surveillance data*: 48° 07´ 57' N 038° 39´ 47' E at time 13.22:10 (15.22:10 CET). This is 10 km north-east from the aeroplane's recorded position at 13.20:03 (15.20:03 CET).
- *primary radar data*: 48°06´ 39'N 038° 36´ 35' E at time 13.25:58 (15.25:58 CET). This is 4.5 km south-west from above mentioned secondary position mark, recorded at 13.22:10 (15.22:10 CET).

APPENDIX J

AEROPLANE SYSTEMS AND ENGINES INFORMATION

Aeroplane and engine - general information

General
The Boeing 777 is built by The Boeing Company and the type was first certified in 1995 under Federal Aviation Administration type certificate number T00001SE. Since entry into service, over 1,000 Boeing 777 aeroplanes have been built. Three main models of the Boeing 777 exist; the original -200 series, the longer -300 series and the cargo version of the aeroplane.

In the case of the accident aeroplane, it was a -200 variant of the type, powered by Rolls-Royce Trent 892B engines. The data relating to the accident aeroplane is summarised as follows:

Item	Details
Manufacturer	The Boeing Company
Type / Model	Boeing 777-200 / 777-2H6
Year of construction	1997
Registration	9M-MRD
Serial number	28411
Total flight hours / cycles	76,322.10 / 11,434
Maximum take-off mass	286,897 kg
Engine type	Rolls-Royce Trent 892B

Table 11: Summary of aeroplane information.

The aeroplane's general characteristics are as follows:

Length:	63.73 m
Wingspan:	60.93 m
Height:	18.76 m (when unloaded; this decreases when loaded to no less than 18.42 m).

Structure
The Boeing 777 is a conventional design transport aeroplane that makes use of lightweight structural materials to lessen the overall mass of the aeroplane. Such materials include aluminium alloys (e.g. Alloy 7055 made up of aluminium, zinc (ca. 8%), magnesium (ca. 2%) and copper (ca. 2%) among other elements) and composites such as carbon fibre.

The fuselage structure is semi-monocoque and has a near circular cross-section giving the fuselage a width of about 5.6 metres over most of its length. A pressurised section of fuselage between the forward and aft bulkhead includes both the passenger deck and lower baggage / cargo holds.

The aluminium skin is supported by frames, stringers and beams. A non-structural nose radome, tail cone and wing-to-body fairings complete the fuselage. Dividing the fuselage along its length is a metal / composite floor. The metal components are generally riveted together using countersunk rivets, whilst the composite parts are glued together. Skin panels are riveted and glued.

When referencing the location of structural parts, Boeing has sub-divided the fuselage into seven sections. See Abbreviations and Definitions.

The wing-to-body fairings are made of composite panels with a honeycomb core.

The wings are made up of an aluminium structure covered with aluminium skin panels. The horizontal and vertical tail structures are composed of aluminium boxes covered with a solid laminate carbon fibre reinforced plastic. Leading edges are aluminium covered.

Engines
The Rolls-Royce Trent 800 engine type was first certified by the European Aviation Safety Agency (EASA) in 1997 under EASA type certificate number E.047. The front fan is made up of 26 wide chord hollow titanium blades. The fan has a diameter of 2.79 m.

Engine Health Monitoring (EHM)
The condition of the engine is monitored by measuring engine system temperatures and vibrations, engine oil pressure and the three shaft speeds. These parameters values are compared to validated values of a performance model to verify margins with 'worst case' values. This data (albeit not continuous but 'snap shot' data) from flights during the preceding two weeks was also reviewed by Rolls-Royce to analyse engine trend performance and health. It is noted by Rolls-Royce that for the accident flight, only take-off and climb data reports were received; the cruise data having not been sent via the data link to the operator prior to the crash. The data is transmitted by the Aircraft Communication Addressing and Reporting System (ACARS) from time to time during the flight, but not necessarily at the time of data capture. Once received by the operator, Malaysia Airlines, it is forwarded to Rolls-Royce for analysis.

Based upon Rolls-Royce's Engine Health Monitoring analysis it was concluded that no parameter limits were exceeded. The left engine showed, since 4 July 2014, an increase in vibration for take-off and cruise, although this was still within limits. This was followed by corrective action taken by the operator to re-lubricate the blade roots. Rolls-Royce

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

reported the following to the Dutch Safety Board regarding the engines: '*From the available data for the accident flight and for the preceding two weeks of operation of the engines installed on the aeroplane, there is no evidence of any unusual engine behaviour or trend with the engines that is outside of Rolls-Royce's experience or expectation for any Trent 800 engines with similar service lives*'.

Other engine data
Each engine is controlled by its own Electronic Engine Controller located on the engine fan casing. The Electronic Engine Controller, which is normally powered by the electrical system of the aeroplane, has a separate electrical generator system supplying its own back-up power as soon as the engine rotates.

Therefore, it is believed that engine data may still have been recorded in the non volatile memories of the Electronic Engine Controller's after the abrupt stop of Flight Data Recorder and Cockpit Voice Recorder recordings due to the failure of the normal aeroplane power supply. As both Electronic Engine Controllers were lost in the event, no additional data could be retrieved to support the reconstruction of the flight after Cockpit Voice Recorder and Flight Data Recorder stopped recording.

Aeroplane technical log entries
The history of engine maintenance details back to November 2013, as found in the aeroplane's technical log, were reviewed. The entries show primarily engine systems status messages and a small number of occurrences of minor damage to the acoustic liner material followed by satisfactory systems checks and repairs. Rolls-Royce reported that the acoustic liners are prone to damage over time and that limits are quoted in the engine section of the Aeroplane Maintenance Manual for which approved repair techniques are available. Furthermore, Rolls-Royce stated that multiple repairs to the acoustic liners are common on engines with high service lives.

During the turnaround at Schiphol, engine oil was added to the left engine. Technical log records show that the recent oil consumption was within limits. No technical complaints about the engine were reported on the day of the accident flight.

Rolls-Royce engine field investigation at Gilze-Rijen Air Force Base

The examination of the wreckage of the engines by the Dutch Safety Board and Rolls-Royce showed that both engines impacted the ground in an inverted attitude. Both fans were found detached in a manner consistent with ground impact and the fan blade roots of both engines remained in place in their discs. Not all of the aerofoil material was present. The main core of the right engine was relatively intact and the main core of the left engine had split into two sections between the rear of the intermediate casing and the front of the high pressure compressor. No evidence was found that any major event such as a disc loss, turbine loss or flame breakout had occurred prior to the ground impact.

The low pressure and intermediate shaft of the left engine had fractured and the evidence suggests it was the result from tension due to impact on the ground. As the fan blades and the intermediate compressor blades of the left engine showed little evidence of any rotation at impact, it assumes that at the moment of impact the engine was not under power.

The intermediate pressure compressor and the front of the high pressure compressor of both the left and the right engines showed evidence of unknown foreign material damage that was consistent with a running engine. As this would most likely result in a surge, which has not been recorded at the Flight Data Recorder, it would have occurred after the recording ceased. The ingested material likely caused damage to the compressors and further released material from the compressor in both engines.

Pressurisation and oxygen

General
Accidents in the past show that an in-flight break-up can occur following the sudden failure of a pressurised cabin. Therefore, information relating to the functioning of the pressure cabin has been reviewed. This includes the possible response of the oxygen supply system when the cabin suddenly depressurises.

Flight Data Recorder data shows that up to and including the end of recording at 13.20:03 (15.20:03 CET), there were no warnings recorded that related to the pressurisation system or cabin altitude.

The aeroplane's pneumatic system uses, in flight, engine air primarily for cabin pressurisation, air conditioning, equipment bay and cargo bay heating and cooling and anti-icing purposes. The description here is related to the way that the pneumatic system interfaces with the air conditioning and pressurisation system.

In normal operation, the pressurisation system functions automatically to maintain the cabin pressure at cruise altitudes at a maximum of approximately 4,800 feet and/or have a maximum pressure differential with ambient air. The oxygen content of air pressurised to 4,800 feet is sufficient for breathing during flight. The system also ensures that the aeroplane is de-pressurised on landing. The pressurisation system is controlled, in normal operation, automatically by two cabin pressure controllers. Shut-off valves are used to maintain pressure and air flow rates.

As the pneumatic system normally supplies a greater than required quantity of air for the air conditioning system, outflow valves in the forward and aft areas of the fuselage control the amount of air that flows out of the aeroplane, keeping the cabin air pressure within limits when at altitude.

Emergency oxygen for the flight crew is stored in oxygen bottles installed below the cockpit. When a flight crew member dons a mask, oxygen will flow. As flight crew members usually test the oxygen system prior to each flight, the oxygen pressure in the bottle decreases. Entries in the aeroplane's Technical Log made by ground engineers from Malaysia Airlines demonstrates that the oxygen bottles were refilled on a regular basis in line with standard maintenance practices.

The negative pressure relief valves
The Boeing 777 has four negative pressure relief valves, two on each side. Their purpose is to open when the pressure outside the aircraft is higher than inside, to prevent damage to the fuselage. This is essential, because the fuselage is a pressure cabin and has a differential pressure over the fuselage skin and is designed to withstand a force working from inside to the outside (positive differential pressure). A negative pressure difference normally builds up gradually and as consequence a fully opened valve is practically impossible. The valve has a spring loaded door which keeps the valve closed when the differential pressure is zero and opens when the differential is 0.2 psi.

Landing gear

The aeroplane has a tricycle landing gear arrangement; two main landing gear legs, located mid-fuselage, and a nose landing gear leg. The nose gear is a two-wheel unit that is steerable. The main landing gear legs each have six wheels; two per axle. The rear axle of each leg is steerable.

The primary method of operating the landing gear is by means of the hydraulic system. The normal operation of the landing gear, when extending, is a combination of gravity (lowering without hydraulic assistance) combined with a hydraulically operated locking mechanism. Hydraulic actuation ensures that down locks are engaged, that the landing gear doors close and that the landing gear is tilted to a pre-determined position. In the case of malfunction, the landing gear may be extended by means of an alternate system.

The retraction mechanism is wholly actuated by the hydraulic system. As evidenced by the recovered main landing gear assemblies there were no intact lock links to secure the side/drag braces; both were sheared off. In addition, in an in-flight break-up, air loads from the fall, collision with other debris, ground impact and disturbance during recovery/transportation, could all randomise the motion of unsecured side/drag braces.

Flight Data Recorder information shows that the landing gear was in the 'up' position until the end of recording. It is likely that landing gear extension of one of the gears is a result of the in-flight break-up and/or the following ground impact.

Navigation systems

The aeroplane's navigation systems include Global Positioning System (GPS), air data inertial reference system, instruments for receiving traditional ground based navigational aids,[7] air traffic control transponder, weather radar and the Flight Management System.

7 These include such equipment as VOR, DME and ILS.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

The aeroplane has two GPS antennas and receivers, both of which are tuned automatically. Due to its great accuracy, the GPS data has priority in the navigation system over the inertial system.

The air data inertial reference system calculates the aeroplane's altitude, airspeed, attitude, heading and position for use on the flight crew displays, Flight Management System, flight and engine controls as well as other systems. The air data inertial reference system is supplied with air data from the left, centre and right pitot and static systems. Air data is considered valid by the air data inertial reference system when at least two of the sources provide identical data. The air data sources are supplemented by data from the two angle of attack vanes and a dual air temperature probe.

The ground based navigation aids are normally tuned for use automatically by the Flight Management Computer, but they may be tuned manually by the flight crew, if required. The navigation data in the Flight Management Computer is updated every 28 days as per the usual navigation chart revision cycle; the so-called AIRAC-cycle.

The aeroplane's weather radar consists of a receiver-transmitter unit, an antenna and a cockpit control panel. The weather radar collects data from different scans and merges this data to produce a total weather image for the flight crew. The software eliminates 'clutter' created by terrain to allow weather up to 320 NM ahead to be viewed. In addition, the software allows data from thunderstorms with tops within 5,000 feet of the aeroplane's level to be displayed. Turbulence is sensed by the weather radar based on precipitation. Therefore, clear air turbulence cannot be detected.

The Flight Management System assists the flight crew with the flight's navigation and optimizing the flight's efficiency. After the flight crew have entered a route into the Flight Management System, prior to departure, the Flight Management System uses the navigation database to calculate commands for the aeroplane's flight path control, both vertically and laterally (the vertical and horizontal profiles). These Flight Management System calculated commands may be overridden or otherwise changed by the flight crew during flight.

Other systems

As a potential source of high-energy objects, the Ram Air Turbine was reviewed during the investigation. The Ram Air Turbine is a small electrical generator that can be used in the case of a total electrical failure. It contains a propeller that is deployed into the airflow. Deployment is automatic in the case of a major electrical failure but it can be deployed by the flight crew on demand. It is located on the right side of the aeroplane behind the wing. The Ram Air Turbine was severely damaged and could not be examined.

The fixed Emergency Locator Transmitter had been tested in the week prior to the crash as part of routine maintenance during a routine maintenance check on 11 July 2014 and no faults were identified.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Maintenance information

General
An investigation was held into the airworthiness of the aeroplane using documents provided by Malaysia Airlines. In addition, interviews were held with staff from the operator's maintenance department.

The maintenance programme is built up of routine maintenance inputs named A, C and D, based on their complexity and frequency with 'A' being the most simple and 'D' being the most complex. The A-check is split into four parts (A1 to A4) with each part being performed on a 600 flight hour cycle; a so-called equalised maintenance concept. A similar approach is applied to the C-check; 2 checks each 750 days.

Aeroplane Maintenance Schedule
The operator's Maintenance Schedule for the Boeing 777-200 is based on the Maintenance Planning Document produced by Boeing for the Boeing 777-200. The resulting schedule of maintenance check cycles is shown in Table 12.

Check type	Details
Transit and Stay-over	Aeroplane in transit between flights
A-check	A1 - 550 flight hours A2 - 550 flight hours A3 - 550 flight hours A4 - 550 flight hours
C-check	C1 - 750 days C2 - 750 days
D-check	D - 3,000 days

Table 12: Maintenance check intervals.

A review of the maintenance records for the accident aeroplane revealed a sequence of checks as indicated in Table 13.

Date	Check	Total flight hours	Flight hours since last check
15 NOV 2013	D	73,136:44	
25 DEC 2013	A1	73,653:32	517
04 FEB 2014	A2	74,172:36	519
13 MAR 2014	A3	74,652:18	480
16 APR 2014	A4	75,096:33	444
28 MAY 2014	A1	75,679:42	583
11 JULY 2014	A2	76,251:13	572

Table 13. Maintenance data for the aeroplane.

Prior to the check in 2013, the previous D-check was completed on 9 September 2005. Using a 3,000-day limit, the D-check that was completed on 15 November 2013 was due by 26 November 2013. The D-check was combined with a number of A and C-checks. The last scheduled maintenance prior to the crash was an A-check, conducted on 28 May 2014.

The Malaysian Department of Civil Aviation does not issue Airworthiness Directives for large foreign-built aircraft. Instead, Malaysian operators are required to apply the directives of the State of Manufacture. For the Boeing 777, this means that US Federal Aviation Administration Airworthiness Directives apply. For the engines, built by Rolls-Royce, European Aviation Safety Agency directives are applicable. The means for identifying and implementing such directives was reviewed. The company's Technical Services department produces a document for each Airworthiness Directive, identifying its applicability, implementation timescale and how the task shall be accomplished.

A similar administrative process exists for Service Bulletins. As these are not automatically applicable, Malaysia Airlines performs a technical and financial analysis on each Service Bulletin with a view to determining the need to implement it.

The procedure in use for evaluating and determining the need to implement both Airworthiness Directives and Service Bulletins is considered by the Dutch Safety Board to be complete and correct.

Maintenance history

The investigation reviewed the aeroplane's maintenance history by taking the D-check that ended on 15 November 2013 as a baseline for serviceability. For the following cases, the baseline is different:

- engines: from installation date, and
- structural items relating to pressure hull: from hour zero.

Airframe, engines and APU	Item	Details
Airframe	Serial number	28411
	FAA Export CofA	29 July 1997
	Last inspection	A2-check
	Date last inspection	11 July 2014
	Cycles	11,434
	Flight hours	76,322.10
Left engine	Serial number	51093
	Date installed	26 September 2008
	Cycles	9,899
	Flight hours	66,838.42
Right engine	Serial number	51159
	Date installed	19 February 2014
	Cycles	9,643
	Flight hours	62,188.49
APU	Serial number	P1476
	Date installed	2 August 2010
	Cycles	17,672
	Flight hours	13,718

Table 14: Airframe, engines and APU data.

A review of the Malaysia Airlines maintenance database for planned maintenance showed that the aeroplane underwent a D-check between 18 September and 15 November 2013. The first flight following that maintenance was on 15 November from the maintenance base at Sultan Abdul Aziz Shah Airport at Subang to Kuala Lumpur.

The maintenance records were reviewed to identify any maintenance tasks that had not been completed as per the planned schedule. None were found for those tasks or parts limited by time, flight hours or flight cycles. No items were discovered in the analysis of the maintenance documentation that showed exeedances with the planned or life limits.

In addition, repeat defects are of interest. In the investigation's review of Technical Log entries for the period from November 2013 to July 2014, a number of cabin pressure related items were noted:

- The left two flight deck windows were reported to be making buzzing or whistling noises repeatedly between November 2013 and January 2014;
- The left two flight deck windows were reported to be making hissing or whistling noises several times in April and May 2014;
- In November 2013, several reports were made about a noise coming from passenger door 3L, and
- The lower crew rest compartment had repeated problems with its heating and airflow.

Repairs to seals of the two windows and the passenger door were made. The lower crew rest compartment problems were rectified with the replacement of an electronic control card.

Three deficiencies were open as deferred items on flight MH17. These were:

- the cockpit Voice Recorder microphone cap in the cockpit was missing;
- a complaint about the condition of two cabin overhead bins, and
- a 1 x 3 inch damage of the left engine acoustic lining.

The Federal Aviation Administration issued Airworthiness Directive 2014-05-03 regarding the possibility of cracking in the fuselage skin underneath the satellite communication (SATCOM) antenna adapter, (see also Boeing Service Bulletin 777-53A0068). The Airworthiness Directive was issued to detect and correct cracking and corrosion in the fuselage skin, which could lead to rapid decompression and loss of structural integrity of the aeroplane.

For the aeroplane that crashed, various codes and numbers exist for production, operation and certification. The aeroplane's registration was 9M-MRD. In addition to the serial number, 28411, the variable number WB 164 is also used. Service Bulletin 777-53A0068 showed a list of variable numbers for aeroplanes to which the Service Bulletin applied. Variable number WB 164 was not on this list. The Airworthiness Directive and Service Bulletin did not apply to the aeroplane that crashed.

Furthermore, Malaysia Airlines provided a list with mandatory occurrence reports for the aeroplane reflecting the period between October 2002 and November 2013. The reports were sent to the Malaysian Department of Civil Aviation and described occurrences which had no relation to the functioning of the pressure cabin or the engines.

Malaysia Airlines reported that only one structural repair had been made to the aeroplane as the result of damage found. A minor repair was made to the left wing spar web at STA1308 near body line 122.45. The repair was made during a C-check in October 2007 as per the Boeing Structural Repair Manual.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

APPENDIX K

BALLISTIC TRAJECTORY ANALYSIS METHODS

Ballistic trajectory analysis can be applied to selected wreckage pieces to assist in the determination of the breakup sequence. The ballistic trajectory of a wreckage piece can be calculated based on its mass and aerodynamic characteristics, or the Ballistic Coefficient. The Ballistic Coefficient is a function of an object's weight, aerodynamic drag coefficient, and its effective cross sectional area. It should be noted that it is difficult to estimate the attitude of the wreckage pieces during descent. Also, the attitude of the object, relative to the air stream, affects the object's effective cross-sectional area. It is assumed for this analysis that the Ballistic Coefficient for an object is constant. Thus, the ballistic analysis can only be used as reference information to support the flight MH17's break-up sequence analysis.

Dynamic model of the ballistic trajectory
Given an object with mass (*M*) and velocity (*V*). Its flight path is in the *XZ*-plane, making an angle (*Y*) with the direction on the x-axis.

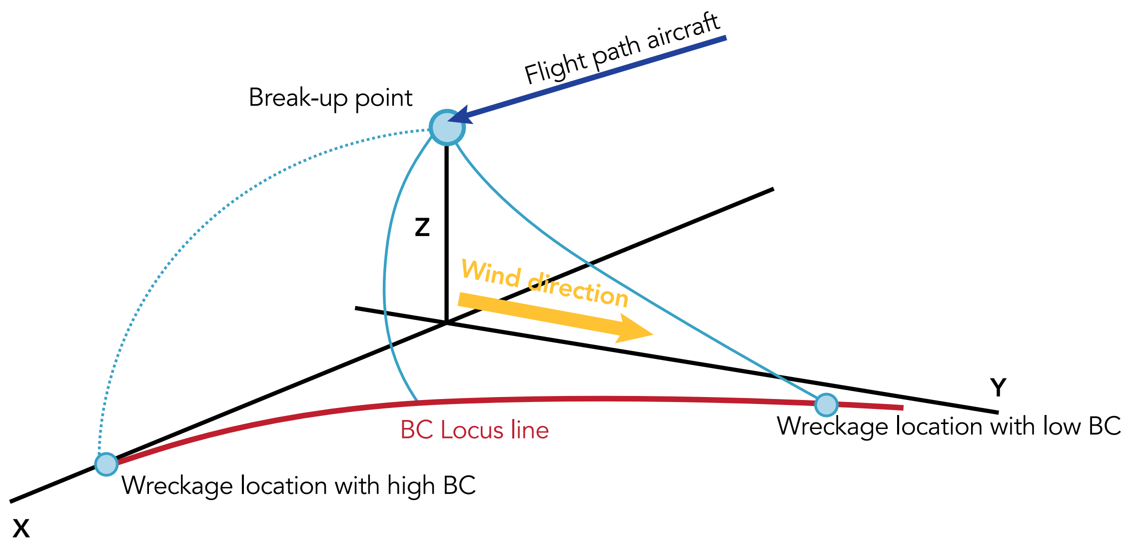


Figure 14: Schematic overview of the effect on the flight path and final position of an object for a high and a low value of the Ballistic Coefficient (BC). The wind is coming along the y-axis in this example. (Source: Dutch Safety Board)

Applying Newton's law, $F = M*a$, the accelerations in the directions of the axes, *X, Y* and *Z* can be written as:

Equation 1

$$\dot{V}_x = \frac{-Dg}{W}\cos\gamma\sin\psi + a_x = -\frac{\rho V^2}{2BC}g\ \cos\gamma\sin\psi + a_x$$
$$\dot{V}_y = \frac{-Dg}{W}\cos\gamma\cos\psi + a_y = -\frac{\rho V^2}{2BC}g\ \cos\gamma\cos\psi + a_y$$
$$\dot{V}_z = \frac{Dg}{W}\sin\gamma - g + a_z = -\frac{\rho V^2}{2BC}g\ \sin\gamma - g + a_z$$

Where:

$$BC = \frac{W}{CD * S};D = {}^1/_2\,\rho V^2 S;\ \gamma = \tan^{-1}\left(-\frac{V_z}{V_{xy}}\right);V_{xy} = \sqrt{V_x^2+V_y^2}$$

$\rho = 0{,}002378e^{-z/30000}, y < 30000\ feet;\ \rho = 0{,}0034e^{-z/22000}, y \geq 30000\ feet$ (Imperial units)

And for the components of the velocity (V) in the directions of the axes:

Equation 2

$$\dot{X} = \int \dot{V}_x dt + V_w \cos\psi_w(h)$$
$$\dot{Y} = \int \dot{V}_y dt + V_w \sin\psi_w(h)$$
$$\dot{Z} = \int \dot{V}_z dt$$

Where:
γ: flight path angle in the XZ- plane
Ψ : flight path angle in the XY- plane
$\Psi_W(h)$: Angle between x-axis and wind velocity, function of the height above sea level
ρ : air density
a_x, a_y and a_z: longitudinal, lateral and vertical un-modelled accelerations along the three axes *X*, *Y* and *Z*, respectively. These un-modelled accelerations are assumed to be zero for this study
CD: zero-lift drag coefficient
D : aerodynamic drag of the object
M : mass of object
S : reference area of a ballistic object
V: velocity of the object
V_x, V_y and V_z: components of the velocity along the axes *X*, *Y* and *Z*, respectively
VW: wind velocity, function of the height above sea level
W: weight of the object (*M*g*)

It should be noted that in equation 1 the acceleration equals zero along the Z-axis when the terminal velocity is reached. The terminal velocity is defined as the velocity at which aerodynamic drag equals the weight of the ballistic object.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

Method 1; trajectory analysis selected wreckage piece
The first method is to calculate the wreckage piece trajectory with a time step simulation from its initial conditions to the ground. The initial condition is described with six parameters: positions (East, North, and altitude), airspeed, flight path angle and heading. After integrating equation 1 in time with the wreckage Ballistic Coefficient and inputting the wind profile, the three axes position variables in equation 2 can be obtained. Applying the initial position and integrating equation 2, the ballistic trajectory of the wreckage piece can be obtained.

For a ballistic trajectory simulation the last recorded altitude, airspeed, and heading parameter values by the Flight Data Recorder are used as the known initial conditions of the simulation. A computer program then outputs a three-dimensional trajectory of the specific wreckage object when it hits the ground. This position is then compared to the wreckage position where it was found.

There are several sources of error in the ballistic trajectory analysis that should be taken into account when interpreting the results. These error sources are not limited to uncertainties in the estimation of:

- the wreckage mass;
- aerodynamic drag coefficient, and
- the wind profile.

The ballistic trajectory analysis assumes that the wreckage pieces fell with a constant Ballistic Coefficient from the moment of separation from the aircraft main body. In fact, wreckage orientation during descent is very difficult to predict. During initial separation, dynamic forces on the wreckage would result in an initial separation condition from a pure ballistic trajectory for a period, which could induce an error in the final descent point. Furthermore, the ballistic trajectory generated does not consider the possible sub-separations of the wreckage pieces. Ballistic trajectory analysis also assumes that wreckage objects separated from the main fuselage at an initial airspeed and with a heading equal to the last recorded flight condition. The accuracy of wind profiles would also impact the accuracy of the results. The wind profile would affect the initial positions of the wreckage items, and may also affect their sequence of separation during the rapid descent.

It is also possible to inverse method 1 and use the wreckage position as the initial condition, hereby calculating the altitude of break-up. In this calculation the errors mentioned previously will also affect this calculation.

Method 2: Ballistic Coefficient locus line
Another way of applying the ballistic simulation is to calculate the ground positions for multiple Ballistic Coefficients thereby creating a locus line. A locus is a shape created by the set of points whose position satisfies a given set of rules. The locus line represents the projected positions of wreckage pieces after break-up given an initial position.

The trajectory of an object with a high Ballistic Coefficient will asymptotically approach its initial heading when the break-up occurres. The trajectory of an object with a low

Ballistic Coefficient will asymptotically follow the wind drift. Thus, for pieces with higher Ballistic Coefficient, the trajectory matching to the recovery location will be more accurate as lighter (low Ballistic Coefficient pieces are influenced more by the wind).

When running this simulation it has the advantage that it creates a representative (locus) line including wind errors but without estimation errors for specific wreckage pieces characteristics (mass, surface area etc). In essence this simulation creates a baseline of expected position after break-up given the initial conditions.

Ballistic Coefficient calculation
During the investigation a video showing falling debris from flight MH17 was published on the internet by unknown persons. By research it was determined that this debris was in fact textile rolls transported as cargo aboard flight MH17. A number of these (partly and fully unrolled) textile rolls were recovered en transported to the Netherlands. Based on the textile retrieved, the full length wound on one roll was estimated at 100 meters. Analysing the video footage a probable location where the video was taken was established. From this location and the known heading of the aircraft five textile rolls were found and identified on satellite imagery in wreckage site 4.

Figure 15: Video showing falling debris (5 white textile rolls) from MH17, the black smoke in the background is from site 6. Image transmitted by various media organisations. (Source: unknown)

The video was further analysed to determine if the Ballistic Coefficient of these textile rolls could be calculated. Several assumptions were made for this calculation:

- The textile roll is fully unrolled (100 metres long);
- The beginning or end of the textile roll is fully visible, and
- Static camera position (no (little) camera movement).

Images from the video were extracted to create an overlay for analyses purposes. For the textile roll #1 images were taken which were 11 seconds apart. The shed roof was used as reference. The drop distance was extracted using image pixels. The length of the textile roll (100 metres) was also defined in pixels. The result was a drop speed of 5.2 metres/second. Another textile roll was calculated defined as roll #5.

Calculation of the drop speed was done using six images. This yielded a result of 4.1 metres/second. For calculation a range of drop speeds were taken between 4 and 5.5 metres per second which resulted in a Ballistic Coefficient between 0.252 and 0.363.

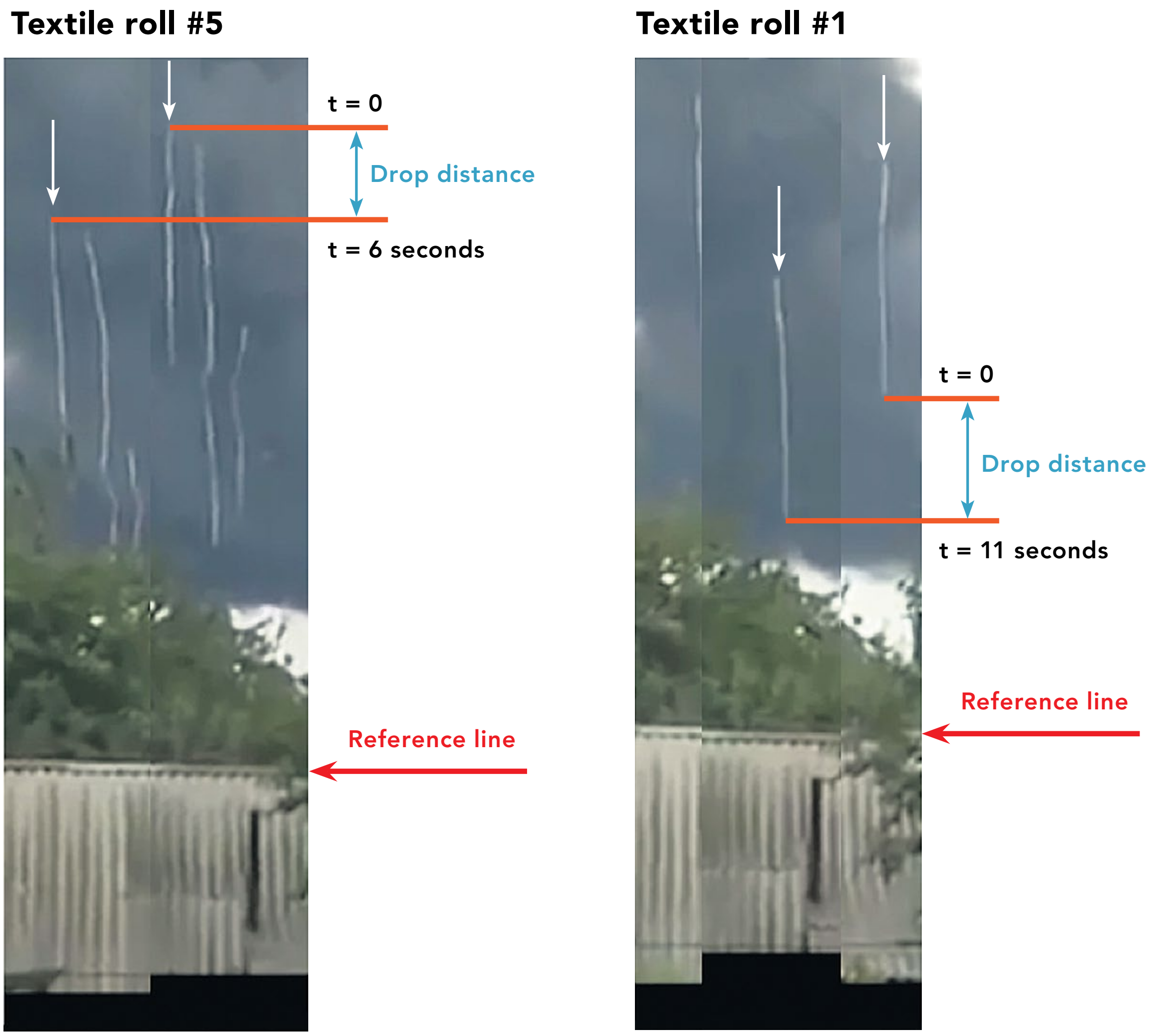


Figure 16: Video image overlay of first and last frame to determine the drop speed of the textile roll. Image transmitted by various media organisations. (Source: unknown)

Wind profile

The wind profile of weather balloon measurements from Rostov on Don Airport was used as input for the trajectory analysis calculations. The last recorded wind on the Flight Data Recorder was 219 degrees at 36 knots.

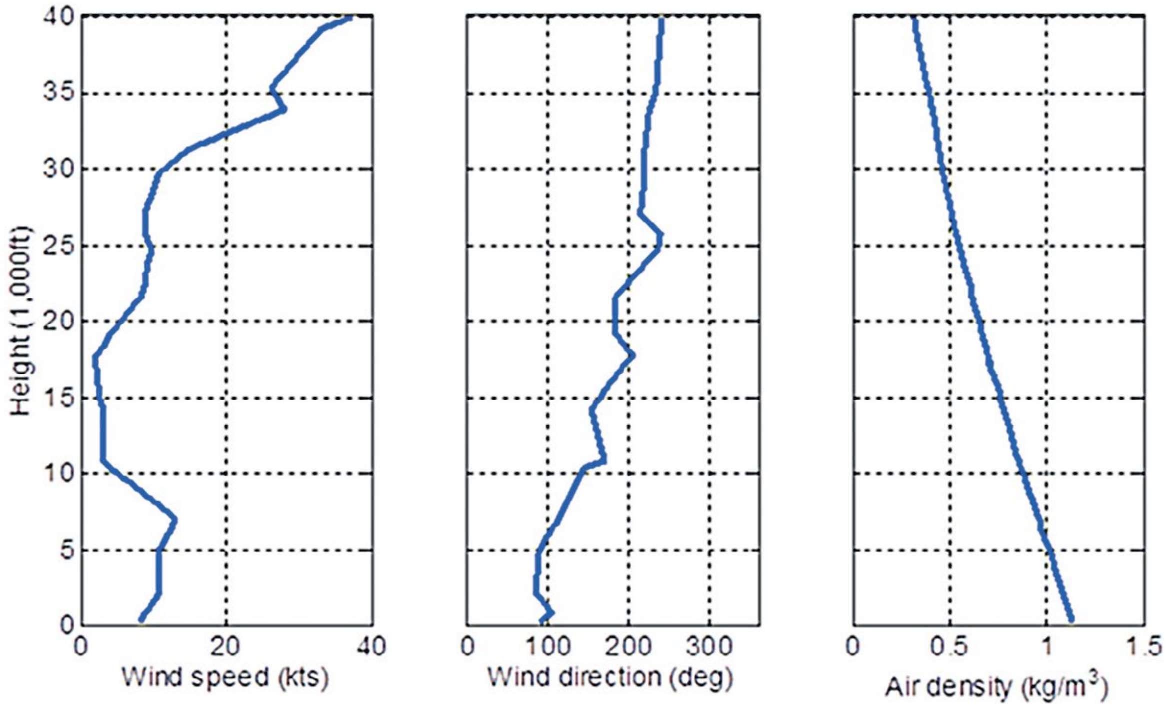


Figure 17: Wind profile used in the ballistic trajectory analysis. (Source: UK Met Office)

APPENDIX L

TYPICAL FRACTURE MODES

In current metallic thin-walled aeroplane structures, static overloading will cause fractures in the components. In such type of structure the following types of overload failures can be expected:

- tension failure;
- shear failure;
- compression failure;
- bending and peeling, and
- skin/sub-structure separation.

During the investigation of the break-up of the aeroplane these main types of structural overload fractures were analysed.

Tension failure
Tension overload failure refers to failure of the skin due to excessive tensile loading. The nature of this failure mode results in a relatively clean and straight fracture line along a natural weak-point in a structure such as a riveted joint or coupling. Examples of a pure tension failure include straight cracks in net-sections,[8] paint cracks aligned with skin cracks and stiffener failures at the first fastener. See Figure 18. It should be noted that paint cracks are parallel to the fracture.

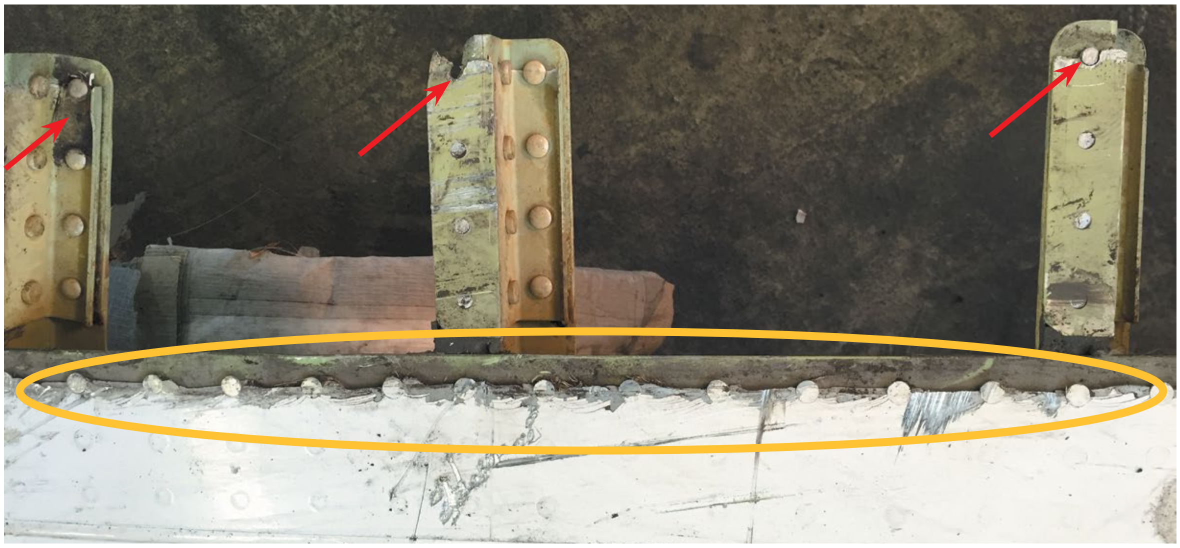


Figure 18: Typical case of net section failure, straight cracks in net section, paint cracks aligned with skin crack, stiffener failure perpendicular to its axis, at first fastener. (Source: Dutch Safety Board)

8 Location where the material is weakened by drilled holes for the purpose of the construction.

Shear failure
Pure shear failure is not very common. Figure 19 shows an example.

Figure 19: Pure shear failure, fracture in circumferential joint. (Source: Dutch Safety Board)

Combination of shear and tension failure
Most fractures in mechanical joints are caused by a combination of tension and shear loading. In this type of fractures the orientation of the fracture is perpendicular to the resultant of the loading. Hence under an angle. In this type of failure, cracks link-up between fastener holes after cracking along an angle (see Figure 20). This is also valid for the paint cracks (see Figure 21).

Figure 20: Typical failure under tension and shear, cracks link-up between fastener holes after growing along an angle. Continuation of crack under angle away from fastener row indicates direction of crack growth downward. (Source: Dutch Safety Board)

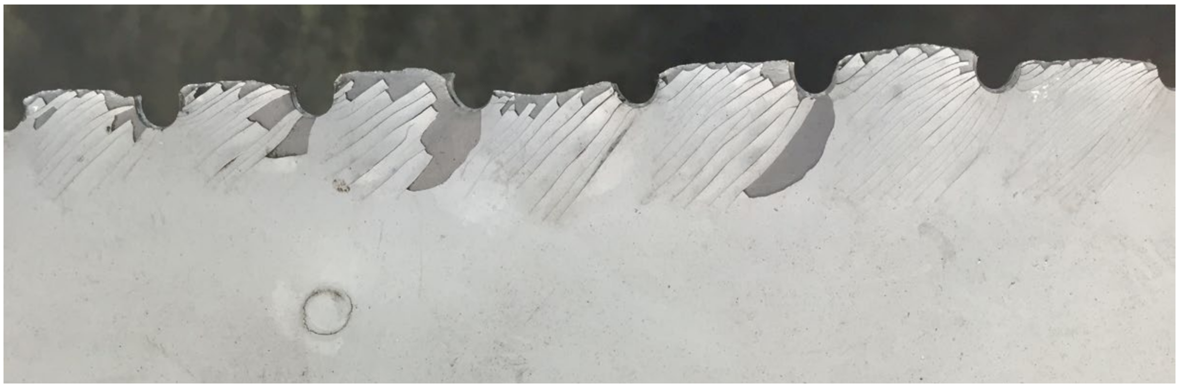


Figure 21: Paint cracks indicating a combination of tension and shear loading. Net-section failure with indication of tension and shear, the paint cracks perpendicular to the resulting loading. (Source: Dutch Safety Board)

Compressive failure
Compressive failure can either be buckling of a skin or plate panel or buckling of a stringer. The phenomenon of stringer buckling in the wreckage was in general very local. Figure 22 shows examples of (local) buckling of stringers.

Figure 22: Illustration of stringer buckling, see red arrows, indicating compression. (Source: Dutch Safety Board)

Peeling of a mechanical joint
In this case one of the skins is pulled away, out of plane, from the other skin. See Figure 23.

Figure 23: Typical case of longitudinal joint failure by peeling, in the right part of the figure. (Source: Dutch Safety Board)

Bending and peeling

Isolated bending/peeling refers to the presence of a distinct bend-line resulting from the final separation of one piece of wreckage from another. The separation of the pieces of wreckage causes one piece to peel away from the other, producing the localised bending deformation in the wreckage. See Figure 24.

Figure 24: Example of bending/peeling at a fracture line associated with the final separation between two pieces of wreckage. (Source: Dutch Safety Board)

Skin/sub-structure separation

Skin/sub-structure separation refers to an area of a wreckage piece where the skin has torn away from the underlying stringer and frame sub-structure (See Figure 25). The lower stiffness of the skin relative to the substructure indicates that the flap of unreinforced skin must have been torn from the substructure. The location of this feature also indicates a convergence point for developing fractures as it typically indicates the last point of connection between two pieces of wreckage.

Figure 25: Typical case of skin/sub-structure separation. The skin has been pulled away from stringers and frames. (Source: Dutch Safety Board)

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

AGREEMENT REGARDING UKRAINIAN ATC DATA

PROTOCOL

of the working meeting between representatives of Ukrainian State Air Traffic Service Enterprise (UkSATSE), investigators of Ukraine and International investigators regarding the accident of Malaysian Boeing 777 200 9M (M-MRD)

23.07.2014 UkSATSE office, Boryspil

Participants of the meeting:

International investigators:

- [redacted] EASA;
  AAIB, UK;
  AAIB, UK.

Investigators of Ukraine:

- [redacted] - member of the State commission for investigation (part time);
  - member of Ukrainian AAIB commission for investigation;
  - member of Ukrainian AAIB commission for investigation;

Representatives of UkSATSE:

- [redacted] Deputy Director General for ATM;
  Head of Center for Management and Support of ATC units;
  software engineer;
  Head of the Ukrainian Airspace Management and Planning Center;
  Head of ASM Department of the Ukrainian Airspace Management and Planning Center;
- group of experts.

Ukrainian Bureau of Air Accidents Investigations:

- [redacted] representative of Ukrainian AAIB.

Ukrainian Side provided full access for international investigators to audio and video records of the flight MAS17 within L'viv, Kiev and Dnepropetrovsk ACCs. Also, the international investigators filmed all history of the flight MAS 17 within sector № 4 of the Dnepropetrovsk ACC and recorded voice information of air traffic controllers of Dnepropetrovsk and Rostov (Russian Federation) ACCs.

The international investigators were provided by the Ukrainian Side with the presentation and electronic files of all available information about the flight MAS 17 (trajectory) received from the ADS-B ground station, radar ATCR-33S/SIR-S (mode S) and ATC automated system (system track). The information from the above mentioned sources was drawn on the map by UkSATSE's

1

experts to show the actual trajectory of the flight MAS17 and the place of the accident. In addition, Ukrainian Side has provided international investigators with accident related meteorological information received from the MET radar.

During the meeting international investigators were provided with the detailed description of Ukrainian system of airspace utilization and rules / procedures for setting restrictions / prohibitions within airspace of Ukraine, NOTAM publications etc.

Following the discussions the preliminary conclusions prepared by the Ukrainian Side within Ukrainian AAIB investigation process related to the proper services for the flight MAS17 were duly noted. Also, it was noted that services provided for the flight MAS17 by air traffic controllers of L'viv, Kiev and Dnepropetrovsk ACCs did not have any impact on safety to be the reason of the accident.

Signed:

[redacted]

N.B. For privacy reasons, names of individuals, their signatures and some contact details have been blanked out in this document.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

APPENDIX N

BACKGROUND TO OCCUPANTS EXPOSURE

Due to the missile exploding, the occupants were exposed to:

Metal fragments from warhead and missile
Metal fragments struck the aeroplane at a speed of 4,500 - 9,000 km/h, tearing off part of the cockpit. Not only did the warhead fragments perforate the aeroplane's fuselage, they also struck the crew members in the cockpit. Due to the high speed and the large number of fragments, this impact was instantly fatal. There were no missile fragments found in the bodies of the other occupants.

Effects of the pressure wave
A pressure wave of hot air immediately followed the impact (blast). This pressure wave originated outside the aeroplane, above and to the left of the cockpit, and lasted just a few milliseconds. The pressure wave travelled across the aeroplane extremely quickly and greatly decreased in force with distance.[9] Given the damage pattern on the aeroplane, it was established that the pressure wave only penetrated the cockpit. As a result, the crew were directly exposed to the pressure wave, the other occupants were not.[10] This does not detract from the fact that when it hit the aeroplane, the pressure wave caused a shock that may have been felt through the entire aeroplane.

Noise
The pressure wave caused by the missile exploding is accompanied by a deafening sound wave. This loud and abnormal sound must have been audible to everyone on board.

Due to the aeroplane breaking up, the occupants were exposed to the following factors:

Deceleration and acceleration
The aeroplane was flying at cruising altitude and at a constant speed. The separating of the front section of the aeroplane caused a sudden deceleration, which changed into an acceleration as a result of the aeroplane falling down. This sudden deceleration and the subsequent acceleration exerted forces on the occupants' bodies. It may have caused dizziness, nausea and loss of consciousness.[11,12] Powerful deceleration or acceleration could have resulted in (serious) injury due to contact with hard objects (for example,

9 From a point 12.5 metres from the nose of the aeroplane, the exterior of the aeroplane showed no visible damage caused by the pressure wave.
10 Additional information from TNO taken from the investigation into the cause of the crash (11 May 2015).
11 Van Lieshout E.J., J.J. Van Lieshout, J. Krol, M. Simons, J.M. Karemaker, 'Maximal Tolerance to High-g in the Human Centrifuge is Not Set by Neural Cardiovascular Control', Pflugers Archiv-418, R148, 1991 (Abstract).
12 Van Lieshout J.J., W. Wieling, J.M. Karemaker, N.H. Secher, 'Syncope, Cerebral Perfusion, and Oxygenation', Journal of Applied Physiology, 94, 2003, 833-848.

Contents
Contents of the Appendices to Part A
Appendix A
Appendix B
Appendix C
Appendix D
Appendix E
Appendix F
Appendix G
Appendix H
Appendix I
Appendix J
Appendix K
Appendix L
Appendix M
Appendix N

seats or luggage) or due to the seatbelt. Occupants who were not wearing their seatbelt or were walking around the cabin, risked a greater chance of injury. It is likely that people were also injured by objects flying around such as hand luggage and parts of the aeroplane that had torn loose.

Decompression
After the aeroplane was hit by metal fragments, cabin pressure was lost and became equal to the ambient pressure (decompression).[13] The sudden decrease in air pressure causes acute expansion of the chest and can lead to (serious internal) injury.[14,15]

Decompression in the aeroplane was accompanied by the formation of mist resulting from the condensation of water vapour present in the cabin. This mist is so dense that it is often confused with smoke as the result of a fire. Research has revealed that, even though it soon disappears, this mist can contribute to disorientation.[16]

Reduced oxygen availability
Loss of cabin pressure also resulted in the oxygen supply being lost. This meant that the occupants were exposed to thin air with a greatly reduced oxygen level. At an altitude of 10 kilometres, the amount of oxygen available is approximately a quarter compared with that at sea level.[17]

A lack of oxygen can result in shortness of breath, dizziness, disorientation, loss of concentration and eventually to loss of consciousness. The speed at which a person loses consciousness as a result of oxygen deficiency[18] depends on the altitude. At an altitude of 9 to 10 km (30,000-33,000 feet), the lack of oxygen leads to unconsciousness within 30 seconds to one minute. A rapid descent, as in the case of flight MH17, leads to an increase in the amount of available oxygen.[19]

Cold
The outside air temperature at the flight altitude at the time of the impact varied between -40 °C to -50 °C. This means that the difference between the temperature inside the aeroplane and the ambient temperature exceeded 60 °C. A sudden exposure to this temperature difference causes a shock effect and leads to immediate physical reactions, such as a reduction in skin blood flow. Additionally, acute exposure to extreme cold

13 At the time of the impact, the air pressure in the aeroplane as recorded by the flight data recorder was comparable to the air pressure at an altitude of 1,463 metres (4,800 feet).
14 This mechanism is comparable to the effects of a diver descending or ascending too rapidly while using compressed air, especially in the last three metres below the surface. The differences in pressure between the air in the body cavities and that in the environment then increase quickly. If not compensated for actively (clearing the ears, exhaling), this results in injury.
15 FAA, Aviation Pilot Handbook, Chapter 16 Aeromedical Factors, fig 16-1. http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2016.pdf, consulted on 5 June 2015.
16 Information from CML.
17 The oxygen percentage, compared to other gases, at ground level and at high altitude is similar (approximately 21%), but the number of particles per volume (expressed in partial oxygen pressure or particles per volume unit) decreases drastically, halving every 5,500 metres - the air becomes thinner.
18 Also known as 'time of useful consciousness' (TUC).
19 Source: FAA, Aviation Pilot Handbook, Chapter 16 Aeromedical Factors, fig 16-1. http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2016.pdf, consulted on 5 June 2015.

leads to an increased respiratory rate (hyperventilation) with a decreasing level of carbon dioxide in the blood, and corresponding decrease in blood flow to the brain.[20,21] This can lead to dizziness and reduced consciousness.[22,23]

Airflow

When an aeroplane breaks up, the people on board are exposed to the airflow caused by the speed of the aeroplane. In this case, there was an airflow with a speed of roughly 900 km/h (480-490 knots). By comparison, the winds accompanying hurricane Katrina[24] had a maximum speed of 282 km/h.[25, 26] A human being can withstand this kind of airflow, but will have difficulty breathing and moving and is entirely caught up by the powerful airflow.[27] Injuries may be caused as parts of the body are caught by the airflow. In addition to possible injuries, the extreme airflow also causes further loss of body heat (wind chill effect).

Detached aeroplane parts, luggage and occupants who were walking around in the cabin may have been caught by the airflow. The airflow was strongest at the fracture edges, decreasing towards the rear section of the aeroplane because of the obstacles in the interior. The airflow created by the rapid descent caused a noise comparable to that of a very severe storm. This could have contributed to possible startle reactions and disorientation.

From photographs by journalists and eyewitness accounts it appears that several passengers were found at the scene of the crash without any clothes. This finding concurs with previous aeroplane crashes. The explanation is that the powerful airflow ripped off the light holiday clothes many people were wearing.

Impact on the ground

All occupants were exposed to the force associated with falling to the ground from an altitude of 10 kilometres. Regardless of the exact speed, the impact on the ground after a fall from this altitude is regarded as non-survivable.

20 Mantoni T., B. Belhage B. L.M. Pedersen LM, F.C. Pott, 'Reduced Cerebral Perfusion on Sudden Immersion in Ice Water: A Possible Cause of Drowning,' Aviation, Space, and Environmental Medicine, 78, 2007, 374-376.
21 Mantoni T., J.H. Rasmussen J.H., B. Belhage, F.C. Pott, 'Voluntary Respiratory Control and Cerebral Blood Flow Velocity Upon Ice-Water Immersion', Aviation, Space, and Environmental Medicine, 79, 2008, 765-768.
22 Hida W, Y. Kikuchi, S. Okabe, H. Miki, H. Kurosawa, K. Shirato k. 'CO2 Response for the Brain Stem Artery Blood Flow Velocity in Man', Respiration Physiology, 104, 1996, 71-75.
23 Immink R.V., F.C. Pott, N.H. Secher, J.J. van Lieshout, 'Hyperventilation, Cerebral Perfusion, and Syncope', Journal of Applied Physiology 116, 2014, 844-851.
24 New Orleans, USA, 2005.
25 In comparison: a hurricane of 12 BF has wind speeds exceeding 117 km/h, http://www.knmi.nl/cms/content/25772/orkaan, consulted on 6 May 2015.
26 National Hurricane Center, http://nhc.noaa.gov.
27 Information from CML.

MH17

Appendices part B: Flying over conflict zones

APPENDICES PART B: FLYING OVER CONFLICT ZONES

APPENDIX O

PARTICIPANTS IN THE INVESTIGATION (PART B)

Guidance committee

The guidance committee consists of members with expertise that is relevant to the investigation and advises the Dutch Safety Board on the investigation. Members are appointed to the committee in a personal capacity. The guidance committee convened on four occasions: on 23 September 2014, 27 November 2014, 15 April 2015 and 18 August 2015. During the third and fourth meeting, the guidance committee for the investigation into the crash circumstances of flight MH17 was also present. This was because parts of this report are also relevant for the investigation of on the crash circumstances. Some of the members were also consulted about elements of the investigation when the occasion arose. The guidance committee comprised the following persons:

M.B.A. van Asselt (chairperson)	Board Member of the Dutch Safety Board
M. Beringer	Independent Air Traffic Management consultant
R. van Dam	President of the International Foundation for Public Aviation
B.A. de Graaf	Professor of History of international relations, Utrecht University
P.M.J. Mendes de Leon	Professor at Leiden University, Director of the International Institute for Public, Air and Space Law
M.A.G. Peters	CEO, NLR
A. Verberk	Former CEO, Martinair Holland
B.J.A.M. Welten	Associate Member of the Dutch Safety Board

Project team

The project team consisted of the following persons:

M. Visser	Investigation manager
F. Bloemendaal	Project manager as of 1 November 2014
D.C. Ipenburg	Project manager up to 1 November 2014; then investigator
A. Faas	Investigator from 1 October 2014 to 1 April 2015
R.J. Francken	Investigator from 25 August 2014 to 1 April 2015
S. van 't Klooster	Investigator from 7 August 2014 to 1 April 2015
A. van der Kolk	Advisor research and development
G. Oomen	Investigator
H. van Ruler	Investigator
V. Telkamp	Investigator
Th.M.H. van der Velden	Investigator

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

DEVELOPMENTS RELEVANT TO THE INVESTIGATION

Since the crash of flight MH17, various initiatives have been taken with the aim of reducing the risk of such a crash in the future. Below is a brief overview of the most important initiatives as far as this investigation is concerned.

In August 2014, the International Civil Aviation Organization (ICAO) set up a high official task force with the international branch organisations of operators (IATA),[28] aerodromes (ACI)[29] and air traffic control services (CANSO)[30] to discuss the selection of flight routes and destinations in or near conflict zones.

The task force compiled a work programme comprising of twelve actions that was approved during ICAO's 2nd High Level Safety Conference in February 2015. Three of these have been accelerated and approached as a pilot. First and foremost, these concern the question of how relevant safety and security information about conflict areas can be made available using the NOTAM system. The second action concentrates on developing guidelines for assessing risks to civil aircraft in or near conflict areas. The Aviation Security Panel Working Group on Threat and Risk (WGTR) provided the initiative for this action. The third action aims to develop a prototype website for sharing information about risks to civil aircraft in relation to conflict areas. The work programme was adopted by the ICAO Council (23 February - 6 March 2015).

The ICAO website has been operational on a test basis since 2 April 2015. In the meantime, a number of countries, including the United States, the United Kingdom, France, Germany, Saudi Arabia and the United Arab Emirates, have placed information on the website (situation in July 2015). ICAO requested Member States to report their experiences with the website by 15 December 2015. On the basis of these experiences, an ICAO working group may issue recommendations to the ICAO Council in the first half of 2016.

The WGTR has identified a series of factors that are important for estimating the risks that conflict zones pose to civil aviation. The working group has focused on the dangers to air traffic at higher altitudes, with an emphasis on medium or long-range surface-to-air missiles.

In addition, a working group has been set up in response to the ICAO 'Report from the Senior-Level Task Force on risks to Civil Aviation Arising from Conflict zones'. This group is tasked to review the application of ICAO provisions relating to conflict zones in order

28 International Air Transport Association (IATA).
29 Airports Council International (ACI).
30 Civil Air Navigation Services Organisation (CANSO).

to reinforce and clarify the responsibilities of States for safe operations in their sovereign and delegated airspace and for the operation of their own operators outside of that airspace.

The European Union
Since the summer of 2014, the European Aviation Safety Agency (EASA) has issued Safety Information Bulletins (SIB'S) related to conflict areas. In these Bulletins, EASA refers to reports that states (France, the United Kingdom, the United States) issue to their operators. Since the crash involving flight MH17 on 17 July 2014, EASA has published SIBs related to Syria, Afghanistan, Mali, North Sinai, South Sudan, Pakistan, Libya, Iraq and Yemen.

The European Commission is working on establishing a structure with the aim of increasing the sharing of information relevant to flying over conflict areas. The first step involves the exchange of information between Member States and setting up a shared methodology for risk analyses. Under the chairmanship of the Directorate-General for Migration and Home Affairs (DG HOME) a working group has been set up that will map out the risks conflict areas pose to civil air traffic. The information that emerges from this working group will be processed by the Directorate-General for Mobility and Transport (DG MOVE) and EASA, with the aim of informing the aviation sector about possible risks posed by conflict areas. The risk analysis performed by DG HOME will be done on a confidential basis, in which classified information will be exchanged. Only the outcome of the risk analysis, and not the underlying information, will be made available to EASA. If a high risk is established, EASA will issue a recommendation to avoid an airspace, or not to fly below a certain Flight Level. The draft recommendation will first be submitted to the parties involved for their consultation. For the time being, it is not the intention to issue legally binding information.[31] In this respect, the European Commission strives for a joint methodology for risk analyses.

The Netherlands
The Dutch Ministry of Infrastructure and the Environment sends the EASA advance information and other relevant information about the Safety Information Bulletins to Dutch operators to support their risk analysis for safe flight operations. The Ministries of Infrastructure and the Environment, Security and Justice and Foreign Affairs (situation in July 2015) are consulting with Dutch operators (KLM, Corendon, ArkeFly) and the Dutch Airline Pilots Association on the international developments at ICAO and EASA and about the Dutch system of information exchange and risk analyses.[32]

31 Source: EASA.
32 Ministry of Security and Justice, state of affairs letter MH17, 30 June 2015.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

APPENDIX Q

LAWS AND REGULATIONS

This appendix sequentially addresses (1) the International Civil Aviation Organization, (2) the European Union, (3) Nation States, and (4) operators.

1. International Civil Aviation Organization

The International Civil Aviation Organization (ICAO) establishes the international framework for the use of airspace. This intergovernmental organization was founded in 1944 and is a United Nations body that specialises in aviation. ICAO fulfils the United Nations' objectives related to civil aviation, such as enforcing peace and security and achieving international cooperation in solving global issues of an economic nature. ICAO currently has 191 Member States including Ukraine, Malaysia and the Netherlands.

The principles on which ICAO's work is based are defined in the Chicago Convention.[33] The Chicago Convention applies exclusively to civil aviation.[34] The Convention does mention the interests of military aviation and the necessary coordination with the military aviation.[35] The most important principles with regard to this investigation are:

- The Member States recognise that each State has sovereignty over the airspace above its territory.[36]
- Member States recognise that each State must refrain from the use of weapons against civil aircraft during flights.[37]
- Each Member state may close (parts of) the airspace belonging to its territory, or impose restrictions on flights in this airspace if necessary for military purposes or in the interests of public safety.[38]
- In the event of war or of a national state of emergency, the provisions of the Chicago Convention do not affect a Member State's freedom to act.[39]

ICAO's principles have been elaborated, in cooperation with the Member States and international aviation organisations, in various Appendices and specific supporting guidance in the form of documents (Docs). The Appendices include Standards and Recommended Practices (referred to hereafter as SARPs) related to aviation safety and aviation security. The Appendices most relevant to this investigation are:

33 Convention on International Civil Aviation, ICAO Doc 7300/9.
34 Convention on International Civil Aviation, ICAO Doc 7300, Article 3 (a).
35 Convention on International Civil Aviation, ICAO Doc 7300, Article 3 (d).
36 Convention on International Civil Aviation, ICAO Doc 7300, Articles 1 and 2.
37 Convention on International Civil Aviation, ICAO Doc 7300, Article 3 bis.
38 Convention on International Civil Aviation, ICAO Doc 7300, Article 9.
39 Convention on International Civil Aviation, ICAO Doc 7300, Article 89.

- Annex 2 'Rules of the Air': This Annex includes SARPs related to the use of airspace and aerodromes including flight altitudes and access rules such as the conditions for possessing a flight plan and authorisation from air traffic control.
- Annex 6 'Operation of Aircraft': This Annex includes SARPs related to flight operations, including the requirements imposed on the crew, the equipment necessary for a flight, maintenance, the provision of information to passengers and safety on board an aircraft.
- Annex 11 'Air Traffic Services': Annex 11 describes the responsibility of the Member State to organise the airspace and regulate the associated air traffic services. This Annex also describes the SARPs related to air traffic services with a particular focus on the need for coordination between civil and military authorities charged with air traffic services.
- Annex 15 'Aeronautical Information Services': The objective of this Annex is to ensure the flow of information necessary for safe and efficient flight operations. The Annex describes various resources that Member States can employ for this provision of information, such as the 'Aeronautical Information Publication (AIP)' and the NOTAM. The latter specifically aims to inform parties concerned about modified conditions or the availability of aviation facilities, services, procedures or dangers.
- Annex 17 'Security': Annex 17 stipulates that the primary objective of each Member State must be to protect passengers, crew, ground staff and civilians from acts of unlawful interference such as the destruction of an aircraft. To this end, requirements are imposed related to the establishment of the national organisation necessary for this purpose.
- Annex 19 'Safety Management': Annex 19 contains the principles for a safety management system. It includes requirements imposed on the Member State, aviation service providers and operators.

Member States adhere to the standards by incorporating them in their national legislation, unless they file a difference compared to an ICAO standard.[40]

ICAO has seven regional offices that promote the implementation of the ICAO SARPs. Ukraine and the Netherlands both fall under the area of responsibility of the 'European and North Atlantic (EUR/NAT) office', which is based in Paris. Malaysia falls under the area of responsibility of the 'Asia and Pacific (APAC) office', based in Bangkok.

The most powerful resources that ICAO possesses to promote the implementation of SARPs are the 'Universal Safety Oversight Audit Programme (USOAP)' and the 'Universal Security Audit Programme (USAP)'. Member States are periodically audited as part of these programmes. To promote aviation safety, USOAP focuses on, for example, the introduction and implementation of aviation regulation, training and licensing of aviation staff, incident investigations, airworthiness, flight operations and air traffic services. USAP focuses on the introduction of critical elements of aviation security using nine basic principles, including State sovereignty, transparency, objectivity, quality and reliability.

40 Convention on International Civil Aviation, Articles 37 and 38.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

2. The European Union (EU), EASA and EUROCONTROL

Regulations are also established at the European level. These regulations apply to Member States and to all persons in these States. European aviation safety regulations are based on the Regulation[41] on common rules in the field of civil aviation and establishing a European Aviation Safety Agency.[42] Since EU Member States are also bound to ICAO, European requirements must be consistent with ICAO SARPs. In many cases, European requirements are an elaboration of the SARPs, which enforces a harmonised European-wide interpretation of the global requirements.

The European Aviation Safety Agency (EASA) is a specialised agency that acts as the aviation safety authority on behalf of the European Union. EASA is predominantly concerned with the strategic development of aviation safety management. In this respect EASA plays a prominent role in the development and introduction of European aviation regulations. In addition EASA, in cooperation with national authorities, ensures the certification of aviation products and the auditing of accepted aviation organisations. In its role as an authority, EASA issues 'Safety Information Bulletins' that inform Member States and aviation organisations about new risks to aviation safety that have been identified.

The European Organisation for the Safety of Air Navigation Services (EUROCONTROL) is a European intergovernmental organisation consisting of 41 Member States, including Ukraine. EUROCONTROL supports Member States with the safe, efficient and sustainable performance of their air traffic services and flight operations in the European region. EUROCONTROL provides substantive expertise that is used to develop and implement European regulations.[43] In addition to general support tasks, EUROCONTROL has three executive roles:

- Network Manager: This body proactively manages the aviation navigation network of Member States in close cooperation with air navigation service providers, airspace users, military parties and aerodromes. The Network Manager coordinates the use of the controlled airspace and flight routes therein using national input related to the availability of flight routes. It is the task of the Member States to communicate the routes that are available at a given time and the amount of air traffic that can be handled per sector. The Network Manager uses this information to regulate air traffic flows to make optimal use of the route network and prevent any delays.
- Central Route Charges Office (CRCO): This body invoices, collects and distributes charges for the use of flight routes. Most EUROCONTROL Member States use the CRCO. This is established in the 'Multilateral Agreement relating to route charges'. Up until 2014, the CRCO also collected route charges for Ukraine, based on a bilateral agreement with that country. However, in 2014, Ukraine decided to start collecting the charges using a different method.

41 European regulation is established in Regulations and Directives. Regulations are immediately binding, directives are subject to integration in national legislation. Regulations and Directives can be elaborated at the European level into Implementing Rules.
42 Regulation (EC) no. 216/2008.
43 Cooperation between the European Commission and EUROCONTROL is established in a memorandum: Memorandum concerning a framework of cooperation between the European Organisation for the Safety of Air Navigation and the Commission of the European Communities.

- Maastricht Upper Area Control Centre: This body provides air traffic management services in the upper airspace for the Netherlands, Belgium, Luxembourg and the northern part of Germany.

The EU has concluded a number of treaties with non-EU Member States or is in the process of doing so. Their objective is to establish a common liberalised aviation market with neighbouring countries. Harmonising regulations is an important element in this process. Since 2007, the European Commission has been involved in negotiations related to such a bilateral treaty with Ukraine. In Ukraine, aviation regulation is therefore not formally harmonised with that of EU Member States.

Ukraine joined the European Civil Aviation Conference (ECAC), which has 44 member countries, in 1951. The ECAC's mission is *the promotion of the continued development of a safe, efficient and sustainable European air transport system*. Moreover, in 2007, a bilateral agreement was established between EASA and the State Aviation Administration of the Ministry of Transport of Ukraine (as a non-EU member of ECAC) on the collection and exchange of information related to the safety of aircraft using Community and Ukrainian aerodromes.

3. National States

ICAO Member States must integrate the SARPs in their national legislation, unless this has already been achieved in another way such as in European regulations. This means that the SARPs become binding for aviation parties operating in the relevant country and its corresponding airspace. Member States can introduce stricter or supplementary rules as long as they do not conflict with mandatory ICAO or regional rules.

Countries possess one or more aviation authorities that are responsible for, or play a role in, aviation safety. Although the governing structure may differ considerably between countries, a number of key tasks are present in each country to a greater or lesser extent.

Airspace management

As mentioned, the sovereignty of Member States is ICAO's starting point. Member States therefore bear responsibility for managing the airspace above their territories.[44] Member States have the possibility and responsibility to restrict or totally prohibit access to their airspace, if necessary.

While ICAO focuses on civil aviation, national authorities must also take account of their country's military interests. ICAO regulations devote attention to the use of airspace and of various facilities and services by both civil and military aviation.[45] ICAO stipulates that authorities on air traffic services must work closely with military authorities.[46] This coordination aims to limit the consequences of potentially dangerous activities as much as possible.[47] The 'Manual Concerning Safety Measures Relating to Military Activities

44 This includes the airspace above bordering areas above land and water that fall under the state's management.
45 ICAO Assembly Resolution A27-10, Appendix P.
46 ICAO Annex 11, Para 2.17.
47 ICAO Annex 11, Para 2.18.

Potentially Hazardous to Civil Aircraft Operations' provides a more detailed interpretation of this civil-military cooperation. ICAO stipulates the following in the event of an armed conflict, or the risk thereof:

'*Based on the information which is available, the State responsible for providing air traffic services should identify the geographical area of the conflict, assess the hazards or potential hazards to international civil aircraft operations, and determine whether such operations in or through the area of conflict should be avoided or may be continued under specified conditions. An international NOTAM containing the necessary information, advice and safety measures to be taken should then be issued.*'[48]

ICAO Circular 330 AN/189[49] also provides recommendations related to cooperation between civil and military air traffic control. In paragraph 4.2.1 the circular states that 'during any crisis situation, there will be a requirement for increased coordination between civil and military ATM authorities in order to allow civil air traffic to continue to operate to the maximum extent possible, while facilitating operational freedom for military air operations.'

The documents cited are not formal requirements and as such are not subject to mandatory implementation.

Air traffic service providers
Air navigation service providers are responsible for providing air traffic services. The most well-known type of air traffic service is air traffic control: separating and lining up air traffic by means of clearances and instructions. There are also other types of air traffic services that only provide information. The pilot-in-command is at all times responsible for the flight's operation, even in the case air traffic control services are being provided.

Airspace structure has a close relation to the chosen type of service.[50] In controlled airspace, considerable use is made of flight routes. Air navigation service providers play an advisory role in the organisation and opening of airspace and flight routes due to their knowledge of air traffic management.

Air navigation service providers must also work closely with military authorities.[51] The ICAO 'Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations' focuses entirely on this civil-military cooperation. In this document, ICAO devotes particular attention to civil-military coordination in the event of an armed conflict, in which this coordination is viewed as even more crucial.[52] According to ICAO, civil-military coordination during a crisis must contribute to the

48 ICAO Doc 9554, Para 10.3.
49 ICAO Circular 330 is currently being updated and reviewed. It is expected to be completed in 2015.
50 ICAO Annex 11, Para 2.5.1.
51 ICAO Annex 11, Para 2.17.
52 ICAO Doc 9554, Para 10.1.

continuation of civil aviation as much as possible, while ensuring the military air operation benefits from adequate operational freedom.[53] In this respect, it involves military flights taking precedence with regard to the use of the airspace.[54]

Just like for operators, ICAO anticipates a role for states and air navigation service providers in assessing safety and taking action if the usual coordination processes are no longer effective due to a sudden outbreak of violence.[55] As part of their role, air navigation service providers must possess a safety management system and a security programme that is used to assess the risks involved in executing their tasks.[56]

Most air navigation service providers, as part of their crucial role in the aviation infrastructure, are part of or linked to the government, while their degree of independence varies from one country to another.

The provision of aeronautical information
NOTAMs[57] are a commonly used means in aviation to communicate announcements of temporary or late changes to previously provided information, that are relevant to flight operations.[58] This is necessary, for example, if there is a change in the use of airspace or flight routes or if a danger exists to air navigation services.[59] NOTAMs are published by national authorities for a number of reasons, such as:

- Military exercises resulting in restrictions to the airspace;
- The establishment or end (including activation and deactivation) of, or changes to the status of the prohibited, restricted or danger areas. Military activities resulting from a conflict are not mentioned separately as a reason for issuing a NOTAM, but may constitute a reason for the establishment of a restricted area. This information is published in the 'Integrated Aeronautical Information Package' of the State concerned.[60]

In addition to the AIP and the NOTAM, 'Aeronautical Information Circulars (AIC)' are used. These contain any information that is not suitable for inclusion in the AIP or in a NOTAM, such as announcing future regulation, and recommendations and background information that involve flight safety, regulations or administrative processes.[61]

The use of a NOTAM arises from the State's responsibility to provide aeronautical information about its airspace and the aerodromes located in its territory.[62] It is based on the directives of the Chicago Convention (Convention on International Civil Aviation,

53 ICAO Circular 330-AN/189, Para 4.2.1.
54 ICAO Circular 330-AN/189, Para 4.2.4 and 4.2.5.
55 ICAO Doc 9554, Para 3.1.1.
56 ICAO Annex 19, Paras 3.1.3 and 4.1 and ICAO Annex 17, Para 3.3.1.
57 The term NOTAM originates from the English term 'Notice to Airmen'.
58 ICAO Annex 15, Para 5.1.1.
59 ICAO Annex 15, Para 5.1.1.1.
60 ICAO Annex 15, Para 3.1.7. NOTAMs are part of the Integrated Aeronautical information Package. This is a compilation of all aviation-related permanent publications. It contains the Aeronatical information Publications, supplements, NOTAMs and PIBs, AICs, checklists and lists of NOTAMs.
61 ICAO Annex 15, Para 7.1.
62 ICAO Annex 15, Para 3.1.1.

ICAO Doc 7300) and Annex 15. The objective of providing aeronautical information is to make the information available that is necessary for the safety, regularity and efficiency of air traffic services to anyone involved in flight operations and air traffic services.[63]

Most Member States have a specialist organisation that is responsible for providing aeronautical information. In many countries, including Ukraine, this task is assigned to the air navigation service provider.

Aviation security

Authorities responsible for aviation security must strive to protect passengers, crew, ground staff and civilians from acts of unlawful interference.[64] ICAO considers the destruction of an operational aeroplane as a specific example of such an unlawful act of interference.[65] This protection includes authorities continuously gathering and analysing threat-related information. When necessary, they must take action to maintain aviation security at the desired level.[66] Authorities must, insofar as is possible, share threat-related information with other states that have an interest in aviation security.[67]

ICAO Member States are required to implement a national aviation security programme.[68] Specific guidelines for developing this programme are described in the 'Aviation Security Manual'.[69] The exact content of this document is confidential. To be able to accurately interpret the scope of the standards, the following observations related to the 'Aviation Security Manual' are important:

- A National Aviation Security Plan focuses on aircraft, aerodromes, equipment for air traffic services, passengers, luggage, cargo, mail and catering within the borders of the country concerned.
- The 'in-flight' component of a National Aviation Security Plan focuses on threats from passengers and/or cargo in the aircraft. Such threats are primarily managed at the aerodrome or by on-board security measures.
- Sharing security information takes place on a need-to-know basis in which the emphasis lies on protecting information.

The details specified in the 'Aviation Security Manual' make it clear that the National Civil Aviation Security Programme focuses on Member States' own airspace, although Annex 17 does not preclude states from assessing risks to fight routes through foreign airspace. This is consistent with the principles of sovereignty in the Chicago Convention.

63 ICAO Annex 15, Para 3.1.6.
64 ICAO Annex 17, Para 2.1.1.
65 ICAO Annex 17, Chapter 1, definition of 'acts of unlawful interference'.
66 ICAO Annex 17, Para 3.1.3.
67 ICAO Annex 17, Para 2.4.3.
68 ICAO Annex 17, Para 3.1.1.
69 ICAO Doc 8973.

Safety management
Each ICAO Member State must have a State Safety Programme in place that describes the State's safety policy, safety objectives, risk management, safety assurance and safety promotion.[70]

Monitoring
Each Member State must have systems in place that monitor requirements related to flight safety and aviation security.[71] Inspectors monitor compliance with national and international flight safety and aviation security requirements.[72]

Aviation treaties
States have established mutual agreements in aviation treaties to facilitate the development of international commercial aviation. Such treaties establish that operators can use each other's aerodromes.

Ukraine's national regulations
During the investigation, Ukraine's authorities referred in various documents to articles in Ukraine's aviation legislation. This legislation consists of:

- The Air Code of Ukraine. The beginning of this code stipulates (translated): *'The Air Code of Ukraine determines the legal basis for aviation activities. State regulation of aviation activities and of the use of Ukraine's airspace is intended to ensure aviation safety, and meet the State's interest, national security, and to satisfy requirements of society and the economy related to air transport and aerial work.'* Article 30:1 of this code reads: *'The use of Ukraine's airspace or a part thereof can be fully or partially restricted by the competent service for civil aviation and by the bodies of the united civil-military system of airspace organisation in accordance with the Regulation on the use of Ukraine's airspace.'*
- Regulation on the Use of Ukraine's Airspace. This regulation establishes the organisation and management of the airspace over Ukraine in a large number of articles.
- Rules of Aeronautical Information Service. This Resolution establishes the way in which aeronautical information is communicated to airspace users. It describes the compilation, publication and distribution of NOTAMs, among other things.

Malaysia's national regulations
In Malaysia, the tasks and roles of the Director General of Civil Aviation include monitoring and implementing aviation regulations with regard to guaranteeing the safe growth of civil aviation.[73] The Civil Aviation Regulation of 1996 was developed to regulate civil aviation. This regulation stipulates, for example, the conditions with which one must comply before an aeroplane is permitted to fly, the conditions that must be satisfied before passengers and cargo may be transported by air and the conditions related to an aeroplane's safety. The Director General, or a person authorised by the latter, has the

70 ICAO Annex 19, Para 3.1.
71 ICAO Annex 19, Para 3.2 and ICAO Annex 17, Paras 3.4.5 and 3.4.6.
72 ICAO Annex 6, Part I, Paras 4.2.1.1 and 4.2.1.7.
73 Civil Aviation Act 1969, Section 2B(a) and (c).

power to prevent aircraft flying, as specified in the Civil Aviation Regulation of 1996.[74] The Director General is responsible for protecting civil aviation against acts of unlawful interference.

4. Operators

Operators are commercial companies that provide air transport for people and goods. They must possess an Air Operator Certificate as proof that they comply with a number of requirements. The AOC is issued by the State in which the operator is based. The operator must demonstrate that it possesses an adequate organisation, method of control and supervision over flight operations, a training programme as well as ground handling and maintenance arrangements consistent with the nature and extent of the operations.[75]

An operator is responsible for safe flight operations.[76] To this end, operators are subject to the mandatory use of a safety management system and a security programme.[77]

The aircraft's pilot-in-command is responsible for operating the flight safely, in accordance with the rules of the air as included in ICAO Annex 2.[78] This also involves flight preparations.[79] ICAO does not specify the assessment of safety and security aspects related to the airspace and flight route used.

ICAO identifies a role for the operator as well as the pilot-in-command if there is a sudden outbreak of armed violence.[80] On this matter, ICAO states that once, due to a sudden outbreak of violence, the usual coordination processes between civil and military authorities are no longer followed, the operators and the pilot-in-command must assess the situation, using the information available to them, and take action to prevent a security risk.[81] ICAO does not specify what actions must be taken and which persons must take them. For example, just before the flight, the operator may change the route, or not allow the flight to depart. During the flight, the pilot-in-command bears ultimate responsibility, and must take all measures deemed necessary to safely complete the flight. The operator then provides support with recommendations insofar as it is still able to communicate with the pilot-in-command.

Many operators use 'code sharing' as a marketing tool. It involves two or more operators offering seats under their own names on a single flight operated by one of these operators. ICAO does not stipulate any standards for the operators concerning the use of code sharing but does recognise the issues posed by the practice.[82] ICAO does stipulate that Member States must consider the public interest of the code sharing and assess whether the operating operator satisfies relevant international standards.[83]

74 Civil Aviation Regulations 1996, Regulation 180.
75 ICAO Annex 6, Part II, Para 4.2.1.4.
76 ICAO Annex 6, Part II, Para 4.1.
77 ICAO Annex 19, Paras 3.1.3 and 4.1 and ICAO Annex 17, Para 3.3.1.
78 ICAO Annex 2, Para 2.3.1.
79 ICAO Annex 2, Para 2.3.2.
80 In the 'Manual Concerning Safety Measures Relating to Military Activities Potentially Hazardous to Civil Aircraft Operations'.
81 ICAO Doc 9554, Para 3.1.1.
82 ICAO Circular 269-AT/110.
83 ICAO Doc 8335, Part V, Chapter 4, Para 4.1.2, ICAO Annex 17, Recommendation 3.3.5 and ICAO Doc 8973, Appendix 24, Paras 80, 81 and 82.

The International Air Transport Association (IATA) is the global trade association of operators.[84] IATA has approximately 250 members, including Malaysia Airlines, which are responsible for 84% of all air traffic. IATA's objective is to support, represent and lead the aviation industry in developing a safe, reliable, profitable and sustainable aviation industry. One of the pillars of IATA's service involves performing audits. The IATA Operational Safety Audit (IOSA) is an essential component of the audit programme offered and is designed to assess an operator's operational management systems. The IOSA audits are mandatory for all IATA members. IATA considers security management to be an integral component of an operator's operational processes. Security management has been part of the IOSA audits since 1 March 2007.

Code sharing

Code sharing (sharing a flight under different codes[85]) is common in civil aviation. Two or more operators offer seats under their own code and flight number on a scheduled flight operated by one of the operators involved. Therefore, an operator can sell a flight ticket under its own name for a flight that, in practice, is operated by another operator. As established, for example, in Regulation (EU) no. 2111/2005, Article 11, the operator with which the ticket is booked (the 'contracting carrier') is obligated to inform passengers about the actual operator ('operating carrier') of the flight concerned. In accordance with international practices, like those endorsed by ICAO, the operator operating the flight is the party responsible for flight operations and for the passengers.[86] Liability for any damage may however be borne by the operator that sells the ticket.[87]

The establishment of code sharing

If a European operator wants to conclude a code share agreement with an operator from outside the EU, a bilateral aviation agreement ('air services agreement') between the operators' states generally forms its basis. In an air services agreement, two states agree to allow each others' designated operators the right to operate air services on specific routes between and in each other's territories.[88] This agreement also establishes that the designated operators in the two contracting states may enter into a code sharing agreement for code sharing services between certain destinations.

Operators can then conclude a code share agreement by drawing up a contract for this purpose. A code share agreement is predominantly a commercial agreement, which operators conclude to, for example, maintain, protect or expand their market share through partnerships and to be able to offer routes that they do not fly themselves.[89] These are contracts governed by private law, which, for example, may contain provisions related to safety and security, time tables, prices, in-flight services, liability and insurances and aerodrome operations.

84 There are also regional trade organisations such as the Association of Asia Pacific Airlines (AAPA).
85 The two-letter code of the airline concerned, such as MH for Malaysia Airlines and KL for KLM. See also F. Rossi dal Pozzo, 'EU legal framework for safeguarding air passenger rights' (Springer Cham Heidelberg 2014).
86 ICAO Doc 9626, para 4.8 says on this matter: 'With respect to responsibility regarding user-related issues, the usual airline industry rules and practices apply, i.e. responsibility rests with the operating carrier.'
87 The Montreal Convention, 1999.
88 The Netherlands and Malaysia concluded an air services agreement on 15 December 1966, see: *Treaty Series of the Kingdom of the Netherlands*, 1967, no.14, 'Agreement between the Kingdom of the Netherlands and Malaysia on air services'. This was reviewed/updated in confidential MoUs in 1991, 1995 and in 2008.
89 ICAO Circular 269/AT/110, 'Implications of airline code sharing' (1997).

Establishing equivalence of safety standards
ICAO does not set any rules to operators related to code sharing other than the obligation for operators to disclose code sharing arrangements to their respective government authorities. ICAO does stipulate that Member States should consider the public interest of the code sharing and be assured that the operation by a foreign operator comply with international safety standards. The responsible authority may require that an audit be performed to ascertain whether the operator from the other state complies in this respect.[90] This state's aviation authority may also request that the code share partner be continuously monitored, for example, to establish the number of accidents and incidents, its financial and economic position, the management, organisation, lifespan of its equipment and operational capacities.[91]

At the European level, Commission Regulation (EU) no. 965/2012 establishes that the competent authority in an EU Member State must be assured that the third-country operator, with which an operator in an EU Member State wants to enter into a code share agreement, complies with the applicable ICAO Standards. The competent authority must also ascertain whether the EU operator has an audit programme to continuously monitor the operator from the third country. It is the responsibility of the EU operator to demonstrate and monitor that the operator from the third country complies with the applicable ICAO standards. The operator must possess a code share audit programme for this purpose. In accordance with Regulation (EU) no. 965/2012, this audit must focus on the operational, management and control systems of the operator from the third country.[92]

To establish compliance with international safety standards, ICAO proposes that operators use the IATA Operational Safety Audit (IOSA).[93] IOSA is broadly recognised in the international aviation sector as a system for auditing an operator's operational management and control systems. The IOSA standards are, for example, based on ICAO standards. IATA considers safety management and security management to be integral components of an operator's operational processes. IOSA's 'guidance material' specifies new flight routes as a reason for a risk assessment, but there is no specific reference to a risk assessment for existing routes.[94]

A Dutch operator that enters into a code share agreement with a non-Community operator must first obtain approval from the Dutch Human Environment and Transport Inspectorate (*Inspectie Leefomgeving en Transport*, ILT).[95] General approval may be issued to the Dutch operator for the method used to select its code share partners. Such approval replaces the need for individual assessment of code share agreements. To this end, ILT must have approved a procedure in the operator's Operation Manual. The Dutch operator must use its procedures to establish that the non-Community operator operates in compliance with an equivalent safety standard, which the Dutch operator demonstrates

90 ICAO Doc 8335, Part V, Chapter 4, Para 4.1.2.
91 ICAO Doc 8335, Part V, Chapter 4, Para 4.1.5.
92 Regulation (EU) no. 965/2012 (Annex II Part-ARO and Annex III Part-ORO).
93 ICAO Doc 8335, Part V, Chapter 4, Para 4.1.3.
94 All members of IATA are IOSA-registered and must remain so to maintain their IATA membership, http://www.iata.org/whatwedo/safety/audit/iosa/Pages/index.aspx, consulted on 23 December 2014.
95 This applied at the time of the crash of flight MH17. The procedure changed as of 28 October 2014.

by performing an initial audit in accordance with an approved lease audit programme, such as IOSA. Once the code share agreement has been concluded, the Dutch operator must continue to ensure and verify that the non-Community operator complies with the equivalent safety standard for the duration of the code share agreement. Operators with safety shortcomings, as per the criteria of Regulation (EC) no. 2111/2005, are not eligible for code sharing.[96]

96 This is in accordance with Regulation (EU) no. 965/2012, in force since 28 October 2014, see AIC-B 03/2014, Human Environment and Transport Inspectorate (ILT). Before this, the practice was established in AIC-B 05/10, Transport and Water Management Inspectorate (IVW) 'Leasing, code sharing and interchange manual ('*Handleiding leasing, codesharing en interchange*'), 2 December 2010. The AIC-B was based on Regulation (EU) no. 1008/2008 (that replaced Regulation (EU) no. 2407/92 as of 1 November 2008) and Appendix III to Regulation (EU) no. 3922/91 (EU-OPS). These Regulations did not contain any specific provisions related to safety standards for code sharing, but in accordance with a notification by the European Commission from 2000 (COM/2000/365 final. No. 61) the provisions for 'wet lease' (related to equivalent safety requirements) also applied to code sharing. This notification provided the then IVW with general approval for a Dutch airline's selection procedures related to code share partners, based on an approved lease audit programme (such as IOSA).

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

OPERATORS THAT FLEW OVER THE EASTERN PART OF UKRAINE

The Dutch Safety Board used the flight data supplied by EUROCONTROL to produce a list of all the operators that flew through the Dnipropetrovsk FIR (UKDV) in the period between 14 and 17 July 2014, and the countries in which they are based.

The Dutch Safety Board also produced a list of all flights that took place in UKDV on 17 July, the day when flight MH17 crashed, until the airspace was closed at 15.00 (17.00 CET).[97]

The following must be taken into account when using these data:

- The data were automatically generated by EUROCONTROL. No check was performed on the data's accuracy.
- These are the operators whose flight numbers are used to identify the flights and to whom the route charges are charged. This is not necessarily the operator that actually operated the flight. An operator sometimes allows one or more flights to be operated by a different operator. The operator that actually operates the flight does so under its own air operator certificate (AOC), which means that this operator is bound by its own rules and conditions. Moreover, the operator generally performs the risk assessment for the flight to be operated. However, the flight keeps the flight number of the original operator to which the route charge is charged. Due to the large number of flights, the Dutch Safety Board was not able to investigate per flight whether the operating operator performed the risk assessment in all cases.
- The following lists contain all flights through the eastern part of Ukraine (UKDV), i.e. not only flights that travelled from west to east and vice versa.

Between 14 and 17 July 2014, flights were operated in UKDV by or on behalf of the following operators:

97 All times mentioned in this report and appendixes are in UTC and CET (Central European Time). CET = UTC +2.

OPERATOR	DOMICILE
AEGEAN AIRLINES	Greece
AEROFLOT - RUSSIAN AIRLINES	Russian Federation
AEROLOGIC	Germany
AIR ARABIA	United Arab Emirates
AIR ASTANA	Kazakhstan
AIR BALTIC	Latvia
AIR EUROPA	Spain
AIR FRANCE	France
AIR INDIA	India
ATLAS AIR	United States
AUSTRIAN AIRLINES	Austria
AZERBAIJAN HAVA YOLLARI	Azerbaijan
BANGLADESH BIMAN	Bangladesh
BELAVIA	Belarus
BUSINESS JET TRAVEL AIRLINE LTD	Austria
CARGOLUX AIRLINES	Luxembourg
CLASSIC JET	Latvia
CZECH AIRLINES	Czech Republic
DELTA AIR LINES	United States
DEUTSCHE LUFTHANSA	Germany
DNIEPROAVIA	Ukraine
ELITAVIA	Slovenia
EMIRATES	United Arab Emirates
ETIHAD AIRWAYS	United Arab Emirates
EVA AIRWAYS CORPORATION	Taiwan
EXECUJET EUROPE	Switzerland
FEDERAL EXPRESS	United States
FLYDUBAI	United Arab Emirates
GERMAN AIR FORCE	Germany
GLOBAL JET LUXEMBOURG	Luxembourg

OPERATOR	DOMICILE
HANG KHONG VIET NAM	Vietnam
IKAR	Russian Federation
JET AIRWAYS	India
JET EXECUTIVE INTERNATIONAL CHARTER	Germany
KLM ROYAL DUTCH AIRLINES	The Netherlands
LUFTHANSA CARGO	Germany
MALAYSIAN AIRLINES SYSTEM	Malaysia
MONTENEGRO AIRLINES	Montenegro
NETJETS	Portugal
ORENAIR	Russian Federation
PAKISTAN INTERNATIONAL AIRLINES	Pakistan
QATAR AIRWAYS COMPANY	Qatar
SHELL AIRCRAFT LTD.	The Netherlands
SINGAPORE AIRLINES	Singapore
SINGAPORE AIRLINES CARGO	Singapore
SWISS INTERNATIONAL AIR LINES	Switzerland
THAI AIRWAYS INTERNATIONAL	Thailand
TITAN AIRWAYS	United Kingdom
TNT AIRWAYS	United States
TRANSAERO AIRLINES	Russian Federation
TURKMENHOVAYOLLARY	Turkmenistan
TYROLEAN JET SERVICE	Austria
UKRAINE INTERNATIONAL AIRLINES	Ukraine
UNITED AIRLINES	United States
UTAIR-UKRAINE AIRLINES	Ukraine
UZBEKISTAN AIRWAYS	Uzbekistan
VIRGIN ATLANTIC	United Kingdom
VISTA JET	Switzerland
WIZZ AIR UKRAINE	Ukraine
YAMAL AIRLINES	Russian Federation

OPERATOR	DOMICILE
YANAIR	Ukraine

On 17 July 2014, the following flights were operated in UKDV by or on behalf of these operators. In total, 160 flights were conducted on this day until the airspace was closed at 15.00 (17.00 CET) see below:

Operator	Type	Country of departure	Country of destination
AEROFLOT	A320	RUSSIAN FEDERATION	RUSSIAN FEDERATION
AEROFLOT	A320	RUSSIAN FEDERATION	RUSSIAN FEDERATION
AEROFLOT	A320	RUSSIAN FEDERATION	RUSSIAN FEDERATION
AEROFLOT	B77W	RUSSIAN FEDERATION	ISRAEL
AEROFLOT	A321	RUSSIAN FEDERATION	CYPRUS
AEROFLOT	A320	RUSSIAN FEDERATION	RUSSIAN FEDERATION
AEROFLOT	A321	CYPRUS	RUSSIAN FEDERATION
AEROFLOT	A320	RUSSIAN FEDERATION	CYPRUS
AEROFLOT	A321	RUSSIAN FEDERATION	RUSSIAN FEDERATION
AEROFLOT	A321	RUSSIAN FEDERATION	RUSSIAN FEDERATION
AEROFLOT	A333	ISRAEL	RUSSIAN FEDERATION
AEROFLOT	B77W	ISRAEL	RUSSIAN FEDERATION
AEROLOGIC	B77L	GERMANY	THAILAND
AIR ASTANA	A321	KAZAKHSTAN	NETHERLANDS
AIR ASTANA	A321	NETHERLANDS	KAZAKHSTAN
AIR BALTIC CORPORATION	B735	AZERBAIJAN	LATVIA
AIR BALTIC CORPORATION	B733	GEORGIA	LATVIA
AIR EUROPA	B738	RUSSIAN FEDERATION	SPAIN
AIR INDIA	B788	INDIA	UNITED KINGDOM
AIR INDIA	B788	INDIA	UNITED KINGDOM
AIR INDIA	B788	INDIA	UNITED KINGDOM
AIR INDIA	B788	INDIA	GERMANY
AIR INDIA	B788	INDIA	FRANCE
AIR INDIA	B77W	INDIA	UNITED KINGDOM

Operator	Type	Country of departure	Country of destination
AIR INDIA	B788	UNITED KINGDOM	INDIA
AIR INDIA	B788	UNITED KINGDOM	INDIA
AIR INDIA	B744	GERMANY	INDIA
ATLAS AIR	B744	KUWAIT	LATVIA
AUSTRIAN AIRLINES	F70	RUSSIAN FEDERATION	AUSTRIA
AUSTRIAN AIRLINES	B763	INDIA	AUSTRIA
AUSTRIAN AIRLINES	F70	AUSTRIA	RUSSIAN FEDERATION
AZERBAIJAN HAVA YOLLARI	A320	AZERBAIJAN	FRANCE
AZERBAIJAN HAVA YOLLARI	A320	FRANCE	AZERBAIJAN
AZERBAIJAN HAVA YOLLARI	A320	AZERBAIJAN	RUSSIAN FEDERATION
AZERBAIJAN HAVA YOLLARI	E190	AZERBAIJAN	UKRAINE
AZERBAIJAN HAVA YOLLARI	E190	UKRAINE	AZERBAIJAN
AZERBAIJAN HAVA YOLLARI	A320	RUSSIAN FEDERATION	UKRAINE
AZERBAIJAN HAVA YOLLARI	B763	AZERBAIJAN	UNITED KINGDOM
BELAVIA	B735	GEORGIA	BELARUS
BELAVIA	E170	ARMENIA	BELARUS
BELAVIA	E190	AZERBAIJAN	BELARUS
BELAVIA	CRJ2	GEORGIA	BELARUS
BELAVIA	B733	BELARUS	RUSSIAN FEDERATION
BELAVIA	B733	RUSSIAN FEDERATION	BELARUS
CARGOLUX AIRLINES INTERNATIONAL	B748	LUXEMBOURG	AZERBAIJAN
CARGOLUX AIRLINES INTERNATIONAL	B748	AZERBAIJAN	LUXEMBOURG
DEUTSCHE LUFTHANSA	A346	CHINA	GERMANY
DEUTSCHE LUFTHANSA	A333	INDIA	GERMANY
DEUTSCHE LUFTHANSA	B748	INDIA	GERMANY
DEUTSCHE LUFTHANSA	A343	AZERBAIJAN	GERMANY
DEUTSCHE LUFTHANSA	A343	THAILAND	GERMANY
DEUTSCHE LUFTHANSA	A343	GERMANY	INDIA
DEUTSCHE LUFTHANSA	A346	GERMANY	INDIA
DEUTSCHE LUFTHANSA	B748	GERMANY	INDIA

Operator	Type	Country of departure	Country of destination
DEUTSCHE LUFTHANSA	B748	CHINA	GERMANY
DNIEPROAVIA	E145	UKRAINE	ARMENIA
DNIEPROAVIA	E145	ARMENIA	UKRAINE
DNIEPROAVIA	E145	UKRAINE	ARMENIA
DNIEPROAVIA	E145	ARMENIA	UKRAINE
ELITAVIA D.O.O.	GLEX	RUSSIAN FEDERATION	CYPRUS
EMIRATES	A388	CANADA	UNITED ARAB EMIRATES
EMIRATES	B77W	SWEDEN	UNITED ARAB EMIRATES
EMIRATES	A345	UNITED ARAB EMIRATES	UKRAINE
ETIHAD AIRWAYS	B77L	UNITED STATES	UNITED ARAB EMIRATES
ETIHAD AIRWAYS	A319	UNITED ARAB EMIRATES	BELARUS
ETIHAD AIRWAYS	B77W	UNITED ARAB EMIRATES	CANADA
ETIHAD AIRWAYS	B77W	UNITED ARAB EMIRATES	UNITED STATES
ETIHAD AIRWAYS	A319	BELARUS	UNITED ARAB EMIRATES
EVA AIRWAYS	B77W	CHINA	FRANCE
EVA AIRWAYS	B77W	THAILAND	UNITED KINGDOM
EVA AIRWAYS	B77W	THAILAND	NETHERLANDS
EVA AIRWAYS	B744	INDIA	GERMANY
EVA AIRWAYS	B77W	FRANCE	CHINA
HANG KHONG VIET NAM	B772	VIETNAM	GERMANY
HANG KHONG VIET NAM	B772	VIETNAM	FRANCE
HANG KHONG VIET NAM	B772	GERMANY	VIET NAM
HANG KHONG VIET NAM	B772	FRANCE	VIET NAM
JET AIRWAYS	A333	INDIA	BELGIUM
JET AIRWAYS	B77W	INDIA	UNITED KINGDOM
JET AIRWAYS	A333	BELGIUM	INDIA
JET AIRWAYS	B77W	BELGIUM	INDIA
JET AIRWAYS	B77W	INDIA	UNITED KINGDOM
JET AIRWAYS	B77W	INDIA	UNITED KINGDOM
JET AIRWAYS	B77W	UNITED KINGDOM	INDIA

Operator	Type	Country of departure	Country of destination
JET EXECUTIVE INTERNATIONAL	LJ35	RUSSIAN FEDERATION	GERMANY
KLM ROYAL DUTCH AIRLINES	B772	MALAYSIA	NETHERLANDS
KLM ROYAL DUTCH AIRLINES	B77W	SINGAPORE	NETHERLANDS
KLM ROYAL DUTCH AIRLINES	A332	INDIA	NETHERLANDS
KLM ROYAL DUTCH AIRLINES	B77W	THAILAND	NETHERLANDS
KLM ROYAL DUTCH AIRLINES	A332	NETHERLANDS	INDIA
LUFTHANSA CARGO AG	MD11	KAZAKHSTAN	GERMANY
LUFTHANSA CARGO AG	MD11	GERMANY	KAZAKHSTAN
MALAYSIAN AIRLINES	A388	MALAYSIA	UNITED KINGDOM
MALAYSIAN AIRLINES	B772	MALAYSIA	NETHERLANDS
MALAYSIAN AIRLINES	A388	UNITED KINGDOM	MALAYSIA
MALAYSIAN AIRLINES	A388	MALAYSIA	UNITED KINGDOM
MALAYSIAN AIRLINES	B772	NETHERLANDS	MALAYSIA
MALAYSIAN AIRLINES	A388	UNITED KINGDOM	RUSSIAN FEDERATION
MALAYSIAN AIRLINES	A388	FRANCE	MALAYSIA
ORENAIR	B738	GREECE	RUSSIAN FEDERATION
ORENAIR	B738	RUSSIAN FEDERATION	GREECE
PAKISTAN INTERNATIONAL AIRLINES	B772	PAKISTAN	UNITED KINGDOM
PAKISTAN INTERNATIONAL AIRLINES	B77L	PAKISTAN	UNITED KINGDOM
QATAR AIRWAYS	B788	QATAR	SWEDEN
QATAR AIRWAYS	B788	NORWAY	QATAR
QATAR AIRWAYS	B788	QATAR	NORWAY
QATAR AIRWAYS	B788	SWEDEN	QATAR
SINGAPORE AIRLINES	B772	SINGAPORE	DENMARK
SINGAPORE AIRLINES	A388	SINGAPORE	GERMANY
SINGAPORE AIRLINES	A388	SINGAPORE	FRANCE
SINGAPORE AIRLINES	B77W	SINGAPORE	GERMANY
SINGAPORE AIRLINES	B772	SINGAPORE	NETHERLANDS
SINGAPORE AIRLINES	A388	SINGAPORE	UNITED KINGDOM
SINGAPORE AIRLINES	A388	UNITED KINGDOM	SINGAPORE

Operator	Type	Country of departure	Country of destination
SINGAPORE AIRLINES	A388	SINGAPORE	UNITED KINGDOM
SINGAPORE AIRLINES	B77W	SINGAPORE	UNITED KINGDOM
SINGAPORE AIRLINES	B77W	SINGAPORE	GERMANY
SINGAPORE AIRLINES	B772	NETHERLANDS	SINGAPORE
SINGAPORE AIRLINES	A388	UNITED KINGDOM	SINGAPORE
SINGAPORE AIRLINES	B772	DENMARK	SINGAPORE
SINGAPORE AIRLINES	A388	FRANCE	SINGAPORE
SINGAPORE AIRLINES	A388	GERMANY	SINGAPORE
SINGAPORE AIRLINES	A388	UNITED KINGDOM	SINGAPORE
SWISS INTERNATIONAL AIRLINES	A343	THAILAND	SWITZERLAND
THAI AIRWAYS	A388	THAILAND	GERMANY
THAI AIRWAYS	A388	THAILAND	FRANCE
THAI AIRWAYS	A346	THAILAND	SWITZERLAND
THAI AIRWAYS	B744	THAILAND	UNITED KINGDOM
THAI AIRWAYS	B772	THAILAND	SPAIN
THAI AIRWAYS	B77W	THAILAND	BELGIUM
THAI AIRWAYS	B744	THAILAND	ITALY
THAI AIRWAYS	A346	UNITED KINGDOM	THAILAND
THAI AIRWAYS	A346	THAILAND	GERMANY
THAI AIRWAYS	A346	THAILAND	UNITED KINGDOM
THAI AIRWAYS	B744	THAILAND	GERMANY
THAI AIRWAYS	B77W	BELGIUM	THAILAND
THAI AIRWAYS	A388	FRANCE	THAILAND
THAI AIRWAYS	B744	UNITED KINGDOM	THAILAND
THAI AIRWAYS	A388	GERMANY	THAILAND
TURKMENHOVAYOLLARY	B752	UNITED KINGDOM	TURKMENISTAN
UKRAINE INTERNATIONAL AIRLINES	B735	ARMENIA	UKRAINE
UKRAINE INTERNATIONAL AIRLINES	B739	GEORGIA	UKRAINE
UKRAINE INTERNATIONAL AIRLINES	B738	GEORGIA	UKRAINE
UKRAINE INTERNATIONAL AIRLINES	E190	AZERBAIJAN	UKRAINE

Operator	Type	Country of departure	Country of destination
UKRAINE INTERNATIONAL AIRLINES	B733	UKRAINE	GEORGIA
UKRAINE INTERNATIONAL AIRLINES	B733	GEORGIA	UKRAINE
UTAIR - UKRAINE AIRLINES LLC	B738	UKRAINE	TURKEY
UZBEKISTAN AIRWAYS	B763	UZBEKISTAN	UZBEKISTAN
UZBEKISTAN AIRWAYS	B752	UZBEKISTAN	ITALY
UZBEKISTAN AIRWAYS	B763	UZBEKISTAN	GERMANY
UZBEKISTAN AIRWAYS	B752	ITALY	UZBEKISTAN
UZBEKISTAN AIRWAYS	B763	GERMANY	UZBEKISTAN
VIRGIN ATLANTIC	A333	UNITED KINGDOM	INDIA
VIRGIN ATLANTIC	A333	INDIA	UNITED KINGDOM
VIRGIN ATLANTIC	A333	INDIA	UNITED KINGDOM
VIRGIN ATLANTIC	A333	UNITED KINGDOM	INDIA
WIZZ AIR UKRAINE	A320	UKRAINE	GEORGIA
WIZZ AIR UKRAINE	A320	GEORGIA	UKRAINE
YAMAL AIRLINES	A321	RUSSIAN FEDERATION	TURKEY
YAMAL AIRLINES	A321	RUSSIAN FEDERATION	CYPRUS

Comparison of 12-14 July with 15-17 July 2014
From 12-14 July there were 719 flights over the eastern part of Ukraine and between 15 and 17 July there were 603. It basically concerns the same operators. The differences in the number of flights can be explained by changes in flight schedules and routes that were not related to safety.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

APPENDIX S

PRECEDENTS: ACCIDENTS INVOLVING CIVIL AVIATION OVER CONFLICT ZONES

Introduction
The shoot-down of a civil aircraft with a surface-to-air missile may be a rare event, but it is not without precedent. Since the Second World War there have been a number of similar cases. There are several lists and studies in circulation.[98] Comparisons of these lists have resulted in more than 20 occurrences that possibly involved cases of civil aeroplanes being shot down, or attempts to do so.

Criteria
Flight MH17 was flying at a cruising altitude of 33,000 feet, beyond the reach of MANPADS. To select similar precedents, the Dutch Safety Board focused on civil aeroplanes flying en route (in most cases, above FL250[99]), which were accidentally shot down with anti-aircraft missiles. Not included are attacks on military airplanes and attacks during approaches or take-offs.

Based on these criteria three similar incidents can be cited.

- *1980*: DC-9 Aerolinee Itavia flight 870, crashed in the Tyrrhenian Sea on 27 June 1980. On 23 January 2013, the highest Italian legal authority ruled that there was clear evidence that it had been downed by an anti-aircraft missile.
- *1988*: A300 Iran air flight 655, downed on 3 July near the Strait of Hormuz, in the Persian Gulf. It involved a misidentification by a U.S. cruiser that then fired an anti-aircraft missile.
- *2001*: TU 154 Siberia Airlines flight 1812, downed above the Black Sea on 4 October. Firing exercises were being conducted close to the flight route of flight 1812. One missile missed its target and subsequently hit flight 1812.

Other incidents
Including civil aeroplanes shot down in cruise flight by military planes, the number increases to eight incidents. It should be noted that, in these five additional cases, the involved military planes intentionally downed the civil aeroplanes. The respective locations can be considered as conflict areas. The most recent of these five was Korean Air Lines flight KAL007 in 1983. The other four occurred in the 1950s and 1970s.

98 The following lists were consulted: a study by HCSS, Aviation Safety Network, Gutenberg list.
99 This altitude was selected to filter out MANPADS.

MANPADS

The Dutch Safety Board also examined cases in which aeroplanes were downed while flying at a cruising altitude lower than FL250. Apart from one exception,[100] all cases involved turboprop or piston engine aircraft, and they were shot down using MANPADS.

100 Iran Air flight 655.

APPENDIX T

REPORT OF THE DUTCH REVIEW COMMITTEE FOR THE INTELLIGENCE AND SECURITY SERVICES

Dutch Review Committee for the Intelligence and security services (CTIVD[101])

Review Report arising from the crash of the flight MH17
The role of the General Intelligence and Security Service of the Netherlands (AIVD) and the Dutch Military Intelligence and Security Service (MIVD) in the decision-making related to the security of flight routes.

101 The CTIVD is responsible for the content of this appendix, including the terminology used, which may deviate from the terminology used by the Dutch Safety Board.

Review Report

arising from the crash of flight MH17

The role of the General Intelligence and Security Service of the Netherlands (AIVD) and the Dutch Military Intelligence and Security Service (MIVD) in the decision-making related to the security of flight routes

CTIVD nr. 43

8 April 2015

CTIVD Review Committee on the Intelligence and Security Services

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

Review Committee
on the Intelligence and
Security Services

CTIVD nr. 43

REVIEW REPORT

arising from the crash of flight MH17

Table of Contents

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

Review Committee
on the Intelligence and
Security Services

CTIVD nr. 43

SUMMARY

arising from the crash of flight MH17

What is the reason for this investigation?

Following the crash of Malaysia Airlines flight MH17 on 17 July 2014 in Eastern Ukraine, the Dutch Safety Board is investigating, among other things, the decision-making related flight routes. The question arose whether the AIVD and the MIVD have a legal duty in this respect and how they implement it. The Dutch Review Committee for the Intelligence and Security Services conducted an investigation into this matter at the request of the Minister of the Interior and Kingdom Relations and the Minister of Defence. Our Committee presented its report to the Dutch Safety Board on 10 April 2015.
What did we investigate?

The report focuses on answering the following questions:

- Do the Services have a legal duty related to the security of flight routes through foreign airspace?
- How is the formal consultation structure organised between the AIVD and the MIVD and the civil aviation parties with regard to security issues and what information exchange takes place in this respect?
- What information did the Services possess prior to the crash regarding the security of civil aeroplanes above Eastern Ukraine and did they share this knowledge with external parties?

What are our conclusions?

Below we present the broad outlines and main conclusions of the report.

Do the Services have a legal duty related to the security of flight routes through foreign airspace?

The Committee has established that the legal security and intelligence tasks of the AIVD (Art. 6 paragraph 2 a/d Wiv 2002 (Intelligence and Security Services Act 2002, Wet op de inlichtingen- en veiligheidsdiensten 2002)) and the MIVD (Art. 7 paragraph 2 subsection a, c/e) do not include the Services conducting independent investigations into the security of foreign airspace and therefore into the security of flight routes that lie within it.

The Committee is of the opinion that the security of flight routes through foreign airspace does fall under the AIVD's security promotion task (Art. 6 paragraph 2 c). Other aspects of civil aviation security, such as promoting the security at Dutch airports and checking passengers and their luggage, also form part of this task. The MIVD also has a security promotion task but it focuses on the defence sector.

The AIVD's security promotion task does not involve conducting independent investigations. The task focuses on making a contribution to promoting the protection of important and vulnerable parts of society in the Netherlands. This is done using all the information gathered in investigations that fall under the security and intelligence task. When performing this task the AIVD can be expected to make a contribution to effectively providing information to Dutch airlines. This comprises two aspects:

- On the one hand, at the AIVD's initiative: The AIVD is expected to share information that points to an actual threat to civil aviation abroad, such as shooting down an aircraft, as quickly as possible with Dutch airlines or the National Coordinator for Security and Counterterrorism (NCTV).
- On the other hand, at the initiative of the Dutch airlines: They can, for example, ask the AIVD for information related to flight routes and airports in foreign countries. The AIVD cannot be expected to independently assess which information airlines need (except in the event of an actual threat).

The MIVD can also be expected to share information that points to a specific threat to civil aviation abroad as quickly as possible with the NCTV or Dutch airlines. This arises from the general principles of good governance.

How is the formal consultation structure organised between the AIVD and the MIVD and civil aviation parties with regard to security issues and what information exchange takes place?

The AIVD performs various activities that focus on promoting the security of civil aviation. The MIVD's role in this area is more limited due to its military orientation.

The AIVD participates in several consultation structures with which it shares non-classified information about potential threats.

- Joint consultation with the so-called vital sectors, including civil aviation;
- The Schiphol Security and Public Safety Platform (BPVS);
- Consultation with regional airports.

At the NCTV's request, the AIVD and the MIVD compile threat analyses for civil aviation (national airports and arriving and departing air traffic) that include threat-related information from their ongoing investigations.

Moreover, the AIVD maintains an extensive network of relationships with the civil aviation sector, including Dutch airlines. The AIVD provides information from its investigations to the airlines on a demand-driven basis. The MIVD only maintains contact with KLM. In this relationship, the MIVD provides information from its investigations on a demand-driven basis.

The Services share specific threat-related information with Dutch airlines and/or the NCTV on the basis of each Service's policy. They determine the severity and probability of a threat using a set of threat factors (i.e. capacity, potential, intention and activity). The Committee is of the opinion that these factors constitute an effective basis for this assessment.

What information did the Services possess prior to the crash regarding the security of civil flights above Eastern Ukraine and did they share this knowledge with external parties?

The Committee is the only body other than the Services themselves that has had access to all the State secret material that the Services possessed prior to the crash of flight MH17. It arrived at the following judgement:

The material available at the Services does not indicate any factors that point to a specific threat to civil aviation prior to the crash of flight MH17. The material available to the Services does not indicate that any one or more actors involved in the conflict in Eastern Ukraine displayed a combination of military resources, possibilities and intention to shoot down a civil aeroplane at cruising altitude, prior to the crash.

Based on the available information it therefore follows that the MIVD and the AIVD could not have been expected to identify any specific threat to civil aircraft above Eastern Ukraine or report it to external parties.

Recommendation

In light of the discussion within the international community and in Dutch society following the crash of flight MH17 related to improving the provision of information in the context of the security of flight routes, the Committee recommends that Dutch airlines be able to address a single contact point for both Services with their questions about the security of flight routes, including routes through foreign airspace. Establishing such a contact point would help increase collaboration in this area between the AIVD and the MIVD, as well as information exchange with Dutch airlines.

Review Committee
on the Intelligence and
Security Services

CTIVD nr. 43

REVIEW REPORT

arising from the crash of flight MH17

1 Introduction

On 21 November 2014, the Dutch Review Committee for the Intelligence and Security Services (the Committee) received the request from the Minister of the Interior and Kingdom Relations and the Minister of Defence to conduct an investigation into the role of the AIVD and the MIVD in the decision-making related to the security of flight routes.

The Dutch Safety Board asked the ministers to submit this request to the Committee. Following the crash of Malaysia Airlines flight MH17 on 17 July 2014 in Eastern Ukraine, the Dutch Safety Board is investigating, inter alia, the decision-making related to the selection of flight routes. This investigation raised three research questions related to the role of the AIVD and the MIVD that the Dutch Safety Board wanted the Committee to investigate.

The following research questions were presented to the Committee:

a) What is the formal structure between the AIVD or the MIVD respectively and the parties relevant to aviation security, such as airlines, air navigation service providers and ministries, with regard to the provision of information about security threats?

b) What are the two Services' specific activities related to exchanging information with parties relevant to aviation security?

c) What information did the AIVD and the MIVD possess prior to the crash regarding the security situation in Eastern Ukraine, and to what extent did they share this information with parties involved in aviation security and safety? What were the considerations for doing / not doing so?

On 6 January 2015, the Committee announced that it would conduct the requested investigation.

This review report is structured as follows:

- Chapter 2 describes the procedure followed for this report and the Committee's research method.
- Chapter 3 includes the legal framework that applies to the role of the AIVD and the MIVD in the decision-making related to flight routes.
- Chapter 4 focuses on research questions (a) and (b): the consultation structure and the information exchange between the AIVD and the MIVD and the civil aviation sector.

- Chapter 5 concerns the situation prior to the crash of flight MH17. This chapter focuses on research question (c): what information did the Services possess and did they share this information?
- Chapter 6 includes the final conclusion and therefore the answers to the research questions.
- Chapter 7 provides the Committee's concluding remarks with a view to the future.

The Committee's review report was presented to the Dutch Safety Board on 10 April 2015, to be included in its entirety as an appendix to the report that the Dutch Safety Board will publish on the decision-making related to flight routes.

2 The organisation of the investigation

2.1 Procedure

The Committee's task is laid down in the Intelligence and Security Services Act 2002 (Wiv 2002). The Committee monitors the legality of the AIVD's and the MIVD's operations. The research questions that the Dutch Safety Board presented to the Committee do not directly fall under this task. The Committee did, however, conduct this investigation in accordance with the application of the Wiv 2002. This was based on the request submitted by the two ministers.

In contrast to what is stipulated in the Wiv 2002, in this particular case the Committee reports its findings directly to the Dutch Safety Board. The ministers will not send the report to both Chambers of the States General accompanied by their response. The Dutch Safety Board will make the Committee's report public, along with its own report. In this respect, the ministers and the Dutch Safety Board agreed that the Dutch Safety Board will first present the Committee's report to both ministers to examine it for the presence of any State secret information before the Dutch Safety Board makes the Committee's report public.

This report does not contain any secret appendix.

2.2 Methodology

Shortly after receiving the letter from both ministers, the Committee launched a preparatory investigation. In this phase the Committee held exploratory interviews with the management of the AIVD and the MIVD, conducted an exploratory case study of both Services and developed an action plan for the investigation.

In its investigation, the Committee focused on the period from 1 January 2014 through 17 July 2014. The Committee interviewed seventeen people during the investigation. Several people were interviewed twice. In total, the Committee conducted twenty interviews. They mainly involved staff from both Services. The Committee also conducted an extensive case study of both Services.

The investigation consisted of two phases. The initial phase was characterised by a process of familiarisation and elaboration. In this phase an initial investigation of the systems took place and a request was submitted for the material that the Services had gathered as part of internal investigations into the level of knowledge prior to the crash.

This material was studied and then assessed and supplemented by interviews with the staff members involved. During the second phase, the Committee performed a cross-check in the Service's digital systems. Broad investigative activities were conducted to examine the systems and ascertain whether all the relevant documents had been identified. This approach provided the Committee with a complete picture of the level of knowledge both Services possessed prior to the crash of flight MH17.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

3 Legal framework

3.1 Introduction

Following the crash of flight MH17, society raised the question whether the AIVD and the MIVD have a legal duty with regard to the security of flight routes through foreign airspace. The first step is to examine what the law says on the matter. This constitutes the content of the current chapter. In the following chapter the Committee addresses the Services' specific activities related to civil aviation security.

This chapter provides an answer to the following question:

- Is the security of civil aviation flight routes through foreign airspace within the legal duties of the AIVD and the MIVD?

3.2 The responsibility of central government

The question in this paragraph is to which extent central government is responsible for the security of the airspace and the flight routes Dutch airlines use abroad.

According to the Convention on International Civil Aviation (ICAO Treaty[1]), each State has sovereignty over its own airspace. This means that the airspace above a State is part of the territory over which the State concerned exercises sole authority[2]. This has two implications:
- On the one hand the State has sole authority to take measures related to its airspace. This includes the decision to open its airspace to international air traffic, possibly subject to a particular flight altitude.
- On the other hand the State is responsible for the safety of its airspace and for the national and international air traffic that passes through it.

It follows from the above that the Dutch central government is sovereign with regard to Dutch airspace. This is the airspace above the Netherlands. This means that it exclusively possesses the power to take measures related to this airspace. Examples of such measures are closing the airspace or establishing a compulsory flight altitude. The powers of central government to make decisions related to the airspace goes hand in hand with a responsibility for its safety. The national and international air traffic that passes through it also falls under this responsibility.

Based on the principle of sovereignty, the Dutch central government therefore has no power to take measures related to foreign airspace. This also means that the Dutch central government bears no responsibility for the safety of the airspace above other States.

---

[1] CAO stands for International Civil Aviation Organization (in Dutch: 'internationale burgerluchtvaartorganisatie'). The organisation was founded in 1947 by the United Nations Convention on International Civil Aviation (the Chicago Convention). Its objective is to develop international standards and agreements for safe and orderly air traffic.

[2] In the event of an armed conflict this may be different. Based on the UN Charter, the UN Security Council can decide to establish a No-Fly Zone. Parties embroiled in the fighting (ie, States that are involved in the armed conflict) can also establish such zones and may enforce them above their own territory as well as above enemy territory.

There is another aspect that is closely related to the limitations of central government's responsibility outlined here. It involves the decision-making of Dutch airlines with regard to the use of open foreign airspace, whether subject to a compulsory flight altitude or not. This does not involve the demarcation of responsibilities between sovereign States, but between the authorities and the business community. The decision whether to use foreign airspace or not falls beyond the Dutch central government's sphere of influence. The Dutch Aviation Act does not contain any explicit provision for imposing a flight ban on Dutch airlines with regard to flying in foreign airspace. In the Netherlands the airlines are the ones that decide whether they use other countries' open airspace or not. This decision also includes the consideration of any relevant safety aspects. To this end, in practice, the airlines use risk analyses that they produce in-house.

The answer to the question posed is: Central government has no control over the decision-making related to opening foreign airspace and therefore no responsibility for the safety of that airspace; it has no control either over the choices made by Dutch airlines with regard to use of the airspace and therefore it does not bear responsibility for those choices.

3.3 The security tasks of the AIVD and the MIVD

In short, the legal security duties of the AIVD and the MIVD[3] involve the Services conducting investigations into threats to national security. In doing so the AIVD focuses on civil aspects and the MIVD on military aspects. Investigating threats includes monitoring the security situation so that new threats can be identified. The objective of these investigations is to enable the central government to assume its responsibility for protecting national security.

In the previous paragraph, the Committee established that the Dutch central government has no control over, and consequently does not bear responsibility for, decisions related to opening foreign airspace, or for the choices made by Dutch airlines with regard to using the airspace. Since the AIVD and the MIVD's task allocation is linked to the central government's responsibilities, the Committee concludes that the AIVD and the MIVD do not have a legal duty related to the safety of foreign airspace and consequently for the safety of flight routes that pass through them.

3.4 The intelligence tasks of the AIVD and the MIVD

The AIVD and the MIVD are charged with the task of conducting investigations concerning other countries.[4] This is the foreign intelligence task. The Services perform this task with regard to matters that are referred to in the Foreign Intelligence Designation Order. This order does not mention the safety of foreign airspace or foreign civil aviation flight routes. Conducting investigations into the safety of foreign flight routes and the decision to use them is not part of this task.

---

[3] This is the so-called 'a' task of the AIVD (Article 6 paragraph 2 subsection a Wiv 2002) and the 'a' and 'c' tasks of the MIVD (Article 7 paragraph 2 subsections a and c).

[4] This is the so-called 'd' task of the AIVD (Article 6 paragraph 2 subsection d Wiv 2002) and the 'e' task of the MIVD (Article 7 paragraph 2 subsection e).

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

Contents

Contents of the Appendices to Part B

Appendix O

Appendix P

Appendix Q

Appendix R

Appendix S

Appendix T

Appendix U

Contents of the Appendices available on the website

Appendix V

Appendix W

Appendix X

Appendix Y

Appendix Z

3.5 The AIVD security promotion task

One of the legal duties of the AIVD and the MIVD is to promote measures to protect the interests these Services serve.[5] This is called the security promotion task. The MIVD focuses on the defence sector (including the defence industry) when executing this task, which means that although the MIVD produces threat analyses for military flights to support Dutch defence, civil aviation falls outside its scope.[6] Therefore we only discuss the AIVD below.

The AIVD's security promotion task is not an investigative task per se. This task mainly involves using the information that the Service has gathered during its investigations in the context of its security task to better protect vulnerable and/or vital parts of society. This could be by providing the information to administrative bodies that can take measures, such as the NCTV[7], or by informing the business community, het is e.g. by means of presentations. This allows companies to better protect themselves against certain threats.

A broad interpretation of the security promotion task is appropriate given its nature and objective. It does not involve obtaining a comprehensive view of potential threats (as in the security task), but of making a contribution to protecting important parts of society where possible. In the Committee's opinion, in addition to promoting other security aspects related to civil aviation, such as airport security and passenger and luggage control, this task also includes promoting the security of flight routes.

To perform this task, the AIVD can be expected to make a contribution to effectively provide reliable information to the civil aviation sector.

Information that is relevant to the security of civil aviation can be divided into two categories:

- Specific threat information

If information from ongoing investigations points to a specific threat[8] (such as shooting down an aircraft), the AIVD must take the initiative to report this as soon as possible. The report is made either directly to the civil aviation party concerned or to the NCTV. Chapter 4 explores this matter in more detail.

---

[5] This is the so-called 'c' task of the AIVD (Article 6 paragraph 2 subsection c Wiv 2002) and the 'd' task of the MIVD (Article 7 paragraph 2 subsection c).

[6] The MIVD does have a separate legal duty (Article 7, paragraph 2 subsection f Wiv 2002), just like the AIVD, in the context of the so-called surveillance and protection system (stelsel bewaken en beveiligen), which may include civil aviation (airports and arriving and departing air traffic) in the Netherlands. In this system, the central government bears responsibility for taking security measures (or additional security measures) for certain people, services and objects in the so-called State domain due to the national interest involved in their security and unimpeded operations. The MIVD compiles threat analyses at the request of the NCTV, who acts as information coordinator in the system. This activity is further addressed in Chapter 4 insofar as it is relevant to this report.

[7] For the sake of completeness, here we also refer to the separate legal duty assigned to the AIVD in the context of the surveillance and protection system (Article 6 paragraph 2 subsection e Wiv 2002). This system is explained in the previous footnote. At the NCTV's request, the AIVD compiles threat and risk analyses for the persons, objects and services in the State domain. This activity is further addressed in Chapter 4 insofar as it is relevant to this report. The Service often performs this system task alongside the security promotion task. There may be a certain degree of overlap in the focal areas of the two tasks. The security promotion task extends to, among other things, vulnerable and important parts of society, such as civil aviation, which can also fall under the system's State domain.

[8] This term is elaborated in the AIVD's policy. See Chapter 4, paragraph 4.2.3.

- Other information that is relevant to security

With regard to other information that the AIVD possesses, it will be difficult for the Service to independently estimate exactly what the civil aviation parties need. Close collaboration with these parties is therefore required to properly implement this information provision.[9] The AIVD will not generally be aware of the flight routes taken by Dutch airlines or of the foreign airports at which the airlines land. In this respect, the initiative must be taken by the airlines and not the AIVD. This means that information requests from airlines must constitute the basis for the provision of information by the AIVD (except in the event of an actual threat). Subsequently it is up to the AIVD to consider whether it falls within its legal tasks to provide information.[10] Chapter 4 explores this matter in more detail.

3.6 Threat reporting by the MIVD

In contrast to the AIVD, the MIVD does not have a legal duty that relates to civil aviation security. Therefore, the MIVD cannot generally be expected to provide civil aviation parties with information that is important for civil aviation security.

Specific threat information[11] constitutes an exception to this. The Committee is of the opinion that if ongoing investigations conducted by the MIVD reveal a specific threat to civil aviation, the MIVD must take the initiative to report it as quickly as possible, either directly to the civil aviation party concerned or to the NCTV. This arises from the principle of balanced interests that is part of the general principles of good governance.[12]

3.7 Collaboration between the AIVD and the MIVD

The law stipulates that the Services must collaborate with each other as much as possible.[13] This collaboration can at any rate involve providing data that may be important to the other Service.[14] Since the AIVD has a security promotion task that also includes civil aviation security, the MIVD can be expected to cooperate in this area. This is important because, given the MIVD's military orientation, it often possesses specific knowledge of weapons and weapons systems.

---

9 Dutch Parliamentary Papers *(Kamerstukken) II* 1999/00, 25 877, no. 8, p. 122.

10 See Article 36 Wiv 2002.

11 This term is elaborated in the MIVD's policy. See Chapter 4, paragraph 4.3.1.

12 These legal principles arise from jurisprudence. See: Damen et al., *Bestuursrecht* (Administrative Law) *1*, The Hague: Boom Juridische uitgevers 2005, p. 336-342.

13 Article 58 paragraph 1 Wiv 2002.

14 Article 58 paragraph 2 subsection a Wiv 2002.

4 Consultation structure and information exchange

4.1 Introduction

This chapter provides answers to two research questions that were presented to the Committee. These questions are:

a) What is the formal structure between the AIVD or the MIVD respectively and the parties relevant to aviation security, such as the airlines, air navigation service providers and the ministries, with regard to the provision of information about security threats?
b) What are the two Services' specific activities related to exchanging information with parties relevant to aviation security?

This chapter describes how the AIVD and the MIVD generally contribute to promoting civil aviation security. The specific activities of the Services related to providing information about the security situation in Eastern Ukraine prior to the crash are discussed in Chapter 5.

This is followed by an overview of the structure per Service (first the AIVD, followed by the MIVD), of the consultation between the Service and the parties relevant to civil aviation related to security and threats (question a). In this context the Committee also identifies the Services' specific activities related to promoting civil aviation security, especially how the Services exchange information with the parties relevant to civil aviation security in the sector and the type of information which the Services share (question b). Question b also involves the policy adopted by both Services related to sharing information about threats.

The other parties (including government parties) that play a role in aviation security, such as the National Coordinator for Security and Counterterrorism (NCTV), are only mentioned here where relevant.

4.2 The AIVD

This section provides an overview of the consultation structure between the AIVD and parties in the civil aviation sector and of AIVD's specific activities related to promoting the security of civil aviation.

This section is organised as follows:

- Contact with the vital sectors: Joint consultation with the vital sectors, the Schiphol Security and Public Safety Platform (BPVS) and consultation with regional airports.
- The compilation of threat analyses for civil aviation.
- The account manager and the network of relationships with the civil aviation sector.
- Sharing information with Dutch airlines, both on request and of its own accord.

4.2.1 Contact with the vital sectors

Joint consultation with the vital sectors

Based on its security promotion task, the AIVD maintains contact with the so-called vital sectors in the Netherlands. These include transport sectors, such as the railways and Amsterdam Airport Schiphol, as well as major events and the gas and electricity sector. The Minister of the Interior and Kingdom Relations has designated fourteen sectors.[15] The failure of the products or services that fall under these sectors may cause social disruption.

The AIVD holds formal joint consultations with the vital sectors two to four times a year. KLM represents the Dutch civil aviation sector at these consultations. During the meetings, the AIVD shares information that is deemed relevant for the security of the vital sectors. In doing so, the AIVD does not share any State secret information. It involves, for example, political analyses.

Schiphol Security and Public Safety Platform (BPVS)

The AIVD also contributes to informing civil aviation parties about security in other ways. One example is its participation in the Schiphol Security and Public Safety Platform (BPVS). This platform is a consultation body with a coordinating and steering role. Public and private parties cooperate in the Platform to improve the effectiveness and efficiency of security and crime management at Schiphol. It was founded following the diamond heist at Schiphol in 2005.

The Platform is chaired by the director of Schiphol and the NCTV. The NCTV is jointly responsible for the security of national airports. In addition, parties that have an interest in and can contribute to security at Schiphol are represented, such as the Mayor, the Royal Netherlands Marechaussee, the Public Prosecution Service (OM), customs, the national police, KLM, air traffic control, the Ministry of Infrastructure and the Environment and the AIVD. The Ministry of Infrastructure and the Environment and Air Traffic Control the Netherlands are (partly) responsible, on behalf of the government, for the safety of Dutch airspace and for inbound, outbound and domestic air traffic.

The Platform convenes twice a year. At this level the AIVD is represented by a member of its management. Operating below the Platform is a steering group that meets every two months. The steering group mainly focuses on aligning policy. A head of unit from the AIVD participates in this group. Another working group operates below the latter, convening on a monthly basis. The working group especially serves to share needs and questions. The AIVD is represented in this group by its civil aviation account manager. The AIVD has several account managers that maintain contact with the vital sectors.

In the Platform, the AIVD shares unclassified information about threats to Schiphol airport. This concerns information about the situation on the ground in the Netherlands. Examples of this kind of information are: What general impression does the Service have with regard to Schiphol? Is left-wing extremism stirring things up at Schiphol? Are there any problems expected involving factions related to asylum policy or animal rights extremism? The Platform also addresses themes such as security investigations involving employees.

Consultation with regional airports

Each regional airport is also involved in a similar biannual consultation to discuss, among other things, security issues. The AIVD account manager participates in the consultation in his/her capacity as relationship manager. This allows the AIVD to reach airports that do not participate in the BPVS Platform.

---

15 Information brochure on vital sectors, Ministry of the Interior and Kingdom Relations (BZK), 25 June 2010, available (in Dutch) at www.rijksoverheid.nl.

4.2.2 Threat analyses on request

Every six months, the AIVD compiles an update of its threat analysis related to civil aviation at the request of the NCTV. This activity is performed in the context of the Alerteringssysteem Terrorismebestrijding (Dutch Counterterrorism Alert System, ATb) for the airports sector in the Netherlands. In addition to the AIVD, the NCTV also submits requests to the MIVD and the National Information Organisation Service of the National Police (DLIO)[16] for information on this matter.

In its threat overview, the AIVD not only includes threats to national airports, but also associated threats related to incoming aircraft in the Netherlands (eg coming from risk areas), threats to Dutch airlines abroad or their interests (eg the security of Dutch crews during a stay abroad, the security of foreign destination airports, threats from known terrorist groups to civil aircraft that are going to land or possibly overfly) and threats to air traffic departing from the Netherlands (e.g. a person posing a threat in the Netherlands).

To this end, the AIVD draws on the information, knowledge and expertise regarding specific and possible threats already available to the Service. The AIVD bases this on known Dutch and foreign persons and factions that pose a threat, their working methods and the extent to which they have the intention and potential (in this context: resources and possibilities) to actually violate the safety of the civil aviation sector. These threat analyses are classified as State secret, because the AIVD reveals its subjects under investigation, level of knowledge, working method and/or sources in them.

4.2.3 Contact with the civil aviation sector

Network of relationships with the civil aviation sector
The AIVD has an account manager civil aviation. His/her main task is to maintain an extensive network of relationships with parties in the Dutch civil aviation sector. This concerns relationships with the security managers of the Dutch airlines[17], with security managers of Dutch airports, flight school owners, Air Traffic Control the Netherlands, the Dutch Air Line Pilots Association and other parties involved in civil aviation, such as the Royal Netherlands Marechaussee, the NCTV and certain ministries.

The objective of the relationships network is to promote mutual information provision. On the one hand, the AIVD aims to provide an entry point for relevant reports coming from the civil aviation sector and, on the other, to create an opening for developing the Service's security promotion task. In practice the AIVD does this by, for example, informing civil aviation parties about developments in the area of terrorism and cyber threats that are relevant to them. This may, for example, involve providing instruction through presentations to pilots of Dutch airlines about possible threats. The AIVD contributes to increasing security awareness by providing instruction and sharing knowledge. Furthermore, the AIVD enables the sector to take security measures.

[16] DLIO is charged, as part of the national police, with international information exchange, national information coordination, acquiring an insight into and an overview of the national and international security situation for operational police work (source: thesaurus.politieacademie.nl).

[17] Airlines registered with the Dutch Human Environment and Transport Inspectorate (IL&T) as Dutch airlines.

An important component of the AIVD's contact, via the account manager, with Dutch airlines involves sharing information that is relevant to civil aviation security. The AIVD can do so in a solicited or unsolicited manner (see below). Dutch airlines bear independent responsibility with regard to selecting the flight routes they use, selecting the foreign airports at which they land and the safe execution of their flights.[18] In addition to the information that airlines obtain independently and the risk analyses they compile in-house, the AIVD can be a link in the chain of information provision for airlines.

Unsolicited sharing of threat-related information

The AIVD informs Dutch airlines in an unsolicited manner about a specific threat to civil aviation. This may, for example, involve a terrorist attack on board an aircraft or a specific threat targeting civil air traffic above a certain area. The information supplied by the AIVD may relate to areas (ground situations) over which flights will or may pass. It may also involve risks to foreign airports where flights will or may land.

One instance of an actual threat about which the AIVD informed Dutch airlines took place at the end of 2013. It involved a threat from a terrorist group in the Sinai desert, in Egypt, that specifically targeted civil aviation. At the time, the AIVD issued a report to the NCTV, the Ministry of Foreign Affairs and the Dutch airlines. The latter subsequently decided not to fly over the Sinai desert temporarily.

In accordance with the AIVD policy, an actual threat exists if there are three threat factors. These factors denote the severity and probability of a threat. These factors are:

- Capacity (the availability of resources)
- Potential (capabilities of resources and actors)
- Intention (motives)

This policy applies to all threats, not only threats to civil aviation. For example, an actual threat exists if a person or a faction possesses a resource such as a weapon or explosives (capacity) that enables it (potential) to target civil aviation, for example, and the person or faction also has the motivation to use that resource as such (intention). If the AIVD possesses such information (intelligence), it often constitutes classified material (State secret), such as that from sensitive sources. Therefore, the AIVD cannot simply make this intelligence public. However, the AIVD can issue a report (alert) to enable the authorities and the business community to take the necessary measures.

The Committee is of the opinion that these factors constitute an effective basis for assessing whether an actual threat exists.

With regard to issuing such a report, the AIVD, the NCTV and the Ministry of Foreign Affairs established joint agreements (including procedural agreements) following the situation in the Sinai. They agreed that, if the occasion arises, the AIVD, together with the NCTV, will contact the Dutch airlines (or their security managers). If the information is relevant to all Dutch airlines, their representatives, the NCTV and the AIVD's account manager for civil aviation will meet to discuss it. If it involves an individual airline, the NCTV and the AIVD's account manager for civil aviation would specifically approach the airline concerned.

Solicited sharing of information

Dutch airlines can ask the AIVD account manager for specific information about the security of its foreign destinations. Questions may pertain to the security of flight routes, as well as whether it is safe enough to land in certain countries or for crews to stay overnight there. The AIVD may possess relevant information in this respect.

---

[18] See section 3.2.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

In that case, the AIVD can share information in accordance with its security promotion task. As discussed in Chapter 3, the AIVD will not generally be aware of the flight routes used by Dutch airlines or of the airports at which they land. The provision of information therefore only takes place based on the airlines' request.[19]

4.3 The MIVD

This section provides an overview of the consultation structure between the MIVD and the civil aviation sector and of the MIVD's specific activities related to promoting the safety of civil aviation. In contrast to the AIVD, the MIVD does not have a security promotion task that partly focuses on the safety of civil aviation. Due to its military orientation, the MIVD does not participate in consultation with civil aviation such as joint consultation with the vital sectors and the Schiphol Security and Public Safety Platform. However, the MIVD does contribute to civil aviation security in three ways.

This section is organised as follows:

- Contact with the NCTV:
  - Compiling threat analyses.
  - Reporting specific threat information related to civil aviation.
- Informal contact with KLM following requests for information sharing.

4.3.1 Contact with the NCTV

The compilation of threat analyses for civil aviation
Every six months, the MIVD compiles an update of its threat analysis related to civil aviation at the request of the NCTV, just like the AIVD. This activity is performed in the context of the Dutch Counterterrorism Alert System for the airports sector in the Netherlands.

Due to the military orientation of its intelligence operations, the MIVD possesses barely any information related to actual and potential threats to civil airports in the Netherlands. In its threat analyses, the MIVD provides knowledge and information about mission areas (including potential mission areas) for which the Service is conducting an investigative assignment, or information from ongoing investigations that is relevant to civil aviation. In this respect, the MIVD takes a broader perspective of the airports sector than just Dutch airports and also includes threats to civil aviation abroad in its analysis. The MIVD coordinated this response method with the NCTV.

In its threat analyses, the MIVD provides an overview of known terrorist organisations that possibly pose a threat to civil aviation, per area or region in which the Service is conducting its investigations. The assessment of the severity and probability of the threat is based on the intention, capacity and activities of the persons involved. These threat factors are discussed below.

Reporting actual threat information
In the event of an actual threat to civil aviation, the MIVD issues a report on its own initiative to the NCTV. This also applies to specific threats that involve flight routes.

---

[19] See section 3.5.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

In accordance with the MIVD's policy, an assessment is made of whether a genuine threat is involved using three threat factors[20]:

- Intention
- Capacity
- Activity

These factors provide an indication of the severity and probability of a threat. They apply regardless of the nature of the threat. Thus they do not only apply to a threat to civil aviation.

The policy says the following with regard to these factors. The intention describes an actor's (i.e. an enemy's or faction's) willingness and desire to carry out a particular threat. The intention may be deduced from the enemy or faction's objective (or strategic objective), political and/or military ideology, military doctrine, socio-cultural context or statements made, etc. The intention may also be deduced from actions performed in the past. Capacity refers to the resources and possibilities that an actor possesses to carry out the threat. The activity factor comprises all of an actor's activities that directly or indirectly relate to carrying out an identified threat. The threat factor activity can be viewed as a 'list' of critical indicators or necessary conditions. In other words: a minimum number of conditions must be met before a threat manifests itself.

The Committee is of the opinion that these factors constitute an effective basis for assessing whether a genuine threat exists.

The Committee recognises that the Services do not use the same terminology. It has established that both Services use the capacity factor for the availability of resources. The AIVD uses a separate 'potential' factor to refer to the possibilities of the resources and of the actors. The MIVD includes the possibilities of the resources and of the actors in the capacity factor. Both Services use the intention factor to refer to the actors' motivation for focusing on a particular goal. In addition, the MIVD uses another factor, 'activities', that the AIVD does not use separately.

The Committee proposes that the Services examine the extent to which they can align the terminology related to the threat factors that they use.

4.3.2 Contact with KLM

In contrast to the AIVD, the MIVD does not maintain any extensive, structured network of relationships with the civil aviation sector in the Netherlands. Given the MIVD's military orientation, this is not to be expected. Consequently, at the MIVD there is no account manager role for civil aviation. A number of years ago, informal communications with KLM were established, however. In this context, KLM can submit specific questions to the MIVD related, for example, to the security of flight routes. The MIVD provides, for example, information about weapons systems, such as the range and possibilities of MANPADS[21] or about the situation in a particular area. This exclusively concerns unclassified information.

[20] These factors are in line with the working method and definition with regard to threat analyses as used by NATO.
[21] This stands for *man-portable air-defence systems*. This is a weapon that is fired from the shoulder

4.4 Answers to research questions a and b

The AIVD has a security promotion task that partly focuses on the security of civil aviation. The Service engages in various activities in this field:

- The AIVD participates in various consultation structures in which, among other things, the security of the civil aviation sector plays a key role. The AIVD holds formal joint consultations with the vital sectors several times a year. The Schiphol Security and Public Safety Platform is concerned with security at Schiphol airport. In addition, the AIVD participates in meetings of regional airports. At these consultations, the AIVD shares information that it possesses related to the security of the airports concerned.
- At the NCTV's request, the AIVD compiles threat analyses for civil aviation that includes available threat-related information.
- The AIVD maintains an extensive network of relationships with parties in the civil aviation sector, including Dutch airlines. On a demand-driven basis, the AIVD provides the airlines with available information that could be relevant to civil aviation security (including the security of flight routes). The AIVD also provides information about potential threats as part of this relationship.
- The AIVD shares information that indicates specific threats to civil aviation on an unsolicited basis with the Dutch airlines and with the NCTV.

Due to its military orientation the MIVD does not have a security promotion task that also focuses on civil aviation. Consequently the MIVD plays a limited role in this sector. However, the MIVD does contribute to civil aviation security in three ways.

- At the NCTV's request, the MIVD compiles threat analyses for civil aviation that includes available threat-related information.
- The MIVD shares information that indicates a specific threat to civil aviation with the NCTV on an unsolicited basis.
- The MIVD maintains informal contacts with KLM. As part of this relationship, the MIVD provides available information that could be relevant to civil aviation security (including the security of flight routes) on a demand-driven basis.

5 The MIVD and AIVD's level of knowledge prior to the crash of flight MH17

5.1 Introduction

This chapter provides an overview of the information related to the security situation in Eastern Ukraine, which the MIVD and the AIVD possessed prior to the crash of flight MH17. It also addresses whether the Services shared information on this matter externally and the Services' consideration for doing or not doing so. This answers the following research question:

c) What information did the AIVD and the MIVD possess prior to the crash regarding the security situation in Eastern Ukraine, and to what extent did they share this information with parties involved in aviation security? What were the considerations for doing / not doing so?

In contrast to the previous chapters, in this chapter the Committee first discusses the MIVD followed by the AIVD. This is because the MIVD, due to its military orientation, possessed more information regarding the security situation in Eastern Ukraine than the AIVD.[22]

In discussing the information related to the security situation in Eastern Ukraine that the Services possessed prior to the crash, the Committee focused on the information that is relevant for identifying a threat to civil aviation. This information relates to the threat factors that were discussed in the previous chapter.

The Committee will treat the three threat factors in the following sections in a specific order, which it will first explain. First, the threat factors capacity (MIVD)/capacity and potential (AIVD) are addressed (i.e., military resources and possibilities), because the Committee is of the opinion that these factors can serve as a clear indicator for identifying a threat (a so-called 'red flag'). The availability of certain military resources may constitute a reason for examining the other factors. In most cases, intention will not be easy to establish and will therefore only constitute a red flag in exceptional cases. The 'activity' factor used by the MIVD will generally form the final element in the assessment, because it involves examining indications that the 'enemy' has begun carrying out the identified threat (on which the intention is focused).[23]

Since the Dutch airlines were not flying to destinations in Eastern Ukraine, only threat information that was relevant to civil aircraft flying over the area plays a role.

With regard to the conflict in Eastern Ukraine, there were three relevant actors with military capacities in the period prior to the crash:

- Russian armed forces
- Ukrainian armed forces and
- Pro-Russian separatists

The information that the Services possessed concerning these three actors will be treated per threat factor.

---

[22] See paragraphs 5.2.1 (MIVD) and 5.3.1 (AIVD) for the Services' investigative assignments

[23] However, it cannot be ruled out that specific information related to a particular intention or particular activities represents the first indication of a threat.

Information that can be traced back to the current level of knowledge and the working method or sources of the AIVD and the MIVD is State secret. This means that the Committee will not name any specific documents or sources in this chapter. Details will only be described insofar as they are necessary to substantiate a conclusion. The AIVD and the MIVD's investigative assignments are only provided in general terms because these assignments could provide a picture of the Services' current level of knowledge.

5.2 The MIVD's degree of knowledge

5.2.1 The MIVD's focus

During the investigative period (1 January through 17 July 2014) there was no separate investigative assignment inside the MIVD focusing on Ukraine. An investigative team at the MIVD (referred to hereafter as the Team) was occupied with the Russian Federation. The Team worked on the basis of the MIVD investigation plan for 2014, which is based on the 2014-2019 Defence Intelligence and Security Needs (Inlichtingen- en Veiligheidsbehoefte Defensie 2014-2019) and the 2011-2016 Foreign Intelligence Designation Order. In general terms, the assignment was to conduct research into the foreign, security and defence policies of the Russian Federation. This also involved examining the proliferation of Russian weapons, military knowledge and technology.

The political situation in Ukraine had been unstable since October 2013. From 18 February 2014, when shots were fired at demonstrators on the Ukrainian Maidan Square in Kiev, the conflict in Ukraine began to escalate. At the end of February, Russia conducted military activities in the Crimean Peninsula and this area was annexed. This event was followed by unrest in Eastern Ukraine between Ukrainian armed forces and pro-Russian separatists (referred to hereafter as the Separatists). The Team investigated these developments as part of its existing investigative assignment. This means that it examined possible Russian involvement in the conflict.

In March 2014, the Ministry of Defence issued the MIVD with the request to submit weekly reports on the crisis between Ukraine and the Russian Federation. This led to a slight shift in the focus of the investigation, towards Russian military capacities and activities in the vicinity of Ukraine. To a lesser extent, attention was also devoted to the Ukrainian armed forces and the Separatists.

From the beginning of the unrest in Eastern Ukraine, the Team focused on the threat of a Russian attack in the area. The information it received was viewed from this perspective.

5.2.2 The information in the MIVD's possession

The capacity of the Russian armed forces and the Ukrainian armed forces
The information that the Team gathered as part of its investigative assignment provided a more complete picture of the Russian capacities than of those of the other two actors.

The general impression with regard to anti-aircraft defence systems was that the Russian armed forces possessed advanced systems that had been installed in the territory of the Russian Federation close to the border with Ukraine. These systems had sufficient range to be able to hit a civil aircraft at cruising altitude, which is a height of at least 7.5 kilometres.[24] Anti-aircraft systems that have sufficient range to reach this height are referred to hereafter as powerful anti-aircraft systems.
According to the MIVD's information, the Ukrainian armed forces mainly possessed outdated resources, including, however, certain powerful anti-aircraft systems. A number of these systems were located in the eastern part of the country.

The Separatists' capacity

The MIVD's information indicates that the Separatists were procuring an increasing number of weapons in the months prior to the crash. Since they were also attacked from the air by the Ukrainian armed forces, mainly after the Ukrainian government had reactivated its so-called anti-terrorism operation in the course of May 2014, the Separatists tried to acquire anti-aircraft systemswith the aim of defending themselves.

Prior to the crash, the MIVD knew that, in addition to light aircraft artillery, the Separatists also possessed short-range portable air defence systems (man-portable air-defence systems; MANPADS) and that they possibly possessed short-range vehicle-borne air-defence systems. Both types of systems are considered surface-to-air missiles (SAMs). Due to their limited range they do not constitute a danger to civil aviation at cruising altitude.

On 29 June 2014, the Separatists captured a Ukrainian armed forces military base in Donetsk. At this base, there were Buk missile systems.[25] These are powerful anti-aircraft systems. This development was reported extensively in the media prior to the crash. The MIVD also received intelligence information on the subject, on 30 June and 3 July 2014 as well as on other dates. During the course of July, several reliable sources indicated that the systems that were at the military base were not operational. Therefore, they could not be used by the Separatists.

Since the beginning of the unrest in Eastern Ukraine, the question arose whether the Separatists were receiving material support and training from the Russian Federation. It was fitting that attention would be devoted to this matter in the MIVD's investigation. Even though there was information pointing to the fact that the Separatists had been supplied with heavy weapons by the Russian Federation, there were no indications that these were powerful anti-aircraft systems. Certain documents from the end of June 2014 state that material was being assembled at collection sites in the west of the Russian Federation to subsequently be supplied to the Separatists. One document (from a publicly accessible source), dating from 14 July 2014, states that advanced anti-aircraft systems (further details unknown) had also arrived at a collection point. However, according to this document, such systems, if they were indeed powerful anti-aircraft systems, had not (or not yet) been delivered to the Separatists in Ukraine.

---

[24] Based on the 'Report on the development of best practice guidance for conducting and sharing risk assessments' by the International Civil Aviation Organization (ICAO), adopted at the conference held in Montreal on 2-5 February 2015. This document States that the cruising altitude for civil aircraft is at least 25,000 feet. This is equal to 7.620 metres.

[25] Another name for it is SA-11.

The MIVD's impression was that the Separatists were trained to use weapon systems, including MANPADS, in the Russian Federation. There were no indications that they were being trained to use powerful anti-aircraft systems. The Separatists' training in the Russian Federation came to light as a result of the press conference given by General Breedlove, Supreme Allied Commander Europe (SACEUR) of NATO, on 30 June 2014. Breedlove stated that Separatists on the Russian side of the border had been trained to use vehicle-borne air defence systems. He also stated that the Americans had not yet observed that these systems were being transported across the border to Ukraine. These statements contained little new information for the MIVD. The terms 'vehicle-borne capability' and 'air defence vehicles' are generic and are also used to refer to short-range anti-aircraft systems.

On 14 July 2014, an An-26 military cargo aeroplane (referred to hereafter as: the Antonov), belonging to the Ukrainian airforce, was shot down. The Ukrainian authorities reported the event the same day in a briefing with Ukraine's presidential administration in Kiev. The MIVD also received a concise report of the briefing from the Dutch Defence attaché. The report revealed that the Ukrainian Minister of Foreign Affairs, Klimkin, declared that the situation in the east had reached a new and dangerous phase because the Russian Federation was now openly providing the Separatists with military support. As an example of the escalation, Klimkin cited the Antonov's being shot down in the area of Lugansk. Klimkin reported that the Antonov was flying at an altitude of 6,200 metres and could only have been hit with Russian equipment, because the Separatists did not possess this kind of anti-aircraft systems. According to a media report on 14 July 2014 (which the MIVD possessed), the Ukrainian authorities stated that the aeroplane was flying at 6,500 metres and was not shot down by a portable anti-aircraft system but by a more powerful system. This was probably carried out from Russian territory. In the media, the Separatists claimed that they had shot down the aeroplane and taken some of the crew prisoner.

If the Antonov had indeed been shot down by, or even from, the Russian Federation, this would have been a game changer. Direct Russian participation in the conflict would have become a fact. That is why the MIVD immediately launched an investigation into the incident.

In the morning of 17 July 2014, the MIVD communicated the results of this investigation in its daily intelligence summary ('dagintsum'), which had a number of users, including the NCTV and the AIVD. The MIVD assessed it to be unlikely that the Antonov had been shot down by a powerful anti-aircraft system (separate from the question whether this had been carried out from Russian territory). From pictures of the wreckage and eyewitness accounts it was clear that the aeroplane's right-hand engine had been hit and that 5 to 6 parachutes had subsequently appeared. The Antonov had allegedly crashed only then. On this basis, the MIVD concluded that the appearance of the damage was not consistent with a hit by a powerful anti-aircraft system. The aeroplane would in that case probably have been destroyed in the air.

The crew would probably not have survived if this had been the case. According to the MIVD, the wreckage and the eyewitnesses supported the fact that the aircraft was shot out of the air by a MANPADS from Ukrainian territory. This would only have been possible if the Antonov were flying substantially lower than 6,200 or 6,500 metres. Another possibility was that a short-range, vehicle-borne anti-aircraft system had been used. The MIVD's information does indicate the use of a powerful anti-aircraft system.

On 14 July 2014, the Ukrainian authorities publicly issued a NOTAM, which meant that Ukrainian airspace was closed up to a height of 9,700 metres (FL320). The MIVD did not receive any information regarding the reasons for this restricted airspace.

The intentions of the Russian armed forces, the Ukrainian armed forces and the Separatists
Prior to the crash, the MIVD did not possess any indication that one of the three actors involved in the conflict in Eastern Ukraine had the intention to shoot down a civil aircraft.

However, unlike the other two actors, the Separatists were not a homogeneous group. They were composed of factions with different specific objectives and working methods. It was clear, however, that the Separatists all shared the intention to shoot Ukrainian air force fighter aeroplanes and helicopters out of the air.

In a threat analysis performed at the end of June 2014, as part of the potential police training mission in Eastern Ukraine, the MIVD reported that the Separatists were attacking Western targets of opportunity. This involved the kidnapping of OSCE officials in Donetsk and Slavyanks. According to the MIVD, the Separatists' intention was probably to keep 'unwanted' outsiders at a distance or to kidnap foreign officials to use them as bargaining chips in negotiations. This information does not reveal any indication of the intention to shoot down a civil aircraft.

The activities of the Russian armed forces, the Ukrainian armed forces and the Separatists
As is clear from the above, the MIVD had no indication that one of the three actors (the Russian armed forces, the Ukrainian armed forces or the Separatists) had the intention, combined with the necessary capacity, to shoot down a civil aircraft. There was no information either pertaining to activities aimed at carrying out a threat to civil aviation, such as preparatory actions.

Information from foreign partner services
During the investigative period (1 January 2014 through 17 July 2014) the MIVD did not receive any warnings from its foreign partner services pertaining to a risk to civil aviation above Eastern Ukraine. The messages that the MIVD received from partner services during this period also did not contain any passages that - even with hindsight - should have served as a warning.

5.3 The AIVD's level of knowledge

5.3.1 The AIVD's focus

During the investigative period (1 January 2014 through 17 July 2014) a team from the AIVD (referred to hereafter as: the Team) conducted an investigation into matters related to the domestic, foreign and energy policies of the Russian Federation. In this context, the Team predominantly examined Russia's political intentions and Russian geopolitics, with a special focus on relationships with the Netherlands, the EU, NATO and neighbouring countries such as Ukraine.

The AIVD did not have a separate investigative assignment focusing on Ukraine. The investigation into the Russian Federation originated from the 2011-2016 Foreign Designation Order. It concerns the AIVD's foreign intelligence task. As part of this task, the AIVD gathers intelligence that can support the government in determining foreign policy and conducting international negotiations. This is also called 'political intelligence'.

The escalation of the conflict in Ukraine starting in February 2014 affected European, and therefore Dutch, interests. Ukraine became a pawn in a geopolitical power struggle between the EU and the US on the one hand and the Russian Federation on the other. In March 2014, this led the Ministry of Foreign Affairs to request that the AIVD also report on developments in political circles in Ukraine. As part of its existing task, the Team was already investigating the Russian influence over Ukraine, and Russia's energy policy. It was important to the Dutch government to obtain political intelligence in order to be able to determine its standpoint on potential measures to be taken by the European Union against the Russian Federation and pro-Russian leaders in Ukraine.

During the period prior to the crash, the Team's focus was on the political power play in Ukraine and the Russian influence on this. The AIVD Team examined the information it received from this perspective. It is important to note that the AIVD Team did not gather any information about the military capacities of the parties involved in the conflict in Eastern Ukraine. The Team was occupied, as previously mentioned, with the politico-strategic aspect of the conflict. The Team did receive information that offered a broader perspective on the conflict in Eastern Ukraine and on the military capacities and activities of the parties involved. The Team used this intelligence as background information to support its investigative assignment.

5.3.2 The information in the AIVD's possession

The capacity and potential of the Russian armed forces and the Ukrainian armed forces
The Team was aware, via the MIVD, that Russian armed forces on their side of the border with Eastern Ukraine possessed powerful anti-aircraft systems.

The Team was also aware that the Ukrainian armed forces possessed powerful anti-aircraft systems in certain parts of Eastern Ukraine.

The Separatists' capacity and potential
The AIVD's information indicates that the Separatists were procuring an increasing number of weapons in the months prior to the crash. Furthermore, a connection could be made between the intensification of the fight against the Separatists by the Ukrainian armed forces. In April 2014, the Ukrainian government launched its so-called anti-terrorism operation in Eastern Ukraine, aimed at isolating the Separatists. From May onwards, the Ukrainian armed forces increased their air operations. The Separatists gradually obtained more and better weapons with greater potential.
The AIVD was aware that the Separatists, in addition to a broad range of artillery (eg machine guns), light anti-aircraft artillery (e.g. rocket launchers), anti-tank weapons and tanks, also possessed MANPADS and possibly short-range vehicle-borne anti-aircraft systems. Both types of systems are considered surface-to-air missiles (SAMs). Due to their limited range, the aforementioned weapons do not constitute a danger to civil aviation at cruising altitude.
On 16 July, the AIVD received a report from a reliable source that stated that there was no information that indicated that the Separatists possessed a medium-range SAM system. This comment was made in view of the circumstances related to the Ukrainian armed forces' Antonov being shot down on 14 July 2014 in Eastern Ukraine.
The AIVD did not have any information that indicated that the Separatists possessed an operational, powerful anti-aircraft system such as a Buk system, also called an SA-11, prior to the crash of flight MH17.

In its investigative assignment, the Team focused on the question how the Russian Federation exerted political influence on Ukraine and on the conflict. This also extended to the question whether the Russian Federation was involved in the Separatists' activities in Eastern Ukraine. The Team possessed several pieces of intelligence that referred to the Russian Federation's involvement with the Separatists with more or less certainty. The information contained indications that the Separatists (or some of them) were probably under the control of the Russian Federation. There were also indications that the Russian Federation provided the Separatists with support in the form of manpower and weapons. Those cited included artillery, anti-tank weapons, tanks and MANPADS. The AIVD had no indications that the Russian Federation had provided the Separatists with powerful anti-aircraft systems.

The AIVD had indications that the Separatists were being trained to use weapon systems, including MANPADS, in the Russian Federation. There were no indications that they were being trained to use powerful anti-aircraft systems.

On 14 July 2014, the Team received a concise report from the Ministry of Foreign Affairs concerning a briefing by Ukraine's presidential administration in Kiev. The report revealed that the Ukrainian Minister of Foreign Affairs, Klimkin, declared that the situation in the east had reached a new and dangerous phase because the Russian Federation was now openly providing the Separatists with military support. As an example of the escalation Klimkin cited the Antonov's being shot down in the area of Lugansk.

During the morning of 17 July 2014, the AIVD received the MIVD's daily intelligence summary ('dagintsum'). In this summary the MIVD reports, among other things, on its investigation into the circumstances related to the Antonov's crash. We refer you to paragraph 5.2.2 for these findings.

The intention of the Separatists, the Russian armed forces and the Ukrainian armed forces

The Team did not possess any indication that the Separatists in Eastern Ukraine had the intention of shooting down civil aeroplanes above Eastern Ukraine. The same applied to the other two parties, the Ukrainian armed forces and the Russian armed forces.

The information did make the Team aware of the fact that the Separatists harboured the motivation to shoot down military aeroplanes and helicopters of the Ukrainian airforce.

Information from foreign partner services

During the investigative period (1 January 2014 through 17 July 2014), the AIVD did not receive any explicit or implicit warning from its foreign partner services regarding a risk to civil air traffic above Eastern Ukraine, as was the case at the MIVD.

5.4 Collaboration between the MIVD and the AIVD

In March 2014, the two Teams from the AIVD and the MIVD that were working on the crisis in Ukraine and Russia's role in this crisis established a close collaboration. The Teams made agreements regarding the exact details and established them in writing. The Committee has viewed the agreements and discussed their practical implementation with the Teams.

This led the Committee to conclude that, among other things, the Teams shared relevant information with each other in the context of their investigative assignments. The Teams held weekly consultations. The aim of this was to avoid any overlap in the investigations and to keep each other informed. The Teams also presented each other with their end products. In this way, they could stay abreast of possibly relevant information that the other Service possessed. This could lead to a further exchange of information. Which information was actually shared was not recorded at this stage. However, the Committee has no indication that the Services' information position was flawed due to a lack of information exchange.

5.5 Assessment of the information by the MIVD and the AIVD

Above, the Committee explained which of the information that the MIVD and AIVD possessed prior to the crash it considers relevant to assessing the threat to civil aviation above Eastern Ukraine. At the time, the Services did not identify any specific threat to civil aircraft flying over the area. In internal investigations that took place following the crash, the Services also came to the conclusion that, during the period from 1 January through 17 July 2014, there were no indications of a threat to civil aviation above Eastern Ukraine.

5.6 The provision of information to external parties

Given that the Services did not identify any specific threat to air traffic above Eastern Ukraine, they did not issue any threat warning to external parties prior to the crash.

The MIVD and the AIVD stated that the Dutch airlines did not ask them about the security situation in Eastern Ukraine prior to 17 July 2014. This has been confirmed by the Committee's investigation.

The MIVD did provide information about the security situation in Eastern Ukraine to, among others, the NCTV in the form of daily intelligence summaries ('dagintsums'). These summaries did not report a threat to civil air traffic.

In April 2014, the NCTV asked the AIVD and the MIVD for an update of the biannual threat analysis related to civil aviation in the Netherlands. This analysis involves potential new threats, modi operandi and resources. The NCTV was especially looking for information regarding three specific aspects that could present a potential threat to the airports sector and/or arriving and departing civil air traffic, including the current situation in Ukraine. In their threat analyses of May 2014 the AIVD and the MIVD did not provide any information about the security situation in Eastern Ukraine. This was because, at that time, the Services did not possess any information about persons or factions in Eastern Ukraine that presented a possible threat to civil aircraft.

5.7 Answer to research question c

With regard to the level of knowledge that the Services possessed before the crash of flight MH17, the Committee has established the following:

- The MIVD's investigation focused on the Russian Federation and the possible risk of an incursion into Eastern Ukraine. Knowledge of the Ukrainian armed forces and the Separatists was limited.
- The AIVD's investigation focused on the politico-strategic aspect of the conflict in Eastern Ukraine and on the Russian Federation's political influence on Ukraine. The AIVD was not focused on information related to military capacities.

- According to the information the Services possessed, the Russian and Ukrainian armed forces had the capacity and potential to hit a civil aeroplanes at cruising altitude. However, they did not have the intention. There were no indications that they were engaged in activities (such as preparations) targeted against civil aeroplanes.
- The AIVD and the MIVD did not have any indication that the Separatists had the capacity to hit civil aeroplanes at cruising altitude. Moreover, there were no indications either that they would target civil aeroplane or that they were engaged in activities with this objective in mind.
- The AIVD and the MIVD did not receive any information from partner services that explicitly or implicitly indicated a risk to civil aviation above Eastern Ukraine.
- The AIVD and the MIVD's assessment is that, prior to the crash, there were no indications that pointed to a specific threat to civil aircraft above Eastern Ukraine.
- The Services did not provide any information to external parties due to the absence of information related to a specific threat.

The Committee's assessment

The above findings constitute the answer to the research question. The Committee believes that it is also important to draw its own conclusion based on the information the Services possessed. Ultimately, it is the only body to have had access to all the State secret material, apart from the Services themselves.

The Committee believes that the material available to the Services does not reveal any factors that point to a specific threat to civil aviation prior to the crash of flight MH17. The information available to the Services does not indicate that one or more actors that were involved in the conflict in Eastern Ukraine prior to the crash displayed a combination of military resources, possibilities and the intention to shoot down a civil aeroplane at cruising altitude.

This analysis reveals that, based on the available information, the MIVD and the AIVD could not have been expected to identify any specific threat to civil aircraft above Eastern Ukraine or share it with external parties.

6 Conclusions

Below are the answers to the research questions that are submitted to the Committee. As mentioned previously, questions (a) and (b) we are addressed jointly.

Research questions a and b

a) What is the formal structure between the AIVD or the MIVD respectively and the parties relevant to aviation security, such as airlines, air navigation service providers and ministries, with regard to the provision of information about security threats?

b) What are the two Services' specific activities related to exchanging information with parties relevant to aviation security?

The AIVD has a security promotion task that partly focuses on the security of civil aviation. The Service engages in various activities in this field:

- The AIVD participates in various consultation structures which focus on, among other things, the security of the civil aviation sector. The AIVD holds joint consultations with the vital sectors several times a year. The Schiphol Security and Public Safety Platform (BPVS) is concerned with security and safety at Schiphol Airport. In addition, the AIVD participates in meetings of regional airports. At these consultations, the AIVD shares information that it possesses relevant to the security of the airports concerned.
- At the NCTV's request, the AIVD compiles threat analyses related to civil aviation that include threat-related information from its ongoing investigations.
- Apart from the consultation structures cited above, the AIVD maintains an extensive network of relationships with parties in the civil aviation sector and with Dutch airlines. The AIVD provides the airlines with basic information from its investigations that could be relevant to civil aviation security (including the security of flight routes) on a demand-driven basis. The AIVD also provides information about potential threats in the context of this relationship.
- The AIVD shares information indicating specific threats to civil aviation with the Dutch airlines and the NCTV on an unsolicited basis.

Due to its military orientation, the MIVD does not have a security promotion task that also focuses on civil aviation. Consequently, the MIVD plays a limited role in this sector. However, the MIVD does contribute to civil aviation security in three ways:

- At the NCTV's request, the MIVD compiles threat analyses related to civil aviation that include threat-related information from its ongoing investigations.
- The MIVD shares information that indicates a specific threat to civil aviation with the NCTV on an unsolicited basis.
- The MIVD maintains informal contacts with KLM. The MIVD provides basic information from its investigations that could be relevant to civil aviation security (including the security of flight routes) in the context of this relationship on a demand-driven basis.

Research question c

What information did the AIVD and the MIVD possess prior to the crash related to the security situation in Eastern Ukraine, and to what extent did they share this information with the parties relevant to aviation security? What were the considerations for doing / not doing so?

What information did the AIVD and the MIVD possess prior to the crash related to the security situation in Eastern Ukraine?

Prior to the crash of flight MH17, the AIVD and the MIVD possessed the following information regarding the security situation in Eastern Ukraine that was relevant for assessing a threat to civil aircraft flying over the area:

- The Russian and the Ukrainian armed forces did have the capacity and potential to hit a civil aircraft at cruising altitude. However, they did not have the intention. There were no indications that they were engaged in activities (such as preparations) targeting civil aviation.
- There were no indications that the Separatists had the capacity to hit civil air traffic at cruising altitude. Moreover, there were no indications that they would target civil air traffic or that they were engaged in activities with this objective in mind.

Prior to the crash, the MIVD and the AIVD did not possess any information that indicated that one or more of the three actors involved in the conflict in Eastern Ukraine displayed a combination of military resources, possibilities or the intention to shoot down a civil aeroplane at cruising altitude. The AIVD and the MIVD did not receive any information from partner services either that explicitly or implicitly pointed to a risk to civil aviation above Eastern Ukraine. Based on its findings, the Committee shares the assessment made by the MIVD and the AIVD: the available information did not reveal a specific threat to civil air traffic flying over the area.

To what extent did the Services share this information with parties relevant to aviation security and what were the considerations for doing/not doing so?

The AIVD and the MIVD did not issue any notifications to external parties concerning a specific threat to civil aircraft above Eastern Ukraine. The reason for not providing any information to external parties was that, prior to the crash of flight MH17, the AIVD and the MIVD did not possess any information that pointed to a specific threat.

7 Concluding remarks

The crash of flight MH17 has led to a discussion in the international community and Dutch society about improving the provision of information in the context the security of flight routes.

With this in mind, the Committee deems it desirable that Dutch airlines be able to approach a single contact point for both Services with their questions related to the security of flight routes, including foreign flight routes. Establishing such a contact point would help intensify collaboration in this area between the AIVD and the MIVD as well as the information exchange with Dutch airlines.

Furthermore, the Committee recommends that the Services examine the extent to which they can align the terminology they use in relation to the threat factors.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

Review Committee
on the Intelligence and
Security Services

CTIVD nr. 43

GLOSSARY

arising from the crash of flight MH17

This list explains a number of terms that are used in this review report. In the definitions provided, the Committee has not aimed for completeness but rather to provide the reader with an explanation of these terms that is as specific as possible.

Airspace
The volume of air above the earth's surface in which air traffic can take place. The airspace above a State is part of the territory over which the State has sole power (sovereignty). The airspace above the Netherlands is part of the territory of the Dutch State. The Dutch Government is responsible for the safety of Dutch airspace.

AIVD Account Manager
A position that focuses on maintaining a network of relationships with a vital sector. The objective is the mutual provision of information. One example is the AIVD giving presentations to increase security awareness in the sector concerned. The AIVD has a number of account managers, such as for the Dutch aviation sector (which includes civil aviation).

AIVD head of unit
AIVD official who is hierarchically embedded in the organisation as follows: head, director, head of unit, team head.

Anti-aircraft weapons
Weapons intended for shooting down airborne targets such as aeroplanes or helicopters. Today, these are often guided systems, such as the radar-guided Buk/SA-11. They can also be non-guided systems, such as anti-aircraft guns or certain machine guns. Anti-aircraft systemsare often mobile (eg, mounted on a truck or trailer) so that it can be transported easily.

Anti-tank weapon
Any weapon that can disable armoured vehicles such as tanks. These include missile launchers, cannon and mines. These weapons do not have sufficient range to hit aeroplanes that are flying at a great altitude.

BPVS Platform
Schiphol Security and Public Safety Platform. This is a cooperative partnership between public and private parties aimed at improving security and crime control at Schiphol airport. The Platform is a consultation body with a coordinating and steering role. The AIVD is one of the participants. It was founded following the diamond heist at Schiphol in 2005.

Buk system

This weapon system is a radar-guided, ground-based air defence system for medium long range (maximum 35 kilometres). The system consists of the following components (referred to as a battalion): six 9A310M1 radar and launch vehicles, three 9A39M1 reload and launch vehicles, a 9S18M1 (SNOW DRIFT) target search and acquisition radar and a 9S470M1 battalion command post. Each 9A310M1 radar and launch vehicle is fitted with a 9S35 (FIRE DOME) fire control radar and can be fitted with a maximum of four ready-to-fire 9M38M1 (GADFLY) surface-to-air missiles. Because the 9A310M1 radar and launch vehicle is fitted with its own fire control radar, the 9S35 (FIRE DOME), it is possible to operate it independently without support from the battalion. The vehicle can detect, establish and monitor targets using the 9S35 radar. With only the 9M39M1 reload and launch vehicle, it is not possible to independently attack an aircraft; this is because it lacks a fire control radar which means that once fired, the missile cannot be guided to its target. In NATO terminology, the Buk system is referred to as the SA-11.

Capacity

A factor that is relevant to identifying a threat. It reflects the extent to which an actor possesses certain resources (eg weapons) or knowledge to carry out a particular action.

Civil aviation sector

The term 'sector' collectively refers to the parties in the Netherlands involved in civil aviation, such as the Dutch airports and Dutch airlines.

Cruising altitude

A flight altitude that is maintained for a considerable part of the duration of the flight.

Dagintsum

Intelligence summary. An MIVD intelligence product. This product is published on a daily basis. It is distributed to a fixed number of users, including the NCTV and the AIVD.

Dutch airline

An airline that is registered with the competent authority in the Netherlands, e.g. KLM and ArkeFly.

Dutch Counterterrorism Alert System (Alerteringssysteem Terrorismebestrijding, ATb)

A system of information provision focused on reporting threats and potential threats in and to the Netherlands. The National Coordinator for Security and Counterterrorism acts as the central collection point for relevant information. He can subsequently take security measures. The AIVD is one of the information suppliers.

Foreign Intelligence Designation Order (Aanwijzingsbesluit buitenland)

A list of subjects and areas abroad into which the AIVD and MIVD conduct investigations. This list is established for several years by the Minister-President in consultation with the Minister of the Interior and Kingdom Relations and the Minister of Defence. The intelligence collected by the AIVD and the MIVD can support the government in its foreign policy and international negotiations.

APPENDIX U

FLYING OVER CONFLICT ZONES - RISK ASSESSMENT

Introduction

As established in section 7, operators assumed that Ukraine, as the airspace manager, ensured the safety of air traffic. However, the country's situation was rather complex; major interests other than civil aviation also played a role, such as State security. Moreover, Ukraine did not always possess a complete overview of what was playing out in the conflict area. Other countries did not either. There may have been countries that closely monitored developments in the area, but in doing so their focus was on geopolitical and military-strategic aspects. Nobody seemed to realise that there was busy traffic involving civil aeroplanes high above the area and that it was potentially at risk. Consequently, other countries also failed to issue any warnings about potential threats to civil air traffic.

Immediately after the crash of flight MH17, reports appeared in the media stating that some operators had stopped flying over the eastern part of Ukraine prior to the crash, while others continued to fly over the conflict area. Thus the suggestion was that the operators that had stopped possessed more or better information about the armed conflict and that this information could have or should have been shared with other operators. There was also the idea that some authorities possessed threat-related information that they could or should have shared.

Section 7 describes how, from mid April through 17 July 2014, virtually all operators that flew over the eastern part of Ukraine, continued to do so. Some operators did stop earlier, but with a few exceptions these had stopped before the conflict in the eastern part of Ukraine started. In addition, in the period that the conflict expanded into the airspace no state prohibited operators and airmen based in that state to fly over the area, or explicitly warned of possible threats in the air as a result of the armed conflict. The idea that crucial information was not shared with operators, does not appear to be true. There must be another explanation for the fact that so many parties did not identify the risk to civil aviation.

This explanation is that all parties adopted a selective focus. Ukraine, operators, other states and international organisations acted from their own perspective, which meant that the relevance of events that fell outside this immediate perspective was not identified. The consequence was that the emergence of a weak link (airspace management) in the system of responsibilities did not result in other involved parties taking action to help ensure civil aviation safety above the conflict area. No effective safety net was in place. This raises questions about the organisation of the system of responsibilities and current practice for assessing the risks that armed conflicts pose to civil aviation.

This appendix describes how parties cooperate in the system, in collecting and assessing risk information about conflict areas in relation to civil aviation. What differences can be observed and what vulnerabilities characterise the risk assessment process? The Dutch Safety Board aims to use this to lay the foundations for lessons that can be learned.

In this appendix, the Dutch Safety Board devotes attention to states as well as operators. States play a major role in decision-making processes related to conflict areas because they usually have more possibilities than operators for gathering intelligence. Operators choose from the available flight routes. The investigation therefore focuses on the way in which operators assess threats and risks related to their flight routes over conflict areas. This naturally applies to situations in which the airspace is open and in which operators are not subject to any flight bans imposed by their national authorities. For this part of the investigation, data were obtained from thirteen operators and eight states. The data have been made anonymous at the request of the parties, who cooperated voluntarily, given that they were not parties involved in the crash of flight MH17.

In this appendix, the Dutch Safety Board uses the following illustrative categorisation of the risk assessment process.

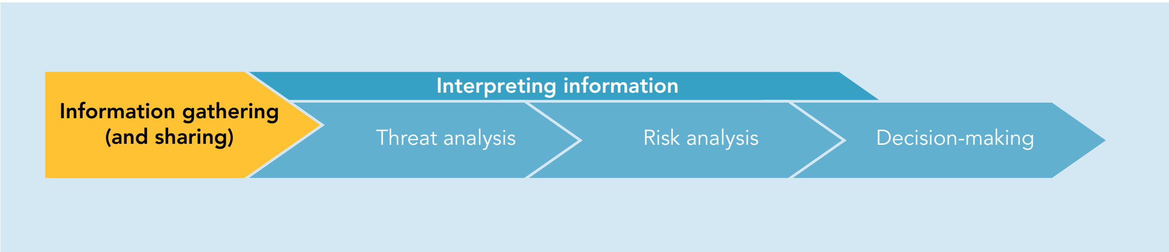


Figure 26: Steps in the risk assessment process. (Source: Dutch Safety Board)

- Information gathering (and sharing): gathering information from diverse sources related to a potential threat and sharing information with other parties ('What could happen? Are there intention and capability?')
- Threat analysis: determining the probability of a threat occurring.
- Risk analysis: estimating the risks to the operator, based on vulnerability and consequences.
- Decision-making: to fly or not to fly. If the decision is made to fly, are additional measures necessary?

The various steps are not always strictly differentiated. However, there is a logical order: information gathering about risks is performed prior to its assessment. Whether and which parties gather information depends on how they interpret their responsibility. Therefore, this appendix will first address how states and operators interpret their responsibilities.

States' interpretation of their responsibilities related to risk assessment

This section describes what states - other than the state that manages the airspace - do and can do to identify and manage risks posed by flying over conflict areas, while retaining the sovereignty of the state that manages the airspace. In this respect, states will first focus on operators based in their own states. They can also share relevant information with other states or operators. Operators decide whether or not to fly over an area partly on the basis of information they receive from other parties. Parties such as ICAO and EASA can play a role in providing (additional) information to the aviation sector.

The states in which the operators are based can also play a role in the decision-making related to flight routes, by providing information, recommendations or by restricting or prohibiting overflights. ICAO regulations provide room to choose between these respective roles. Despite the international character of civil aviation, national authorities also differ in the way and the extent to which they manage potential risks to 'their' operators. This depends, for example, on how they view and interpret their responsibility in relation to that of the operator. The following paragraph discusses these differences.

Differences between the guidance provided by states
Differences between states are characterised by two extremes. One extreme involves States in which the authorities do not or virtually do not provide any guidance for the operators; the other extreme involves states in which the authorities play a profoundly regulatory role. In between there are states that go no further than (informally) providing operators with information and countries that issue recommendations. Broadly speaking, this results in four types of countries or 'practices'. Obviously this is a simplified representation, but it illustrates which differences exist on an international level.

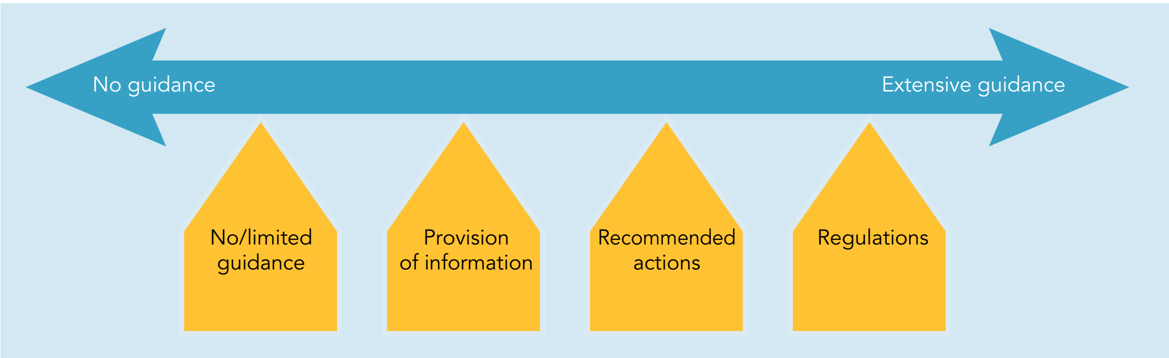


Figure 27: Differences between authorities in the degree of guidance they offer. (Source: Dutch Safety Board)

No or limited guidance from the authorities
In some of the countries examined, the national authorities generally do not interfere in the selection of flight routes and flying over foreign conflict areas in particular, or strictly limit any interference. This applies to Malaysia, for example, where the authorities focus solely on domestic security, also with regard to aerodromes. Authorities in these countries do not advise operators based in their countries or provide them with information about flying over foreign conflict areas.

Information provision by the authorities
In some countries, including the Netherlands and Australia, the authorities can provide operators with threat-related information to support their threat analysis, risk assessment and decision-making processes. The way in which and the extent to which authorities provide information in this practice differs from one country to another. It is possible for a national authority to only provide operators with *informal* information, to support their risk assessment and decision-making processes. Personal relationships and trust play a major role in these types of informal contacts; in many cases it concerns information that originates from the intelligence services, which must be protected. As a result, it is possible that not all operators have access to the same information sources.

There are also countries that provide information to (national) operators on a *formal* basis. In this case there is a formal procedure that regulates the provision of information and the handling of confidential information.

Information is then provided via an officially designated contact at a government service (such as an account manager for civil aviation). The operators can also report any information they may have to this contact.

The initiative involved in information exchange is generally taken by the operators in this practice. In the event of a specific threat, the authorities actively communicate the situation to the operators.

Recommendations provided by the authorities
The investigation revealed that there are authorities that not only (informally) provide their national operators with threat-related information, but also provide aviation-specific risk analyses or issue a recommendation based on this information. Some states, such as France, take it a step further and issue formal (whether urgent or not) recommendations and warnings, such as in the form of NOTAMs, about destinations and flight routes outside its own airspace. The operators include this advice in their decision-making process.

France

The French *Pôle d'Analyse de Risques de l'Aviation Civile* (PARAC), part of the *Direction Générale de l'Aviation Civile* (DGAC), performs risk analyses to support operators. The risk analyses are made available to the operators, on a need to know basis. The authorities do not have the legal power to issue a flight prohibition related to a specific airspace. If the need arises, PARAC can issue a notification or NOTAM to French operators, with a warning about flying to or over a specific country or area. In practice, an urgent recommendation has the same effect as a prohibition.

Regulation by the authorities
In a number of countries the authorities can prohibit operators based in that country from flying to specific destinations or from using (part of) foreign airspace. The state concerned uses this option if the need arises, based on intelligence and its own threat

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

and risk analyses. In the United States, the Federal Aviation Administration (FAA) can prohibit U.S. operators and airmen from flying over or to specific areas, or impose altitude restrictions for their operations in foreign airspace, using a NOTAM issued as an emergency order of the FAA Administrator or an SFAR. Even prior to 17 July 2014, FAA prohibitions/restrictions were in force in several conflict areas.[102]

The Department for Transport (DfT) in the United Kingdom can issue an overflight prohibition based on the 1982 Aviation Security Act (see text box below). In 2015, for instance, operators based in the United Kingdom were prohibited from using Libyan airspace due to the 'potential risk to overflying air traffic from dedicated anti-aviation weaponry'.[103] The Ministry focuses on developing risk analyses and potentially warning or advising operators.

In Germany the state can impose a flight prohibition based on German Aviation law. This occurred in July 2015 for the airspace of Yemen on the basis of the increased risk due to military activities in the airspace over the country.[104]

The United Kingdom

The Department for Transport (DfT) receives intelligence and threat analyses from the Joint Terrorism Analysis Centre (JTAC), which was set up in 2003 and in which staff are employed from various intelligence organisations and government departments JTAC gathers rough intelligence and uses it to identify trends and tries to establish links with the aviation sector, before making the threat analyses available to DfT. DfT translates the airspace threats identified by JTAC into a risk analysis and based upon this makes it advice available to all aviators UK air carriers as the basis for their own risk assessments. If necessary, the DfT can take several steps, including issuing NOTAMs to UK air operators, depending on the risk level identified in an area:

1. Low level risk. Warning: 'we want you to take this into account'
2. Medium level risk. Advice: 'guidance to avoid', DfT strongly advises you not to overfly'
3. High level risk. Direction: 'you shall / will not fly'

Four practices and differences in information gathering and analysis
States must possess information about conflict areas in order to compile a risk analysis and warn or advise operators. In the countries examined, the authorities that provide

102 The director of the FAA has the legal authority, based on 49 US Code 40.113 (a) and 44.701 (a) (5), to restrict or prohibit U.S. civil aviation in the airspace managed by other countries to combat the danger posed by conflicts or other weapons-related dangers to U.S. civil aviation. The FAA can issue this type of flight prohibition as an emergency measure on the grounds of 49 US Code 40113 (a) and 46.105 (c). NOTAMs including a flight prohibition are, if necessary, followed by a SFAR specifying the flight prohibition. SFAR prohibition are also specified in OpSpec B050. The FAA can also use NOTAMs to issue flight recommendations to U.S. civil aviation to warn about any danger posed by conflicts or other weapons-related dangers in the airspace managed by other countries.
103 NOTAM V0003/15.
104 http://www.bmvi.de/SharedDocs/DE/Artikel/LR/verbot-luftraum-jemen.html, consulted on 19 August 2015.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

more extensive guidance say that they use the information they receive from their own intelligence services.[105] In addition, these authorities, like operators, participate in informal and formal networks with other national and foreign governments to exchange and verify information.

In general, in situations in which national authorities inform or advise their operators about flight routes or prohibit them from flying somewhere, they mutually exchange information. During the information gathering and threat and risk analysis processes, the authorities are in contact with the operators and the latter can ask questions and verify information as well as provide information. One of the authorities involved, for example, stated that it has also received threat-related information that operators have, in turn, gathered through their stations in other countries.

Once threat-related information has been gathered, the threat analysis and subsequently the risk analysis and decision-making processes take place. In some states, the authorities that advise operators base their advice on threat-related information (analysis) from a different government party and 'translate' it into risk information for their registered operators. In other states, in practice, the distinction between threat and risk analysis is less strict and these processes are performed by a single body. The authorities concerned say that they also examine the probability of the identified threats. These authorities then examine which measures are possible, such as in the form of an altitude restriction.[106]

Four practices and their implications
The differences identified in the way in which states manage their responsibility related to safe flight routes for their operators are important for learning lessons from the crash of flight MH17. Especially the two most extreme practices involve disadvantages.

A state that adopts a detached role ('practice 1') considerably reduces the chance of operators in the state concerned being able to receive confidential information related to the potential lack of safety along one of its flight routes. This increases the need for those operators to actively gather relevant information, and not all operators have the same resources for doing so. Moreover, operators have fewer possibilities than states for gathering information about conflict areas.

States that are able to impose flight prohibitions on their operators ('practice 4'), offer an additional barrier for limiting risks. They cause a shift in the distribution of responsibility between the state and the operators based therein. When they actually impose a prohibition, states deprive the operators' of their ability to perform an independent risk assessment and thus to fulfil their responsibility.

105 This information may however also involve conflict areas in general. It is also unknown whether the involved intelligence services in these states actually examine threats to the aviation sector or whether this 'translation' is produced later on in the process by state bodies that process the intelligence to produce aviation-specific analyses.
106 The Dutch Safety Board does not know the extent to which authorities in these states proactively took upper airspace into consideration in their risk analyses for civil aviation prior to the crash of flight MH17 and whether the crash resulted in changes to information gathering, threat analysis and risk analysis processes.

Assessment of and decision-making related to risks

This section discusses risk assessment by states and operators and how they go about it. First and foremost, this section describes how operators assess the risks posed by flying over conflict areas. Risk factors are then derived from the characteristics of a number of conflict areas. These can help clarify the risks involved in flying over such areas.

Steps in the assessment and decision-making process
To determine whether a flight can be executed safely, operators perform a risk assessment. In their risk analysis and decision-making processes, operators examine the safety of the flight route as a whole, from take-off to landing at the destination, including the crew's stopover at the location and the possibility and safety of any alternative routes (see Figure 28). Security assessments are part of this process. For the differentiation between risk assessment related to safety and security, respectively, see Table 15.

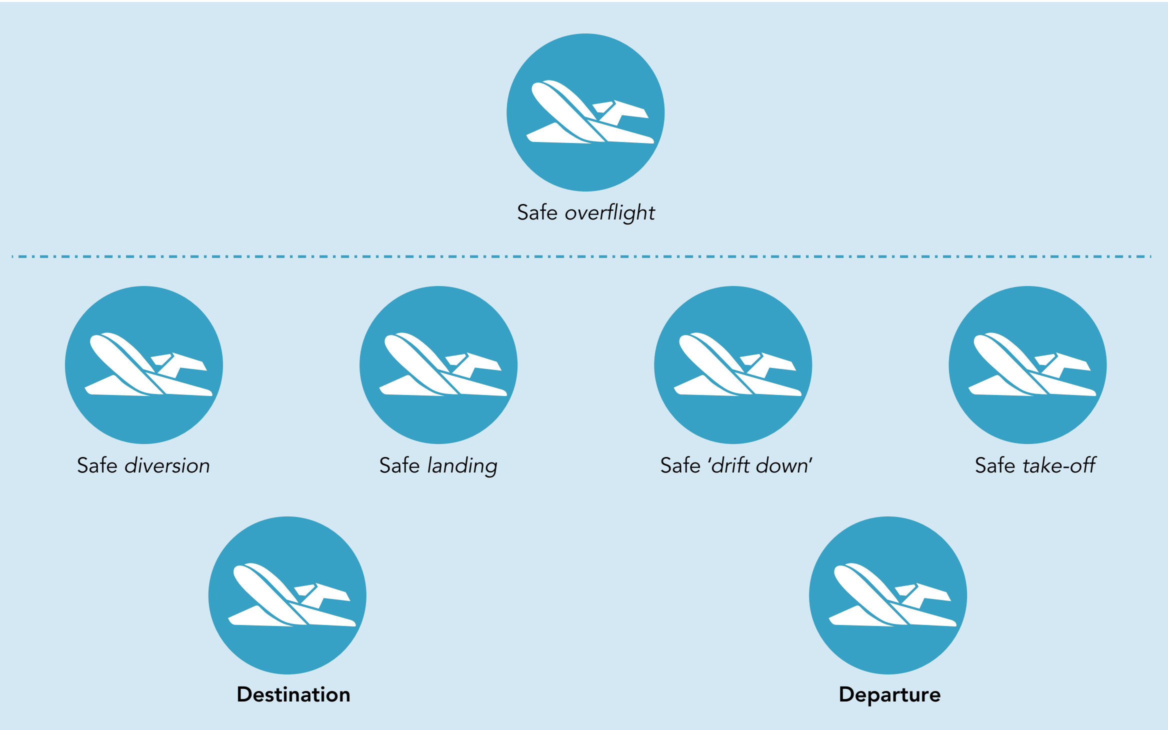


Figure 28: Different aspects that airlines take into account when determining a safe flight route. (Source: Dutch Safety Board)

The steps that operators follow to signal and assess potential threats are largely the same. There may be differences. Many operators have a security department where threat-related information is collected, analysed and interpreted. The 'security analysts' perform an advisory role in the decision-making process and concern themselves with different security aspects related to flight operations. Annex 17 to the Chicago Convention establishes that states must ensure that operators possess a written security programme that complies with the requirements in the National Security Plan of the

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

relevant state.[107] Annex 17 includes provisions for operators mainly related to security at aerodromes or in the aircraft. The safety of flight routes through foreign airspace is not part of the regulations. The safety of flying over countries can, as part of the flight, also be the focus of a security department but this is not standard practice among all operators.

Safety	Security
Accidents are limited to an acceptable level	Threats are limited to an acceptable level
Focus on human error or technical failure	Focus on acts of unlawful interference
Looking back (statistics)	Looking back and looking forward (+ new threats)
Worst case scenarios	(Probable) worst case scenarios
Large adjustability	Small adjustability
Focus on the ground and the air	Focus on the ground
Safety also incorporates security	Security enables safety

Table 15: Differentiation between risk assessment related to safety and security in aviation.

Information gathering
Firstly, to be able to perform a risk assessment it is important to possess relevant threat-related information about a specific area and the airspace concerned. Operators can use diverse sources in this respect.

Aeronautical information
As previously mentioned, the formal provision of information by airspace managers (authorities) to airspace users (operators) takes place through NOTAMs. However, it turned out that NOTAMs rarely contain information about threats above conflict areas. Other aviation organisations and authorities also provide information communication.

Media reports
Operators use media such as newspapers, magazines and television to identify potential threats to their flight routes and destinations. Some operators also follow social media. Various operators revealed that they subscribe to daily newsletters and regularly consult databases to stay up-to-date about risks to the aviation sector and other developments related to security throughout the world.[108]

107 Annex 17 to the Chicago Convention may afford states room for a broad interpretation in which risks to foreign flight routes are also part of the National Security Plan, but the elaboration in the 'Aviation Security Manual' illustrates that such a broad interpretation is uncommon.
108 For an example see: http://ww1.jeppesen.com/company/alerts/alerts.jsp (consulted on 10 March 2015).

A 'geographical bias'

Some operators in Asia revealed that media in their country reported very little about the armed conflict in Ukraine ('half a world away'). Therefore, authorities and operators paid little attention to the conflict. The use of the media as an important source of public information could therefore also involve a 'geographical bias', in which the risks of flying over conflict areas are not identified.

Informal networks

Many operators do more than base their decisions on public information. These operators also gather aviation-specific, confidential or classified threat-related information from (informal) networks (Figure 29). This non-public information exists at various levels. A rough distinction can be made between four groups of 'information suppliers' in these networks:

- Operators' eyes and ears on the ground, such as station managers and ground crew, tour operators and operational staff on location.
- Other operators. This involves a form of reciprocity: operators provide and receive information.
- Government parties (ministries, intelligence services, embassies, defence attachés).
- Private service providers.

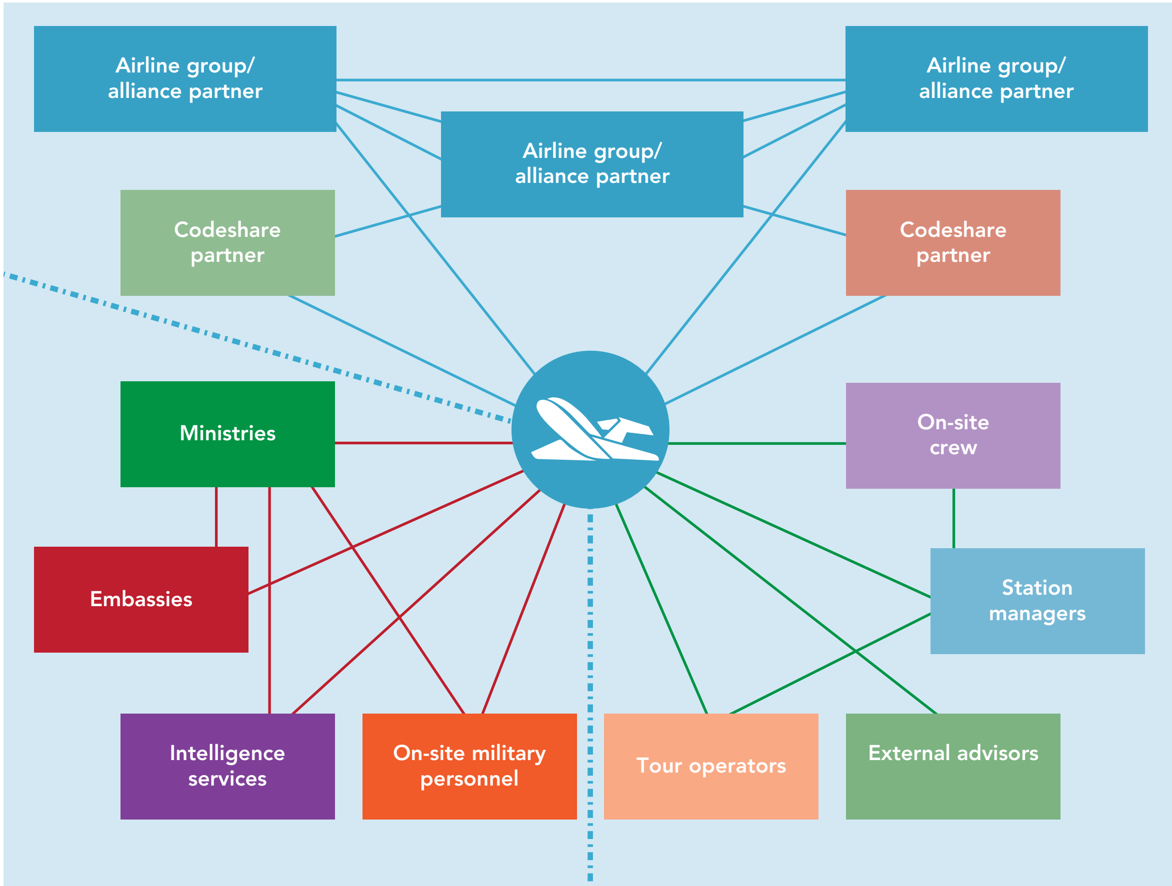


Figure 29: Informal networks. (Source: Dutch Safety Board)

Within these networks there are (partially) open as well as closed circuits in which the parties exchange confidential or classified information. One example of a closed circuit is the network of operators within an airline group, which means a group of operators that work together. These closed circuits are characterised by the fact that sources of received intelligence are shared relatively freely. In (more) open circuits intelligence is shared, for example, between alliance partners and code share partners ('befriended' operators) and information sources will not be revealed or will be but to a limited extent. Both cases involve reciprocity: operators in these networks provide and receive information.

There are operators that obtain non-public information in an informal manner via their national authorities. Government parties with which these operators maintain contacts include ministries, embassies, defence attachés and other military informants and intelligence services. The extent to which operators obtain information from their authorities varies from one country to another and from one operator to another. The type of threat-related information the operators receive also differs. In one of the states examined, an operator revealed that it regularly obtained formal and informal information from the authorities. In other states, operators revealed that they had to request information and verify it using their own network. In these cases, the contacts are often informal and personal, unstructured and not institutionalised. One operator stated that it received information from the intelligence services more often than other operators in the same state 'due to a personal connection'.

Sector-specific analyses and (formal) recommendations from operators' own authorities
As described before, there are also states in which operators form part of institutionalised networks with their national authorities. In these states, the authorities collect and analyse intelligence for operators related to foreign airspace and destinations, and provide operators with additional, sector-specific information, such as risk analyses. Operators in these states also receive advice from their authorities.

Interpreting information
Operators may arrive at a different decision based on the same information. This indicates that there are differences in the way operators interpret and weigh information.

Threat analyses
Threat analyses focus on determining the general threat level. There are differences in how operators perform threat analyses, but several generic steps can be broadly differentiated (see Figure 30). If information is found related to a possible threat to the aviation sector, operator or involving a flight route or destination, this specific information is analysed systematically.

The general steps are:

1. A 'reference' is created by examining political, economic and other relevant local circumstances in a state.[109]
2. Research is conducted into whether there is *capacity*, or available means or skills to intentionally cause damage, and whether there is an *intention* to intentionally cause damage to the aviation sector or operator.
3. Information is verified: what are open and closed sources saying and can the picture of the threat be hitherto confirmed? In this respect, operators also consider the decisions made by other operators: whether or not they are avoiding the state and if they are, what are their reasons for doing so?[110]
4. The threat level is determined: the extent to which the threat is found to be specific, credible and/or probable and whether measures are necessary to combat the threat. In the event of a potential or specific threat, the decision will be taken to perform a more specific risk analysis.

109 To this end the 'Fragile States Index', is often used, with information about current performances by states in relation to numerous indicators, including political stability [state legitimacy] and factionalised elites', see http://ffp.Statesindex.org/. Another database that various airlines consult is the 'risk map' developed by the maritime industry. This database provides information per state about risks in terms of politics, security, the risk of abduction and risky 'waters' (https://riskmap.controlrisks.com/).

110 In addition, an operator examines whether the other airline, which has decided to avoid the airspace, possesses essential threat-related information. It may also be that the decision to opt for a detour is the result of a secondary analysis; the state of registration can, for example, have a certain international 'risk profile', which means that operators from this state are more likely to face security threats throughout the world. As a result, the decision made by one operator does not invariably have implications for another airline's threat analysis.

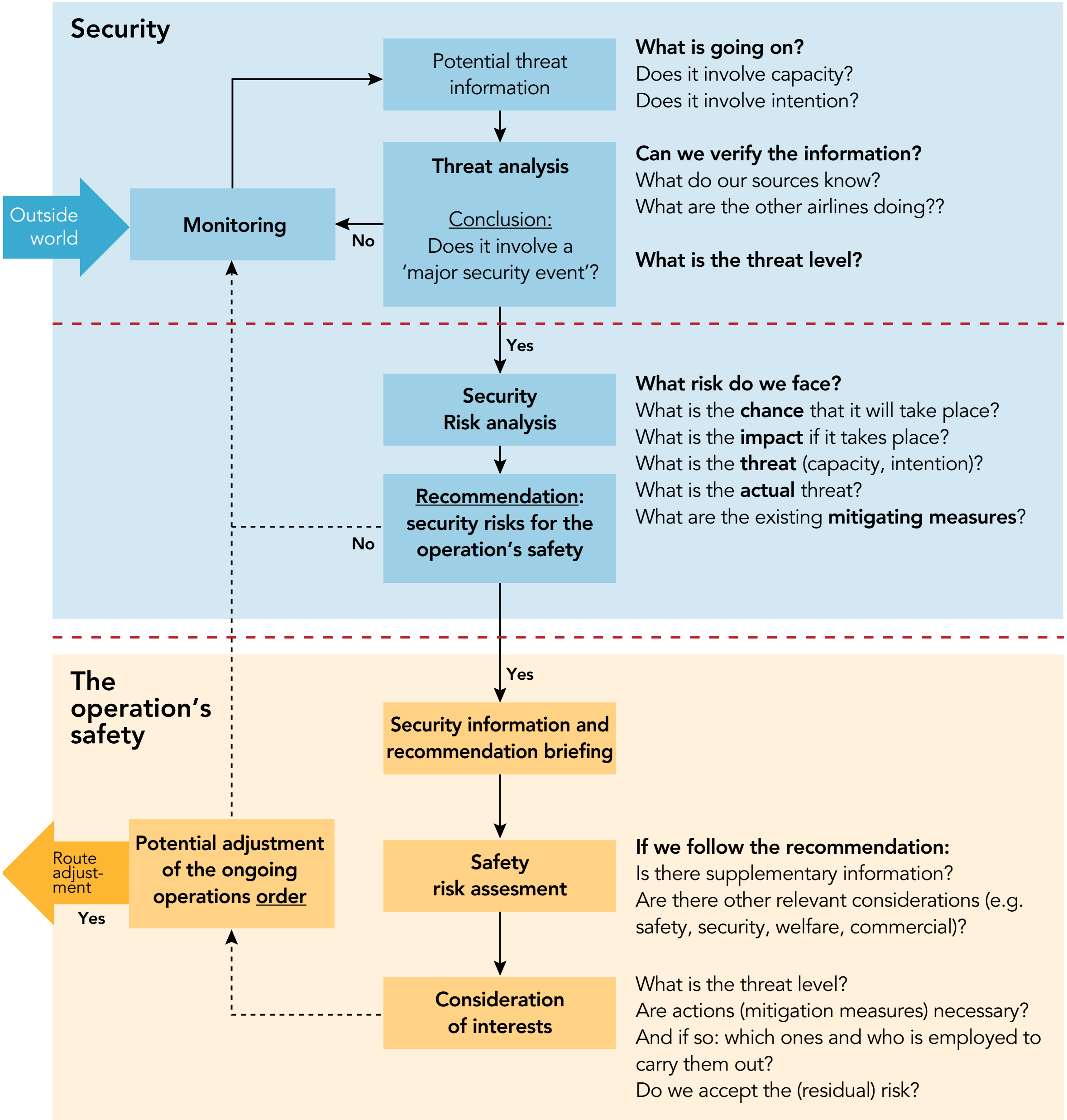


Figure 30: Example of decision-making at an airline. (Source: Dutch Safety Board)

Risk analysis

The threat analysis serves as input for the risk analysis that follows. The risk analysis translates the threats into risks facing the operator. These could be risks to the organisation in general (such as the 'organisation's objectives' or 'reputation'), as well as more specific risks to the continuity of commercial activities and the safety of people and/or property. The risk analysis determines vulnerability and considers the consequences of not taking mitigating action by the operator.

When studying the risks, the operator produces an estimate of the *probability* of an incident occurring. Statistical data are leading when determining the probability of a particular incident occurring: has the incident already occurred in the past, and if so, how often? By examining historic series, the operator can estimate a scenario's statistical probability. It weighs the probability against the potential *impact*, namely the expected severity and scope of the damage. It does so using a risk matrix. Risk matrices may differ from one operator to another, but generally have one axis representing an event's impact on a scale ranging from extremely low (no risk to safety, damage or injury is negligible, no action necessary), to extremely high/catastrophic (safety not guaranteed, all safety nets failed, irreparable major economic damage, fatalities), while the other axis represents the chance/ probability of it occurring, on a scale ranging e.g. from frequent to extremely unlikely or from more than once a week to less than once a year. Below we provide an example.

Likelihood	Severity				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A Certain / frequent	Moderate (1A)	Moderate (2A)	High (3A)	Extreme (4A)	Extreme (5A)
B Likely / occasional	Low (1B)	Moderate (2B)	Moderate (3B)	High (4B)	Extreme (5B)
C Possible / remote	Low (1C)	Low (2C)	Moderate (3C)	Moderate (4C)	High (5C)
D Unlikely / improbable	Negligible (1D)	Low (2D)	Low (3D)	Moderate (4D)	Moderate (5D)
E Exceptional	Negligible (1E)	Negligible (2E)	Low (3E)	Low (4E)	Moderate (5E)

Figure 31: Example of a risk index matrix. (Source: ICAO Safety Management Manual, Doc 9859)

The idea behind the matrix is that activities that involve an extreme risk may not be undertaken. High and moderate risks require different types of mitigating (risk-reducing) measures. Low and negligible risks can be accepted without any further measures.

For the risk facing civil aircraft above conflict areas, the severity of a related threat (shooting down an aircraft) falls under the 'catastrophic' category. This matrix illustrates that, as soon as the probability increases from 'exceptional' or 'unlikely' to 'possible', the risk category shifts from 'moderate' (5D or 5E) to 'high' (5C). This leads to a different risk evaluation than that produced if a lower probability is involved. It is therefore important that the chance of an event is determined as accurately as possible, and not solely in a strictly quantitative manner. The next section will explain which improvements are possible for conflict areas.

After the threat analysis there is usually an advice from the security department to those persons at the operator who must make the decision (usually the 'Accountable Manager' in consultation with the 'Post Holders' and sometimes supplemented with more operational managers such as the Head of the Operations Control Centre).[111] A decision will eventually be taken based on this advice, such as the decision to avoid an area or to continue to fly there, whether or not subject to specific mitigating measures.

111 Some operators also refer to the role of insurance companies in the final decision: they can refuse to insure risky flights.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

Mitigating measures

A mitigating measure related to flying over a conflict area is, for example, the obligation to have certain equipment on board (a 'Minimum Equipment List'), increasing the visibility of a civil aeroplane, additional instructions for pilots prior to a flight or additional instructions for performing a possible emergency landing above a conflict area.

Each operator performs its own risk assessment. Different factors can play a role when assessing the identified risks with regard to the flight route, such as the number of flights an operator operates on a route (the more often you fly, the greater the risk that something can happen to one of the aeroplanes, but also the greater the route's importance in commercial terms), the relationship with the states to or over which an operator flies (an operator from a state that is at war with another state runs a greater risk of being attacked) and the nature of the armed factions (are they hostile to certain states, are they disciplined?). An operator's history of incidents can also play a role: if an operator has previously been involved in an incident in or above a conflict area, it may be more inclined to avoid the situation. Thus operators that possess the same threat-related information may, nevertheless, come to a different conclusion, also with regard to flying over conflict areas.[112]

Factors related to conflict areas that increase risks
For conflict areas over which civil air traffic is still possible, it is important to obtain a picture of the factors that could increase risks to civil air traffic flying over it. To this end the Dutch Safety Board identified, insofar as is possible, characteristics that could be relevant for determining risks to civil aviation, for a number of conflict areas, including Ukraine.[113]

The conflicts that pose the greatest threat to civil aviation are those in which non-state parties are involved. Such conflicts are characterised by a high degree of unpredictability. It is difficult to ascertain the weapons systems these parties possess. Furthermore, these parties are not bound by international treaties and conventions and their intentions are unclear with regard to parties not directly involved in the conflict.

The weapons systems that could pose a threat to civil aviation are primarily anti-air missiles. MANPADS are present in most of these conflict areas, but their range is lower than the altitude at which civil aeroplanes fly over the area. Insofar as can be determined, medium or long-range surface-to-air missiles are not present in most of the conflict areas described here. Conflicts in which major powers that do possess these weapons are involved (behind the scenes), present a greater possibility that they will become available than in other conflicts. Additionally, fighting factions seized these types of systems from the state's armed forces in several conflict areas. It is not known whether these factions possess the knowledge and skill needed to actually use the systems seized, but it cannot be ruled out that they are able to obtain the necessary knowledge and skill.

112 One example of this is a report in the media (Noordhollands Dagblad, 4 May 2015) that one Turkish Airlines flight crosses conflict areas near Mosul and Tikrit in Iraq, while other airlines avoid Iraq and fly via Iran and Turkey.
113 It concerns the situation at the time the inventory was performed: July 2015. See section 6.

In ICAO, the Working Group on Threat and Risk (WGTR) launched an initiative to assess the criteria related to risks posed by conflict zones more effectively.[114] The criteria are intended for areas that are known, or can be assumed, to have anti-air missiles. Factors that are of notable importance for determining the threat and risk of civil aircraft being shot down are:

- Civil aviation is the target of one of the fighting parties;
- Those operating the anti-air missiles are (poorly) trained;
- Flights involving military aircraft in a combat role are taking place;
- Military transport flights are being operated;
- Flight routes run through or close to locations of strategic importance, which can be attacked from the air;
- The absence of effective air traffic control above the area, such as because the state in which the conflict is taking place does not exercise complete control of its territory.

According to ICAO, these factors increase the risk of flying over such a conflict zone. The Dutch Safety Board believes that these criteria can be used to obtain a more effective analysis of the risks posed by conflict areas to civil air traffic flying over them. The Dutch Safety Board adds that the involvement of a major power in the conflict can increase the chance of medium or long-range surface-to-air missiles being present, because these types of systems cannot usually be acquired on the black market.

Applying these types of factors in a risk matrix, such as the example in Figure 31, could result in a higher estimation of the probability of fighting parties shooting down a civil aircraft intentionally or unintentionally, for some conflict areas. As the risk matrix demonstrates, this estimated probability does not have to be much higher to produce a different risk assessment.

Vulnerabilities involved in risk assessment

The crash of flight MH17 has raised questions in the aviation sector with regard to the provision of information to operators related to flying over conflict areas. One of the conclusions was that the sharing of available information about potential threats must be improved, in the first instance between states.[115]

The crash teaches us that simply sharing information may not be enough to prevent such disasters. Information related to the expansion of the armed conflict into the air was available, but none of the parties connected these developments to an increasing threat to civil aviation. Since the upper airspace was not closed, operators assumed that it was safe. They also made no connection between the conflict on the ground and risks to their aircraft.

114 ICAO, HLSC15- WP/10, 7 January 2015.
115 ICAO High Level Meeting, August 2014.

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

An effective risk assessment largely depends on the quality of the information and the way in which parties interpret the information and assess risks. This section discusses the vulnerability inherent to these processes. Vulnerabilities are: the fundamental principle that 'flying is the standard', the varying and sometimes limited interpretation of their responsibilities by states and operators, the dominant military perspective, the focus on intention, the focus on the ground, operating from the perspective of destinations and problems with sharing classified and confidential information.

The importance of imagination

Past events also illustrate that, when signals indicating the existence of a threat can be identified using public information or gathered intelligence, it is still not easy to actually view these signals and interpret them as a potential threat. The National Commission on terrorist attacks upon the United States (9/11 Commission) reveals that, in the event of the attacks of 11 September 2001, signals indicating an imminent attack may have been present but that the authorities concerned did not interpret them as such due to a lack of 'imagination' (9/11 Commission 2004: 344 - 348).

By default, flights take place
The international civil aviation system is based on the assumption that, in principle, civil air traffic is always possible: flying is the standard. States managing airspace shall impose as few restrictions as possible. This system can provide an incentive to keep the airspace open if potential dangers to air traffic are not yet entirely clear.

Flying is also the standard for operators. When it comes to new flight routes, they assess whether they want to fly somewhere, whereas continuing to fly along existing routes over conflict areas is a 'non-decision' in most cases. The investigation revealed that operators only reconsider existing routes for safety reasons if there are specific indications of danger. This largely determines how operators collect and interpret threat-related information: they wait until an actual threat has been identified. They use available information to justify continuing to fly and to carry on doing exactly what they were already doing.[116] This perspective was observed with regard to flying over the eastern part of Ukraine: the operators viewed the NOTAMs issued by Ukraine prior to 17 July 2014 as a signal that Ukraine was managing the airspace; not as an indicator for the worsening safety situation in the airspace.

States and operators' understanding of their responsibilities
The more a state or operator actively collects information about threats, the greater the chance that it will identify threats that are not actively reported by a state that is involved. There are operators that rely entirely on aeronautical information that is provided to

116 This is a general pattern of behaviour. Bazerman and Watkins (2004:7) refer to the human tendency to maintain the status quo: 'When a system still functions and there is no crisis to catalyse action, we will keep doing things the way we have always done them.'

them, without seeking additional information about potential threats to the airspace. In doing so they are not contravening any ICAO provisions; Annex 17 does not stipulate any explicit measures for preventing threats in the (upper) airspace.

Operators that rely solely on aeronautical information and do not gather any additional information, are acting in accordance with the basic principle of the sovereign state, which manages the airspace and provides users of its airspace with adequate information. In doing so they make themselves highly dependent on other parties. In the first place, that is the state responsible for managing the airspace. However, in a state in which there is an armed conflict with another state or between domestic parties, it is possible that the safety of civil airspace is not accorded the highest priority. Moreover, it is not always clear whether the state exercises full control over its territory. In the existing aviation system, there are few formal possibilities for helping a state, which finds itself in these circumstances, to ensure the safety of the airspace for civil air traffic, because the state could view this as a violation of its sovereignty.

A possible additional guarantee in the existing system is that operators gather supplementary information about the risks to the airspace above a conflict area. As mentioned, there are clear differences in the extent to which operators do so. The differences arise, for example, from the decisions operators make in their security management. The size of the operator is not always decisive, as there appear to be differences between operators of a similar size.

To collect information about conflict areas operators can use public sources, but are partly dependent on information they receive from their national authorities. It generally concerns information from intelligence sources, and this type of information is pre-eminently gathered by a states. Although operators also have a security department, it does not benefit from the resources and competences of the intelligence services.

There appear to be major differences in the extent to which states gather intelligence that may concern 'their' operators' safety. There are states that only do this within their borders (such as Malaysia), there are states that gather intelligence beyond their borders on a limited scale, but in principle do not regard this as an active responsibility towards the civil aviation sector (such as the Netherlands), and there are states that regard protecting civil aviation as a responsibility, by actively passing on the information and/or by issuing flight prohibitions if necessary (such as the United States). These differences undoubtedly involve a states' possibilities to secure an intelligence position (capacity, diplomatic relationships with countries, geopolitical position), but they are also the result of the choice that states make with regard to the responsibility for the safety of operators. The willingness of states to become embroiled in the decision made by sovereign states to keep their airspace open also varies. The crash of flight MH17 may lead to a rethink involving these decisions.

The military perspective dominates
As described above, a states gathered intelligence about the development of the conflict in the eastern part of Ukraine to be able to assess what the military-strategic and geopolitical consequences could be. This explains why a states did not make a connection between the possible presence of powerful weapon systems and risks to air traffic flying

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

over the area. The list of conflict areas in other parts of the world provided a similar picture: the military perspective is dominant and the interests of civil aviation play a subordinate role.

Focus on intention

The investigation revealed that the parties involved view the potential risks to civil aviation in terms of an intentional threat: the preconceived intention to shoot down civil aeroplanes or specific civil aeroplanes (such as those from a particular country). This approach, which is the domain of the security departments, leaves little room for the possibility that civil aeroplanes could be unintentionally hit by military attacks.

The observations performed at operators revealed that there, too, intention is viewed as a precondition for a threat. As one source said: '*The fight in the eastern part of Ukraine was about territory. It did not involve a terrorist group. Therefore there was no mention of a high threat level to civil aviation.*'

If there is a lack of any strong indication of intention, the threat analysis stops. In this way, the potential threat disappears from the risk assessment process very quickly and does not reach the domain in which operational risk assessments are performed (see Figure 30).

The crash of flight MH17 demonstrates that just the (possible) presence of weapons in a conflict area - usually referred to as 'capacity' - means that a threat to civil aviation can be assumed and that it is also important to determine which weapons are present, who possesses them (regulated or unregulated troops) and whether those that possess the weapons could have an interest in actually using them. Even without any involvement of intention, a genuine risk to civil aviation may arise from this, which can quickly score a high 'rating' in the previously cited risk matrices, due to the serious consequences. The assessment of the risks in conflict areas will thus also have to include unintentional acts.

The verifiability of information from the intelligence services

A sensitive point when using classified or confidential information is that it is difficult for operators to verify the information they receive (directly or indirectly from aviation authorities) from intelligence services. In a number of states (such as the United Kingdom) security-cleared staff from operators can obtain access to certain non-public threat-related information and analyses that form the basis for the public risk analyses. This makes it possible for them to acquire an insight into the value of the supplied information. In other states operators only receive the conclusions. This also plays a role within operators: the security department provides a threat analysis as input for the risk analysis, but cannot reveal anything about the source due to confidentiality. Since information is provided on a *need-to-know* basis and the security department determines what is *need-to-know*, there is no guarantee that important information will not be left behind. This process demands a high degree of confidence in the professionalism of the links at the beginning of the chain.

Not all states possess the capacity to gather information about potential threats in other countries. These states can still obtain information if other countries are willing to share it with them. As a result of the crash of flight MH17, ICAO *Task Force on Risks to Civil Aviation arising from Conflict Zones* (TF RCZ) advocated a central information system, including a web application for NOTAMs, supplemented with relevant safety and security information related to risks that conflict zones pose to civil aviation. However, it will still be difficult to verify this information, even with such a system. To be of value to civil aviation, it is essential that the information be sufficiently clear and reliable. The extent to which states are willing to share information gathered by intelligence services has yet to be established.

Focus on the ground
With regard to the conflict in the eastern part of Ukraine, the examined foreign parties focused mainly on the development of the conflict on the ground. Government departments, embassies and intelligence services viewed the conflict from a geopolitical perspective. They did not recognise that the risk to civil aviation increased when the conflict expanded to the air. This was not only true in states where the authorities did not focus specifically on threats to aviation, but also in states where the authorities play a more guiding role with regard to operators based in their country flying over conflict areas. In this sense we can conclude that *due to* the conflict in the eastern part of Ukraine and its geopolitical dimensions, authorities had a blind spot when it came to risks to civil aviation at cruising altitude. The focus of government parties was mainly on developments on the ground. This 'focus on the ground' emerges among authorities at the level of information gathering and how information was interpreted.

Annex 17 to the Chicago Convention does not expressly stipulate that, e.g. when establishing a National Civil Aviation Security Programme for aviation, which generally focuses on in-flight security measures on the ground, states must also focus on the risks related to using foreign airspace, although it does not preclude states from applying any additional measures, as appropriate. Threats related to, for example, aerodromes, flight crews, passengers and baggage are explicitly included in Annex 17. These provisions have arisen from incidents (hijacking and explosives brought on board). Although Annex 17 to the Chicago Convention does not explicitly rule out the risk assessment of foreign airspace, the investigation into the crash of flight MH17 shows that many states and operators do not use this possibility. The crash of flight MH17 reveals a lack of provisions related to risk assessment with regard to threats to the upper airspace.

The operators examined, which strive to identify threats to existing routes and if necessary perform a risk assessment, with regard to conflict areas mainly focus on threats to the aeroplane on the ground. They are concerned with the security of their take-off and landing locations ('point-to-point'). This was also true in the case of the conflict in the eastern part of Ukraine. No connection was made between the conflict and potential threats to the upper airspace.

MH17

Appendices available via the website

APPENDICES AVAILABLE VIA THE WEBSITE

Contents
Contents of the Appendices to Part B
Appendix O
Appendix P
Appendix Q
Appendix R
Appendix S
Appendix T
Appendix U
Contents of the Appendices available on the website
Appendix V
Appendix W
Appendix X
Appendix Y
Appendix Z

CONSULTATION PART A: CAUSES OF THE CRASH

In accordance with ICAO Annex 13, the draft Final Report is submitted to the parties involved, inviting their significant and substantial comments. The parties were requested to check the report for any errors and ambiguities. The draft Final Report was submitted to the following parties:

State	Parties
State of Occurrence - Ukraine	• NBAAI • UkSATSE
State of Operator and State of Registry - Malaysia	• DCA • Malaysia Airlines
State of Design and State of Manufacture (aeroplane) - USA	• NTSB • Boeing
State of Design and State of Manufacture (engines) - United Kingdom	• AAIB • Rolls-Royce
States and organisations providing information	• Australia - ATSB • Russian Federation - FATA, GKOVD, JSC Concern Almaz-Antey • EUROCONTROL
Others	• EASA • ICAO

The comments received have been dealt with in the following manner:

- Corrections of factual inaccuracies, additions at the detail level and editorial comments have been adopted by the Board insofar as they were relevant. The sections of text involved have been adapted in the final report. These comments have not been specified individually.
- Any comments that were not adopted have been provided with counter arguments. These comments have been included in a table on the Dutch Safety Board's website (www.safetyboard.nl). This table contains the literal text of the comments, plus the sections they apply to, the parties who provided them and the Dutch Safety Board's response.

CONSULTATION PART B: FLYING OVER CONFLICT ZONES

In accordance with ICAO Annex 13, the draft Final Report is submitted to the parties involved, inviting their significant and substantial comments. The parties were requested to check the report for any errors and ambiguities. The draft Final Report was submitted to the parties mentioned in Appendix V and to the Dutch government.

The comments received have been dealt with in the following manner:

- Corrections of factual inaccuracies, additions at the detail level and editorial comments have been adopted by the Board insofar as they were relevant. The sections of text involved have been adapted in the final report. These comments have not been specified individually.
- Any comments that were not adopted have been provided with counter arguments. These comments have been included in a table on the Dutch Safety Board's website (www.safetyboard.nl). This table contains the literal text of the comments, plus the sections they apply to, the parties who provided them and the Dutch Safety Board's response.

APPENDIX X

NLR REPORT: INVESTIGATION OF THE IMPACT DAMAGE DUE TO HIGH-ENERGY OBJECTS ON THE WRECKAGE OF FLIGHT MH17

Introduction

The impact damage due to high-energy objects on the wreckage of flight MH17 was investigated. To investigate the possible cause of this damage, three scenarios using different classes of weapon systems in use in the region were analysed. The following three simulation models were used, which are described in the report: Fragmentation Visualization Model, Kinematic Fragment Spray Pattern Simulation and the missile flyout simulation from WEST (Weapon Engagement Simulation Tool).

The report is published on the Dutch Safety Board's website www.safetyboard.nl.

APPENDIX Y

TNO REPORT: DAMAGE RECONSTRUCTION CAUSED BY IMPACT OF HIGH-ENERGETIC PARTICLES ON MALAYSIA AIRLINES FLIGHT MH17

Introduction

The purpose of this investigation is to determine the most probable detonation point of a typical fragmenting warhead, in order to find the circumstances by which the observed damage is reproduced in the best possible manner. Starting point is a warhead containing high explosive material and preformed fragments. Terminal ballistics simulations were performed.

The report is published on the Dutch Safety Board's website www.safetyboard.nl.

APPENDIX Z

TNO REPORT: NUMERICAL SIMULATION OF BLAST LOADING ON MALAYSIA AIRLINES FLIGHT MH17 DUE TO A WARHEAD DETONATION

Introduction

The objective of this investigation is to establish the blast pressure evolution for a number of discrete points on the aircraft contour. This information can be used by the Dutch Safety Board to predict possible failure of the aircraft structure. A so-called Computational Fluid Dynamics (CFD) simulation has been performed to provide high-fidelity quantitative description of the blast loading.

The report is published on the Dutch Safety Board's website www.safetyboard.nl.

DUTCH
SAFETY BOARD

Visiting Address
Anna van Saksenlaan 50
2593 HT The Hague
T +31(0)70 333 70 00
F +31(0)70 333 70 77

Postal Address
PO Box 95404
2509 CK The Hague

www.safetyboard.nl