Safety and Airspace Regulation Group

Guidance regarding flight operations in the vicinity of volcanic ash

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Revision history

Version 1 **10 February 2011**

Original issue in the form of a single document, bringing together guidance previously issued as AIRCOMs, ATSINs, FODCOMs and NOTALs. The opportunity has been taken to make some minor updates to the text.

Version 2 **26 May 2011**

The document has been updated to include information on the underflight of Volcanic Ash and to provide more details about what information should be included in a Safety Risk Assessment.

Version 3 **1 October 2014**

At the International Volcanic Ash Task Force (Meeting 4 13-15 June 2012) a recommendation (4/16) was agreed that “That States should not declare a danger or restricted area in respect of volcanic ash, except over and in proximity to an erupting volcano.” As a consequence this version removes all references to Temporary Danger Areas (TDA), replacing them with the term high contamination areas.

In this version an aligned policy has been provided with regards the application of a buffer zone to the top and bottom of the ash layer.

Version 4 **27 January 2017**

The document has been updated to take account of an update to the ICAO European and North Atlantic Volcanic Ash Contingency Plan, in particular States’ responsibilities and methods for the publication of information relating to forecast volcanic ash concentration. There are also updates to various references to European legislation and other minor editorials.

Glossary

Abbreviation	Meaning
ANO	Air Navigation Order
AOC	Air Operator's Certificate
ASR	Air Safety Report
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATS	Air Traffic Service(s) **NOTE:** ATS encompass the provision of ATC and FIS.
CAA	Civil Aviation Authority
CAT	Commercial Air Transport
EASA	European Aviation Safety Agency
EC	European Commission
ECCAIRS	European Coordination Centre for Accident and Incident Reporting Systems
EUR	European
FAA	Federal Aviation Administration
FIR	Flight Information Region
FIS	Flight Information Service

FISO	Flight Information Service Officer
FL	Flight Level
HEMS	Helicopter Emergency Medical Services
ICAO	International Civil Aviation Organisation
IMC	Instrument Meteorological Conditions
MEL	Minimum Equipment List
MOR	Mandatory Occurrence Report
MSA	Minimum Safe Altitude
NAA	National Aviation Authority
NAT	North Atlantic
NOTAM	Notice to Airmen
OEM	Original Equipment Manufacturer
PT	Public Transport
RA	Resolution Advisory
REG	Regulation
RFFS	Rescue and Fire-Fighting Services
SAR	Search And Rescue
SRA	Safety Risk Assessment
SVFR	Special Visual Flight Rules

TCAS	Traffic Alert and Collision Avoidance System
TRA	Temporary Reserved Area
TRUCE	Training in Unusual Circumstances and Emergencies
USGS	United States Geological Survey
VAA	Volcanic Ash Advisory
VAAC	Volcanic Ash Advisory Centre
VOLCEX	Volcanic Ash Exercise
VMC	Visual Meteorological Conditions

Chapter 1

Introduction

Purpose

1.1 This guidance aims to provide the essential information regarding planning and undertaking flight operations in or near volcanic ash for pilots, aircraft owners, Air Traffic Service (ATS) staff, aerodrome operators and maintenance engineers.

1.2 The guidance contains information and advice that may be issued by other States in the form of an Aeronautical Information Circular entitled "The approach to management of volcanic ash events."

1.3 It should be noted that this document concerns issues relating to volcanic ash but does not address volcanic gases in the atmosphere, such as suplhur dioxide. There are currently a number of studies being undertaken on volcanic gases and further guidance will be developed in due course, as necessary.

Amendments

1.4 Marginal lines are used to indicate changes from the previous version, and the changes at each version are listed in the Revision History.

General points regarding volcanic ash

1.5 It is emphasised that the responsibility for the risk assessment and management, and for the safe operation of the aircraft, rests firmly with the operator of the aircraft. Operation through or within any area where volcanic ash is forecast is at the discretion of the operator and subject to the regulation of the operator by the State of Registry and the State of the Operator and taking into account any restrictions placed by the state in whose airspace the contamination is forecast.

1.6 The information provided here,[1] whilst not exhaustive, is intended to facilitate as much flight as is safely possible in airspace in which an encounter with an ash cloud is a hazard, especially where those flights (and machines typically used for those flights) are used to provide essential services to communities.

1.7 Volcanic ash may extend for several hundred miles and may not be visible to the naked eye.

1.8 It should be recognised that the ash cloud can be the cause of a common failure mode (e.g. it would affect all engines on one aircraft) - that is why, for example, a twin-engine helicopter should be operated as if any engine failure would be a double engine failure.

1.9 This guidance does not supersede any guidance or recommendations issued by the Original Equipment Manufacturers (OEMs), a phrase which refers mainly to aircraft and engine manufacturers. All aircraft operators should consult their OEMs when preparing safety cases to operate in airspace forecast to be contaminated with volcanic ash. Air Operator's Certificate (AOC) holders conducting Commercial Air Transport (CAT) or Public Transport (PT) must have an appropriate Operator Safety Risk Assessment (SRA) accepted by their National Aviation Authority (NAA) and suitable measures in place before considering penetrating areas with forecast medium or high ash contamination, published by the UK Met Office and Météo-France, including overflight and underflight. In areas where contamination levels are not provided, all affected airspace must be treated as forecast high.

1.10 The ICAO European (EUR) Regional Office arranges volcanic ash exercises (VOLCEX) allowing the effectiveness of local (organisational) volcanic ash contingency plans and/or procedures to be tested. It is strongly recommended that operators and Air Navigation Service Providers participate in these exercises.

[1] Other States might provide similar information on the approach to the management of volcanic ash events via an AIC.

Chapter 2

Flight preparation

Applicability

2.1 This chapter is of particular relevance to:

- Aircraft operators and owners planning their flights.
- Aerodrome operators managing their aerodromes.
- ATS providers briefing their staff.

Areas of contamination

2.2 In the International Civil Aviation Organization (ICAO) Volcanic Ash Contingency Plan EUR and NAT Regions [Appendix 2, reference 6], three ash contamination levels have been defined as described below[2]. All forecast ash concentrations are subject to a level of uncertainty. 'Defined dimensions' refers to horizontal and vertical limits.

Area of low contamination: An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or less than $2x10^{-3}$ g/m^3, but greater than $2x10^{-4}$ g/m^3.

Area of medium contamination: An airspace of defined dimensions where volcanic ash may be encountered at concentrations greater than $2x10^{-3}$ g/m^3, but less than $4x10^{-3}$ g/m^3.

Area of high contamination: An airspace of defined dimensions where volcanic ash may be encountered at concentrations equal to or greater than $4x10^{-3}$ g/m^3, or areas of contaminated airspace where no ash concentration guidance is available.

[2] Some Volcanic Ash Advisory Centres (VAACs) in other parts of the world may not differentiate between different levels of contamination.

2.3 Note that paragraph 2.4 applies to airspace for which the UK is responsible for the provision of air navigation services[3]. In other areas of the world there are variations. In particular, in some areas of the world only a SIGMET or Notice to Airmen (NOTAM) may be published defining the airspace contaminated by volcanic ash. In addition danger or prohibited areas may be established and must be respected.

Notification of areas of contamination

2.4 In the airspace for which the UK is responsible for the service provision, areas of ash contamination will be displayed on Volcanic Ash Concentration Charts available from the UK Met Office. Additionally a file containing the coordinates of the boundaries of the various ash areas will be available from the UK Met Office web site. The UK Met Office will also issue a volcanic ash SIGMET, which will provide the defined dimensions of the forecast low contamination area for the following 6 hour period.

2.5 During an Icelandic volcanic eruption, the Icelandic Civil Aviation Authority (CAA) will promulgate information relating to volcanic ash contamination in their FIR, via NOTAM. Once an eruption has occurred it is likely that an initial Danger Area will be established within a 120 NM radius around the volcano site or 60NM downwind from the site, if wind direction is known. When further information becomes available, the Danger Area is redefined.

2.6 The UK CAA will promulgate the following information relating to a volcanic ash eruption via NOTAM; its onset, a significant change in the eruption strength and the cessation of the eruption.

Note 1: UK NOTAM will not provide details of volcanic ash contamination areas; instead notification will be as per paragraph 2.4.

[3] For the purposes of this document this includes the London and Scottish Flight Information/Upper Information Regions and that portion of the North Atlantic airspace provided by the Shanwick arrangements.

Note 2: A cessation of an eruption may only be short-lived and therefore flight crew and operators are advised to maintain a close watch on the situation in the hours and days following a notification of the cessation of a volcanic eruption.

Clearing volcanic ash from aerodrome surfaces

2.7 The following guidance is available regarding clearing ash from aerodrome surfaces:

- Flight Safety Foundation article [Appendix 2, reference 3]. The chapter 'Aircraft Also Face On-ground Ash Hazards', starting on page 5, is particularly useful to aerodrome operators.
- Guidance from the United States Geological Survey (USGS) [Appendix 2, reference 8].
- USGS article [Appendix 2, reference 9]. Guidance on surfaces starts on page 13 of the report.

2.8 The approaches to ash removal discussed in these documents have been endorsed by the Federal Aviation Administration (FAA), which has considerable experience of volcanoes in Alaska.

2.9 Aerodrome operators will have their own recovery plans, but may wish to consider in advance options for clearing aerodrome surfaces, should this become necessary. Following any ash clearance, aerodrome operators should conduct a thorough pre start-up inspection to ensure that:

- ash has been cleared from paved surfaces used by aircraft;
- all visual aids including aeronautical ground lighting, markings and signage are fit for purpose; and
- the runway surface has adequate friction levels.

Aerodrome contingency arrangements

2.10 Should a volcanic event occur rapidly that results in a significant increase in the number of operations (e.g. due to aircraft requiring to be grounded at short notice due to airspace restrictions) the CAA will permit

aerodromes to accept aircraft larger than their infrastructure code, or of one Rescue and Fire-Fighting Services (RFFS) category higher than they normally provide, which should be managed through the normal contingency arrangements.

2.11 Aerodrome operators should ensure that aircraft operators affected by these contingency arrangements are aware of the facilities and operations that will be made available at the aerodrome, and aerodrome licence holders should apprise their allocated aerodrome inspector of the arrangements in place.

Parked aircraft

2.12 Aircraft parked in areas that may be contaminated by volcanic ash should be suitably protected in accordance with the aircraft OEM's advice and covered where possible.

2.13 Clouds, especially cumuliform clouds, may produce precipitation, which may be dirty if ash is present.

2.14 Any volcanic residues must be removed prior to operations by following the appropriate OEM's recommendations.

Operations to or from an aerodrome known to be affected by volcanic ash

2.15 The aircraft OEM's advice should be sought prior to any operation to or from aerodromes contaminated with volcanic ash. Service Bulletins and Operations Manuals should be consulted. In addition to the hazards of contamination by volcanic ash, the runway braking action may be significantly affected, typically to the equivalent of:

- a wet runway for dry ash; and
- a slush-covered runway for wet ash.

Deciding whether and where to fly

2.16 A volcanic ash encounter is potentially extremely hazardous and the decision as to whether and where to operate in areas of known or forecast volcanic ash contamination rests with the operator and aircraft commander, and decisions should be taken in accordance with the operator's approved SRA. In all cases, in accordance with the Air Navigation Order (ANO) 2016 articles 68 and 69, commanders must satisfy themselves that it is safe to conduct the flight.

2.17 All UK operators of commercial air transport, non-commercial operations with complex aircraft and commercial specialised operations must comply with the provisions of the Regulation on Air Operations (EC Reg No. 965/2012) Part-ORO. This contains extensive guidance material for operations in known or forecast volcanic ash.

2.18 In accordance with Part-ORO, Part-CAT and Part-NCC, all aeroplane and helicopter operators conducting CAT or PT in airspace likely to be affected by volcanic ash, or to/from affected aerodromes, must carry out a SRA prior to planned operations. The operator must have its SRA accepted by its supervising NAA before initiating operations into areas or at aerodromes, which may be contaminated by volcanic ash. For a SRA to be accepted, the operator must have:

- A functioning Safety Management System;
- An adequate proven safety record;
- The management experience and capability to manage flight operations in areas where ash is forecast and evaluate the risk in accordance with a SRA;
- The required documented procedures and the provision of training; and
- Understanding of the hazards and its safety risks limits.

Operators should, where possible, laterally avoid forecast areas of ash contamination. Where this is unacceptably restrictive operationally, it may

consider overflight, underflight and lastly penetration of such areas in accordance with its SRA.

2.19 When formulating the operator specific no fly zone, the SRA must treat VAAC and NAA promulgated information, and in the UK the Met Office volcanic ash supplementary products, as primary information and account taken of the availability of flight watch and the capability of the operations unit to monitor volcanic ash information.

2.20 The operator must ensure that sufficient fuel is carried such that should a diversion be required, either en-route or at the destination, a diversion airfield available, and not affected by any forecast ash, may be reached with normal reserves. A review of Minimum Equipment List (MEL) relief must be included in the SRA.

2.21 Guidance on carrying out a SRA or deciding whether and where to fly is at Appendices A and B of ICAO Guidance Material [Appendix 2, reference 5] and Appendix 1.

Overflight of volcanic ash clouds

2.22 Operators without an appropriate SRA are not permitted to overfly areas of ash contamination.

2.23 It is likely that only aeroplanes have the performance capabilities to overfly volcanic ash clouds.

2.24 Providing an operator has an appropriate SRA and can plan a flight such that in the event of any credible emergency the aeroplane can continue to remain clear of the air mass containing significant concentrations of volcanic particles, there is nothing in the available data that would indicate overflight of such airspace is unacceptable. It is recommended that airspace with significant ash contamination be treated as a ‘solid object’ for the purposes of flight planning. This is analogous to a mountainous area with a high Minimum Safe Altitude (MSA) and no alternate aerodromes within it. In general, the assumed MSA should be at least 2,000 ft above the top of the ash cloud. The overflight SRA must include a

review of MEL relief and consideration of the availability of alternates, uncontaminated, and clear of contaminated airspace.

2.25 The following should be considered in relation to emergency descents:

- Extensive damage may be caused if the level of airborne contamination is high, potentially leading to engine shutdown, loss of air data systems and significant airframe damage. Lower levels of contamination may have a long-term detrimental effect on engines and systems.
- A review by the CAA was conducted of emergency descents reported under the Mandatory Occurrence Reporting scheme in a three-year period from 2007 until 2010 in UK airspace. There were 51 in 4.5 million flight hours. However, operators should carry out their own risk assessment for their particular operation.

2.26 Issues that operators need to consider include descent due to engine failure and depressurisation:

- **Engine failure:** The requirements are set out in Part-CAT CAT.POL.A.210, CAT.POL.A.215 and CAT.POL.A.220. CAT.POL.A.210 requires an aeroplane to be capable of avoiding all obstacles in the climb until it can comply with the en-route requirements of CAT.POL.A.215 or CAT.POL.A.220. To comply with CAT.POL.A.215 or CAT.POL.A.220, in general, the aeroplane must be capable of maintaining 2,000 ft above all terrain and obstacles after an engine failure, or a critical point must be calculated, with an associated minimum cruise altitude, which will allow the aeroplane to maintain the above clearance during drift down and diversion.
- **Depressurisation:** The oxygen requirements are given in Part-CAT CAT.IDE.A.235 and CAT.IDE.A.240. The limiting requirement is usually the one that calls for supplemental oxygen to allow continued flight above MSA where this is in excess of Flight Level (FL) 100.

2.27 Volcanic ash is continually moving depending on weather patterns. Therefore the position and vertical extent of ash is not known to a precise

level of accuracy. The density of ash will also vary. Operators should ensure that they use the most recent data from a recognised source for planning, with suitable safety margins. Recognised sources include charts and NOTAMs issued by the Meteorological Offices and NAAs responsible for the airspace.

Underflight beneath areas of ash contamination

2.28 Operators without an appropriate SRA are not permitted to underfly areas of ash contamination.

2.29 For operators with an appropriate SRA the maximum usable level beneath a forecast Volcanic Ash Moderate or High Contamination Area will be 2,000 ft below the promulgated base. ATS providers do not need to apply any additional buffers and, subject to the following considerations and guidance, ATS may be provided at or below this maximum usable level in accordance with normal procedures. In the event that an aircraft operating at the maximum usable level beneath the Volcanic Ash Contamination Area receives a Traffic Alert and Collision Avoidance System (TCAS) Resolution Advisory (RA) 'climb', this can be complied with as per normal procedures.

2.30 Aircraft operators should be aware that the restricted vertical availability of airspace beneath a forecast area of contamination may result in reduced airspace capacity and consequent application of airspace flow control measures. The exact nature of these restrictions will vary according to the specific nature of the size, shape and location of the ash areas, and the potential impact it has on the surrounding airspace.

2.31 Aircraft operators should endeavour to ensure that their submitted flight plan replicates their anticipated vertical profile and route for flight beneath or around the forecast Volcanic Ash Contamination Area. Failure to do so is likely to result in increased need to apply airspace flow control measures to ensure that appropriate airspace planning takes place and for ATS availability to match anticipated demands.

2.32 As part of their SRA, aircraft operators must consider planning and operating criteria, including, but not limited to:

- The requirements for flying at medium and lower airspace levels whilst still ensuring that they do not penetrate airspace containing ash concentrations not consistent with their approved SRA.
- Availability of diversion airfields uncontaminated by ash.
- Increased fuel burn for flight at lower than optimum levels.
- Engine failure.
- En-route obstacle clearance/MSA in relation to the base of the forecast ash contamination area.
- En-route weather and possible increased need to avoid weather laterally.
- Availability of air traffic services.
- Air traffic flow management procedures to facilitate multiple aircraft in reduced available airspace including potential en-route holding, enforced speed controls and re-routings.
- Maximum flight levels, or altitudes, to be flown taking into account reported lower levels of the forecast ash Contamination Area.
- The likely accuracy of the forecast and the availability of supporting evidence.
- MEL relief particularly Enhanced Ground Proximity Warning System and Airborne Collision Avoidance System.

2.33 Any new aircraft operating procedures should be adequately explained, promulgated and trained, and all stakeholders informed of differing operating conditions in order to manage change effectively.

Chapter 3

During flight

Applicability

3.1 This chapter is of particular relevance to:

- Pilots during flight.
- ATS providers.

Encountering volcanic ash

3.2 Airborne weather radar systems are not designed to detect volcanic ash clouds and extra precautions should be taken during flight, particularly during hours of darkness and in Instrument Meteorological Conditions (IMC) when volcanic ash may be present in the atmosphere. The following are signs that volcanic ash may be present during flight:

- Smoke or dust in the cockpit.
- Reduced visibility.
- An acrid or sulphurous odour.
- St Elmo's Fire and static discharges around the windshield.
- Changing engine conditions, particularly exhaust gas temperature and a bright white or orange glow in the engine inlets.
- Sharp, distinct beams from the landing lights.

3.3 The procedures provided in the Operations manual must be immediately actioned if volcanic ash is encountered and it must be reported as soon as possible to the Air Traffic Control Officer (ATCO) or Flight Information Service Officer (FISO). General advice is to execute a 180-degree turn to leave the ash cloud. If possible, the engine thrust should be reduced to flight idle to minimise the build-up of ash in the engines.

3.4 A precautionary landing should be made at the nearest suitable airport after a significant ash encounter or if it is suspected that the engines or

aircraft systems may have been adversely affected or there is aircraft damage.

Advice for general aviation pilots

3.5 The guidance in this section should be read in conjunction with paragraphs 3.2 to 3.4.

3.6 Flights in or close to cloud should be avoided. Cloud, especially cumuliform cloud, forms around particles in the atmosphere and volcanic ash particles provide ideal cloud (and ice) nuclei.

3.7 Engine damage is particularly concerning for turbine-engined aircraft, but probably less so for other internal combustion engines, where the combustion air can be filtered. However, in some piston engine installations, fixed-wing or rotary-wing, the use of carburettor hot air will bypass the air intake filter and therefore pilots should be aware of the potential for airborne contamination to reach the engine. If possible, conditions of cloud, drizzle, mist and any other known or probable areas of high humidity requiring the extended use of carburettor hot air should be avoided.

3.8 Increased haze may indicate a high concentration of ash. Below the top of the haze layer, dust concentration levels are usually high and discrimination between normal dust and ash will be extremely difficult. Above any haze tops, variations in the normally good visibility may be apparent. However, in an anticyclonic situation air at medium to upper levels, which may be affected by volcanic eruptions, is slowly descending. Air from the surface rises with convection during the day and descends very slowly during the night, so the highest concentration of ash may well end up at the top of the anticyclonic haze layer. Climbs and descents through the levels around the haze tops should be flown at the maximum safe rate possible, as should those through likely high humidity areas if carburettor hot air may be needed.

3.9 Airframe, propeller, rotor, intake and windscreen damage is caused by dust impacting surfaces. The extent of the damage depends on dust concentration, the composition of the dust and energy of impact (which is proportional to the square of impact speed). Operating airspeeds should therefore be chosen carefully, taking into account the rate at which any possible damage is likely to accumulate. However, aeroplanes should not be flown so slowly that they cannot be manoeuvred safely in an emergency.

3.10 It may be prudent to avoid flight over areas where the choice of landing areas in the event of engine failure is limited, even in twin-engine aircraft.

3.11 Ash may also find its way into pitot/static systems, or affect the lubrication of moving parts such as rotor heads, gearboxes and other bearings.

3.12 Glider pilots should avoid flight through cloud if the presence of ash has been notified, for the reasons given above. Balloon pilots are unlikely to be affected by volcanic ash, but should remain in Visual Meteorological Conditions (VMC) if flying where ash is present.

Provision of air traffic services

NOTE: This paragraph applies to ATS provision in the UK Flight Information Regions (FIRs), excluding airspace where ATS is delegated to other States. ATS procedures in other parts of the world may vary.

3.13 ATS providers should inform pilots of the presence of a Volcanic Ash Moderate or High Contamination Area before the aircraft enters or operates in such an area and ask them for their intentions. The following phraseology should be used:
"*You are about to enter a notified volcanic ash [Moderate]/[High] Contamination Area in your (xx) o'clock (up to FL (xxx)/active from FL (xxx) to FL (xxx)). Report your intentions.*"

3.14 ATCOs/FISOs are not required to question a pilot's approval to fly over, under or through a volcanic ash Moderate or High Contamination Areas. There is no requirement to terminate or amend the ATS provided.

3.15 ATS providers should give a high priority to passing reports from pilots about observed ash contamination to the UK Met Office (see paragraph 4.3). The European Coordination Centre for Accident and Incident Reporting Systems (ECCAIRS) European Reporting Portal should be used for volcanic ash events where considered appropriate.

3.16 Within the various volcanic ash concentration areas it is for the aircraft operator and aircraft commander to determine that it is safe to operate the aircraft in such airspace.

3.17 ATS providers are to ensure that ATCOs and FISOs are aware that, should an aircraft unexpectedly encounter a significant concentration of volcanic ash, the pilot may (possibly without prior warning):

- execute a 180° turn,
- descend,
- reduce engine power,
- declare an emergency.

3.18 Pilots operating within an area of contamination may decline a vector or climb/descent instruction. This may be particularly the case if that would take the aircraft into an area of higher contamination. A pilot may also be likely to request to leave an area if ash is encountered, possibly declaring an emergency. ATCOs and FISOs should accommodate any such request as expeditiously as operational safety considerations allow.

3.19 ATS providers should ensure that:

- ATCOs and FISOs are appropriately briefed before they assume responsibility for a control position, on the actions to be taken in the event that a pilot intends to operate an aircraft over, under or through Volcanic Ash Contaminated Airspace, and potential pilot actions in the event of a significant volcanic ash encounter;
- ATCO and FISO workloads are managed such that sufficient capacity is maintained at all times to appropriately reflect the revised airspace arrangements, and also to enable appropriate reaction to pilots who unexpectedly encounter volcanic ash;

- flow control or limitations on the number of aircraft in a defined airspace block or sector are applied as necessary;
- interface procedures with adjacent ATC sectors/units/control centres appropriately cater for aircraft that are likely to operate on non standard routes and/or levels;
- adequate resources are available to accommodate planned aircraft movements, including an unexpected emergency/diversion incident; and
- service provision in areas of volcanic ash is considered to be an unusual circumstance and is therefore to be included in Training in Unusual Circumstances and Emergencies (TRUCE).

3.20 ATS providers should give a high priority to passing reports from pilots about observed ash contamination to the UK Met Office. Special Air Reports provided by pilots should be forwarded to the UK Met Office via telephone on +44 (0) 1392 884918 and contain the following information:

- Volcanic Ash encounter;
- Aircraft identification;
- Position or Latitude and Longitude;
- Time;
- Flight Level or altitude; and
- Any further relevant information.

3.21 These reports should be made with maximum urgency. This information may assist the relevant bodies to predict more accurately the presence, movement and altitude of the volcanic ash, and any potential effect on flight.

3.22 An occurrence report should be submitted for volcanic ash events in accordance with EC Reg No. 376/2014 on the Reporting, Analysis and Follow-up of Occurrences in Civil Aviation. The UK CAA web site provides further information on reporting requirements. The European Coordination Centre for Accident and Incident Reporting Systems (ECCAIRS) European Reporting Portal should be used for volcanic ash events where considered appropriate.

Chapter 4

After flight

Applicability

4.1 This paragraph is of particular relevance to:

- Aircraft operators and owners after flight.
- Engineering and maintenance staff.

Reporting

4.2 If any ash is encountered, whether or not damage occurs, the crew should report it to the operator by the most expeditious means and through the operator's Air Safety Report (ASR) system. It should be reported to the CAA using the European Coordination Centre for Accident and Incident Reporting Systems (ECCAIRS) via www.aviationreporting.eu.

4.3 The European Aviation Reporting Portal provides both on-line reporting via a web-interface and off-line reporting using of a pdf form that may be downloaded from the portal. In both cases, the act of submitting the report will trigger a submission report to the Competent Authority.

4.4 In the portal, there are five reporting forms (ATM/ANS, Flight Operations, Technical, Aerodrome and General Aviation). Organisations should chose the most adequate form for the type of occurrence which is being reported to the Agency.

4.5 In addition to the Special Air Reports of volcanic ash, When time permits, the pilot is encouraged to complete the Section 2 of the Volcanic Activity Report (VAR) message format giving additional details of the eruption, ash cloud and, if relevant, the effect on the aircraft. This information is handed in to ground personnel as a complete written post-flight special air-report at the next point of landing and is of assistance to vulcanologists

in determining the type of eruption. A copy of the Model VAR form is given at Appendix C.

4.6 If a volcanic ash encounter occurred or is suspected to have occurred during flight it must be reported to engineering staff and an entry made in the Aircraft Technical Log or Journey Log. Engineering action may be required prior to subsequent flight. The Aircraft Maintenance Manual should be consulted and advice sought from the aircraft OEM where necessary.

Maintenance programmes

4.7 Where aircraft require routine schedule minor maintenance but are unable to fly to their normal maintenance facility, the possibility of issuing one-off maintenance authorisations to local maintenance staff in accordance with Part 145.A.30(j)(5) should be considered. Operators should also consider whether inspection for signs of volcanic dust contamination needs to be performed before returning an aircraft to service.

4.8 In all cases where it is not possible to have outstanding maintenance performed at the aircraft's current location, the aircraft operator should contact the CAA for further advice.

Note: In such circumstances options may include issuing a temporary permit to fly to move the aircraft to a place where the maintenance can be performed or granting a variation / temporary amendment to the aircraft maintenance programme to extend the task.

4.9 Even if no volcanic ash damage is apparent, it is advisable for all possibly affected areas to be checked (if necessary by a qualified engineer) more frequently than called for in most maintenance schedules. The latest information from the OEM, for both airframe and engine, should specify any particular areas of concern or any additional requirements that need to be observed.

4.10 Many aircraft and engine OEMs have updated their instructions for continuing airworthiness to include additional and revised information for

aircraft operating in areas where volcanic ash could be present. It is recommended that operators immediately incorporate any new or revised information into their approved maintenance programmes. Insurance policies may also contain relevant clauses.

4.11 In the absence of specific information from an OEM, there is some generic guidance available via the European Aviation Safety Agency (EASA) Safety Information Bulletins.

Chapter 5

Summary

Disclaimer

5.1 This summary is designed to provide key information for the various groups of people who need to know how volcanic ash affects all aspects of flight. However, it is recommended that they read the document as a whole.

Aerodrome licence holders

5.2 The responsibility for the safe operation of the aircraft rests firmly with the aircraft operator (see paragraph 1.5).

5.3 Aerodrome operators should clear volcanic ash from aerodrome surfaces prior to operations taking place (see paragraphs 2.7-2.9).

5.4 Aerodrome operators should have in place contingency arrangements to manage events which occur at short-notice, e.g. airspace restrictions (see paragraphs 2.10 to 2.11).

Aircraft owners and operators

5.5 The responsibility for the safe operation of the aircraft rests firmly with the aircraft operator (see paragraph 1.5).

5.6 Whether and where to fly should be considered carefully (see paragraphs 2.16-2.33), with the decision based on the most recent and relevant volcanic ash information obtained through established procedures.

5.7 General Aviation pilots should pay particular attention to the advice specific to them (see paragraphs 3.5 to 3.12).

5.8 Pilots should be aware of what information and service they can expect from ATS providers (see paragraphs 3.13 to 3.19).

5.9 Pilots should be aware of the symptoms of a volcanic ash encounter and the escape procedures. Pilots should report any volcanic ash encounters appropriately (see paragraphs 4.2 to 4.6).

Air traffic service providers

5.10 The responsibility for the safe operation of the aircraft rests firmly with the aircraft operator (see paragraph 1.5).

5.11 ATS providers are to ensure ATCOs and FISOs are aware of the procedures for the provision of ATS to aircraft intending to operate in a forecast Volcanic Ash Moderate or High Contamination Area and likely pilot actions on encountering volcanic ash (see paragraphs 3.13 to 3.19).

5.12 ATS providers should report any volcanic ash encounters appropriately (see paragraphs 3.20 to 3.22).

Maintenance personnel

5.13 Maintenance personnel should report evidence of any volcanic ash encounters appropriately (see paragraph 4.6).

5.14 Maintenance personnel should check airframes and engines more frequently if volcanic is likely to have been encountered (see paragraphs 4.7 and 4.11). They should carry out a thorough investigation of any signs of unusual or accelerated abrasions or corrosion or volcanic ash accumulation.

Appendix A

Guidance for combinations of aircraft types and airspace types

	Class A	Class C	Class D	Class G
Turbine aeroplanes	All flights must comply with their SRA or avoid areas of medium and high ash contamination, including overflight and underflight.			
Piston aeroplanes and airships	All flights must comply with their SRA or avoid areas of medium and high ash contamination, including overflight and underflight.		CAA advises no flight in areas contaminated by Medium and high ash contamination, including overflight and underflight except in VMC, by day only, and avoiding visible ash. AOC holders conducting CAT or PT must submit a safety case.	
Turbine helicopters	All flights must comply with their SRA, otherwise Special Visual Flight Rules (SVFR), by day only, in VMC. Only one aircraft in any airspace 'block' as determined by Air Navigation Service Provider (ANSP). Special rules apply to operations in Heathrow area. SVFR, by day only. AOC holders conducting PT must submit a safety case. Multi-engine helicopters should be operated as if any engine failure would be a multiple-engine failure.		All flights must comply with their SRA. If flying, do so in VMC, by day only, and avoid visible ash. Exercise extreme caution. AOC holders conducting PT must submit a safety case. Multi-engine helicopters should be operated as if any engine failure would be a multiple-engine failure.	
Piston helicopters	All flights must comply with their SRA, otherwise SVFR, by day only,		All flights must comply with their SRA. If flying, do so in VMC, by day	

	Class A	Class C	Class D	Class G
	in VMC. Only one aircraft in any airspace ‘block’ as determined by ANSP. Special rules apply to operations in Heathrow area. SVFR, by day only. AOC holders conducting PT must submit a safety case.		only, and avoid visible ash. Exercise extreme caution. AOC holders conducting PT must submit a safety case.	
Balloons	Not permitted.	Only exists above FL195 (therefore not permitted except by special arrangement).	Normally permitted only by prior arrangement. CAA advises avoid visible ash.	CAA advises avoid visible ash. Otherwise, no restrictions.
Gliders	Not permitted (except by specific Letter Of Agreement and associated procedures, or other specific arrangements).	In VMC only within Temporary Reserved Area (TRA) (Gliding).	CAA advises avoid visible ash. In VMC only.	CAA advises avoid visible ash. Otherwise, no restrictions.

Appendix B

References

No.	Organisation	Document
1	Airbus	Flight Operations Briefing Note – 'Volcanic Ash Awareness' (PDF)
2	FAA	Federal Aviation Administration Aeronautical Information Manual Official Guide to Basic Flight Information and ATC Procedures
3	Flight Safety Foundation	'Volcanic Hazards and Aviation Safety: Lessons of the Past Decade' (May 1993)
4		Document 9766 'Handbook on the International Airways Volcano Watch (IAVW): Operational Procedures and Contact List'
5		Document 9974 'Flight Safety and Volcanic Ash'
6		ICAO Volcanic Ash Contingency Plan – European and North Atlantic Regions (EUR/NAT VACP Ed 2.0, EUR Doc 019, NAT Doc 006 Part II)
7	UK Met Office	Volcano – Information for Customers
8	United States Geological Survey	USGS Volcano Hazards Program Site
9		'Volcanic Ash and Airports – Discussion and Recommendations from the Workshop on Impacts of Volcanic Ash on Airport Facilities' (1993)
10	European Aviation Safety Agency	EASA Safety Information Bulletin (SIB) 2010-17 Revision 7, Flight in Airspace with Contamination of Volcanic Ash.

Appendix C

Model VAR form

MODEL VAR: to be used for post-flight reporting

VOLCANIC ACTIVITY REPORT

Air-reports are critically important in assessing the hazards which volcanic ash cloud presents to aircraft operations.

OPERATOR:			A/C IDENTIFICATION: (as indicated on flight plan)		
PILOT-IN-COMMAND:					
DEP FROM:	DATE:	TIME; UTC:	ARR AT:	DATE:	TIME; UTC:
ADDRESSEE			AIREP SPECIAL		
Items 1–8 are to be reported immediately to the ATS unit that you are in contact with.					
1) AIRCRAFT IDENTIFICATION			2) POSITION		
3) TIME			4) FLIGHT LEVEL OR ALTITUDE		
5) VOLCANIC ACTIVITY OBSERVED AT (position or bearing, estimated level of ash cloud and distance from aircraft)					
6) AIR TEMPERATURE			7) SPOT WIND		
8) SUPPLEMENTARY INFORMATION SO_2 detected Yes ☐ No ☐ Ash encountered Yes ☐ No ☐			Other _____ (Brief description of activity especially vertical and lateral extent of ash cloud and, where possible, horizontal movement, rate of growth, etc.)		
After landing complete items 9–16 then fax form to: (Fax number to be provided by the meteorological authority based on local arrangements between the meteorological authority and the operator concerned.)					
9) DENSITY OF ASH CLOUD	☐ (a) Wispy		☐ (b) Moderate dense		☐ (c) Very dense
10) COLOUR OF ASH CLOUD	☐ (a) White		☐ (b) Light grey		☐ (c) Dark grey
☐	(d) Black		☐ (e) Other _____		
11) ERUPTION	☐ (a) Continuous		☐ (b) Intermittent		☐ (c) Not visible
12) POSITION OF ACTIVITY	☐ (a) Summit		☐ (b) Side		☐ (c) Single
	☐ (d) Multiple		☐ (e) Not observed		
13) OTHER OBSERVED	☐ (a) Lightning		☐ (b) Glow		☐ (c) Large rocks
FEATURES OF ERUPTION	☐ (d) Ash fallout		☐ (e) Mushroom cloud		☐ (f) All
14) EFFECT ON AIRCRAFT	☐ (a) Communication		☐ (b) Navigation systems		☐ (c) Engines
	☐ (d) Pitot static		☐ (e) Windscreen		☐ (f) Windows
15) OTHER EFFECTS	☐ (a) Turbulence		☐ (b) St. Elmo's Fire		☐ (c) Other fumes
16) OTHER INFORMATION (Any information considered useful.)					