Australian Government
Civil Aviation Safety Authority

AIRWORTHINESS BULLETIN

Flight in Airspace with Volcanic Ash Contamination

AWB 02-038 **Issue** : 7
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1. Effectivity

All Australian registered aeroplanes and helicopters, aircraft operators, owners and maintenance organisations involved with aircraft operating into, or near, areas of airspace, located in Australia or overseas, that are known or suspected of being contaminated with volcanic ash or at aerodromes with runway volcanic ash contamination.

2. Purpose

- To continue to provide aircraft operators, owners and maintenance organisations with an overview of CASA recommendations regarding operations into, or near, areas of airspace, located in Australia or overseas, that are known or suspected of being contaminated with volcanic ash or at aerodromes with runway volcanic ash contamination.

- To provide information and recommendations referenced in *ICAO Doc 9974 "Flight Safety and Volcanic Ash – Risk Management of flight operations with known or forecast volcanic ash contamination or Forecast Volcanic Cloud Contamination"*. **http://www.icao.int/publications/documents/9974_en.pdf**

- A separate Civil Aviation Advisory Publication CAAP 215-1(2) "*Guide to the preparation of operations manuals"* – is now available from the CASA website. Annex B of this document contains specific guidance on Volcanic Ash. Its focus is on RPT operations, but the same basic risk management principles apply to non-RPT operations (i.e. private and GA operations). This revision to the AWB contains elements from this CAAP, including Hazard identification, Risk Assessment and Risk Management aspects.

3. Reason for revision

This minor revision to the Airworthiness Bulletin updates the revision status of the EASA SIB No. 2010-17 to Revision 7.

The previous issue of this AWB (Issue 6) was revised to update the revision status of the EASA SIB No. 2010-17 to Revision 6. It also included the latest EASA volcanic ash reporting form.

4. Background

Volcanic ash contains extremely fine particles of pulverized rock. It is comprised predominantly of silica (> 50 per cent), together with smaller amounts of the oxides of aluminium, iron, calcium and sodium. The glassy silicate material is very hard and, in pulverized form, extremely abrasive. The abrasive nature of volcanic ash can be very damaging for aircraft structures, cockpit windows and engines. In addition to the abrasive nature of volcanic ash, another important property is its melting point. Being made up predominantly of glassy silicates, whose melting temperature (~1 100°C) is below the temperature of jet engines operating at normal thrust (1 400°C), volcanic ash can melt and get deposited in the hot section of the jet engines. Furthermore, volcanic ash could clog the Pitot-static system, penetrate into air conditioning and equipment cooling systems and contaminate electrical and avionics units, fuel and hydraulic systems and cargo-hold smoke-detection systems.

Flying through an ash cloud must be avoided by all means due to the extreme hazard it presents. Volcanic ash can cause extreme abrasion to all forward facing parts of the aircraft, to the extent that visibility through the windshields may be totally impaired, aerofoil and control surface leading edges severely damaged, airspeed indications become unreliable through blocking of the Pitot heads/static ports, and engines may even shut-down rapidly or lose power gradually, often only being detected when catastrophic performance loss has occurred.

In addition to volcanic ash, volcanic eruption columns also contain many gases including water vapour, sulphur dioxide, chlorine, hydrogen sulphide and oxides of nitrogen. Following the eruption, oxidation and hydration, the sulphur dioxide forms sulphuric acid droplets. The resulting ash/acid mix is highly corrosive and can cause further damage to jet engines and pitting of windscreens.

The highest concentration of active volcanoes in the world lies around the rim of the Pacific Ocean, the so-called “ring of fire”, which stretches northwards along the western edge of South and North America, across the Aleutian and Kurile Island chains, down through Kamchatka, Japan and the Philippines and across Indonesia, Papua New Guinea and New Zealand to the islands of the South Pacific. Volcanic ash from eruptions of these volcanoes could not only impact aircraft operations in the airspace located around these volcanoes but also, subject to the prevailing winds and jet streams, the operations in Australia.

Flight in airspace with a volcanic ash contamination can be hazardous to aviation. Even flights in airspace with a low volcanic ash contamination, where no immediate threat to the safety of the aircraft appears to exist, could have medium and long term consequences for the airworthiness of aircraft.

The IVATF has developed a globally applicable process to facilitate the management of flight operations into, or near, areas of known or forecast volcanic cloud through the provision of appropriate information to assist in minimising safety risk in such operations. The approach is based on a formalised risk assessment process for use by an operator wishing to conduct such an operation.

5. Recommendations

Hazard identification, Risk Assessment and Risk Management

Operations into areas of airspace with a visible volcanic ash cloud **should not be conducted.** It is highly probable that, within a short period of time, the ash could cause damage to the aircraft that would reduce the airworthiness of the aircraft below acceptable levels.

If operations into, or near, areas of airspace or aerodromes with known or forecast volcanic ash contamination, need to be conducted, it is essential that the airworthiness of the aircraft is maintained at all times to ensure the continuation of safe operations. It is essential that a Safety Risk Analysis (SRA) is carried out in accordance with the company Safety Management System (SMS), or as recommended by ICAO as referenced below:

1) The company is responsible for assessing the risk of operations into, or near, areas of airspace with known or forecast volcanic ash cloud contamination or at aerodromes with runway volcanic ash contamination, and for determining and implementing appropriate mitigation measures.

2) Before carrying out a SRA, use the Safety Risk assessment worksheet in Appendix 4 of ICAO Doc 9974, or the hazard identification/risk management template in the SMS.

3) The SRA analysis should address, but not be limited to, the following list of known hazards:

- Higher concentrations of volcanic ash than reported;
- Failure to obtain or update volcanic ash information, both pre-flight and en route
- Inadvertent encounter with an area of volcanic ash, with potential loss of thrust on one or more engines.
- Undetected damage or degradation of performance of airframe, engines and/or aircraft

- Long-term detected or undetected cumulative effects which degrade the aircraft airworthiness and which require maintenance rectification/actions before further flight
- Catastrophic loss of aircraft performance
- Reduced visibility
- Incorrect forecast of ash cloud location or density
- Regulatory requirements concerning operations in volcanic regions not currently incorporated into the flight planning process;

4) Operations into areas of airspace with known or forecast volcanic ash cloud should only occur where contamination levels have been measured and the ash concentration and extent is known and where the location of the volcanic ash cloud and the level of contamination can be communicated to the crew at every stage of the operation. The outcomes of the SRA should be at acceptable levels. Acceptable levels are considered to be operations that remain within the accepted safety boundaries, as established within the operators SMS.

5) The SRA should be reviewed when changes that are material to the integrity of the SRA occur.

6) Every effort should be made to liaise with organisations such as Meteorological Watch Offices, Air Navigation Service Providers, including Aeronautical Information Services, Meteorological Service providers, Volcanic Ash Advisory Centres, Volcano Observatories and Original Equipment Manufacturers of aircraft and engines, and to use their information in the SRA process.

Airworthiness Considerations – Hazards and Risk Mitigation

1) Unless specific pre- and post-flight inspections have been defined by the aircraft and engine Type Certificate (TC) holders, it is essential to carry out thorough daily **inspections** to detect any erosion, ash accumulation, airframe, engine or system damage or degradation, including the following:

- Wing leading edges
- Navigation and landing lights, radomes
- Landing gear
- Horizontal stabiliser
- All extruding structure
- Pitot tubes and static ports

- Windows and windshields
- Engine inlets and nacelles
- Engine air inlet filters (for piston engines)
- Engine air intake filters (for turbine engines equipped with air intake filters)
- Engine compressors and turbines
- Engine oil systems
- Engine fuel systems
- Rotor blades
- Air conditioning and equipment cooling systems
- Electrical and avionics units

Based on the results of the above inspections, more detailed inspections may be necessary.

2) **After any encounter with volcanic ash**, and whenever the following phenomena are observed, detected or experienced during flight:

- Acrid odours similar to electrical smoke
- Rapid onset of engine problems
- St. Elmo's fire
- Bright white/orange glow appearing at the engine inlets
- Dust in the cockpit or cabin
- Sudden (unexpected) outside darkness
- Airspeed fluctuations
- Landing lights casting sharp, distinctly visible beam

It is essential that the aircraft is **inspected in line with the guidance in the previous section, after each flight**.

3) Aircraft parked in areas that may be contaminated by the fall-out or settling of volcanic ash should be protected and covered in accordance with the aircraft and engine TC holders' advice where possible. Any volcanic ash residue should be removed prior to operations, following the TC Holders' recommendations where available.

Hazard Identification, Risk Assessment and Risk Management – Non RPT Operations.

It is accepted that the requirement for an SMS based formal hazard identification and risk assessment is not a legislative requirement for these types of operations. In many cases no operations manual will exist, nor will there be a requirement to have a formal Safety Management System in place. The absence of these requirements does not negate the need for effective identification and management of the hazards and risks associated with flight near or within volcanic ash contaminated airspace.

The same physical hazards exist to non-RPT operations, often conducted in smaller general aviation aircraft or helicopters powered by internal combustion piston or smaller turbine engines. In these operations, advantage should be taken of existing resources available to aviators, such as:

- NOTAMS, SIGMETS and other advisory information issued by AirTraffic Services and Meteorological Services, including the VAAC.
- Pilot reports of volcanic ash events or aircraft performance degradation, particularly for their specific aircraft type.
- Manufacturers guidance and recommendations.
- The ICAO volcanic ash guidance material referenced in this AWB, particularly ICAO document 9974, as it relates to Risk Management of Flight Operations with known or forecast volcanic ash contamination.

Reporting of Ash Events

Operators should report encounters with volcanic ash which cause damage to aircraft through the normal Service Difficulty Reporting (SDR) system. Encounters which cause an operational incident or accident should be reported through the Air Safety Incident Reporting System (ASIR) via the Australian Transport Safety Bureau (ATSB). Near Encounters or observations of volcanic ash cloud or activity should be reported via usual means to Airways Authorities and/or Meteorological Advisory Services, so other airspace users can be apprised of the presence of volcanic ash in the atmosphere. Volcanic ash related incidents are to be reported immediately to the nearest ATS unit, CASA and the ATSB as appropriate.

The following publications provide additional source of information for operations into, or near, areas of airspace with known or forecast volcanic ash cloud contamination or at aerodromes with runway volcanic ash contamination.

- ICAO Procedures for Air Navigation Services – Air Traffic Management (PANS)
- ICAO Procedures for Air Navigation Services – Rules of The Air and Air Traffic Services (ICAO Doc 4444)
- ICAO Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds (ICAO Doc 9691)
- ICAO International Airways Volcano Watch (IAVW) Handbook (ICAO Doc 9766)
- ICAO Safety Management Manual (ICAO Doc 9859)
- ICAO Regional ATM contingency plans such as the *Volcanic Ash Contingency Plan – EUR and NAT regions*
- ICAO Doc 9974 “Flight Safety and Volcanic Ash” – Risk Management of flight operations with known or forecast volcanic ash contamination. **http://www.icao.int/publications/documents/9974_en.pdf**
- EASA SIB No. 2010-17 (latest revision available from EASA website, currently at Rev 7 as of issue date of this AWB).

Links to documents referenced in this AWB are correct at the time of publication of this AWB, and are uncontrolled after this date. The responsibility to ensure the link provided is to the referenced document remains the responsibility of the document user.

6. Reporting

Australian operators should report encounters with volcanic ash through the normal Service Difficulty Reporting (SDR) system and complete the attached notification form as an attachment to the SDR.

7. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address:

AirworthinessBulletin@casa.gov.au

or in writing, to:

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