Australian Government
Civil Aviation Safety Authority

ADVISORY CIRCULAR
AC 91-33 v1.0

Flight in airspace with volcanic ash contamination

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Advisory circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.

Advisory circulars should always be read in conjunction with the relevant regulations.

Audience

This advisory circular (AC) applies to:

- flight crew operating where volcanic ash may be encountered
- operators who have aircraft operating where volcanic ash may be encountered.

Purpose

This AC provides guidance on operating into or near 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.

For further information

For further information, contact CASA's Operations Standards (telephone 131 757).

Status

This version of the AC is approved by the Branch Manager, Flight Standards.

Table 1. Status

Version	Date	Details
v1.0	June 2024	Initial AC. The information in this AC is primarily drawn from Issue 7 of CASA Airworthiness Bulletin (AWB) 02-038. Issue 8 of this AWB was published in March 2024 to re-focus the AWB on the provision of airworthiness guidance related to volcanic ash. The operational guidance previously in that AWB has been moved to this AC.

Unless specified otherwise, all subregulations, regulations, Divisions, Subparts and Parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Contents

Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to Elders past, present and emerging.

Artwork: James Baban.

1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Table 2. Acronyms

Acronym	Description
AC	advisory circular
AIP	Aeronautical Information Package (AIP) from Air Services Australia
AIREP	Air Report
ATSB	Australian Transport Safety Bureau
AWB	Airworthiness Bulletin
BoM	Bureau of Meteorology, Australia
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulations 1998
SIGMET	Significant Meteorological conditions report
VA	Volcanic Ash Advisory report
VAAC	Volcanic Ash Advisory Centre
VAR	Volcanic Activity Report

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below. Where definitions from the civil aviation legislation have been reproduced for ease of reference, these are identified by 'grey shading'. Should there be a discrepancy between a definition given in this AC and the civil aviation legislation, the definition in the legislation prevails.

Table 3. Definitions

Term	Definition
Air-Report (AIREP)	A report from an aircraft in flight prepared inconformity with requirements for position and operational and/or meteorological reporting.

1.3 References

Legislation

Legislation is available on the Federal Register of Legislation website https://www.legislation.gov.au/

Table 4. Legislation references

Document	Title
AIP	ENR 1.1 Appendix 1
Part 91 of CASR	General operating and flight rules
Part 119 of CASR	Australian air transport operators—certification and management

International Civil Aviation Organization documents

International Civil Aviation Organization (ICAO) documents are available for purchase from http://store1.icao.int/

Many ICAO documents are also available for reading, but not purchase or downloading, from the ICAO eLibrary (https://elibrary.icao.int/home).

Table 5. ICAO references

Document	Title
Doc 9691	ICAO Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds
Doc 9766	ICAO International Airways Volcano Watch (IAVW) Handbook
Doc 9859	ICAO Safety Management Manual
Doc 9974	ICAO Flight Safety and Volcanic Ash – Risk Management of flight operations with known or forecast volcanic ash contamination.
	ICAO Regional ATM contingency plans such as the Volcanic Ash Contingency Plan – EUR and NAT regions

Advisory material

CASA's advisory materials are available at https://www.casa.gov.au/publications-and-resources/guidance-materials

Table 6. Advisory material references

Document	Title
CASA AC 1-02	Guide to the development of expositions and operations manuals
CASA AC 119-01	Safety management systems for air transport operations
CASA AWB 02-038	Airworthiness Considerations relating to Volcanic Ash Contamination
volcanic-ash.pdf (bom.gov.au)	HAZARDOUS WEATHER PHENOMENA - Volcanic Ash

1.4 Forms

CASA's forms are available at http://www.casa.gov.au/forms

Table 7. Forms

Form number	Title
Form 1	ROUTINE POSITION AND AIREP SPECIAL REPORTS, found in AIP ENR 1.1 Appendix 1.
Form 2	VOLCANIC ACTIVITY FORM (MODEL VAR), found in AIP ENR 1.1 Appendix 1

2 What is the problem?

Flight in airspace with a volcanic ash contamination can be very 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.

This AC provides only a summary of operationally relevant information about volcanic ash. More information on Volcanic Ash can be found in the Hazardous Phenomena section of BoM Aviation Knowledge Centre: www.bom.gov.au/aviation/knowledge-centre/.

2.1 Abrasive ash

2.1.1 Volcanic ash consists mostly of sharp-edged particles of hard glass and pulverized rock. It is comprised predominantly of siliceous materials (> 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.

2.1.2 The abrasive nature of volcanic ash can be very damaging for aircraft structures, cockpit windows, propellors and engines, causing extreme abrasion to all forward-facing parts of the aircraft, to the extent that visibility through windshields may be totally impaired. While propellers, turbine engine blades, aerofoils and control surface leading edges can be severely damaged within seconds.

2.2 Engine deposits

2.2.1 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 (~1100°C) is below the temperature of jet engines operating at normal thrust (1400°C), volcanic ash can melt and deposit in both piston and jet engines. This can result in rapid engine shut-down or gradual power loss, often only being detected when catastrophic performance loss has occurred.

2.3 Acidic solution with water

2.3.1 In addition to volcanic ash, volcanic eruption plumes 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 engines, electrics, windows and windscreens.

2.4 Clogging and contamination

2.4.1 Volcanic ash can clog the pitot-static system, resulting in airspeed indications becoming unreliable and/or erratic through the blocking of pitot heads or static ports. Volcanic ash can penetrate and contaminate air conditioning, equipment cooling systems, electrical systems and avionics units, fuel and hydraulic systems and cargo smoke-detection systems where component life span and normal operation is adversely affected.

2.5 Location of volcanos

2.5.1 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.

2.5.2 Volcanic ash from eruptions of these volcanoes does not only impact aircraft operations in the airspace located around these volcanoes but can also, subject to the prevailing winds and jet streams, impact operations in Australia and around the world.

Figure 1: Map showing the 'ring of fire' courtesy of Bureau of Meteorology, Australia (BoM)

3 Operating around volcanic ash

3.1 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 will cause damage to the aircraft that would reduce the airworthiness of the aircraft below acceptable levels.

3.2 Typical characteristics of flight into volcanic ash contaminated areas include:

- acrid odours similar to electrical smoke
- rapid onset of engine problems
- static discharges (similar to 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.

3.3 After any encounter in-flight with volcanic ash, or whenever the above characteristics are observed, detected or experienced during flight, it is essential that the aircraft be inspected after the flight and before the next flight in line with aircraft manufacturers guidance. Where no specific guidance exists from the AFM, type certificate holder, airframe or engine OEM, refer to CASA Airworthiness Bulletin (AWB) 02-038 - Airworthiness Considerations relating to Volcanic Ash Contamination.

3.4 Where possible, 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 manufacturers advice. Any volcanic ash residue should be removed prior to operations, following the aircraft or engine manufacturers recommendations where available.

3.5 Unless specific pre- and post-flight inspections have been defined by the AFM, type certificate holder, airframe or engine OEM, it is essential to carry out thorough pre and post flight 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 cooling system components
- engine compressors and turbines
- engine oil systems

- fuel tank venting system
- rotor blades
- ventilation and pressurization systems (e.g. ACM, ozone converters, recirculation fans, HEPA filters etc.)
- equipment cooling systems
- electrical and avionics units
- smoke detectors (e.g. detectors located in the cargo compartment, lavatory, electrical equipment bay, remote crew rest areas etc.).

3.6 Based on the results of the above inspections, more detailed inspections may be necessary. For further information, refer to CASA Airworthiness Bulletin (AWB) 02-038 - Airworthiness Considerations relating to Volcanic Ash Contamination.

4 Legal requirements

4.1 Pilots in command are reminded of their obligations under the following rules:

- Regulation 91.055 of CASR - to not operate an aircraft in manner that creates a hazard to another aircraft, a person or property.
- Regulation 91.095 of CASR - to comply with any requirements or limitations of the aircraft flight manual instructions.
- Regulation 91.215 of CASR - to ensure the safety of persons on the aircraft, the safety of cargo on the aircraft and the safe operation of the aircraft during the flight.
- Regulation 91.675 of CASR - to report hazards to air navigation. Volcanic ash should be reported to Air Traffic Services.

4.2 Operators are reminded of their obligations under the following rules which, if their operations could reasonably encounter volcanic ash, would require their exposition or operations manuals to contain procedures related to volcanic ash:

- For Australian air transport operators (i.e. Part 119) - paragraph 119.205(1)(h) of CASR to include details in their exposition of each plan, process, procedure, program and system implemented by the operator to safely conduct and manage their Australian air transport operations in compliance with the civil aviation legislation.
- For aerial work certificate holders (i.e. Part 138) - paragraph 138.155(1)(h) of CASR to include details in their operations manual of each plan, process, procedure, program and system implemented by the operator to safely conduct and manage their aerial work operations in compliance with the civil aviation legislation.
- For Part 141 operators - paragraph 141.260(1)(k) of CASR to include in their operations manual a description of the procedures by which the operator conducts and manages the training.
- For Part 142 operators - paragraph 142.340(1)(k) of CASR to include in their exposition a description of the procedures by which the operator conducts and manages their Part 142 activities.

4.3 If operations need to be conducted into, or near, areas of airspace or aerodromes with known or forecast volcanic ash contamination, it is necessary that the airworthiness of the aircraft is maintained at all times to ensure the continuation of safe operations. To do this it is essential that the associated risks are managed.

4.4 For operators with a company Safety Management System (SMS), use the defined safety risk processes. See ICAO Doc 9974 - Flight Safety and Volcanic Ash for additional guidance. In lieu of an established SMS, ICAO have published Doc 9974 - Flight Safety and Volcanic Ash, which contains guidance and processes to conduct safety risk analysis for flight safety around volcanic ash. For flights to be undertaken, the outcomes of the risk assessments must remain within the accepted safety boundaries, as established within the operators SMS.

4.5 As safety risk analysis is based on scaling of known hazards, 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.

5 Reporting

5.1 Bureau of Meteorology (BoM) reports

5.1.1 Australia operates a Volcanic Ash Advisory Centre (VAAC) in Darwin operated by the BoM, which monitors volcanoes to the north and east of Australia. The VAAC produces Volcanic Ash Advisories.

5.1.2 More information on Volcanic Ash Advisories and Volcanic Ash Strength of Evidence Assessment (VASEA) can be found in the Product Information section of BoM Aviation Knowledge Centre: www.bom.gov.au/aviation/knowledge-centre/.

5.1.3 The BoM produces SIGMETs covering the whole of Melbourne and Brisbane FIR (YMMM and YBBB), which will include volcanic ash cloud reports (VA SIGMETs) when relevant.

5.1.4 More information on SIGMET can be found in the Product Information section of BoM Aviation Knowledge Centre: www.bom.gov.au/aviation/knowledge-centre/.

5.2 Pilot reports

5.2.1 Any observed volcanic activity, near encounters with, or observations of, volcanic ash cloud must be reported by the pilot of an aircraft regardless of any previous reports from other aircraft, so other airspace users can be apprised of the presence of volcanic ash in the atmosphere.

5.2.2 These reports can be made via an AIREP, Volcanic Activity Report (VAR) or radio conversation with ATS.

5.2.3 More information on AIREPs (Form 1) and VARs (Form 2) can be found in AIP ENR 1.1 Appendix 1. (Agree to copyright statement to view AIP Book)

5.2.4 Encounters which cause an operational incident or accident should be in the first instance via phone by calling 1800 011 034 when in Australia or +61 2 6230 4470 from outside Australia, then through the Occurrence Notification - Aviation via the Australian Transport Safety Bureau (ATSB) website.

5.2.5 More information on incident and accident reporting can be found in AIP ENR 1.14 paragraph 2. (agree to copyright statement to view AIP Book) and Aviation reporting requirements or Important information about making a notification on the ATSB website.