Australian Government
Civil Aviation Safety Authority

Airworthiness Bulletin

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Airworthiness Considerations relating to Volcanic Ash Contamination

An Airworthiness Bulletin is an advisory document that alerts, educates, and makes recommendations about airworthiness matters. Recommendations in this bulletin are not mandatory.

1. Effectivity

All Australian-registered aeroplanes and helicopters that may operate in or near airspace or aerodromes that are known or suspected of being contaminated with volcanic ash, whether domestic or international.

2. Purpose

1. To provide an overview of ***airworthiness considerations*** that aircraft operators, owners, and maintenance organisations should take into account when operating and maintaining aircraft that are known or suspected of being exposed to volcanic ash.

2. To clarify the reporting requirements relating to volcanic activity by distinguishing ***airworthiness-related reporting of major defects*** [1] from reporting that is related to air navigation services and / or flight operations (for example, when and how pilots are to report encounters with volcanic ash).

3. To re-focus the information contained within previous issues of this Airworthiness Bulletin to discuss matters relating to the ***airworthiness and maintenance*** of aircraft that may have been exposed to volcanic ash, as opposed to a more generic discussion about Safety Risk Analyses (SRA).

4. The entire content of AWB 02-038 Issue 8 has been revamped to provide up-to-date and accurate information regarding airworthiness considerations relating to volcanic ash contamination.

3. Background

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.

[1] As required under Part 4B of the *Civil Aviation Regulations* (CAR) 1988 and Division 42.C.4 of the *Civil Aviation Safety Regulations* (CASR) 1998

Volcanic ash is very abrasive, which can cause severe damage to the aircraft. It can also clog and contaminate various components and systems. Its melting point (approx. ~1100°C) is below the typical operating temperature (approx. ~1400°C) of a turbine engine at cruise thrust.

Volcanic ash clouds may be accompanied by a gaseous solution of sulphur dioxide and chlorine. When combined with water, the resulting sulphuric acid and hydrochloric acid are corrosive to the aircraft structures and are a health hazard.

The primary strategy must be for operators to prioritise avoiding volcanic ash altogether. However, if an aircraft is exposed, the ash poses a hazard to both the immediate and long-term safety of the aircraft. ICAO Doc 9970 *Flight Safety and Volcanic Ash* presents the following, non-exhaustive list of examples:

a) Risks to the immediate safety of an aircraft:
   - the malfunction or failure of one or more engines
   - erosion of leading edges
   - the blockage of pitot and static sensors resulting in unreliable airspeed indications and erroneous warnings
   - windscreens rendered partially or completely opaque
   - contamination of cabin air requiring crew use of oxygen masks.

b) Risks to longer term safety and costs:
   - erosion of external aircraft components
   - reduced electronic cooling efficiency
   - volcanic ash readily absorbs water, which can cause potential short circuits, leading to a wide range of aircraft system failures and/or anomalous behaviour
   - aircraft ventilation and pressurisation systems becoming heavily contaminated and/or damaged (such as air cycle machine contamination, abrasion to rotating components, ozone converter contamination and air filter congestion).

Operators, owners, and maintainers of aircraft that could be exposed to volcanic ash are to be aware of these risks and how the continuing airworthiness of the aircraft needs to be managed in the event of exposure.

4. Recommendations

Operators are expected to conduct a safety risk assessment to ensure that risks associated with flying in or near areas prone to volcanic activity are properly mitigated. Appendix 2 of ICAO Doc 9974 *Flight Safety and Volcanic Ash* categorises mitigation considerations into four distinct phases. The associated airworthiness recommendations are extracted and presented in the following subsections of this Airworthiness Bulletin.

In making these considerations, operators (and maintainers) must keep the OEM's instructions front-and-centre in mind. For example, ATA Chapter 5 of the Aircraft Maintenance Manual typically provides instructions for *conditional inspections* that must be done if an aircraft is confirmed or even suspected to have been exposed to volcanic ash.

4.1 Preparation

Type Certificate Holders – The operator should obtain advice from the Type Certificate Holders in relation to:

- features of the aircraft and engines that are susceptible to a degradation in airworthiness resulting from exposure to volcanic ash
- the nature and severity of this degradation
- the effect of operating to/from contaminated aerodromes
- the related pre-flight, in-flight, and post-flight precautions to be observed
- the recommended/required continuing airworthiness inspections in the event of exposure; this may take the form of instructions for continuing airworthiness or other advice.

Personnel and service providers – The operator should publish procedures for engineering and maintenance to ensure that personnel are able to assess, report, and carry out necessary maintenance following suspected or actual exposure to volcanic ash.

4.2 Operating considerations

Minimum Equipment List (MEL) or Dispatch Deviations Guide (DDG) - The operator should consider additional restrictions for dispatching aircraft with defects deferred via the MEL or DDG which might affect vulnerable systems, such as (but not limited to):

- air conditioning packs
- engine bleeds
- pressurisation system
- electrical power distribution system
- air data computers
- standby instruments
- navigation systems
- de-icing systems
- engine driven generators
- Auxiliary Power Units (APUs)
- Traffic Collision Avoidance Systems (TCAS)
- Terrain Awareness Warning Systems (TAWS)
- autoland systems
- provision of crew oxygen
- supplemental oxygen for passengers.

4.3 Flight crew considerations

Aircraft Maintenance Log (AML) – The operator should ensure that flight crews:

- make an AML entry related to any actual or suspected volcanic ash encounter whether in-flight or at an aerodrome
- confirm, prior to flight, completion of all necessary maintenance actions related to an AML entry for a volcanic ash cloud encounter on a previous flight.

4.4 Maintenance considerations

Maintenance procedures – Operators and maintainers of aircraft operating in, or near, areas of volcanic ash cloud contamination should:

- enhance vigilance during inspections and regular maintenance and make appropriate adjustments to maintenance practices
- produce a continuing airworthiness procedure to follow when a volcanic ash cloud encounter has been reported or suspected
- ensure that a thorough investigation is carried out for any signs of unusual or accelerated abrasions or corrosion or of volcanic ash accumulation
- cooperate in reporting its observations to Type Certificate Holders (TCH) and relevant authorities
- comply with any additional maintenance recommendations made by the TCH.

NOTE: The above list is not exhaustive; the operator should develop its own list taking into account its specific equipment, experience, knowledge and type of operation.

5. Supplemental airworthiness considerations

If an operator or maintainer is not satisfied with the Instructions for Continuing Airworthiness within the AMM and other OEM service literature, the TCH should be contacted, requesting additional guidance and instructions.

Whilst the TCH recommendations must take precedence, the following supplemental considerations are provided as guidance for operators and maintainers to further refine the continuing airworthiness management of aircraft which are at risk of exposure to *low contamination* of volcanic ash.

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, 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 (for turbine engines)
    - 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.)

Based on the results of the above inspections, more detailed inspections and/or servicing may be necessary, such as borescope inspections of the engines, oil analyses, inspections of filters, and cleaning of parts.

2. Unless specific instructions have already been provided by the TCH, the above inspections should be done after any encounter with volcanic ash, and whenever the following phenomena are observed, detected, or experienced during operations:
    - 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. 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 TCH's advice. Any volcanic ash residue should be removed prior to operations.

6. Resources

Operators, owners, and maintainers may refer to the following industry resources for further understanding of the topic at hand, and further guidance in relation to developing their volcanic ash safety risk assessment and associated procedures:

- Aeronautical Information Package (AIP) from Air Services Australia
- CASA AC 1-02 v3.3 - Guide to the development of expositions and operations manuals
- EASA SIB No. 2023-13 (latest revision available from EASA website, currently at original revision as of issue date of this AWB).
- 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.
- 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 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 Safety Management Manual (ICAO Doc 9859)

7. Reporting

Operators should report encounters with volcanic ash using the operational reporting channels as detailed in the AIP. However, airworthiness concerns relating to operations with volcanic ash, for example, defects observed as a result of exposure, must be reported to CASA through the Defect Reporting System (DRS).

For the avoidance of doubt, reporting that is required in order to meet the operators' and maintainers' obligations under Part 4B of the *Civil Aviation Regulations (CAR) 1988* or Division 42.C.4 of the *Civil Aviation Safety Regulations (CASR) 1998* must be reported through the DRS: other reports are to be made in accordance with the relevant legislation and procedures.

8. Enquiries

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

AirworthinessBulletin@casa.gov.au

or in writing, to:

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