



Subject: All RB211 and Trent Engines - Volcanic Ash Limits Guidance

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The primary purpose of this Worldwide Communication is to inform operators of the susceptibility to volcanic ash of all Trent and RB211 engine marks. The reason for issuing this statement is to provide information on in-service engines which is consistent with the volcanic ash susceptibility statements being declared for new Rolls-Royce engines types that are certified against the latest EASA engine and airframe volcanic ash certification specifications, CS-E 1050 and CS-25 1593 respectively.

Operators shall note that the engine volcanic ash susceptibility statements included below are only to be used to support an approved volcanic ash Safety Risk Assessment (SRA) as laid out in the ICAO manual on Flight safety and Volcanic Ash, (Doc9974, 2012).

The document also provides the current Rolls-Royce recommendations for operation in the proximity of volcanic ash. It supersedes Rolls-Royce Worldwide Communications covering operations in the proximity of volcanic ash issued in 2010 and 2011: WW/10842/01/18May10 and WW/10842/02/24May11.

Operational Recommendations:

Avoidance of ash that is visible or discernible is a principle which maintains in-flight safety margins and minimises any deterioration in engine performance or on-wing life. Rolls-Royce recommends avoidance of visible or discernible ash. Such a position is consistent with recommendations made in the EASA Safety Information Bulletin, Flight in Airspace with Contamination of Volcanic Ash (EASA SIB No.: 2010-17R7, 24 June 2015). In addition to these recommendations, it is an established ICAO principle that operators are responsible for decisions over operations in airspace contaminated with volcanic ash. Further, if flight into airspace forecast to contain visible or discernible ash is undertaken, it should be conducted in accordance with a Safety Risk Assessment (SRA) approved by the appropriate state regulatory authority, as laid out in the ICAO manual on Flight safety and Volcanic Ash, (Doc9974, 2012).

Guidance on Avoiding Visible or Discernible Ash

In the context of this document the definitions of visible and discernible ash are those agreed at the 7th ICAO International Airways Volcano Watch Operations Group (IAVWOPSG/7 March 2013), which are expected to be incorporated into the relevant ICAO manuals, and are:

- Visible ash – volcanic ash that has been observed by the human eye.
- Discernible ash – volcanic ash that has been detected by: defined impacts on/in aircraft; or by agreed in-situ and/or remote sensing techniques.

Defined impacts on/in aircraft are outlined in the ICAO manual on Flight Safety and Volcanic Ash (Doc 9974, 2012). The agreed in-situ and/or remote sensing techniques have yet to be formally agreed within ICAO but Rolls-Royce currently defines this to be multispectral satellite imagery and believes that this is in accordance with how ICAO plans to define discernible ash.

Appropriate operational flight planning is the key to ensure that flight in visible or discernible ash cloud is avoided. Appropriate planning should involve monitoring the position of discernible or visible ash clouds, along with their forecast movements, and operators should produce flight plans which avoid these locations.

All available methods which aid in the dissemination of information about suspected ash cloud locations and vertical extent should be used, including:

- In-flight pilot reports (PIREPs) and notice to airmen (NOTAMs).
- Volcanic ash related significant meteorological information (SIGMETs) produced by Meteorological Watch Offices (MWOs).
- The volcanic ash advisories (VAA) and volcanic ash graphics (VAG) that the 9 volcanic ash advisory centres (VAACs) produce.
- Volcano observatory notice for aviation (VONAs) produced by volcano observatories.

Operators should also note that the VAA and VAG are VAAC forecasts of where they believe discernible ash is likely to be located. Also, where VAACs have produced ash concentration contours, the 0.2 mg/m³ contour is a forecast of where the ash contamination is at a level that would start to be discernible using multispectral satellite instruments. The geographic and flight level positioning of the VAA/VAG and the 0.2 mg/m³ contour will be approximately equivalent without necessarily being identical. It should also be noted that ash can be visible to the human eye at concentrations as low as 0.01 mg/m³, but may not be visible in good light at concentrations as high as 10 mg/m³.

Existing guidance in the case of inadvertent encounters with volcanic ash remains in place: The principle is that the aircraft should exit the volcanic ash cloud as soon and safely as possible. If it is suspected that flight into visible or discernible volcanic ash has inadvertently occurred operators should consult the relevant section of the Aircraft Maintenance Manual for inspection procedures (e.g. power plant inspection after contamination with volcanic ash).

Guidance for Operations in Airspace Forecast to Contain Volcanic Ash

Where operations are being undertaken in airspace forecast to contain volcanic ash, in line with the ICAO manual on Flight safety and Volcanic Ash, (Doc9974, 2012), operators should note for their SRA the engine ash susceptibility statement included in this document below. In addition operators shall note that:

- Engines should be operated in a way that maximises the available operability margins, e.g. switch on engine/nacelle and/or wing anti-icing (as appropriate), minimise engine electrical and hydraulic power offtake.

- Whether flight operations are being conducted in clear skies and good daylight (e.g. Visual Meteorological Conditions - VMC), poor visibility (e.g. Instrument Meteorological Conditions - IMC) or during hours of darkness, if the presence of ash becomes discernible through the ICAO defined impacts on or in the aircraft, or effects such as sparks discharging from the icing indicator, the contaminated airspace should be exited as soon and safely as possible.
- Even if exposure to visible or discernible ash has been successfully avoided, an assessment of the potential ash exposure dose to any ash that was neither visible nor discernible should still be made. This is particularly pertinent during hours of darkness or IMC, but also applies for clear skies and good daylight.
- Note that Rolls-Royce defines the ash exposure dose as the ash concentration multiplied by the duration of the exposure.
- If it is known or suspected that an engine has been exposed to a cumulative volcanic ash dose, accumulated over one or more flights, that exceeds the Engine Ash Susceptibility Statements set out below operators should inspect the engines following the procedures contained in the AMMs covering power plant inspection after contamination with volcanic ash.
- In the absence of direct measurement of an aircraft's ash exposure dose, the dose should be assessed using forecast ash concentrations or remote measurements.
- No fly zones as defined by the relevant authorities must continue to be respected.

Suitable sources of data for establishing what volcanic ash dose an engine is likely to be exposed to (for flight planning purposes), or may have been exposed to (for guiding inspection decisions), are:

- Modelled ash concentration charts produced by VAACs or other meteorological service providers declared in the operator's approved SRA.
- By inference from volcanic ash total column loading charts (displayed as g/m²) generated from ash cloud dispersion models or directly from satellite measurements; note that an ash cloud vertical thickness will need to be established or assumed.
- On-board measuring instruments from which an ash dose exposure can be derived.

In relation to all the above guidance, consult Rolls-Royce for further details if required.

Engine Ash Susceptibility Statements:

If flight into discernible or visible ash occurs this might result in short or long term engine damage that could lead to a reduction in engine performance and unscheduled maintenance or repair costs.

Prolonged exposure to low concentration ash or short duration exposure to high concentration ash may lead to deterioration of flight safety margins. Available in-service and experimental evidence indicates that:

- Exposure to a cumulative volcanic ash dose equivalent to operating for 120 minutes in an actual ash concentration of 2 mg/m³ (i.e. 14.4 g s/m³), or lower, should not lead to a significant reduction in engine related flight safety margins if all measures are taken to maximise engine operability margins.
- It cannot be guaranteed that limiting engine exposure to a dose of less than 14.4 g s/m³ at actual ash concentrations greater than 4 mg/m³ will maintain engine related flight safety margins.
- The ash dose that would represent an unacceptable deterioration in engine related flight safety margins at actual ash concentrations below 0.2 mg/m³ is not known precisely, but evidence indicates that it is so large any exposure to such concentrations will have negligible impact on engine related flight safety margins.

For engines certified under EASA CS-E 1050 and CS-25 1593 the engine ash susceptibility statements above will be included within the Engine Operating Instructions (EOIs), under Chapter 3 – Normal Procedures. |

If you have any questions regarding this communication, please contact your assigned Rolls-Royce Service Representative or Customer Manager.

Kind regards.

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