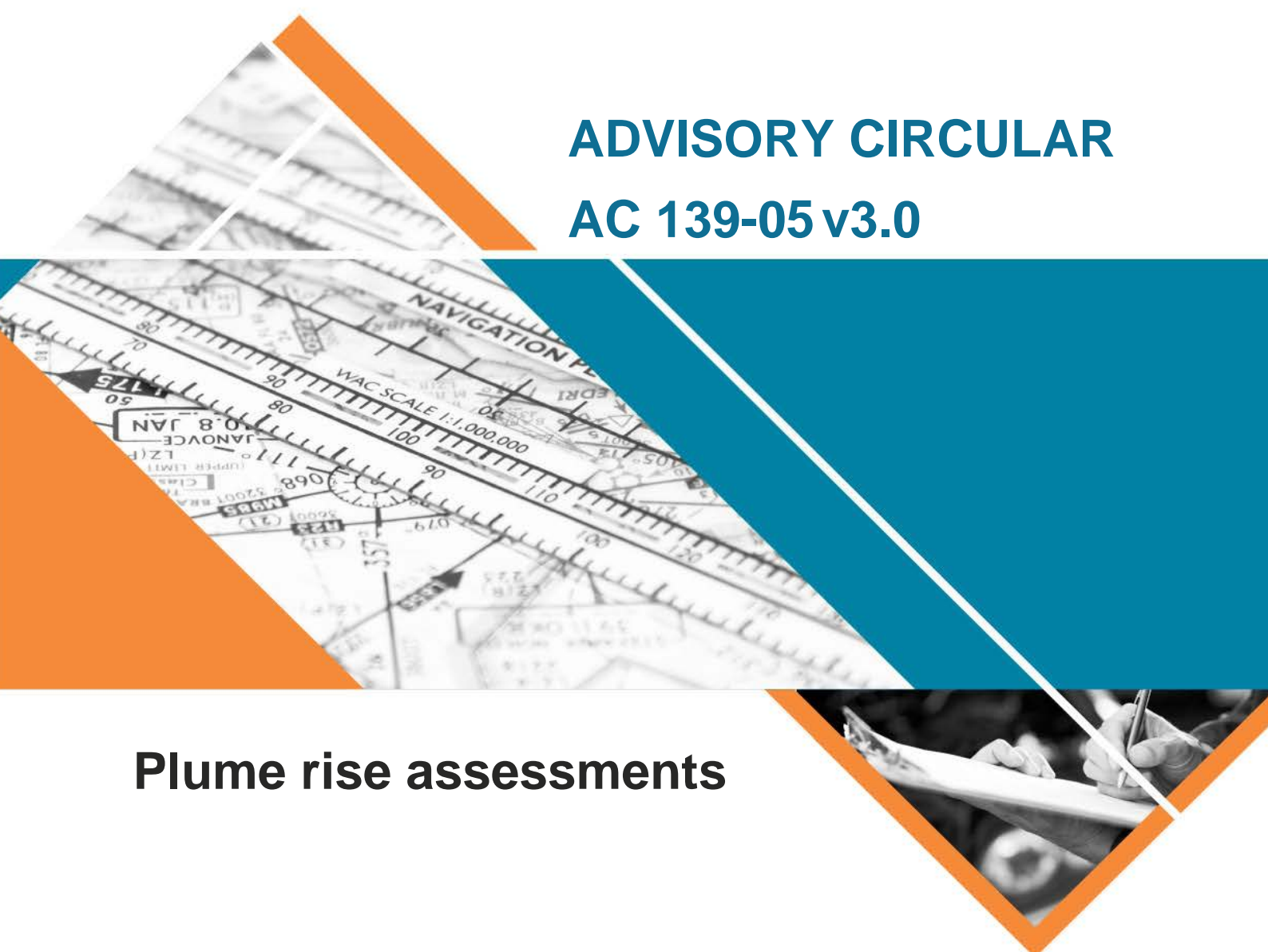




ADVISORY CIRCULAR

AC 139-05 v3.0



Plume rise assessments



Date August 2018
File ref D17/318335

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:

- plume rise proponents
- CASA plume rise assessors.

Purpose

The purpose of this Advisory Circular (AC) is to provide:

- A standard method of determining the critical velocity of a vertical exhaust plume so that the impact of a plume near aerodromes and away from aerodromes can be assessed in a consistent and reliable way.
- Guidance to persons involved in the design, construction and operation of facilities with vertical exhaust plumes about the information required to assess the potential hazard from a plume to aircraft operations.
- Guidance to proponents and stakeholders on the plume rise assessment process.

The Civil Aviation Safety Authority (CASA) has identified that there is a need to assess the potential hazard to aviation posed by vertical exhaust plumes in excess of 4.3 metres per second (m/s) velocity. Relevant legislation includes the determination of hazards to aircraft operations, under Regulation 139.370 of CASR 1998 and the designation of

protective airspace, under Regulation 6 of the Airspace Regulations 2007.

For further information

For further information, contact CASA's Office of Airspace Regulation (telephone 131 757).

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

Status

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

Note: Changes made in the current version are not annotated. The document should be read in full.

| Version | Date | Details |
|---------|---------------|--|
| v3.0 | July 2018 | This is the second revision of the AC relating to the conduct of plume rise assessments and replaces AC 139-5(1) issued in November 2012. It has been amended to include the use of the 6.1m/s benchmark velocity which has been included in the "Screening Tool". |
| (1) | November 2012 | This is the first revision of the AC relating to conducting plume rise assessments and replaces AC 139-5(0) issued in June 2004. It has been simplified due to the introduction of computer-based modelling (referred to as the "Screening Tool", see paragraph 5.1) to assist in the assessment process. The plume rise assessment process has also been clarified. |
| (0) | June 2004 | This is the first AC on the subject of plume rise assessments. |

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1 Reference material

1.1 Acronyms

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

| Acronym | Description |
|---------|---|
| AC | advisory circular |
| AD INSP | Aerodrome Inspector |
| AD OPR | Aerodrome Operator |
| CASA | Civil Aviation Safety Authority |
| CASR | <i>Civil Aviation Safety Regulations 1998</i> |
| CPH | Critical Plume Height |
| CPV | Critical Plume Velocity |
| LSALT | Lowest Safe Altitude |
| m/s | metres per second |
| OLS | Obstacle Limitation Surface |
| TAPM | The Air Pollution Model |
| TIFP | Terminal Instrument Flight Procedure |

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below.

| Term | Definition |
|------------------------------|---|
| Buoyancy Enhancement | Describes a situation in which multiple vertical exhaust plumes in close proximity can merge to alter the plume characteristics. |
| Critical Plume Height | Means the height up to which the plume of critical velocity may affect the handling characteristics of an aircraft in flight. |
| Critical Plume Velocity | The velocity at which a vertical plume rise may affect the handling characteristics of an aircraft in flight and requires assessment by CASA. |
| Obstacle Limitation Surfaces | Are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely. |
| Regulated Aerodromes | Are Certified and Registered aerodromes to which the Part 139 of CASR - Aerodromes applies. At these aerodromes the aerodrome operator must ensure that the obstacle limitation surfaces are established in accordance with the standards set out in these regulations. |
| Screening Tool | Is the computer-generated method of plume rise analysis used by CASA's Office of Airspace Regulation (OAR) to derive the heights at which the plume rise velocity is 4.3 m/s, 6.1m/s and 10.6 m/s. The Screening Tool is based on |

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| Term | Definition |
|--------------------------------------|---|
| TAPM | The Air Pollution Model (TAPM) methodology which includes a buoyancy enhancement factor for multiple plumes. |
| Terminal Instrument Flight Procedure | The Air Pollution Model derived by the CSIRO. Means an instrument approach procedure or instrument departure procedure. These procedures are protected by a series of design surfaces. Penetration of the design surfaces will result in an alteration to the associated instrument approach or departure procedure. Copies of the design surfaces for an aerodrome can be obtained from the aerodrome operator. |

1.3 References

Regulations

Regulations are available on the Federal Register of Legislation website <https://www.legislation.gov.au/>

| Document | Title |
|--|------------------------------------|
| Regulation 6 of the Airspace Regulations 2007 | |
| Regulation 139.370 of the Civil Aviation Safety Regulations 1998 (CASR 1998) | Hazardous Objects |
| Part 173 of CASR 1998 | Instrument Flight Procedure Design |
| Manual of Aviation Meteorology, Bureau of Meteorology (Published by Airservices Australia, 2003) | |

1.4 Forms

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

| Form number | Title |
|-------------|---|
| Form 1247 | Application for Operational Assessment of Proposed Plume Rise |

2 Background

- 2.1.1 Exhaust plumes can originate from any number of sources. For example: industrial facilities release process emissions through stacks or vents; industrial flares create an instantaneous release of hot gases during the depressurisation of gas systems; cooling towers produce large volumes of buoyant gases that can rise a significant distance into the atmosphere and exhaust gases from power generation facilities can produce plumes of varying velocities during different operating scenarios.
- 2.1.2 Aircraft operations in various stages of flight may be affected by an exhaust plume of significant vertical velocity (i.e. a plume rise). A light aircraft in approach configuration is more likely to be affected by a plume rise than a heavy aircraft cruising at altitude. In addition, helicopters and light recreational aircraft may be severely affected by a high temperature plume and the altered air mixture above an exhaust plume and should therefore avoid low flight over such facilities.
- 2.1.3 Part 139.370 of CASR 1998 provides that CASA may determine that a gaseous efflux having a velocity in excess of 4.3 m/s could be a hazard to aircraft operations because of the velocity or location of the efflux.
- 2.1.4 The Manual of Aviation Meteorology (2003) defines the classifications of turbulence intensity as:
- Light (1.5 - 6.1m/s) which can cause momentary changes in altitude and attitude.
 - Moderate (> 6.1 - 10.6m/s) which can cause appreciable changes in altitude and attitude.
 - Severe (>10.6m/s - 15.2m/s) which can cause large abrupt changes in altitude and attitude and a momentary loss of control.
 - Extreme (> 15.2m/s) where it can be practically impossible to control the aircraft and which can cause structural damage.

3 Key stages of the plume rise assessment process

3.1.1 The key stages of the plume rise assessment process are:

- completion of [Form 1247](#) by the proponent
- assessment of the critical plume velocity (CPV)
- assessment of the critical plume height (CPH)
- assessment of the impact of the plume; and
- implementation of mitigation.

3.1.2 More detail on the process is provided at Appendix A to this AC.

4 Assessment of critical plume velocity

4.1.1 The critical plume velocity (CPV) under scrutiny (4.3 m/s, 6.1m/s or 10.6 m/s) will be determined based on the type of operations at the location and any associated risks identified by CASA. Considerations may include the following:

- phase of flight affected
- size of aircraft affected
- geographical factors such as high terrain
- frequently used flight paths
- navigation method in use (visual versus instrument)
- presence of air traffic control
- human factors considerations
- proximity to a regulated aerodrome.

5 Assessment of critical plume height

- 5.1.1 CASA will determine the critical plume height (CPH) for the CPV under scrutiny using the Screening Tool.
- 5.1.2 A plume rise not exceeding a velocity of 4.3 m/s at exit does not require assessment by CASA. However, augmentation of an existing facility producing a plume rise may require CASA assessment. If in doubt, a completed Form 1247 should be forwarded to CASA for screening assessment.
- 5.1.3 To provide guidance during the facility planning process, preliminary screening of locations under consideration can be undertaken. To discuss this option contact CASA OAR (email: oar@casa.gov.au). Alternative methods of assessment may also be put forward for consideration by CASA.

6 Assessment of the impact of the plume rise proposal

- 6.1.1 The impact of the plume rise proposal is assessed using the CPH at the location.
- 6.1.2 Near aerodromes the plume rise may penetrate the obstacle limitation surface (OLS) and may therefore be referred to a CASA Aerodrome Inspector (AD INSP)/Aerodrome Operator (AD OPR) to check this impact and any consequential requirements for obstacle lighting or markings.
- 6.1.3 In the vicinity of aerodromes the plume rise may impact Terminal Instrument Flight Procedures (TIFPs). If so, CASA may determine that it is a hazard under Regulation 139.370 of the CASR 1998. If the facility's plume rise cannot be altered to avoid this impact, changes to TIFPs may be required. Government planning authorities will be advised to include these requirements in the development approval. Should the impact of the plume rise be significant, such that it would be difficult to achieve re-design of TIFPs without compromising the safety and/or environmental impact of the resulting design, CASA may not support the proposal.
- 6.1.4 Away from aerodromes, if the plume rise affects air routes and Lowest Safe Altitudes (LSALTs), this may require the CASR Part 173 authority (Airservices Australia) to make changes to these which may have cost implications for proponents.
- 6.1.5 When necessary, CASA will refer proposals to other relevant authorities for example: the Department of Defence, Airservices Australia, GE Aviation (Naverus), Jeppesen and the Department of Infrastructure and Transport.
- 6.1.6 In some circumstances, the impact of the plume rise may be difficult to determine using the OAR Screening Tool. In such cases, CASA may request a detailed plume rise assessment be conducted which may have cost implications for proponents. Proponents should refer to the technical brief for further information (refer to paragraph 8 of this AC).

7 Mitigation of the impact of the plume rise proposal

7.1.1 Mitigation options for a plume rise exceeding the relevant CPV may include the following:

- Insertion of a symbol and a height on aviation charts to enhance awareness of the plume rise.
- Designation of a Danger Area in accordance with Regulation 6 of the Airspace Regulations 2007 to alert pilots to the potential danger to aircraft flying over the area.
- Designation of a Restricted Area in accordance with Regulation 6 of the Airspace Regulations 2007 to restrict the flight of aircraft over the area.

8 Further information

- 8.1.1 A technical brief regarding the application of plume rise models for the purpose of detailed plume rise assessments is available on request from CASA OAR.

Appendix A

Plume rise assessment process

