



DRAFT

Advisory Circular

AC 139-05(1)

APRIL 2012

GUIDELINES FOR CONDUCTING PLUME RISE ASSESSMENTS

CONTENTS

1. References	1
2. Purpose	2
3. Status of this advisory circular	2
4. Acronyms	2
5. Definitions	3
6. Background	3
7. Key stages of the plume rise assessment process	4
8. Assessment of critical plume velocity (CPV)	4
9. Assessment of critical plume height (CPV)	4
10. Assessment of the impact of the plume rise proposal	5
11. Mitigation of the impact of the plume rise proposal	5
12. Further information	5
APPENDIX A - Plume rise assessment process	6

1. REFERENCES

- *Airspace Regulations 2007* – Regulation 6.
- 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*, Airservices Australia 2003.

Advisory Circulars are intended to provide advice and guidance to the Aviation Community 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. The purpose of this AC is to provide Guidelines for Conducting Plume Rise Assessments.

Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.

ACs should always be read in conjunction with the referenced regulations.

This AC has been approved for release by the Executive Manager Standards Development and Future Technology Division.

2. PURPOSE

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

- 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; and
- 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.

2.2 The Civil Aviation Safety Authority (CASA) has identified that there is a need to assess the potential hazard under Regulation 139.370 of CASR 1998 and the potential danger under the Airspace Regulations 2007 (Regulation 6) to aviation posed by vertical exhaust plumes of sufficient velocity to affect the handling characteristics of an aircraft in flight such that there is the danger of a momentary loss of control.

3. STATUS OF THIS ADVISORY CIRCULAR

3.1 This is the first revision of the AC relating to conducting plume rise assessments and replaces AC 139-05(0) issued in June 2004. It has been simplified due to the introduction of computer based modelling (refer to paragraph 5.1 for the definition of the Screening Tool) to assist in the assessment process. The plume rise assessment process has also been clarified.

4. ACRONYMS

AC	Advisory Circular
AD INSP	Aerodrome Inspector
AD OPR	Aerodrome Operator
CASA	Civil Aviation Safety Authority
CASA OAR	CASA Office of Airspace Regulation
CASR	Civil Aviation Safety Regulations
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

5. DEFINITIONS

5.1 For the purposes of this document:

Buoyancy Enhancement describes a situation in which multiple vertical exhaust plumes in close proximity can merge to form a larger single plume of greater vertical velocity and width than that of a single source plume.

Critical Plume Height means the height to which the plume of critical velocity may impact the handling characteristics of an aircraft in flight such that there may be a momentary loss of control.

Critical Plume Velocity means the velocity at which the vertical plume rise may affect the handling characteristics of an aircraft in flight such that there may be a momentary loss of control. For most circumstances this velocity is in excess of 10.6 m/s.

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 CASR Part 139 - 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 height at which the plume reduces to a trigger velocity of 4.3m/s or 10.6m/s. The Screening Tool is based on The Air Pollution Model (TAPM) methodology incorporating a buoyancy enhancement factor for multiple plumes.

TAPM is The Air Pollution Model derived by the CSIRO which includes a method of assessment of plume rise velocity enabling determination of a critical plume height.

Terminal Instrument Flight Procedure 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 airport can be obtained from the aerodrome operator.

6. BACKGROUND

6.1 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 significant vertical velocities during normal and upset operating conditions.

6.2 Aircraft operations in various stages of flight may be affected by a plume rise of significant vertical velocity. A light aircraft in approach configuration is more likely to be susceptible to a vertical plume rise of significant velocity than a heavy aircraft cruising at altitude. In addition, helicopters and light recreational aircraft may be severely affected by high temperature plumes and the altered air mixture above a plume rise and should therefore avoid low over-flight of such facilities.

6.3 Part 139.370 of CASR 1998 provides that CASA may determine that a gaseous efflux having a velocity in excess of 4.3m/s is or will be a hazard to aircraft operations because of the velocity or location of the efflux.

6.4 The Manual of Aviation Meteorology (Airservices Australia, 2003) defines severe turbulence as commencing at a vertical wind gust of velocity in excess of 10.6 m/s; which may cause a momentary loss of control.

7. KEY STAGES OF THE PLUME RISE ASSESSMENT PROCESS

7.1 The key stages of the plume rise assessment process are: completion of Form 1247 (http://casa.gov.au/wcmswr/_assets/main/manuals/regulate/casr139/form1247.pdf), assessment of the critical plume velocity (CPV), assessment of the critical plume height (CPH), assessment of the impact of the plume, implementation of mitigation. More detail on the process is provided at Appendix A of this AC.

8. ASSESSMENT OF CRITICAL PLUME VELOCITY (CPV)

8.1 The CPV under scrutiny (4.3 m/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;
- frequent flight paths;
- navigation method in use (visual versus instrument);
- presence of Air Traffic Control;
- human factors considerations; and
- proximity to a regulated aerodrome.

9. ASSESSMENT OF CRITICAL PLUME HEIGHT (CPH)

9.1 CASA will determine the CPH using the Screening Tool based on the TAPM methodology designed by the CSIRO incorporating a buoyancy enhancement factor for multiple plumes. The information required to undertake the screening process is identified on Form 1247 (refer to paragraph 7.1 for location of Form 1247). The critical plume velocity under scrutiny will vary depending on the type of operations at the location and any associated risks identified by CASA (refer to paragraph 8.1 of this AC).

9.2 A plume rise not exceeding a velocity of 4.3 m/s 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](#) (refer to paragraph 7.1 for location of Form 1247) should be forwarded to CASA for screening assessment.

9.3 Alternate methods of assessment may also be put forward for consideration by CASA.

10. ASSESSMENT OF THE IMPACT OF THE PLUME RISE PROPOSAL

10.1 The critical plume height will be applied to the location of the plume rise to assess the impact of the plume.

10.2 Near aerodromes the plume rise may impact the obstacle limitation surface (OLS) and may therefore be referred to a CASA Aerodrome Inspector (AD INSP)/Aerodrome Operator (AD OPR) to assess this impact.

10.3 In the vicinity of aerodromes the plume rise may impact the Terminal Instrument Flight Procedure (TIFP) which may cause CASA to determine that it is a hazard under Regulation 139.370 of the CASR 1998. If the proposal cannot be altered to avoid this impact, changes to instrument approach and departure procedures may be required which may have cost implications for proponents. Should the impact of the plume be significant with regards to instrument approach and departure procedures such that it would be difficult to achieve re-design without compromising the safety and/or environmental impact of the resulting design, CASA may recommend against the development.

10.4 Away from aerodromes, if the plume rise impacts 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.

10.5 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 12 of this AC).

11. MITIGATION OF THE IMPACT OF THE PLUME RISE PROPOSAL

11.1 Mitigation options for plume rise exceeding the critical plume velocity 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 Airspace Regulation 6 on aviation charts to alert pilots to the plume rise hazard; and
- Designation of a Restricted Area in accordance with Airspace Regulation 6 on aviation charts to preclude over-flight by all aircraft.

12. FURTHER INFORMATION

12.1 A technical brief regarding the application of plume rise models for the purposes of detailed plume rise assessments is available on request.

12.2 For any further information regarding plume rise assessments refer to CASA Airspace and Aerodrome Regulation Division.

Executive Manager
Standards Development and Future Technology

April 2012

Appendix A

PLUME RISE ASSESSMENT PROCESS

