Advisory Circular
AC139-19

Revision 0

Aircraft Arresting Systems

XX XXXX 2026

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rule and related Civil Aviation Transport Instrument.

Consideration will be given to other methods of compliance that are presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC provides guidance on the requirements for Engineered Material Arresting Systems (EMAS) and Runway End Safety Areas (RESA).

Related Rules

This AC relates to Civil Aviation Rule Parts 139.20, 139.51, and Appendix A.1 to Part 139, and the corresponding Civil Aviation Transport Instrument (CATI 139.51).

Change Notice

Initial issue.

Version History

History Log

Revision No.	Effective Date	Summary of Changes
0	XX XXXX 2026	Initial issue

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Introduction

1. An Aircraft Arresting System (AAS) is a system designed to decelerate an aeroplane overrunning the runway. Under Rule 139.51/Appendix A.1, if an arresting system is installed, the length of the runway end safety area (RESA) may be reduced, based on the design specification of the system. An AAS can provide predictable and effective performance in arresting aircraft overruns, independent of the weather.

2. One such AAS design is based on the use of engineered materials which will crush under the weight of an aeroplane, thereby absorbing energy. This type of system, known as Engineered Materials Arresting System (EMAS) has already been installed at many airports. Other types of arresting systems include the cable/hook-wire arresting system commonly installed at military airfields.

3. Several aerodromes around the world, particularly those with runways constructed before the adoption of more stringent RESA requirements in 1999, have experienced difficulties in providing a standard or recommended RESA. The most frequent causes are natural obstacles, local development and/or environmental constraints.

4. Where it is not practicable to provide a RESA that meets the rule requirements, the Director of Civil Aviation (the Director) may agree to a reduction in declared RESA distances if the aerodrome installs an arresting system. Installing an arresting system may be an appropriate practice to increase safety since the deceleration performance of the system is mainly independent of aircraft braking performance, contamination or weather.

5. The installation of aircraft arresting systems is subject to acceptance by the Director and is conducted on a case-by-case basis.

6. CAA will conduct design evaluation and review of the process to assess the risks associated with the proposed change as part of analysing and accepting the installation of arresting systems at aerodromes. In accordance with Rule 139, Appendix A, it may also be necessary for the Director to accept that a proposed arresting system represents an equivalence to the required distance for a RESA.

Abbreviations and Definitions

Abbreviations	
Aircraft Arresting System	AAS
Engineered Materials Arresting System	EMAS
Maximum landing weight	MLW
Maximum take-off weight	MTOW
Rescue and fire fighting service	RFFS
Runway end safety area	RESA

Definitions	
Critical aircraft	For the purpose of EMAS, aircraft regularly using the associated runway that impose the greatest demand on the EMAS.
Design aircraft	The combination of aircraft types which are or will be operating regularly on the runway.
Exit speed	The speed of the nose gear of the aeroplane as it passes the physical end of the runway or stopway, if provided.
Service road	A road that allows emergency vehicles to circumnavigate the EMAS facility without driving over the EMAS
Setback	The distance between runway end or stopway and the beginning of the EMAS arrestor bed.

Process for acceptance of EMAS

8. CAA has not developed AAS design standards specific to New Zealand. Civil Aviation Rule 139.51 requires that those installing an AAS must comply with the approved design standards in CATI 139.51.

9. At present, only the following design standards have been approved:

- Any AAS that complies with FAA Advisory Circular 150/5220-22B: *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns.*

10. As the only approved AAS in CATI 139.51 is EMAS, this guidance material focuses solely on this approach.

11. The following guidance may also be useful to reference when installing an EMAS:
    a. FAA Advisory Circular 150/5300-13: *Airport Design*

12. Before installing an EMAS an aerodrome operator should demonstrate that the proposed design is approved under CATI 139.51 and that the associated risks have been assessed and are appropriately mitigated.

13. To fulfil these criteria an aerodrome operator should:
    - Review the risks associated with the introduction of the EMAS through an aeronautical study, and
    - Provide the Director with detailed design reports of the proposed EMAS solution and the aeronautical study.

EMAS design and standards

Concept and Operation

14. EMAS is designed to slow down the aeroplane in the event of an overrun by exerting predictable forces on the landing gear. The forces exerted onto the gears are designed to not be excessive so as to avoid injuries to passengers or crew members, nor cause major structural damage to the aircraft.

15. EMAS is a passive system which requires no external means to initiate or trigger the operation of arresting an aircraft, nor does it require any special actions or procedures of the flight crew. However, a basic knowledge of the systems by flight crews is beneficial to prevent undesired evasive manoeuvres that could cause the aircraft to avoid entering the bed or system. EMAS is designed to be entered preferably straight ahead with the unrestricted use of wheel brakes and/or thrust reversers.

16. EMAS is not intended to meet the definition of a stopway, and its availability should not be used for flight planning purposes.

Location and Dimensions

17. The EMAS arrestor bed should be located beyond the end of the runway (or stopway, if provided) at enough setback distance to avoid damage due to jet blast. The minimum setback distance required for jet blast protection may differ depending on the manufacturer and the operational conditions.

18. The calculation of the setback distance balances the risk objectives of:
    a. providing enough area for arresting purposes
    b. providing enough separation to protect the bed from jet blast
    c. providing separation from the threshold to reduce the probability of undershoot in the EMAS, and
    d. decreasing the probability of aircraft overruns passing by one side of the EMAS due to lateral dispersion.

19. The aerodrome operations should assess the relevance of each risk objective as part of the aeronautical study, taking into account the operating conditions such as usage of the runway, types of approach, weather conditions, fleet mix, incidents and accidents, and any other runway safety issues.

20. To reduce the probability of aircraft undershoot into an EMAS, a minimum setback distance of at least 60 m from the threshold or runway end is recommended. However, this separation may be reduced if, after an aeronautical study, it is determined that it is the best alternative for both overrun and undershoot protection.

21. EMAS functional length is designed based on the operating conditions of the associated runway with its centre line typically coincidental with the extended centre line of the runway.

22. EMAS functional width should not be less than the runway width. Where possible, this width is provided throughout the whole length of the bed.

23. *Note*: *Steps and/or slopes normally provided at its end and at both sides of an EMAS bed are considered functional for ongoing maintenance but not for performance calculations.*

Design and Arresting Performance

24. The surface of a RESA may vary depending on the type of soil or pavement, resulting in diversity in the decelerating performance and characteristics of overrunning aircraft. It is not easy to establish a correlation between the performances of a RESA and an EMAS. An EMAS is designed to provide the optimal arresting response achievable with the distances available.

25. The critical aircraft is generally the heaviest or largest aircraft that regularly uses the runway, this may not always be the case. EMAS performance is dependent not only on aircraft weight, but also on the landing gear configuration, tyre pressure and the centre of gravity.

26. In general, the operational maximum take-off weight (operational MTOW) is used for the critical aircraft. However, there may be instances where less than the MTOW will require a longer arrester bed. All parameters should be considered in optimising the design. Where practicable, the EMAS design should consider both the aircraft that imposes the greatest demand on the system and the range of aircraft that operate regularly on the runway.

27. In some instances, a combination of design aircraft may be preferable to optimise the EMAS over a single critical aircraft. Other factors unique to a particular aerodrome, such as available RESA and air cargo operations, should also be considered in the final design. The aerodrome operator should engage with users regarding the selection of the design aircraft that will optimise the EMAS for a specific runway.

28. In addition to analytical validation, the EMAS design method may also be supported by laboratory or onsite testing to confirm system performance.

29. EMAS testing is based either on passage of an actual aircraft or a single wheel bearing an equivalent load through a test bed. The design should consider multiple aircraft parameters, including but not limited to allowable aircraft gear loads, gear configuration, tyre contact pressure, weight, centre of gravity and speed.

30. To the maximum extent possible, EMAS should be designed to decelerate the designated aircraft at an exit speed of 70 knots at both MTOW and 80 per cent maximum landing weight (MLW) without imposing loads that exceed the design limits of the aircraft, which may cause major structural damage to the aircraft or impose excessive force on its occupants.

31. The EMAS provision should provide a stopping distance equivalent to the applicable distances in Rule 139 Appendix A.1 for the largest aircraft regularly using the aerodrome exiting the runway end at a speed of 70 knots.

32. Where there is insufficient distance available for achieving this objective, the EMAS is designed to achieve the maximum arresting performance of the critical aeroplane within the available distance.

33. The 70 knots requirement is based on the state-of-the art design for EMAS, and the analysis of overrun data.

34. The design method for EMAS excludes the use of reverse thrust of the aeroplane, using a 0.25 braking friction coefficient for the runway and length of pavement prior to the arrester bed (also known as the setback).

35. The design method for the EMAS assumes no braking friction coefficient (0.00) within the EMAS arrester bed itself, unless the manufacturer provides documentation of field or laboratory testing which demonstrates the minimum actual braking friction coefficient that can be achieved as an aeroplane passes through the arrester bed material. The designed arresting bed distance is the theoretical calculated distance with margin which could cover the calculation error.

Adjacent areas

36. On both sides of the EMAS, the requirements for RESA according to the relevant provisions in Rule 139 Appendix A are applicable. Service roads, set up at both sides and at the end of the EMAS, are intended for maintenance and emergency access. These roads are provided with adequate width to allow ingress and egress of rescue and fire fighting service (RFFS) vehicles, graded to avoid water accumulation and are capable of supporting the passage of fully loaded RFFS vehicles.

Undershoots

37. An EMAS should be designed so as not to increase the potential for damage in case of an undershoot. The EMAS should be designed so that it does not cause more control problems for or damage to aircraft during an undershoots when compared to touching down in a RESA.

38. It is commonly accepted that compliance with this requirement is difficult to justify, particularly concerning the varieties of undershoot scenarios. Consequently, the compliance with this requirement could be justified through experience of real cases of undershoot in EMAS, flight simulator tests, other type of studies or a combination thereof.

39. The objectives of reducing the risk of damage to an aeroplane undershooting or overrunning the runway are both included in the definition of a RESA. However, different studies[1] developed in the United States and in the European Union with worldwide data show that undershoots occur normally near the runway, and the probability of undershoot decreases when instrumental or visual vertical guidance is provided to pilots.

40. According to the studies, approximately 50 per cent of undershoots occur in the first 60 metres before the runway threshold, and the ratio of undershoots/overruns is reported to be 1:4. This information should be considered in the safety assessment developed, to find the best solution for enhancing runway safety.

41. EMAS is not intended to reduce the risk of damage to an aeroplane undershooting the runway. However, the presence of an AAS should not increase the potential for damage in case of undershoot more than the risk associated with an undershoot in a RESA.

Other considerations

42. Although the EMAS is not regarded as an obstacle on the runway strip or in the RESA for clearing and grading requirements, it should be frangible and mounted as low as possible with ramps provided to avoid a vertical surface, wherever feasible.

43. The arrester bed should be prepared in such a manner so as not to be damaged by jet blast or projected debris during normal aircraft operations.

44. *Note: EMAS is composed of material with the necessary protection to achieve this requirement during its service life.*

45. The mechanical property of the arrester bed should be enough to avoid damage resulting from personnel walking on it for routine maintenance.

46. The presence of the arrester bed should not stop the movement of rescue and fire fighting service (RFFS) vehicles during an emergency. Adequate slopes or steps should be provided to allow the entrance of these vehicles from the front and sides.

47. *Note: The arrester bed may be damaged during normal vehicle access.*

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[1] ACRP Report 50. Improved Models for Risk Assessment of Runway Safety Areas
EASA_REP_RESEA_2011_12. Study on models and methodology for safety assessment of Runway End Safety Areas (RESA)

48. The arrester bed may not impede crew and passenger evacuation. Adequate slopes or steps may be provided around the perimeter.

49. The bed should use materials that do not generate or worsen fire hazards for incoming aircraft, and that are non-sparking, non-flammable, do not promote combustion, and/or emit toxic or malodorous fumes in a fire environment after installation.

50. The EMAS system should:
    - not impede disabled aircraft removal
    - not cause visual or electromagnetic interference with any air navigation aids
    - be compatible with the installation of approach lighting systems and the radio altimeter operating area
    - not have reflecting surfaces that could cause dazzle
    - not increase wildlife hazard
    - ensure the bed, including its surrounding areas, is designed to prevent water from accumulating and allow ice and snow removal.

51. *Note: During snow and ice removal, aerodrome operators need be careful not to cause damage to the EMAS bed.*

52. The EMAS should be compatible with meteorological conditions and the aerodrome environment including water, temperature, ice, snow, hail, salt, UV radiation, de-icing and anti-icing products, aircraft fuels, hydraulic fluids and lubricating oils, paint and herbicides. These factors should be considered for estimating the service life of the system.

Safety Assessment

53. The introduction of an AAS represents a significant change that may affect the safety of aerodrome operations, therefore an aerodrome operator should complete an aeronautical study to ensure that identified risks are appropriately managed. Guidance on aeronautical studies can be found in AC139-15, *Aeronautical Studies for Aerodrome Operators*

Notification

54. The aerodrome operator should notify pilots and aerodrome personnel of the presence of an arresting system and its serviceability by publication in the aerodrome AIP. Information and/or instructions should be promulgated to local runway safety teams and others to promote awareness in the pilot community.

Maintenance

55. The aerodrome operator should establish an EMAS maintenance programme that includes preventive and corrective actions where appropriate, to preserve the system in adequate serviceable condition.

56. The maintenance programme should be prepared before the installation of the EMAS and should include appropriate records to verify that maintenance and all required inspections and periodic service level tests have been performed.

57. Preventive maintenance of the EMAS normally include visual and waterproof (moisture content tests) inspections. The frequency and the type of the preventive actions may differ depending on the manufacturer and the type of system.

58. Maintenance personnel should have received adequate training to perform their duties. They may be part of the aerodrome operator staff or could be subcontracted from the EMAS manufacturer or other third parties. Maintenance personnel should be fully conversant with the maintenance programme activities to preserve the system functionality.

59. The maintenance programme should include tests to periodically assess the service level of the system and to schedule repairs or replacement actions before the end of the service life is reached.

60. The EMAS should be designed for repair to a usable condition (conforming to the original specifications) after an overrun or other type of physical damage. The maintenance programme should include:
    - procedures and agreements for repair work including materials in stock
    - materials production and supply
    - repair methodologies and quality control to maintain the level required of the system, and
    - repair period.

61. The repair period should be appropriate to meet the operational and safety requirements of the aerodrome. Refer AC139-13, *Runway Surface Friction Characteristics and Friction Testing*, for more information.

Recovery of aircraft following an overrun

62. Aerodrome operators should include appropriate plans for recovery of aircraft following an overrun event in their exposition. They should also develop a process to assess the serviceability of the EMAS following any damage to it.

Resources

ICAO

Appendix 5, Doc 9157, Part 1, *Runways.* Available from the ICAO store at the website International Civil Aviation Organization.

FAA

- FAA AC 150/5300-13B: Airport Design- Change 1 AC 150/5300-13B, Airport Design, March 31, 2022 Consolidated to include Change 1, August 16, 2024 (errata updates as of 4/3/2025)
- FAA AC 150/5220-22B: Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns AC 150/5220-22B - Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns