AC 139-4-4 (Rev 1)
28 November 2024

Civil Aviation Authority of Singapore

Advisory Circular

USE OF PAVEMENT UNDER OVERLOAD OPERATIONS

GENERAL

Advisory Circulars (ACs) are issued by the Director-General of Civil Aviation (DGCA) from time to time to provide practical guidance or certainty in respect of the statutory requirements for aviation safety. ACs contain information about standards, practices and procedures acceptable to CAAS. An AC may be used, in accordance with section 11 of the Air Navigation Act 1966 (ANA), to demonstrate compliance with a statutory requirement. The revision number of the AC is indicated in parenthesis in the suffix of the AC number.

PURPOSE

This AC provides the Acceptable Means of Compliance (AMC) and information to guide an aerodrome operator on the criteria to review pavement overload operations.

APPLICABILITY

This AC is applicable to an aerodrome operator who intends to or holds an aerodrome certificate.

RELATED REGULATIONS

This AC relates specifically to Regulations 19, 20 and 22 of the Air Navigation (139 – Aerodromes) Regulations 2023 (“ANR-139”).

RELATED ADVISORY CIRCULARS

- AC 139-2-1 Guidance on aerodrome manual or heliport manual

CANCELLATION

This AC supersedes AC 139-4-4 Rev (0) dated 1 March 2023. In Revision 1, the AC is updated to reflect the change in methodology for reporting of pavement strength to aircraft classification rating-pavement classification rating (ACR-PCR), as specified in Aviation Specification 5 - Aerodromes (AS-5).

EFFECTIVE DATE

This AC is effective from 28 November 2024.

OTHER REFERENCES

- Aviation Specification 5 – Aerodromes
- ICAO Annex 14, Vol. I, Aerodrome design and operations
- ICAO Aerodrome design manual (Doc 9157), Part 3 Pavements
- CASA AC 139.C-07v1.0 Strength rating of aerodrome pavements
- FAA AC 150-5335-5D- Standardised method of reporting airport pavement strength - PCR

1 INTRODUCTION

1.1 Regulations 19 and 22 of the ANR-139 require the aerodrome operator to ensure that the design, operations and maintenance of the aerodrome comply with the relevant Aviation Specifications. Regulation 20 of the ANR-139 requires the aerodrome operator to operate and maintain the aerodrome in accordance with the procedures in the aerodrome manual.

1.2 The aerodrome operator must comply with paragraph 5.6.8 of AS-5 and put in place an inspection regime to closely monitor the pavement condition under overload operations.

2 USE OF PAVEMENT UNDER OVERLOAD CONDITIONS

2.1 Aerodrome pavements are designed and consequently rated to be able to withstand repetitive loadings by the aircraft without needing major pavement maintenance during their design life. However, there may be times when aircraft may impose more severe loading with ACR of the aircraft exceeding PCR of pavement. The consequences of such repeated overloads may lead to the following failure conditions on the pavement:

(a) excessive roughness caused by general loss of shape after repeated operations by heavy wheel loads;

(b) cracking of the seal surface where deflections caused are high or compaction of the pavement material is poor;

(c) surface rutting and cracking of the sealed surface and stripping of aggregate due to high tyre pressure.

2.2 A pavement is not expected to suddenly or catastrophically fail when subjected to minor overloading. Hence, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration.

2.3 It should be noted that overloading movements should not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, it should be avoided when the strength of the pavement or its subgrade could be weakened by water.

2.4 As specified in paragraph 5.6.8 of AS-5, the aerodrome operator needs to adopt an appropriate overload policy and determine the allowable extent of overload operations for the aerodrome. This requires consideration of the pavement strength and condition, frequency of use of pavement, aircraft weight, pavement inspection and maintenance procedures.

2.5 In general, usage of pavement (regardless flexible or rigid) by an aircraft with an ACR higher than the PCR reported for that pavement should not be allowed unless all of the following criteria are met:

(a) the overload movement is by an aircraft with ACR not exceeding 10 percent above the reported PCR; and

(b) the annual number of such overload movements does not exceed approximately 5 per cent of the total annual movements (the number of total annual movements should exclude that of light aircraft[1]).

3 OVERLOAD OPERATIONS EXCEEDING THE CRITERIA[2]

3.1 For aircraft operations where the magnitude of overload and/or the frequency of use exceed the criteria in paragraph 2.5 above, the aerodrome operator must determine the operations allowable based on a detailed technical analysis. The technical analysis should determine how the overload operation contributes to the maximum cumulative damage factor (CDF)[3] when it is mixed with the actual aircraft mix. The technical analysis should determine the number of permitted overload operations so that the CDF of the entire aircraft mix, including the overload aircraft, remains at CDF ≤1. The aerodrome operator can consider using software such as FAARFIELD or ICAO-ACR to conduct detailed technical analysis.

3.2 The aerodrome operator should also refer to **Table 1** for determining if an overload operation may be allowed, and take the actions accordingly.

Overload Operations by aircraft	**Is overload operations allowable?**	**Actions by aerodrome operator**	
		Before overload operations	**After overload operations**
ACR > 10% but not > 50% of reported PCR	Yes, if within the number of permitted overload operations determined by the technical analysis.	(1) Carry out a critical examination of available pavement construction records and test data by a qualified pavement engineer. (2) Carry out a thorough inspection by a pavement engineer to assess any signs of pavement distress.	(1) Carry out a thorough inspection by a pavement engineer on completion of the movement (2) Stop overload operations immediately as soon as distress becomes evident. The pavement distress should be managed in accordance with the maintenance programme established for the aerodrome.
ACR > 50% of reported PCR	Only allowed in an emergency*		

** The determination of "emergency only" overload limits should be based on ensuring the safety of the aircraft from pavement surface "break-through" during the "emergency" operation.*

Table 1 – Actions by aerodrome operator for the different overload operations

[1] Referencing ICAO Annex 8: aircraft with maximum certificated take-off mass of not more than 5,700kg.
[2] The overload evaluation guidance in this section applies primarily to pavements that have PCR values that were established by the technical evaluation method. Pavements that have ratings determined by the using aircraft experience method can use the overload guidelines provided very frequent pavement inspection procedures are followed.
[3] Refer to paragraph 1.1.4.2 in Part 3 of the ICAO Doc 9157 on Aerodrome Design Manual for the CDF concept.

4 OTHER CONSIDERATIONS

4.1 In combination with the overload guidelines, the aerodrome operator should also consider the following when reviewing the overload operations:

(a) Safety of the operations – the extent of overloading operations resulting in aircraft damage and safety of passengers

(b) Probability of pavement damage
- Extent of pavement damage and extend of areas e.g. multiple or localised areas, including reports on damage caused by previous operation, if any
- Basis of pavement design
- Report on pavement evaluation and condition
- Data on aircraft usage
- Frequency of overload operations e.g. one-off, short term or long term; and
- Local conditions e.g. recent prolonged rainfall causing loss of subgrade strength.

(c) Consequence of pavement damage
- Disruption to operations caused by the damage or repairs
- Resources available to repair the damage

(d) Other considerations for instance, if the physical characteristics of the aerodrome movement area suitable for the intended operations of the overloading aircraft, for example, parking and manoeuvrability.

5 INSPECTION AND MONITORING REGIME

5.1 Where overload operations are conducted, the aerodrome operator must put in place a regime to inspect the relevant pavement condition regularly by competent personnel. The aerodrome operator should monitor the pavement condition closely for a period of several weeks or until it is verified that deterioration of the pavement is not occurring. Any significant deterioration of the surface of the pavement may be caused by weakening of the pavement material and/or subgrade, in which case, a technical review of the pavement strength rating may be required. If necessary, increased maintenance and/or rehabilitation earlier than was originally intended should be considered.

5.2 The aerodrome operator should periodically review the criteria for overload operations as excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.