



Advisory Circular

Subject: Runway End Safety Area Bearing Strength

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TABLE OF CONTENTS

1.0	Introduction	2
1.1	Purpose	2
1.2	Applicability	2
1.3	Description of changes	2
2.0	References and documents	2
2.1	Reference documents	2
2.2	Cancelled documents	3
2.3	Definitions and abbreviations	3
3.0	Background	3
4.0	Discussion	4
5.0	Ongoing maintenance	6
6.0	Information management	6
7.0	Document history	6
8.0	Contact us	6

1.0 Introduction

- (1) This Advisory Circular (AC) is provided for information and guidance purposes. It describes an example of an acceptable means, but not the only means, of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements, nor does it establish minimum standards.

1.1 Purpose

- (1) The purpose of this document is to provide guidance on the bearing strength requirements of Runway End Safety Areas (RESA).

1.2 Applicability

- (1) This document applies to all Canadian airport operators, manufacturers, suppliers, Transport Canada Civil Aviation (TCCA) Headquarters and regional personnel, and the aviation industry involved with the planning, design, establishment and maintenance of RESA at Canadian aerodromes.

1.3 Description of Changes

- (1) The transition from the Aerodrome Reference Code to the Aircraft Group Numbers (AGN) methodology under Aerodrome Standards and Recommended Practices (TP 312) 5th edition made it necessary to modify section 4.
- (2) Other changes refer to:
 - (a) The modification of the title of the AC.
 - (b) The amendment of Sections 2.1 and 3 to reflect updated reference to documentation and background.
 - (c) The revision of Section 5.0 to remove the note related to the cancelled AC 302-013 and to refer to Standard 322 instead.

2.0 References and documents

2.1 Reference Documents

- (1) It is intended that the following reference materials be used in conjunction with this document:
 - (a) [Aeronautics Act](#) (R.S.C., 1985, c. A-2)
 - (b) Part III, Subpart 2 of the *Canadian Aviation Regulations* (CARs) — Airports
 - (c) Transport Canada Publication (TP) 312, 5th Edition, 2015-09-15 — Aerodrome Standards and Recommended Practices
 - (d) International Civil Aviation Organization (ICAO) Annex 14 Volume 1, Aerodrome Design and Operations
 - (e) ICAO Doc 9157 — Aerodrome Design Manual, Part I – Runways, Fourth Edition, 2020; and
 - (f) Standard 322 – Division IV – Airport Winter Maintenance.

2.2 Cancelled Documents

- (1) Not applicable.
- (2) By default, it is understood that the publication of a new issue of a document automatically renders any earlier issues of the same document null and void.

2.3 Definitions and Abbreviations

- (1) The following **definitions** are used in this document:
 - (a) **California Bearing Ratio (CBR)**: a measure of the load bearing capacity of a given sample of soil expressed as a ratio relative to the load bearing capacity of crushed limestone
Note: The load bearing capacity of crushed limestone is expressed as a CBR of 100.
 - (b) **Overrun**: occurs when an aeroplane exits the end of the runway unintentionally, due to a late landing or rejected takeoff
 - (c) **Runway End Safety Area (RESA)**: an area, adjacent to or on a runway that is intended to reduce the severity of damage to an aeroplane in the event that the aeroplane undershoots or overruns the runway
 - (d) **Undershoot**: occurs when an aeroplane touches down prior to the runway threshold.
- (2) The following **abbreviations** are used in this document:
 - (a) **AC**: Advisory Circular
 - (b) **AGN**: Aircraft Group Number
 - (c) **ASDA**: Accelerate-stop distance available
 - (d) **CAR**: *Canadian Aviation Regulations*
 - (e) **CBR**: California Bearing Ratio
 - (f) **ICAO**: International Civil Aviation Organization
 - (g) **LDA**: Landing distance available
 - (h) **RESA**: Runway End Safety Area
 - (i) **TCCA**: Transport Canada Civil Aviation
 - (j) **TODA**: Take-off distance available
 - (k) **TORA**: Take-off run available
 - (l) **TP**: Transport Canada Publication

3.0 Background

- (1) If the defined criteria listed in sections 302.600 to 302.604 of the *Canadian Aviation Regulations* (CARs) are met, airport operators will have to ensure that a runway that is used for the take-off or landing of commercial aeroplanes engaged in a scheduled air service for the purpose of carrying passengers has a RESA.
- (2) The objective of a RESA is to have an area free of objects, other than frangible visual aids required to be there by function, so as to reduce the severity of damage to an aeroplane overrunning or undershooting the runway, and to facilitate the movement of rescue and fire

fighting vehicles. Thus, the bearing strength of the RESA should be such that it reduces the severity of damage to the aeroplane during an undershoot or overrun event.

- (3) Section 302.07 of the CARs incorporates by reference Aerodrome Standards and Recommended Practices (TP) 312.
- (4) For the planning and design of airport infrastructure or level of service changes, the 5th edition of TP 312 establishes the minimum level of compliance required.
- (5) It is worth noting that the International Civil Aviation Organization (ICAO) sets forth distinct standards and recommendations under Annex 14 Volume 1 that differ in scope and dimension.
- (6) This AC provides guidance on establishing RESA bearing strength that is appropriate to the level and type of activity at the airport.

4.0 Discussion

- (1) TP 312 5th edition Section 3.2 introductory note states:

The objective of a runway end safety area is to have an area free of objects, other than frangible visual and navigational aids required to be there by function, so as to reduce the severity of damage to an aeroplane overrunning or undershooting the runway and to facilitate the movement of rescue and fire fighting vehicles.
- (2) TP 312 5th edition standard 3.2.1.6 further states:

The runway end safety area:

 - (a) has no abrupt slope changes or open ditches;
 - (b) has an adequate slope to prevent the accumulation of water;
 - (c) beyond the runway strip, has maximum transverse and longitudinal slopes of 5% downwards;
 - (d) does not protrude into an obstacle limitation surface (OLS); and
 - (e) **under dry conditions, is of sufficient strength to reduce the severity of structural damage to the critical aeroplane overrunning / undershooting the runway.**
- (3) Based on the above statements from TP 312, a RESA could be a **natural compacted open area** satisfying the slope, strength “under dry conditions” and other stated requirements. The “under dry conditions” statement is noteworthy here as it is the baseline condition for which the area is prepared to and assessed against. Also, it is recognized that the strength bearing capability of the surface will be affected by changes in moisture content of the soil, such as due to rainfall or seasonal variations.
- (4) With the above clarification on “under dry conditions” noted, the area does not require the same bearing strength capability as the associated runway but only needs to support one or more passages of the critical aircraft. A slight deformation (rutting) of the surface during usage is acceptable and may even be desirable to enhance dissipation of aeroplane energy (deceleration).
- (5) To determine if such a natural area has the bearing strength for use as a RESA, the load imposed by the critical aircraft must first be considered. Of importance to the determination of the load imposed is the gross weight of the aeroplane and the tire pressure, since the tire pressure itself becomes the surrogate for the load. A higher tire pressure results in a smaller tire footprint and higher loads being transferred to the ground. The aeroplane manufacturer may be able to provide a California Bearing Ratio (CBR), usually for runway operations, to compare with the known or sampled bearing strength of the natural area.

- (6) Since the loaded area that is associated with any tire pressure is understood to be the wheel load of the aeroplane divided by the tire pressure - the tire pressure itself becomes the surrogate for load. By classifying commercially operated aeroplane into three groups based on wingspan, the tire pressure regimes result in tire pressures grouped as presented in the table below. With this grouping the associated RESA bearing strength requirements can be identified.

RESA Bearing Strength Requirements

TP312 Table 1-1 Column II (wingspan)	Tire Pressure in psi (MPa)	RESA Minimum Bearing Strength (CBR) [Tire pressure / 10]
AGN I and II	60 - 145 (0.4 – 1.0)	6 -14
AGN IIIA, IIIB, and IV	145 – 200 (1.0 – 1.4)	14 - 20
AGN V and VI	200 – 254 (1.4 - 1.75)	20 - 24

Note: The RESA bearing strength indicated above would provide support to the aeroplane while allowing rutting on the order of 25 to 30 cm. This level of rutting is acceptable, and would even help decelerate an aeroplane with minimal risk of damage to the landing gear.

- (7) The bearing capability may also be established by comparing the known historical use of the area (under dry conditions) by vehicles or heavy equipment. However, in using this method of comparative assessment it is important to consider the configuration of the vehicles/equipment wheels in relation to the aeroplane's landing gear. The larger tire footprint and lower tire pressures on many vehicles/equipment distributes the overall weight on the ground more effectively than the aeroplane's landing gear.
- (8) Another source of information on RESA strength is ICAO Document 9157 – Aerodrome Design Manual, Part I – Runways. This document provides guidance that could be of benefit to an airport serving large heavy airliners, especially international airports. The following are extracts from Doc. 9157:

Strength

5.4.16 A runway end safety area should be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, enhance aeroplane deceleration, and facilitate the movement of rescue and fire fighting vehicles. See 5.3.26 for guidance on the minimum strength of the runway strip.

5.3.26 Since the graded portion of a strip is provided to minimize the hazard to an aeroplane running off the runway, it should be graded in such a manner as to prevent the collapse of the nose landing gear of the aeroplane. The surface should be prepared in such a manner as to provide drag to an aeroplane and below the surface, it should have sufficient bearing strength to avoid damage to the aeroplane. To meet these divergent needs, the following guidelines are provided for preparing the strip. Aeroplane manufacturers consider that a depth of 15 cm is the maximum depth to which the nose gear may sink without collapsing. Therefore, it is recommended that the soil at a depth of 15 cm below the finished strip surface be prepared to have a bearing strength of California Bearing Ratio (CBR) value of 15 to 20. The intention of this underlying prepared surface is to prevent the nose gear from sinking more than 15 cm. The top 15 cm may be of lesser strength which would facilitate deceleration of the aeroplane.

- (9) The above information from the ICAO Doc. 9157 recommends that a RESA should have a CBR of 15 to 20. This CBR range should suffice for the largest of aeroplane overrunning into the RESA.
- (10) The airport operator should also consult with the air operator and/or aeroplane manufacturer to identify any specific requirements that may affect the minimum RESA bearing strength desired.

5.0 Ongoing maintenance

- (1) Once the area is established, minimal maintenance should be required for its upkeep. The airport operator must ensure that grass is cut to manage surface growth, and that deformations due to damage (by aeroplane, wildlife [hole, dens, etc.], etc.) are repaired.
- (2) Snow clearing is not necessary in the RESA, however, the aerodrome operator should be aware of their obligations under Division IV of Standard 322 regarding snow profiles (e.g. snow banks) in the vicinity of the runway:

<https://tc.canada.ca/en/corporate-services/acts-regulations/list-regulations/canadian-aviation-regulations-sor-96-433/standards/standard-322-airports-canadian-aviation-regulations-cars>

6.0 Information management

- (1) Not applicable.

7.0 Document history

- (a) AC 302-015, Issue 01, RDIMS 7796597-V7 (E), 8159258-V11 (F), dated 2013-04-10 – Runway End Safety Area Bearing Strength Requirements

8.0 Contact us

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