Transport Canada Transports Canada

Advisory Circular

Subject: **Runway End Safety Area Bearing Strength Requirements**

Issuing Office:	Standards	Document No.:	AC 302-015
File Classification No.:	Z 5000-32	Issue No.:	01
RDIMS No.:	7796597-V7	Effective Date:	2013-04-10

TABLE OF CONTENTS

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 Runway End Safety Areas (RESA) at Canadian aerodromes.

1.3 Description of Changes

(1) Not applicable.

2.0 REFERENCES AND REQUIREMENTS

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., 1985, c. A-2)*;*

(b) Part III, Subpart 2 of the *Canadian Aviation Regulations* (CARs) — *Airports*;

(c) Advisory Circular (AC) 302-013 — *Airport Winter Maintenance and Planning*;

(d) Transport Canada Publication (TP) 312, 4th Edition, March 1993 — *Aerodrome Standards and Recommended Practices* (revised 03/2005);

(e) Notice of Proposed Amendment (NPA) 2010-012 — *Runway End Safety Area*; and

(f) International Civil Aviation Organization (ICAO) Doc 9157-AN/901 — *Aerodrome Design Manual, Part I – Runways* (Third Edition, 2006);

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 **definition**s are used in this document:

(a) **California Bearing Ratio (CBR) -** is 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 aircraft passes beyond end of the runway during an aborted takeoff or while landing;

(c) **Runway End Safety Area (RESA)** - is an area symmetrical about the extended runway centreline, intended to reduce the severity of damage to an aeroplane undershooting or overrunning the runway; and

(d) **Undershoot** - occurs when an aircraft touches down prior to runway threshold.

(2) The following **abbreviations** are used in this document:

(a) **AC:** Advisory Circular;

(b) **ASC:** Aerodrome Safety Circular

(c) **CAR:** Canadian Aviation Regulations;

(d) **CBR**: California Bearing Ratio;

(e) **ICAO**: International Civil Aviation Organization;

(f) **NPA**: Notice of Proposed Amendment;

(g) **RESA**: Runway End Safety Area;

(h) **TCCA**: Transport Canada Civil Aviation;

(i) **TP**: Transport Canada Publication

3.0 BACKGROUND

(1) 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 aircraft overrunning or undershooting the runway, and to facilitate the movement of rescue and fire fighting vehicles. Subsequently, the bearing strength of the runway end safety area should be such that it reduces the severity of damage to the aircraft during an undershoot or overrun event.

(2) The *Canadian Aviation Regulations* (CARs) Part lll incorporates by reference the standards document TP312 which ***recommends*** a RESA be provided at each end of a runway strip where the code number is 3 or 4 and that it extends from the end of a runway strip for as great a distance as practicable, but at least 90 m.

(3) ICAO Annex 14 ***requires*** a runway end safety area be provided at each end of a runway strip where the code number is 3 or 4, and where the code number is 1 or 2 and the runway is an instrument one. The RESA extends from the end of the runway strip to a distance of at least 90 m. Furthermore, it is recommended that the RESA extend from the end of a runway strip to a distance of at least 240 m where the code number is 3 or 4 and 120 m where the code number is 1 or 2. The width of the RESA is to be at least twice that of the associated runway and wherever practicable, be equal to that of the graded portion of the associated runway strip.

(4) This AC provides guidance on the establishing an acceptable bearing strength that is appropriate to the level and type of activity at the airport.

4.0 DISCUSSION

(1) TP312 4th edition states:

> ***3.1.7.9*** *Recommendation.— 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 and facilitate the movement of rescue and fire fighting vehicles.*

(2) NPA 2010-012 *Runway End Safety Area* provides further clarification on the bearing strength requirement by stating in part:

302.559 *The terrain in the runway end safety area shall:*

(a) have no abrupt slope changes or open ditches;

(b) have an adequate slope to prevent the accumulation of water;

(c) beyond the runway strip end, have maximum transverse and longitudinal slopes of 5 percent downwards;

(d) not protrude into an Obstacle Limitation Surface (OLS); and

(e) under dry conditions, be of sufficient strength to reduce the severity of structural damage to the critical aircraft overrunning / undershooting the runway.

(3) Based on the above statements from TP312 and NPA 2010-012, a RESA could be a ***natural compacted open*** area satisfying the sloping, strength under dry conditions, and other stated requirements, *"under dry conditions".* 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, it is evident that the area does not require the same bearing strength capability as the associated runway, but only needs to support a few 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 aircraft 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 aircraft 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 aircraft 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 aircraft divided by the tire pressure - the tire pressure itself becomes the surrogate for load. By classifying commercially operated aircraft into three general categories based on wing span: small (Codes A and B) aircraft, medium or narrow body (single aisle) aircraft (Codes C and D), and large or widebody (twin aisle) aircraft (Codes E and F) the tire pressure regimes result in tire pressures grouped as presented in Table. With this grouping the associated RESA bearing strength requirements can be identified.

REASA Bearing Strength Requirements

TP312 Table 1-1 Column 2 (Wingspan)	**Tire Pressure in psi (MPa)**	**RESA Minimum Bearing Strength (CBR) [Tire pressure / 10]**
Code A and B (Small)	60 - 145 (0.4 – 1.0)	6 -14
Code C, D, E and F (Medium)	145 – 200 (1.0 – 1.4)	14 - 20
Code E and F (Large)	200 – 254 (1.4 - 1.75)	20 - 24

Note: *The RESA bearing strength indicated above would provide support but the rutting could be in the order of 25 to 30 cm, which would decelerate an aircraft.*

(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 aircraft'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 aircraft'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 document 9157:

> ***Strength***
>
> *5.4.13 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 5.3.22 for guidance on the minimum strength of the runway end safety area.*
>
> *5.3.22 Since the graded portion of a strip is provided to minimize the hazard to an aircraft running off the runway, it should be graded in such a manner as to prevent the collapse of the nose landing gear of the aircraft. The surface should be prepared in such a manner as to provide drag to an aircraft and below the surface; it should have sufficient bearing strength to avoid damage to the aircraft. To meet these divergent needs, the following guidelines are provided for preparing the strip. Aircraft 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 aircraft.*

(9) The above information from the ICAO design manual recommends that a RESA should have a CBR of 15 - 20. This CBR range should suffice for the largest of airliners overrunning into the RESA.

(10) The airport operator should also consult with the air operator or aircraft 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, restoration of damaged (rutted) areas, grass cutting to manage surface growth, etc. Winter maintenance in the RESA is not required; however snow should not be banked at the ends of the runway strip as this would create a hazard to aircraft overrunning, or on approach to, the runway.

Note: *See* Advisory Circular (AC) 302-013 *— Airport Winter Maintenance and Planning for information on snow profiles in the vicinity of the runway*.

6.0 SUMMARY

(1) The bearing strength of the RESA may be significantly less than the strength of the runway, since the RESA frequency of aircraft passage is expected to be significantly less.

(2) Ongoing maintenance of the RESA should be minimal.

7.0 INFORMATION MANAGEMENT

(1) Not applicable.

8.0 DOCUMENT HISTORY

(1) Not applicable.

9.0 CONTACT OFFICE

For more information, please contact:

http://www.tc.gc.ca/eng/regions.htm

Suggestions for amendment to this document are invited, and should be submitted via:

AARTinfodoc@tc.gc.ca

[original signed by]

Aaron McCrorie
Director, Standards
Civil Aviation
Transport Canada

Transport Canada documents or intranet pages mentioned in this document are available upon request through the Contact Office.