



RSA-08

RASG-PA SAFETY ADVISORY – 08

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Regional Aviation Safety Group-Pan America (RASG-PA)

Compatibility Issues Between Required Landing Performance and Touchdown Zone Definition

1. Introduction

1.1 Throughout 2020 and 2021, the COVID-19 pandemic has prompted the Pan-American Regional Aviation Safety Team (PA-RAST) to complement its data-driven process with direct inputs from the Region's Collaborative Safety Teams (CST), by assessing the systemic applicability of conclusions arising from any which Safety Enhancement Projects were being worked on by a CST.

1.2 During that period, the Brazilian Commercial Aviation Safety Team (BCAST) has provided an analysis on the compatibility of required landing performance of turbojets commonly applied to scheduled air transport and the touchdown zone length, after evaluating the landing performance on several operations. The BCAST Runway Excursion Safety Enhancement Team (RESET) has identified that there is a false and widespread perception among the aeronautical community that a long landing would only occur when touchdown occurs outside the touchdown zone or that any landing within the touchdown zone necessarily leads to a safe stop of the aircraft.

1.3 In fact, the definition of touchdown zone length (by means of runway markings standards) have nothing to do with landing performance. The BCAST study indicates that the requirements related to these markings date back to the 1950s and have as their main objective the runway threshold identification and inform the pilot of the aircraft relative position to the aiming point. It is necessary to understand the context of the time: it was probably challenging to find the runway and identify the correct threshold in NDB navigation, while the landing performance was of little relevance for "pre-jet era" aircraft.

1.4 The BCAST RE-SET has carried out data analysis on regular commercial aviation runway excursions accidents in Brazil between 2006 and 2017, which indicated that the touchdown occurred more than 500 meters beyond the threshold on 9 cases (56%), while 3 occurrences displayed touchdown within the touchdown zone. Furthermore, an analysis of data from 10,000 scheduled commercial flights in 2018 showed that more than half of the touchdowns occurred 500 meters beyond the threshold or more.

1.5 When searching for international references, the BCAST found that the FAA already establishes, in the practical checks for obtaining an Airline Pilot License and Type Ratings, that touchdown must occur in the region between 250 feet before and 500 feet after the point of sight (popularly known as the “thousand mark”). Other finding pointed to conspicuity factors on the US regulations regarding touchdown zone markings, that considered suppressing the last pair of stripes when a certain runway was considered short – in practice, reducing the touchdown zone length and thus making for stricter landing requirements for turbojets.

1.6 It was found that such provisions, for pilot training, airline operation specifications or runway markings on ICAO Convention Annexes were missing, therefore there is a possibility a State’s regulatory framework may be considered ICAO compliant, while not providing sufficient awareness or mitigation strategies to such scenarios.

1.7 The PA-RAST has assessed the conclusions of the BCAST Safety Enhancement Project BCAST – GT-RE - SE 02¹ and identified the scenarios are applicable to international flights in the region in a broad sense. Therefore, this RASG-PA Safety Advisory serves to raise awareness on the issues identified by the BCAST and directs some possible mitigation strategies for States, Airlines, and other stakeholders to best select which are the most effective ways to implement safety enhancement mechanisms to maintain an acceptable level of safety.

2. Detailed case analysis

2.1 The original analysis has pointed to the following scenarios that were leading to runway excursion precursor data to increase:

- a) Long landings, around the last touchdown zone marking, on runways with up to 2000 m of length;
- b) Long landings on runways with length greater than 2400 m; and
- c) Short landings on runways of up to 2000 m length and up to 30m wide.

* Please see a list of airports located in many countries of the region in the Appendix to this RSA.

2.2 The first scenario has been tagged as the most significant of the three, due to both

¹ <https://www.gov.br/anac/pt-br/assuntos/seguranca-operacional/grupos-brasileiros-de-seguranca-operacional-bast/bcast/BCASTSE002GTRerev014092021ImportnciadoPontodeToquenaPerformancedePouso.pdf>

prevalence / frequency and unawareness of the landing margins left when an aircraft performed a touchdown very close to the end of but still inside the touchdown zone.

2.3 Combination of several factors (such as runway length round 2000 m ~ 7000 ft or less, standards that require four pairs of TDZ markings solely based on RWY length, runway condition, windshear, wrong flare profile, or LDA assessment with low margins, miscalculation, landing weight, etc.) may lead to the real landing distance available be very close to or even shorter than what the aircraft safe performance require.

2.4 The following image (from @Google Earth) displays such scenario, in a runway with length of 1518 m / 4980 ft, compliant with the applicable standards (both State's and ICAO's), where safety margins may get too low to be acceptable, even though a landing may occur inside the established touchdown zone.



2.5 Such landing could go unnoticed under an airline FOQA program, especially if all other parameters are considered "normal" or "standards compliant". Therefore, attention to both regulators and airlines is considered paramount for that scenario.

2.6 The second scenario is most commonly related to a certain degree of complacency, when the runway is perceived as "too long" and could, in theory, accommodate any such parameters for a long landing and still provide mush margin to prevent an excursion. The following image shows two parallel runways, highlighting the fast exit from the downmost runway (3000 m / 9843 ft length):



2.7 Six pairs or TDZ markings are standards compliant, but both late touchdowns associated with high-speed exits may lead to excessive aircraft speed for the remaining of the runway. Associating several operational factors may also lead to “close to excursion” operations.

2.8 The third scenario involves a misleading perception of runway proximity during landings, on runways with reduced width (30 m / 100 ft). If pilots are usually flying to wider runways, they may have the impression of being “too high” when approaching narrower runways, therefore will face a tendency to an early / short touchdown. Some narrower runways without RESA may increase the rate of occurrence of an undershoot, hard landing or a combination of both – which in turn increase the possibility of an excursion due to loss of control on ground.

2.9 That last scenario may be less common for international flights, but when considering that such runways often lack other navigation aids (and thus operate normally on non-precision visual approaches), an airline or regulator may also face the lack of *performance-based* criteria to require touchdown zone markings or additional operational specifications for airlines.

3. Overall strategy

3.1 The PA-RAST has reviewed and concluded the following general guidance is recommended to States, Airlines, CSTs and related stakeholders to tackle the issues, should local studies identify the presence of such scenarios:

- Promotion on the implementation of effective mitigation measures to prevent landings outside a “Recommended Touchdown Area” should changes to runway markings or regulatory definitions be unfeasible or long-term solutions.
 - Changes in Theoretical / Practical Training Program for pilots;
 - Changes in Operational Manuals, in regard to assessment of locations where said scenarios are likely to occur;
 - Establishment of Continuous Touchdown Monitoring in FOQA, as practicable as possible.
- Updating manuals and training programs to include concepts of runway markings, point of sight, landing performance and recommended touchdown area with a performance-based perspective:
 - Review Theoretical Training Programs, in a clear and objective way, to include the concepts of Touch Zone Markings, Aiming Point, Landing Performance and Recommended Touch Area (Example: markings adjacent to the “aiming point”);
 - Include in their Practical Training Programs (approved by CAAs), during the landing maneuver, the need to touch down in the recommended area;
 - Include in your Operational Manuals, in a clear and objective way, the concepts

and illustrations referring to Touch Zone Markings (Annex 14), Point of Aim, Landing Performance and Recommended Touch Area;

- Include runway characteristics in relation to TDZ and Aiming Point markings in approach briefing policies. Such information must be included in the Airport Briefings of the locations that have some particularity in relation to the topic;
- Include systematic forms of touchpoint monitoring in your Flight Data Tracking and Analysis Programs (taking into account any data recording limitations).
- Evaluate the possibility of incorporating changes to the current Norms and Regulations to facilitate and/or promote harmonization in the application of mitigation strategies for the identified scenarios, for example:
 - Training Programs for Airlines and Schools, referring to the concepts of runway markings, point of view, landing performance, braking modes, recommended touchdown area; approach ramp on narrow runways, among others;
 - Aerodrome design, in relation to the definition of touchdown zone markings in view of the landing performance required for touchdown close to the last pair of markings, situations of suppression of touchdown zone markings, among others.
- Regulators are advised on the need to assess the following regulatory issues and how to incorporate any changes to the rules and regulations related to the prevention of Runway Excursion recommended by this RSA:
 - In order to make the required landing performance compatible with existing markings, modify or include:
 - The definition of “Touch Zone Markings”;
 - Guidance for operators to define a “Recommended Touchdown Area”, compatible with the landing performance of their aircraft; and
 - Assessment of recovery actions/barriers if the landing occurred beyond the recommended touchdown area defined by the operator. Such an assessment may require more detailed studies, see items OPS 21 and 22 of the Global Action Plan for the Prevention of Runway Excursions (GAPPRE) published in May 2021 by the Flight Safety Foundation;
 - Guidance to consider the computational logic of performance calculations (used by the Operations Engineering sector) in defining the required landing distances, their margins, weight limits and tailwind, and their direct relationship with the point of touch;
 - These items must be included, at a minimum, in the flight operations manuals of

air operators, with graphics, images or other clear forms of illustration;

- In order to adapt the conspicuity requirements of horizontal signaling with the performance required for landing, evaluate the possibility of elaborating rules for the suppression of markings in the touchdown zone, in line with the provisions of FAA AC No. 150/5340-1M;
 - Inclusion of the aforementioned topics as theoretical training topics, in the initial and recurrent training of technical crews, using videos and/or flight emulations where the recommended touchdown area was violated and projection of calculation simulations in real time in the tool of performance used by the company, for example: OPT (Onboard Performance Tool - Boeing).
- Promote regulatory review in regards to:
- Airline operations manuals and training programs;
 - Syllabus of aviation schools (theoretical and practical elementary training);
 - Airport infrastructure, on the standards for runway markings (touchdown zone definitions).

3.2 Some obstacles to effective implementation may arise, such as:

- Great diversity of Touch Zone markings found at aerodromes;
- Definition of touch point limit values in view of the performance peculiarities and limitations of the different equipment operated by airlines.

3.3 Due to these potential obstacles, each company may suggest alternative ways of complying with the recommendations of this SE based on the performance characteristics and specific limitations of its fleet, as well as adjustments to its operational and training standards.

3.4 CSTs, airlines, airport authorities and other parties are encouraged to collect data about the presence of said scenarios, mainly by establishing a process to assess the touchdown point of operations and classify occurrences that relate to any of said scenarios, especially if aircraft engaged in international flights are involved.

3. Final remarks

3.1 Any Organization that implements a Flight Data Monitoring / Flight Data Analysis Program (FDM or FDAP) should be aware of the impact of the current scenario on the data parameters collected. RASG-PA can provide specific guidance for the collection of the adequate parameters and thresholds. It is also recommended to take the opportunity to seek implementation or enhancement of a non-punitive reporting perspective in the FDM/FDAP processes.

3.2 RASG-PA therefore encourages the sharing of any information produced by such

programs (either public, restricted or in aggregate/de-identified form of data, etc.), through the data-driven process of the PA-RAST, by all regional organizations interested in collaborating in safety enhancements to the Pan American Region. The RASG-PA will seek to monitor, to the extent possible, any indicators related to the above list of safety areas.

3.3 To request any additional information, please contact the RASG-PA by email rasg-pa@icao.int or visit the RASG-PA website at <http://www.icao.int/RASGPA>

RARG-PA RSA08 – APPENDIX

<i>State</i>	<i>Airport ICAO CODE</i>	<i>Airport IATA CODE</i>	<i>Runway with up to 2000 m of length</i>	<i>Runways with length greater than 2400 m</i>	<i>Runways of up to 2000 m length and up to 30m wide</i>
Argentina	SANC	CTC		X	
	SAVC	CRD		X	
	SACO	COR		X	
	SAEZ	EZE		X	
				X	
	SARF	FMA			X
	SARI	IGR		X	
	SASJ	JUJ		X	
	SANL	IRJ		X	
	SAMM	LGS		X	
	SAME	MDZ		X	
	SAVY	PMY		X	
	SATR	RCQ			X
				X	
	SARE	RES		X	
	SAWG	RGL		X	
	SAWE	RGA	X		
	SANR	RHD		X	
	SLA	SLA		X	
				X	
	SADF	FDO			X
SANU	UAQ		X		
SAOU	LUQ		X		
SANE	SDE		X		
SANT	TUC		X		
SAVV	VDM		X		
SAOR	VME		X		
Aruba	TNCA	AUA		X	
Bahamas	MYNN	NAS		X	
				X	
Belize	MZBZ	BZE		X	
Bolivia	SLVR	VVI		X	
	SLLP	LPB		X	
	SLCB	CBB		X	
			X		
Brasil	SBCF	CNF		X	

	SBGL	GIG		X	
				X	
	SNKP	VCP		X	
	SBSV	SSA		X	
			X		
Chile	SCFA	ANF		X	
	SCCF	CJC		X	
	SCLL	VLR			X
	SCSE	LSC			X
	SCIP	IPC		X	
	SCEL	SCL		X	
				X	
	SCIE	CCP			X
Colombia	SKBO	BOG		X	
				X	
	SKMD	EOH		X	
	SKUI	UIB			X
	SKRG	MDE		X	
Costa Rica	MROC	SJO		X	
	MRLB	LIR		X	
	MRLM	LIO			X
Cuba	MUHA	HAV		X	
Dominican Republic	MDSD	SDQ		X	
	MDPP	POP		X	
	MDCY	AZS		X	
	MDBH	BRX		X	
	MDJB	JBQ			X
	MDAB	EPS			X
		MDPC	PUJ		X
				X	
El Salvador	MSLP	SAL		X	
Ecuador	SEQM	UIO		X	
	SEGU	GYE		X	
	SEGS	GPS		X	
Guatemala	MGGT	GUA		X	
	MGTK	FRS		X	
	MGPB	PBR		X	
Guyana	SYCJ	GEO		X	
			X		
Honduras	MHLM	SAP		X	

	MHPR	XPL		X	
	MHLC	LCE		X	
Jamaica	MKJS	MBJ		X	
México	MMAS	AGU		X	
	MMLO	BJX		X	
	MMGL	GDL		X	X
		KIN		X	
	MMLP	LAP		X	
	MMMM	MLM		X	
	MMML	MXL		X	
	MMPR	PVR		X	
	MMSD	SJD		X	
	MMTJ	TIJ		X	
	MMM	MEX		X	
				X	
	MMCZ	CZM		X	
	MMBT	HUX		X	
	MMMD	MID		X	
	MMOX	OAX		X	
	MMTP	TAP	X		
	MMVR	VER		X	
Nicaragua	MNMG	MGA		X	
	MNCE	ECI			X
	MNBL	BEF			X
Panamá	MPTO	PTY		X	
				X	
	MPMG	PAC			X
	MPPA	BLB		X	
Paraguay	SGAS	ASU		X	
	SGES	AGT		X	
Perú	SPJC	LIM		X	
	SPQU	AQP		X	
	SPHI	CIX		X	
	SPRU	TRU		X	
	SPSO	PIO		X	
	SPZO	CUZ		X	
	SPQT	IQT		X	
Puerto Rico	TJSJ	SJU		X	
				X	
Santa Lucía	TLPC	SLU	X		

	TLPL	UVF		X	
Trinidad & Tobago	TTCP	TAB		X	
	TTPP	POS		X	
Uruguay	SUMU	MVD		X	
	SULS	PDP			X
Venezuela	SVMU	CCS		X	
				X	
	SVCU	CUM		X	
