RAAC/14-IP/05
21/10/15

International Civil Aviation Organization
ICAO South American Regional Office
Fourteenth Meeting of the Civil Aviation Authorities of the SAM Region (RAAC/14)
(Santiago, 27, 28 and 30 October 2015)

Agenda Item 7: Other Matters

RUNWAY EXCURSION MITIGATION

(Presented by the United States)

SUMMARY

The 2014-2016 Global Aviation Safety Plan (GASP) mandates improvement in *runway safety performance* as global safety priorities. ICAO has determined that the *mitigation of runway excursions* is an essential element to achieve this global safety priority.

GREPECAS has also emphasized projects throughout the region to improve runway safety through such activities as runway safety teams and workshops on best practices to prevent runway incursions and excursions.

This Information Paper provides various *aerodrome-specific* technical solutions for implementation within the CAR/SAM Regions. All aerodrome-specific technical solutions relate to either aerodrome designs or aerodrome maintenance, most covered by ICAO Annex 14, Volume I.

Their implementation, as addressed in this IP promotes the GASP's objective that*: "As an integral part of the GASP, Regional Aviation Safety Groups (RASGs), together with Regional Safety Oversight Organizations (RSOOs) will harmonize all activities undertaken to address aviation safety issues specific to each ICAO region."*

This IP provides further information for Member States to consider when expanding their existing runway excursion programs by encouraging the implementation of aerodrome-specific technical solutions.

Additionally, the U.S. FAA Office of Airports is willing to lend its technical support to the ICAO CAR/SAM Regional Offices for their effective implementation.

References:

- ICAO 2014-2016 Global Aviation Safety Plan
- ICAO Annex 14, Volume I, Aerodromes Design and Operations
- ICAO PASG/1-DP/8 dated 1 November 2009
- FAA Advisory Circular (AC) 150/5300-13A, Airport Design
- FAA AC 150/5320-12, Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces
- FAA AC 150/5220-22, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns
- FAA AC 150/5340-18, Standards for Airport Sign Systems

***ICAO Strategic Objectives*:**	*A - Safety*

1. Introduction

1.1 Runway excursions are a common problem associated with aviation accidents; therefore it is important for aerodrome operators to create a safe environment within the airfield for the operation of aircraft while minimizing their risks to runway excursions and their consequences. Annex 14, Volume I identifies various safety practices that include both the design of airfield infrastructures and operational maintenance programs. Paragraph 2 of this IP provides the common aerodrome-specific technical solutions.

1.2 According to the ICAO iSTARs database, GREPECAS States have an effective implementation rate of 60.46% of aerodrome standards and recommended practices. Many of the deficiencies fall under Critical Element 4 (Technical personnel qualification and training) and Critical Element 7 (Surveillance Obligations).

2. Discussion

2.1 *Rubber Removal:* Landing and braking aircraft leave tire rubber embedded in any available surface holes or voids (please see figure 1). It is well documented that rubber build-up on runways will reduce the aircraft’s braking action. Wet runway conditions compound the problem by increasing the potential for water pools, as well as the slippery effect to the surface due to the resulting loss of the pavement tire friction. Because monitoring runway surface friction is an important safety function for aerodrome operators, the CAR/SAM Regions should implement programs for the timely removal of rubber-buildup (please see FAA AC 150/5320-12). The four most popular methods of removing rubber build-up consist of water blasting, chemical removal, shot blasting and mechanical removal.

Figure 1. Excessive rubber build-up on the runway

2.2 *Longitudinal Grading of Final ¼ of Runways:* The first and last ¼ of longitudinal runway grading for code 3 and code 4 runways plays an important safety role in mitigating overshoot and undershoot incidents. When the grades are properly maintained within these runway segments, the pilot’s visibility and the performance of instrument approach systems are enhanced. Physical characteristics, such as runway lights and aiming points are also better sighted and acquired when the first and last ¼ of the runway grades are constructed within the standard parameters. Finally, longitudinal grading constructed within the proper parameters, also increases an aircraft’s ability to properly perform the aircraft braking action. For example, excessive downward slopes at the stop end of a runway only lengthen the stoppage distance of an aircraft, while an excessive upward slope at the approach end of a runway causes pilots (human factor) to over shoot the touchdown zone. FAA AC 150/5300-13, *Airport Design*, clearly prescribes the appropriate runway longitudinal grade profile.

2.3 *Runway Markings, Signage, and Lighting*: Compliance and maintenance of runway markings, signage, and lighting in accordance with Annex 14, Volume I support the mitigation of runway excursions. When Runways are well marked and maintained with the appropriate paint, quantity of signs and lighting; the risk from human factors decreases and thus mitigates the frequency of excursions at an airport.

2.4 *Distance Remaining Signs:* Distance Remaining Signs (DRS) provide situational awareness for pilots. The DRS reduces the time it takes Pilots to determine the runway distance remaining after touchdown or during take-off operations - from both ends of the runway. These signs along the side of the runway also enhance the pilot's ability to determine available runway length to: (1) execute safe deceleration during landing operations, (2) accelerate, rotate and lift-off during take-offs, and (3) safely abort a take-off. In accordance with FAA AC 150/5340-18, *Standards for Airport Sign Systems*, DRS are placed at 1000-foot intervals (300 meters) as shown in figure 2. Although the installation of DRS plays a helpful role in the U.S., Annex 14, Volume I do not address or recognize this signage practice and its safety benefits on airport runways.

Figure 2. Distance remaining signs along a runway; close-up view of an individual installation

2.5 *Runway Grooving and USOP:* The CAR/SAM Regions are known for their high intensity short duration and frequent tropical storms. The use of transverse grooves or pavement channeling (6mm x 6mm spaced at 38mm apart) across the runway surface enables water runoff to flow with less depth beneath the tires footprint.(please see figure 3). The presence of grooves does not increase the frictional characteristics of the pavement; it does however, reduce the risk of hydroplaning. (Please see FAA AC 15/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*). This IP further makes note of the results found in the April 2005-December 2008 USOP audit. That audit revealed the lack of airport reporting of wet runways (70% failure) and identified it as the second highest non-compliant ICAO Annex 14 standard violation (Reference: PASG/1-DP/8 dated 1 November 2009).

Figure 3. Standard (Left) and Trapezoidal (Right) Grooves Side by Side

2.6 *Runway End Safety Areas and Arrestor Bed Systems (RESA)*: Unfortunately, not all runway excursions can be avoided and ICAO recognizes that there are proven methods to employ that may mitigate these excursions. ICAO Annex 14 prescribes the standard design feature of a runway end safety area that extends beyond the runway end as a proven means to minimize personal injury and minimize aircraft damage during excursion events and undershoots. The Annex prescribes both a standard length and a longer recommended length for RESA. Although the Annex prefers that aerodromes comply with at least the standard length (availability of terrain), it also recognizes that many aerodromes are land-constraint. In that case, the Annex provides several design recommendations which comply with the standard length or the recommended length. The principal design options are: (1) the use of declared distances and (2) the installation of an arrestor bed system in substitution of proscribed length, but which would achieve the equivalent effect of a standard or recommended RESA length. Arrestor bed systems are known in the United States as EMAS which stands for "engineered materials arresting system" (please see FAA AC 150/5220-22, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*). Figure 4 shows what has been the typical arrestor bed system installed in the U.S. over the past two decades. Just recently, the FAA technically accepted and approved the use of a second type of EMAS, composed and manufactured with different materials from the bed shown in figure 5.

Figure 4. Aerial photo showing the original, materially-designed arrestor bed system installed off Runway 26 at Burbank Airport, Burbank, California

Figure 5. Ground photo showing the newest, materially-designed arrestor bed system installed off Runway 22L at Midway Airport, Chicago, Illinois

2.7 EMAS is a critical aspect of the FAA's United States Runway Safety Area (RSA) Program requiring all runways to have a RSA at both ends. This IP notes that the FAA RSA begins at the end of the runway (or stopway) as compared to the ICAO Annex RESA which begins beyond the runway strip. For the United States, several RSA improvement projects to meet the FAA standards could only be achieved by installing EMAS arrestor bed systems. Most often, these projects had to overcome the lack of sufficient terrain. Currently there are 83 EMAS installations at 53 airports in the U.S. with 15 planned installations at 12 more airports. U.S. civil aviation has benefited with EMAS successfully arresting 9 aircraft overruns, with little or no damage to 243 passengers and crew and equipment. There have been no fatalities with EMAS.

3. Conclusion

3.1 It is important to note that GREPECAS has emphasized projects throughout the region to improve runway safety through such activities as runway safety teams and workshops on best practices to prevent runway incursions and excursions. These efforts along with implementing the aerodrome-specific technical solutions mentioned in this paper would contribute to the mitigation of runway excursions in this region.

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