International Civil Aviation Organization

Sixth Meeting of the Asia/Pacific Aerodrome Design and Operations Task Force (AP-ADO/TF/6)

Langkawi, Malaysia, 18 - 21 February 2025

Agenda Item 4: Planning, Design and Construction of Aerodromes

TOLERANCE IN AERODROME PHYSICAL CHARACTERISTICS AND ADDRESSING INCONSISTENCIES IN ICAO ANNEX 14 VOLUME I

(Presented by Malaysia)

SUMMARY

This paper presents acceptable tolerances in the physical characteristics and visual aids of aerodromes, addressing the flexibility needed to meet operational needs while maintaining safety standards. It compares ICAO Standards and Recommended Practices (SARPs) with FAA and CAA UK standards for runway and taxiway markings, aeronautical ground lights and wind direction indicators. The paper also highlights inconsistencies in ICAO Annex 14 Volume I, particularly regarding taxiway centerline markings, threshold markings, transverse stripes, pavement edge flush requirements and precision approach lighting. It recommends clarification of these issues to ensure consistency and support global aviation safety and efficiency.

1. INTRODUCTION

1.1 At the Eighth Meeting of the Aerodromes Operations and Planning Sub-Group (AOP/SG/8) and the Fifth Meeting of the Asia/Pacific Aerodrome Design and Operations Task Force (AP-ADO/TF/5) in 2024, Malaysia presented papers addressing the tolerance in the physical characteristics of aerodromes and the inconsistencies in the requirements outlined in ICAO Annex 14 Volume I.

1.2 This paper further examines the acceptable tolerances in the physical characteristics and visual aids of aerodrome exploring how such flexibility can address operational needs without compromising safety or performance standards. The study includes recommendations and factual data from the ICAO Aerodrome Design Manual, as well as other relevant regulatory standards.

2. DISCUSSION

2.1 The following are the acceptable deviations and tolerances in the visual aids for navigation at aerodromes that require further deliberation:

Markings

2.2 In the ICAO Aerodrome Design Manual, Part 4, Appendix 3, which outlines the Selection, Application, and Removal of Paints, it is recommended that the procedures for paint application include an acceptable tolerance of ±5 percent. This study also provides a comparative analysis of permissible tolerances for runway and taxiway markings, referencing the FAA Advisory Circular AC 150/5370-10H, the Standards and Specifications for Construction of Airports, Part 9 as presented in AOP/SG/8 in 2024. *Refer to the appendix*

<table>
<tr><th>Aerodrome Design Manual, Doc 9157 Part 4 - Visual Aids, Appendix 3 (19) (d)</th><th>FAA Advisory Circular AC 150/5370-10H</th></tr>
<tr><td>Ensure that the edges of the markings do not vary from a straight line more than 12 mm in 15 m and that the tolerance for the dimensions is ±5 per cent.</td><td>Marking Dimension and Spacing Tolerance
<table>
<tr><th>No.</th><th>Dimension and Spacing</th><th>Tolerance</th></tr>
<tr><td>1</td><td>36 inch (910 mm) or less</td><td>±1/2 inch (12 mm)</td></tr>
<tr><td>2</td><td>Greater than 36 inch to 6 feet (910 mm to 1.85 m)</td><td>±1 inch (25 mm)</td></tr>
<tr><td>3</td><td>Greater than 6 feet to 60 feet (1.85 m to 18.3 m)</td><td>±2 inch (50 mm)</td></tr>
<tr><td>4</td><td>Greater than 60 feet (18.3 m)</td><td>±3 inch (76 mm)</td></tr>
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2.3 This paper recommends the adoption of a ±5 percent tolerance in the application of markings in the movement area, as outlined in the Aerodrome Design Manual, Doc 9157 Part 4, to ensure uniformity and consistency in runway and taxiway markings, thereby enhancing safety, operational efficiency and regulatory compliance at aerodromes.

Aeronautical Ground Light

Runway Edge Light

2.4 Annex 14 Volume I Para 5.3.9.6 addresses the criteria for the installation of runway edge lights and specifies the necessary conditions whereby the lights shall be uniformly spaced in rows at intervals of not more than 60 m for an instrument runway and at intervals of not more than 100 m for a non-instrument runway.

2.5 Additional analysis of the permissible tolerance has been conducted based on the requirements outlined in CAA UK CAP168 Licensing of Aerodromes, Paragraph 6.52, as well as FAA 150/5340-30J on Design and Installation Details for Airport Visual Aids, Paragraph 2.3.1.2.1 (4), as detailed below:

CAA UK CAP168 Licensing of Aerodromes, Paragraph 6.52	**FAA 150/5340-30J Paragraph 2.3.1.2.1 (4)**
On runways of up to 50 m in width, the longitudinal spacing of the lights should be **60 m ± 6 m**. Where the width of the runway exceeds 50 m, a closer longitudinal spacing as **determined by the CAA** may be required dependent upon the nature of operations and other visual aids serving the runway.	Longitudinal spacing between light units must not exceed **200 ft (61 m).**

Taxiway Edge Light (Straight Section)

2.6 Annex 14, Volume I, Paragraph 5.3.18.3 recommends that taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi route should be spaced at uniform longitudinal intervals not exceeding 60m.

2.7 Additional best practice comparisons are made based on FAA 150/5340-30J, Design and Installation Details for Airport Visual Aids, Table 2-1, which outlines the spacing for taxiway edge lights. The spacing is determined based on the configuration of the taxiway.

Table 2 - 1: Straight Taxiway Edge Light Spacing (FAA 150/5340-30J)

Section Length (L)	**Number, Edge Lights (N) (per side)[1]**	**Maximum Spacing (Max)**	**Spacing (S)**
L ≤ 50 ft (15 m)	2	50 ft (15 m)	L
L > 50 ft (15 m) and L ≤ 100 ft (30m)	3	50 ft (15 m)	L/2
L > 100 ft (30m) and L ≤ 200 ft (61 m)	3 [(L/max) + 1][2, 3]	100 ft (30 m) 50 ft (15 m) (single edges)	L/2 L/(N-1)[3]
L > 200 ft (61 m)	[(L/max) + 1][2]	100 ft (30 m) (single edges)[3] 200 ft (61 m)	L/(N-1)

1. Number (N) excludes lights required for end and entrance/exit indicators.
2. Round value up to the next whole number, i.e., 1.31 becomes 2.
3. Applies to single straight taxiways or aprons, where only one side exists.

2.8 This paper recommends further study on the distance tolerance for runway and taxiway edge lights to ensure compliance with international standards, improve operational safety and optimize the effectiveness of lighting systems in guiding aircraft especially during low-visibility conditions.

Wind Direction Indicator, Circular Band

2.9 The circular band on a wind direction indicator enhances its visibility, providing pilots a clearer reference for assessing wind direction and intensity, especially in adverse weather conditions. Annex 14, Volume I, Paragraph 5.1.1.4 recommends that at least one unit be installed, marked by a circular band with a diameter of 15 meters and a width of 1.2 meters.

2.10 This paper recommends a ±5% acceptable tolerance (similar to markings) for deviations from the standard caused by construction and maintenance work in order to maintain consistency and minimize operational disruptions.

Inconsistencies in ICAO Annex 14 Volume I

2.11 In the AP-ADO/TF/5 meeting in 2024, Malaysia presented a working paper highlighting inconsistencies in the requirements outlined in ICAO Annex 14 Volume I, which could cause confusion in the adoption of SARPs related to taxiway centerline markings, threshold markings, taxiway transverse stripes, flush pavement edges, and precision approach lighting. This paper recommends that ICAO provide further updates to address these inconsistencies and enhance uniformity in aerodrome design and operations across all member States. By addressing these inconsistencies, ICAO can help harmonize aerodrome design and operations, ultimately supporting global aviation safety and operational efficiency.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) deliberate on the information contained in this paper;

b) consider and adopt the recommendations; and

c) discuss any relevant matters as appropriate.

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Appendix

Comparative Review Allowable Tolerance based on Aerodrome Design Manual, Doc 9157 Part 4 - Visual Aids, Appendix 3 (9) (d) and FAA Advisory Circular AC 150/5370-10H

Marking	REQUIRED CHARACTERISTICS		ALLOWABLE TOLERANCE				Remarks
	Dimension		ICAO Aerodrome Design Manual Part 4		FAA		
	Unit	Dimension	Min	Max	Min	Max	
Runway							
Transverse stripe	Width (m)	1.8	1.71	1.89	1.78	1.83	
Threshold	Length (m)	30	28.50	31.50	29.92	30.08	
	Width (m)	1.8	1.71	1.89	1.78	1.83	Runway width ≥ 45m
	Width (m)	1.75	1.66	1.84	1.73	1.78	Runway width ≥ 45m

	Width (m)	1.7	1.62	1.79	1.68	1.73	Runway width ≤ 45m
Runway Designation	Length (m)	9	8.55	9.45	8.95	9.05	
	Width (m)	3.9	3.71	4.10	3.82	3.98	Subject to number
	Width (m)	3.9	3.71	4.10	3.82	3.98	
	Width (m)	3.5	3.33	3.68	3.50	3.50	
Runway Centre Line	Length (m)	30	28.50	31.50	29.92	30.08	
	Width (m)	0.9	0.86	0.95	0.89	0.91	CAT II & III
	Width (m)	0.45	0.43	0.47	0.44	0.46	CAT I
	Width (m)	0.3	0.29	0.32	0.29	0.31	Non-instrument
Aiming Point	Length (m)	45	42.75	47.25	44.92	45.08	Min. length
	Length (m)	60	57.00	63.00	59.92	60.08	Max. length
	Width (m)	6	5.70	6.30	5.95	6.05	Min. length
	Width (m)	10	9.50	10.50	9.95	10.05	Max. length
Touchdown Zone	Length (m)	22.5	21.38	23.63	22.42	22.58	
	Width (m)	3	2.85	3.15	2.95	3.05	Basic pattern
	Width (m)	1.8	1.71	1.89	1.78	1.83	Distance coding
Runway Side Stripe	Width (m)	0.9	0.86	0.95	0.89	0.91	Runway width ≥ 30m
	Width (m)	0.45	0.43	0.47	0.44	0.46	Runway width < 30m

Table 1: Comparison of Permissible Tolerances for Runway Markings

Marking	**REQUIRED CHARACTERISTICS**		**ALLOWABLE TOLERANCE**				**Remarks**
	Dimension		**ICAO Aerodrome Design Manual Part 4**		**FAA**		
	Unit	**Dimension**	**Min**	**Max**	**Min**	**Max**	
Taxiway							
Taxiway Centre Line	Width (m)	0.15	0.14	0.16	0.14	0.16	
Taxi Side Stripe	Width (m)	0.15	0.14	0.16	0.14	0.16	
Transverse Stripe	Length (m)	7.5	7.13	7.88	7.45	7.55	
	Width (m)	0.9	0.86	0.95	0.89	0.91	
Runway-holding position	Length (m)	0.9	0.86	0.95	0.89	0.91	
	Width (m)	0.15	0.14	0.16	0.14	0.16	
Intermediate Holding Position	Length (m)	0.9	0.86	0.95	0.89	0.91	
	Width (m)	0.3	0.29	0.32	0.29	0.31	

Table 2: Comparison of Acceptable Tolerances for Taxiway Markings

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