



CIVIL AVIATION AUTHORITY OF THE PHILIPPINES

Manual of Standards for Aerodromes

2nd Edition

FEBRUARY 2017

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INTRODUCTION

This is a Civil Aviation Authority of the Philippines (CAAP) safety programme document. It contains specifications of uniform application (standards) prescribed and determined to be necessary for the safety of air navigation at aerodromes in the Republic of the Philippines.

This manual is incorporated in Civil Aviation Regulations governing Aerodromes (CAR-Aerodromes), by reference.

Copies of this manual are available from:

**Director General
Civil Aviation Authority of the Philippines
Civil Aviation Authority of the Philippines
Pasay City, Metro Manila,
Philippines 1301**

This manual may be amended from time to time, and the Director General of Civil Aviation will provide such amendment service.

Comments about the content are welcome from members of the aviation industry or the public. Any comments or requests for clarification should be directed to:

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FOREWORD

The Civil Aviation Authority of the Philippines (CAAP) is responsible under the Civil Aviation Authority Act of 2008 (Republic Act No. 9497) of the Republic of the Philippines, as amended) for the regulation of civil aviation in the Philippines. The CAAP exercises regulatory oversight by, in part, developing and promulgating appropriate, clear and enforceable aviation safety standards.

This Manual of Standards for Aerodromes (MOS) is one mechanism that CAAP uses to meet the responsibilities of the Republic Act No. 9497 to ensure the safety regulation of aerodromes. This document, as a component of the state safety programme, prescribes the detailed technical requirements (aerodrome safety standards) that have been determined to be necessary for promoting and supporting aviation safety in general and aerodrome safety in particular.

ICAO Annex 14 Standards and Recommended Practices (SARPs) are contained in MOS, including the requirement that all certified aerodromes shall have a Safety Management System (SMS). Aerodromes are to be certified where international operations occur, or where air transport operations are conducted by aircraft with a passenger seating capacity greater than 30. Certified aerodromes in the Philippines are required to have an acceptable safety management system in place. Other smaller and less complex aerodromes may be registered with CAAP and have aeronautical data published in the AIP, but the need for an aerodrome safety management system is not imposed. Requirements for Permit to Operate for aerodromes are detailed in CAR-Aerodromes Part 2.4 and Chapter 4 of this Manual. Standards are applicable to all aerodromes according to the critical type of aircraft operating at each particular location.

The MOS is referenced to Civil Aviation Regulations governing Aerodromes (CAR- Aerodromes). Users of this document shall refer to the applicable provisions of the Republic Act No. 9497 and CAR-Aerodromes, together with this manual, to ascertain the requirements of, and the obligations imposed by, the civil aviation regulations pertaining to aerodromes and aerodrome operators.

The responsibility for matters within this Manual of Standards rests with the CAAP. Readers should forward advice of errors, inconsistencies or suggestions as the case may be for improvement to Head of AANSOO at the address shown in this manual.



CAPT. JIM C. SYDIONGCO
Director General

Civil Aviation Authority of the Philippines

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AMENDMENT RECORD

The amendments listed below have been incorporated into this copy of Manual of Standards for Aerodromes.

Amendment Number	Details	Signature	Date
Initial issue	Complete manual - initial draft	Exec. Director Daniel A. Dimagiba	May 2008
1	Editorial changes throughout, amendments to Ch. 1, Ch. 2, Ch 3, Ch 4 and Ch5, updated runway holding point markings, amended VOR clearance requirements, new Ch. 15, certificate application form added. ICAO Amendment 10 to Annex 14 incorporated.	DG Ruben F. Ciron	October 2009
2	Table of contents, page xv updated. Appendix 2 updated. Chapter 13 amended to include standards for aerodromes used in aerial agricultural operations	DG Ramon S. Gutierrez	April 2012
3	Editorial changes on Chapters 2, 6, 8, 9, 11, 13, 14 and 15. Amendment record correction effected on title.	DG William K. Hotchkiss	September 2012
4	Revised the MOS and incorporated Amendments 11-A, 12, and 13 to Annex 14 Volume I; Amendments 5, 6, and 7 to Annex 14 Volume II; operational procedures contained in PANS-Aerodromes; other international SARPs not incorporated in the initial issue of MOS; and addition of Attachments A and B.	DG Jim C. Sydiongco	February 2017
5	Amended the MOS-Aerodromes, 2 nd edition to incorporate Amendment 14 to Annex 14 Vol. I (MC 22-19) and Amendment 8 to Annex 14 Vol. II (MC 20-19). The amendment incorporates the following changes: revised aerodrome reference code in Table 2.1-1; runway widths, shoulders, turn pads and strips; taxiway widths, shoulders and strips; reduced taxiway minimum separation distances; updated footnote (e) in Table 7.1-1; and consequential amendment related to change of references, data quality requirements and performance- based data error detection requirements as a result of the restructuring of Annex 15 and the introduction of PANS- AIM (Doc 10066).	DG Jim C. Sydiongco	19 June 2019 and 30 July 2019
6	Amended the MOS-Aerodromes, 2 nd edition to incorporate MC 04-2020. The amendment includes changes in Chapters 3, 4, 10, 12 and 13 on the following subjects: criteria in the application of an aerodrome certificate; scope and content of the aerodrome manual; aerodrome registration Types 1 and 2; and, aerodrome safety management system.	DG Jim C. Sydiongco	06 February 2020

7	Amended the MOS-Aerodromes, 2nd Edition to incorporate Amendment 15 to Annex 14 Vol. I (MC 06-2021) and Amendment 9 to Annex 14 Vol. II (MC 001-2021). The amendment incorporates the following changes in Chapters 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 14, 15 and Attachment A: revised definition of precision approach runway category III; airport master plan; aeroplanes equipped with folding wing tips; reporting of pavement strength; reporting of works in progress on movement areas; width of clearways; standardized taxiway nomenclature; runway guard lights; no-entry bars; minimum sizes of signs; autonomous aircraft detection system; visual aids for denoting closed runways and taxiways or part thereof; training of aerodrome personnel; procedures on management of wildlife, apron safety; establishment of airside driver permit; definitions of design D, D-value, dynamic load-bearing surface, elongated, helicopter stand, helicopter taxiway, helicopter taxi-route, heliport reference point, protection area, touchdown positioning circle, and touchdown positioning marking; physical characteristics; visual aids; and rescue and firefighting. Amendment to Chapter 15 is largely based on the simplified, performance-based provisions which include, among other things, a single common standard for ground-level and elevated heliports to minimize unnecessary design complexities	DG Jim C. Sydiongco	05 January 2021 and 29 January 2021
8	Amended the MOS-Aerodromes, 2 nd Edition to incorporate Amendment 16 to Annex 14 Vol. I (MC 23-2021). The amendment covers the postponement of the applicability date of Amendment 13-B concerning use of an enhanced global reporting format for assessing and reporting runway surface conditions.	DG Jim C. Sydiongco	13 August 2021

TABLE OF CONTENTS

INTRODUCTION	i
FOREWORD	iii
AMENDMENT RECORD	v
TABLE OF CONTENTS	viii
CHAPTER 1. INTRODUCTION	1-1
Section 1.1 General	1-1
1.1.1 Background	1-1
1.1.2 Terminology used in MOS	1-2
1.1.3 Document Set	1-3
1.1.4 Difference between ICAO SARPs and MOS specifications	1-4
1.1.5 Differences published in AIP	1-4
1.1.6 MOS documentation change management	1-4
1.1.7 Related documents	1-5
Section 1.2 Common reference systems	1-6
1.2.1 Horizontal reference system	1-6
1.2.2 Vertical reference system	1-7
1.2.3 Temporal reference system	1-7
Section 1.3 Airport design and Master Plan	1-7
Section 1.3.1 Airport design (<i>Applicable until 02 November 2022</i>)	1-7
Section 1.3.2 Airport design (<i>Applicable as of 03 November 2022</i>)	1-8
Section 1.4 Definition of Terms	1-9
Section 1.5 Abbreviations and Symbols	1-22
1.5.1 Abbreviations	1-22
1.5.2 Symbols	1-25
Section 1.6 Certification of Aerodromes	1-25
CHAPTER 2. APPLICATION OF STANDARDS TO AERODROMES	2-1
Section 2.1 General	2-1
2.1.1 Legislative background and applicability	2-1
2.1.2 Changes to standards	2-1
2.1.3 Aeronautical studies	2-1
2.1.4 Exemption to standards	2-2
2.1.5 Conflict with other standards	2-3
2.1.6 Aerodrome Reference Code	2-3
2.1.7 Aerodrome Reference Codes and aeroplane characteristics	2-5
2.1.8 Providing for future larger aeroplanes	2-7

2.1.9	Non-instrument and instrument runways	2-8
2.1.10	Non-precision approach runways	2-8
2.1.11	Specific Procedures for Aerodrome Operations	2-9
CHAPTER 3. APPLYING FOR AN AERODROME CERTIFICATE		3-1
Section 3.1	General	3-1
3.1.1	Introduction	3-1
3.1.2	Processing an Aerodrome Certificate application	3-1
3.1.3	Granting of an Aerodrome Certificate	3-2
3.1.4	Aerodrome operator organization	3-3
3.1.5	Amendment of an Aerodrome Certificate	3-4
3.1.6	Continued validity of an aerodrome certificate	3-4
Section 3.2	Aerodrome certification process	3-5
3.2.1	Phase 1: Initial certification	3-5
3.2.2	Phase 2: Aerodrome Manual Review and Acceptance	3-5
3.2.3	Phase 3: On-site Verification	3-5
3.2.4	Phase 4: Issuance of Aerodrome Certificate	3-5
3.2.5	Phase 5: Initial Surveillance	3-5
Section 3.3	Aerodrome Manual	3-6
3.3.1	General	3-6
3.3.2	Scope of the Aerodrome Manual	3-6
3.3.3	Format of an Aerodrome Manual	3-6
3.3.4	Contents of the Aerodrome Manual	3-7
3.3.5	Updating of the Aerodrome Manual	3-9
3.3.6	Maintenance and Control of Aerodrome Manual	3-9
3.3.7	Issue and distribution of an Aerodrome Manual	3-10
3.3.8	Amendment of an Aerodrome Manual	3-10
3.3.9	Initiating NOTAM for a new certified aerodrome	3-11
CHAPTER 4.	APPLYING FOR AN AERODROME REGISTRATION TYPE 1, AERODROME REGISTRATION TYPE 2 AND PERMIT TO OPERATE (PTO)	4-1
Section 4.1	Registered Aerodrome Type 1	4-1
4.1.1	Introduction	4-1
4.1.2	Processing an Aerodrome Registration Type 1 application	4-1
4.1.3	Granting of an Aerodrome Registration Type 1	4-2
4.1.4	Aerodrome operator organization	4-3
4.1.5	Amendment of an Aerodrome Registration Type 1	4-3
4.1.6	Transfer of an Aerodrome Registration Type 1	4-3
4.1.7	Continued validity of an Aerodrome Registration Type 1	4-3

4.1.8	Aerodrome Registration Type 1 process	4-4
4.1.9	Aerodrome Manual	4-5
Section 4.2	Registered Aerodrome Type 2	4-6
4.2.1	Introduction	4-6
4.2.2	Approving an Aerodrome Registration Type 2 application	4-7
4.2.3	Maintenance of an Aerodrome Registration Type 2	4-7
4.2.4	Aerodrome Safety Inspection Report	4-8
Section 4.3	Permit to operate (PTO)	4-8
4.3.1	Introduction	4-8
4.3.2	Approving an application for a PTO	4-8
4.3.3	Conditions on Permit to Operate	4-8
4.3.4	Technical specifications and operating standards	4-9
4.3.5	Operating Procedures	4-10
CHAPTER 5. AERODROME INFORMATION FOR AIP		5-1
Section 5.1	General	5-1
5.1.1	Introduction	5-1
5.1.2	Aeronautical Data	5-2
5.1.3	Aerodrome information to be provided for publication in AIP	5-2
5.1.4	Standards for determining aerodrome information	5-4
5.1.5	Condition of the movement area and related facilities	5-12
5.1.6	Obstacle Data	5-14
5.1.7	Runway surface condition(s) for use in runway condition report	5-14
5.1.8	Runway friction level	5-15
5.1.9	Strength of pavements	5-16
Section 5.2	Illustration of declared distances	5-19
5.2.1	Introduction	5-19
5.2.2	Calculation of declared distances	5-19
5.2.3	Obstacle-free Take-off Gradient	5-21
5.2.4	Critical Obstacle	5-21
5.2.5	Declared Distances for Intersection Departures	5-21
Section 5.3	Coordination between aeronautical information services and aerodrome authorities	5-23
5.4	Disabled aircraft removal	5-24
5.5	Rescue and firefighting	5-24
5.6	Visual approach slope indicator systems	5-24
CHAPTER 6. AERODROME PHYSICAL CHARACTERISTICS		6-1
Section 6.1	General	6-1
6.1.1	Introduction	6-1

Section 6.2	Runways	6-1
6.2.1	Number and orientation of runways	6-1
6.2.2	Location of Runway Threshold	6-2
6.2.3	Length of Runway	6-3
6.2.4	Runway Width	6-3
6.2.5	Runway Turn Pads	6-4
6.2.6	Spacing for Parallel Runways	6-6
6.2.7	Runway Longitudinal slope	6-7
6.2.8	Runway Sight Distance	6-9
6.2.9	Transverse Slopes on Runways	6-10
6.2.10	Runway Surface	6-10
6.2.11	Runway Bearing Strength	6-12
6.2.12	Runway Shoulders	6-12
6.2.13	Characteristics of runway Shoulders	6-12
6.2.14	Surface of runway Shoulder	6-13
6.2.15	Width of Runway shoulders	6-13
6.2.16	Slopes on a runway shoulder	6-13
6.2.17	Strength of runway shoulders	6-13
Section 6.3	Runway Strip	6-14
6.3.1	General	6-14
6.3.2	Runway Strip Length	6-15
6.3.3	Runway Strip Width	6-15
6.3.4	Longitudinal Slope on Graded Area of Runway Strip	6-16
6.3.5	Longitudinal Slope Changes on Graded Area of Runway Strip	6-17
6.3.6	Radio Altimeter Operating Area	6-17
6.3.7	Runway Strip Transverse Slope	6-17
6.3.8	Grading of Runway Strips	6-18
6.3.9	Objects on Runway Strips	6-19
6.3.10	Runway Strip strength	6-20
Section 6.4	Runway End Safety Area	6-20
6.4.1	Runway End Safety Area (RESA)	6-20
Section 6.5	Clearway	6-22
6.5.1	General	6-22
6.5.2	Location of Clearways	6-22
6.5.3	Dimensions of Clearways	6-22
6.5.4	Slopes on Clearways	6-22
6.5.5	Objects on Clearways	6-23
Section 6.6	Stopway	6-23

6.6.1	General	6-23
6.6.2	Dimensions of stopways	6-23
6.6.3	Surface of stopways	6-23
6.6.4	Slopes on stopways	6-23
6.6.5	Bearing strength of stopway	6-24
Section 6.7	Taxiways	6-24
6.7.1	Taxiway Width	6-24
6.7.2	Taxiway Edge Clearance	6-25
6.7.3	Taxiway Curves	6-25
6.7.4	Taxiway Longitudinal Slope	6-27
6.7.5	Taxiway Transverse Slope	6-28
6.7.6	Taxiway Sight Distance	6-28
6.7.7	Taxiway Bearing Strength	6-28
6.7.8	Surface of Taxiways	6-28
6.7.9	Taxiway Shoulders	6-28
6.7.10	Width of Taxiway Shoulders	6-29
6.7.11	Surface of Taxiway Shoulders	6-29
6.7.12	Taxiway Strips	6-29
6.7.13	Width of Taxiway Strip	6-29
6.7.14	Width of Graded Area of Taxiway Strip	6-29
6.7.15	Slope of Taxiway Strip	6-30
6.7.16	Objects on Taxiway Strip	6-30
6.7.17	Taxiways on Bridges	6-31
6.7.18	Taxiway Minimum Separation Distances	6-31
6.7.19	Rapid exit taxiways	6-32
Section 6.8	Holding Bays, Runway-Holding Positions, Intermediate Holding Positions and Road-Holding positions	6-34
6.8.1	Introduction	6-34
6.8.2	Provision of Holding Bay, Runway-holding Position, Intermediate Holding Position and Road-holding position	6-34
6.8.3	Location of Holding Bay, Runway-holding Position, Intermediate Holding Position or Road-holding Position	6-34
6.8.4	Distance from of Runway-holding Position, Intermediate Holding Position or Road-holding Position to Runway Centerline	6-35
Section 6.9	Aprons	6-36
6.9.1	Location of apron	6-36
6.9.2	Clearance distances on aircraft stands	6-36
6.9.3	Slopes on Aprons	6-37
6.9.4	Apron bearing strength	6-37

6.9.5	Apron Road	6-38
Section 6.10	Jet Blast	6-38
6.10.1	General	6-38
6.10.2	Jet Blast and Propeller Wash Hazards	6-38
Section 6.11	Isolated aircraft parking position	6-38
CHAPTER 7. OBSTACLE RESTRICTION AND LIMITATION	7-1
Section 7.1	General	7-1
7.1.1	Reserved	7-1
7.1.2	Introduction	7-1
7.1.3	Obstacle Restriction	7-1
7.1.4	Obstacle Limitation Requirements	7-2
7.1.5	Procedures for Aerodrome Operators to deal with obstacles	7-6
7.1.6	Objects outside the OLS	7-6
7.1.7	Objects that could become obstacles	7-7
7.1.8	Monitoring of obstacles associated with instrument runways	7-7
Section 7.2	Aerodrome Obstacle charts	7-8
7.2.1	Type A Charts	7-8
7.2.2	Type B Charts	7-8
Section 7.3	Obstacle Limitation Surfaces	7-9
7.3.1	General	7-9
7.3.2	Description of OLS	7-9
Section 7.4	Principles and Shielding	7-16
7.4.1	General	7-16
7.4.2	Shielding Principles	7-16
CHAPTER 8.	AERODROME VISUAL AIDS: MARKERS, MARKINGS, SIGNALS AND SIGNS	8-1
SECTION 8.1	General	8-1
8.1.1	Introduction	8-1
8.1.2	Permanently closed aerodrome	8-1
8.1.3	Colors	8-1
8.1.4	Visibility	8-1
8.1.5	Non-load bearing surfaces	8-2
Section 8.2	Markers	8-2
8.2.1	Introduction	8-2
8.2.2	The use of markers on a runway strip	8-5
8.2.3	The use of markers on an unsealed runway	8-7
8.2.4	Unpaved taxiway markers	8-7
8.2.5	The use of markers on an unsealed apron	8-7

Section 8.3	Runway Markings	8-8
8.3.1	General	8-8
8.3.2	Pre-runway end markings	8-8
8.3.3	Runway centerline markings	8-9
8.3.4	Runway designation markings	8-10
8.3.5	Runway transverse stripe	8-12
8.3.6	Runway side-stripe markings	8-13
8.3.7	Runway aiming point markings	8-14
8.3.8	Runway touchdown zone markings	8-15
8.3.9	Runway threshold markings	8-18
8.3.10	Runway end markings	8-19
8.3.11	Runway turn pad marking	8-20
8.3.12	Temporarily displaced threshold markings	8-20
Section 8.4	Taxiway Markings	8-26
8.4.1	Introduction	8-26
8.4.2	Taxiway centerline marking	8-26
8.4.3	Runway holding position markings	8-29
8.4.4	Intermediate holding position markings	8-31
8.4.5	Taxiway edge markings	8-32
8.4.6	Holding bay markings	8-32
8.4.7	Taxiway pavement strength limit markings	8-33
Section 8.5	Apron Markings	8-34
8.5.1	Introduction	8-34
8.5.2	Apron taxi guideline markings	8-34
8.5.3	Apron edge markings	8-35
8.5.4	Apron Safety Line (Parking clearance line)	8-35
8.5.5	Aircraft Type Limit Line	8-36
8.5.6	Parking weight limit line	8-36
8.5.7	Leased area line	8-36
8.5.8	Equipment clearance line	8-37
8.5.9	Equipment storage markings	8-37
8.5.10	Apron service road markings	8-37
8.5.11	Aircraft parking position markings	8-39
8.5.12	Lead-in line	8-39
8.5.13	Taxi lead-in line designation	8-40
8.5.14	Pilot turn line	8-42
8.5.15	Primary aircraft parking position markings	8-42
8.5.16	Marshaller stop line	8-42

8.5.17	Pilot stop line	8-43
8.5.18	Alignment Line	8-43
8.5.19	Secondary aircraft parking position markings	8-45
8.5.20	Keyhole marking	8-45
8.5.21	Triangle marking	8-46
8.5.22	Lead-out line	8-46
8.5.23	Designation markings	8-46
8.5.24	Aircraft parking position designation	8-47
8.5.25	Designation characters for taxi and apron markings	8-47
8.5.26	Tug operator guidance marking	8-53
8.5.27	Aircraft push-back lines	8-53
8.5.28	Tug parking position lines	8-53
8.5.29	Tow bar disconnect markings	8-54
8.5.30	Push-back limit markings	8-54
8.5.31	Push-back alignment bars	8-55
8.5.32	Passenger path markings	8-55
8.5.33	Road holding position markings	8-56
8.5.34	Mandatory Instruction markings	8-56
8.5.35	Information markings	8-58
8.5.36	Typical apron markings	8-58
8.5.37	VOR aerodrome checkpoint marking	8-59
Section 8.6	Signs	8-60
8.6.1	Introduction	8-60
8.6.2	Naming of taxiway location signs	8-61
8.6.3	Dimensions, location and lettering	8-61
8.6.4	Sign size and location distances, incl. runway exit signs	8-62
8.6.5	Structural requirements	8-67
8.6.6	Illumination	8-67
8.6.7	Mandatory instruction signs	8-70
8.6.8	Runway designation signs	8-71
8.6.9	Category I, II or III Runway designation signs	8-72
8.6.10	Runway holding position sign	8-73
8.6.11	Aircraft NO ENTRY sign	8-74
8.6.12	Vehicle STOP signs	8-74
8.6.13	Runway/Runway intersection signs	8-74
8.6.14	Information signs	8-76
8.6.15	Taxiway location signs	8-77
8.6.16	Direction signs	8-78

8.6.17	Destination signs	8-79
8.6.18	Intersection take-off sign	8-80
8.6.19	Runway exit signs	8-81
8.6.20	Runway Vacated Sign	8-81
8.6.21	VOR aerodrome checkpoint sign	8-82
8.6.22	Aerodrome identification sign	8-83
8.6.23	Aircraft stand identification signs	8-83
8.6.24	Road-holding position sign	8-83
Section 8.7	Wind Direction Indicators	8-84
8.7.1	Requirements	8-84
8.7.2	Wind direction indicator characteristics	8-85
8.7.3	Signaling Lamp	8-85
Section 8.8	Ground Signals	8-86
8.8.1	Signal Areas	8-86
8.8.2	Ground Signals in Signal Area	8-87
Section 8.9	Visual Aids denoting Restricted Use Areas	8-89
8.9.1	Closed runways and taxiways or parts thereof	8-89
8.9.2	Non-loading bearing surfaces	8-90
8.9.3	Pre-threshold area	8-91
8.9.4	Unserviceable areas	8-91
8.9.5	Works Limit markers	8-92
Section 8.10	Obstacle Markings	8-93
8.10.1	General	8-93
8.10.2	Objects to be marked and/or lighted	8-93
8.10.3	Marking and/or lighting of objects	8-98
8.10.4	Marking of Vehicles	8-104
Section 8.11	Helicopter Areas on Aerodrome	8-104
8.11.1	Introduction	8-104
8.11.2	Helicopter Landing and Lift-off Area markings	8-104
8.11.3	Helicopter apron markings	8-105
8.11.4	Helicopter parking position markings	8-105
8.11.5	Helicopter taxi guideline designation	8-106
8.11.6	Helicopter parking position numbers	8-107
8.11.7	Helicopter apron edge markings	8-107
Section 8.12	Marking of Glider Runway Strips on an aerodrome	8-108
CHAPTER 9. AERODROME VISUAL AIDS – AERODROME LIGHTING		9-1
Section 9.1	General	9-1
9.1.1	Application and definitions	9-1

9.1.2	Standardization of aerodrome lighting	9-2
9.1.3	Reserved	9-2
9.1.4	Minimum lighting system requirements	9-2
9.1.5	Primary source of electricity supply	9-3
9.1.6	Electrical circuitry	9-4
9.1.7	Secondary power supply	9-4
9.1.8	Switch-over time limits	9-5
9.1.9	Standby power supply	9-9
9.1.10	Portable lighting	9-9
9.1.11	Light fixtures and supporting structures	9-10
9.1.12	Elevated and inset lights	9-10
9.1.13	Color of light shown	9-11
9.1.14	Light intensity and control	9-11
9.1.15	Maintenance performance of aerodrome lighting (Visual aids)	9-14
9.1.16	Commissioning of lighting systems	9-17
9.1.17	Emergency lighting	9-18
Section 9.2	Colors of Aeronautical Ground Lights	9-19
9.2.1	General	9-19
9.2.2	Chromaticities for lights having filament-type light sources	9-19
9.2.3	Discrimination between colored lights filament-type sources	9-20
9.2.4	Chromaticities for lights having a solid state light source	9-21
9.2.5	Color measurement for filament-type and solid state-type light sources	9-22
9.2.6	Color for markings, signs and panels	9-22
Section 9.3	Obstacle Lighting	9-31
9.3.1	General	9-31
9.3.2	Types of obstacle lighting and usage	9-31
9.3.3	Location of obstacle lights	9-34
9.3.4	Natural Obstacles	9-37
9.3.5	Temporary obstacles	9-37
9.3.6	Characteristics of low intensity obstacle lights	9-37
9.3.7	Characteristics of medium intensity obstacle lights	9-38
9.3.8	Characteristics of high intensity obstacle lights	9-38
9.3.9	Floodlighting of obstacles	9-39
9.3.10	On-going availability of obstacle lights	9-39
Section 9.4	Aerodrome Beacons	9-40
9.4.1	General	9-40
Section 9.5	Illuminated Wind Direction Indicator	9-41

9.5.1	General	9-41
Section 9.6	Approach lighting systems	9-42
9.6.1	Simple approach lighting system	9-42
9.6.2	Precision approach Category I lighting system	9-44
9.6.3	Precision approach Category II and III Lighting System	9-47
Section 9.7	Isocandela Diagrams of Approach Lighting	9-52
9.7.1	Collective Notes	9-52
Section 9.8	Visual Approach Slope Indicator Systems	9-54
9.8.1	General	9-54
9.8.2	Obstacle protection surface	9-57
9.8.3	T-VASIS and AT-VASIS	9-59
9.8.4	Precision Approach Path Indicator (PAPI) / Abbreviated PAPI (APAPI) System	9-64
Section 9.9	Runway Lighting	9-75
9.9.1	Types of runway edge lighting systems	9-75
9.9.2	Runway edge lights	9-75
9.9.3	Location of runway edge lights	9-75
9.9.4	Longitudinal spacing of runway edge lights	9-76
9.9.5	Lateral spacing of Runway Edge Lights	9-76
9.9.6	Characteristics of low and medium intensity runway edge lights	9-77
9.9.7	Characteristics of high intensity runway edge lights	9-77
9.9.8	Use of bi-directional or back-to-back light fittings	9-78
9.9.9	Runway threshold lights	9-78
9.9.10	Location of runway threshold lights	9-78
9.9.11	Wing bar lights	9-79
9.9.12	Characteristics of runway threshold lights	9-79
9.9.13	Reserved	9-79
9.9.14	Characteristics of high intensity runway threshold lights	9-79
9.9.15	Additional lighting to enhance threshold location	9-81
9.9.16	Runway end lights	9-83
9.9.17	Runway turning area edge lights / turn pad lights	9-84
9.9.18	Stopway lights	9-85
9.9.19	Runway Centerline Lights	9-85
9.9.20	Runway touchdown zone lights	9-87
9.9.21	Simple Touchdown Zone Lights	9-88
9.9.22	Rapid exit taxiway indicator lights	9-89
9.9.23	Photometric Characteristics of Runway Lights	9-90
9.9.24	Installation and Aiming of Light Fittings	9-91

9.9.25	Reserved	9-91
9.9.26	Illustrations of Runway Lighting	9-91
Section 9.10	Isocandela Diagrams of Runway Lighting	9-91
9.10.1	Collective Notes	9-91
9.10.2	Illustrations of Runway Lighting	9-103
Section 9.11	Other Runway Lightings	9-108
9.11.1	Runway lead-in lighting systems	9-108
9.11.2	Runway lead-in lighting systems	9-108
Section 9.12	Taxiway lighting	9-109
9.12.1	Provision of taxiway centerline lights	9-109
9.12.2	Provision of taxiway edge lights	9-110
9.12.3	Taxiway markers	9-110
9.12.4	Apron taxiway lighting	9-110
9.12.5	Use of different types of taxiway lights	9-111
9.12.6	Control lights on taxiways	9-111
9.12.7	Location of taxiway centreline lights	9-111
9.12.8	Spacing of taxiway centerline lights	9-111
9.12.9	Location of taxiway centerline lights on other exit taxiways	9-113
9.12.10	Location of taxiway centerline lights on rapid exit taxiways	9-113
9.12.11	Characteristics of taxiway centerline lights	9-114
9.12.12	Beam dimensions and light distribution of taxiway centreline lights ...	9-116
9.12.13	Location of Taxiway Edge lights	9-117
9.12.14	Spacing of taxiway edge lights	9-117
9.12.15	Characteristics of Taxiway Edge Lights	9-119
9.12.16	Provision of runway guard lights	9-119
9.12.17	Pattern and Location of runway guard lights	9-120
9.12.18	Characteristics of runway guard lights	9-121
9.12.19	Control of runway guard lights	9-122
9.12.20	Provision of Intermediate Holding Position Lights	9-122
9.12.21	Pattern and Location of Intermediate Holding Position Lights	9-122
9.12.22	Characteristics of Intermediate Holding Position Lights	9-123
9.12.23	Stop bars	9-123
9.12.24	Location of Stop Bars	9-123
9.12.25	Characteristics of Stop Bars	9-124
9.12.26	No-entry Bars	9-125
9.12.27	Taxiway edge markers	9-126
9.12.28	Taxiway centerline markers	9-126
9.12.29	Characteristics of taxiway centerline markers	9-127

9.12.30	Photometric characteristics of taxiway lights	9-127
9.12.31	Installation and aiming of light fittings	9-128
9.12.32	Illustrations of Taxiway Lighting	9-128
Section 9.13	Isocandela Diagrams for Taxiway Lights	9-128
9.13.1	Collective Notes	9-128
Section 9.14	Illustrations of Taxiway Lighting	9-141
Section 9.15	Apron Floodlighting	9-143
9.15.1	Introduction	9-143
9.15.2	Provision of apron floodlighting	9-143
9.15.3	Location of apron floodlighting	9-143
9.15.4	Characteristics of apron floodlighting	9-144
Section 9.16	Visual Docking Guidance Systems	9-145
9.16.1	Provision of visual docking guidance systems	9-145
9.16.2	Characteristics of visual docking guidance systems	9-145
9.16.3	Azimuth Guidance Unit - location	9-146
9.16.4	Azimuth Guidance Unit - characteristics	9-146
9.16.5	Stopping Position Indicator - location	9-146
9.16.6	Stopping Position Indicator - characteristics	9-146
9.16.7	Parking position identification sign	9-147
9.16.8	Notification of type of aircraft docking guidance systems.....	9-147
Section 9.17	Lighting associated with closed and unserviceable areas	9-148
9.17.1	Closed runway or taxiway	9-148
9.17.2	Unserviceable areas	9-148
9.17.3	Characteristics of unserviceability lights	9-148
Section 9.18	Other Lights on an Aerodrome	9-148
9.18.1	Vehicle warning lights	9-148
9.18.2	Works limit lights	9-149
9.18.3	Road holding position lights / Road and Car Park Lighting	9-149
9.18.4	Lights which may endanger the safety of aircraft	9-150
Section 9.19	Monitoring, Maintenance and Serviceability of Aerodrome Lighting.	9-153
9.19.1	General	9-153
9.19.2	Reporting of aerodrome lighting outage	9-153
Section 9.20	Lighting in the vicinity of aerodromes (Guidance for Designers and Installation contractors	9-155
9.20.1	General requirement	9-155
9.20.2	Light fittings	9-156
9.20.3	Colored lights	9-156
Section 9.21	Circling guidance lights	9-157

Section 9.22	Advanced visual docking guidance system	9-158
Section 9.23	Aircraft stand maneuvering guidance lights	9-160
CHAPTER 10.	OPERATING STANDARDS FOR CERTIFIED AERODROMES AND AERODROME REGISTRATION TYPE 1	10-1
Section 10.1	General	10-1
10.1.1	Introduction	10-1
10.1.2	Aerodrome Manual and Aerodrome operating procedures	10-1
10.1.3	Training of aerodrome personnel involved with safety functions	10-1
10.1.4	Aerodrome Safety Management System (SMS)	10-2
10.1.5	Framework for Aerodrome Safety Management System	10-2
10.1.6	Safety Reporting System	10-6
Section 10.2	Inspecting and Reporting Aerodrome Serviceability	10-8
10.2.1	General	10-8
10.2.2	Foreign Object Debris (FOD)	10-8
10.2.3	Surface conditions of the movement area, including the presence of water	10-8
10.2.4	Aerodrome markings, lighting, wind direction indicators and ground signals	10-9
10.2.5	Wildlife on, or in the vicinity of, the movement area	10-9
10.2.6	Currency of NOTAMs	10-10
10.2.7	Aerodrome fencing	10-10
10.2.8	Security Lighting	10-10
10.2.9	Inspection Records	10-11
10.2.10	Obstacles Infringing the take-off, approach and transitional surfaces	10-11
10.2.11	Empirical assessment of the bearing strength of unrated runway pavements and runway strips	10-11
Section 10.3	Initiating a NOTAM	10-11
10.3.1	Introduction	10-11
10.3.2	Changes Reported to NOTAM Office	10-11
10.3.3	Time-limited NOTAM	10-13
10.3.4	Permanent NOTAM	10-13
10.3.5	Making changes to aerodrome information published in AIP	10-13
10.3.6	Wildlife Hazard Warning	10-13
10.3.7	New or upgraded visual aids	10-13
10.3.8	Changes to Type A Chart Information	10-13
10.3.9	Follow up actions	10-13
10.3.10	Record keeping	10-14

Section 10.4	Sample Aerodrome Report Forms	10-15
Section 10.5	Examples of NOTAM and Listing of Abbreviations	10-17
10.5.1	Examples	10-17
10.5.2	General abbreviations and phrase contractions to minimize message length of aerodrome NOTAMs	10-20
Section 10.6	Appointment of Reporting Officers	10-30
10.6.1	General	10-30
10.6.2	Reporting Officer Qualifications	10-30
10.6.3	What to report	10-30
10.6.4	Monitoring activities outside aerodrome	10-31
Section 10.7	Aerodrome Emergency Planning	10-31
10.7.1	Introduction	10-31
10.7.2	Records	10-34
10.7.3	Disabled Aircraft Removal	10-34
Section 10.8	Guidelines for Aerodrome Emergency Plans	10-34
10.8.1	General	10-34
10.8.2	Medical Subcommittee	10-35
10.8.3	Testing facilities and reviewing roles	10-35
10.8.4	Aerodrome Emergency Exercises	10-36
10.8.5	Emergency Operations Center and Mobile Command Post	10-36
10.8.6	Definitions of Command, Control, and Coordination	10-37
10.8.7	Role of the Police	10-37
Section 10.9	Control of Airside Access and Vehicle Control	10-37
10.9.1	Introduction	10-37
10.9.2	Aerodrome Vehicle Operations	10-38
10.9.3	Airside drivers	10-38
Section 10.10	Aerodrome Works Safety	10-39
10.10.1	Introduction	10-39
10.10.2	Method of Working Plans	10-39
10.10.3	Time-Limited Works	10-40
10.10.4	Restrictions on Time-Limited Works	10-41
10.10.5	Restoration of Normal Safety Standards	10-41
10.10.6	Resumption of Aerodrome Works	10-41
10.10.7	Management and control of aerodrome works	10-41
10.10.8	Markers, Markings and Lights	10-42
10.10.9	Communication Equipment	10-42
10.10.10	Completion	10-43
10.10.11	Runway Pavement Overlays	10-43
10.10.12	Works on Runway Strips	10-44

Section 10.11	Method of Working Plans	10-44
10.11.1	Introduction	10-44
10.11.2	Title Page	10-44
10.11.3	Works Information	10-45
10.11.4	Restrictions to aircraft operations and issue of NOTAMs	10-45
10.11.5	Work Stages	10-45
10.11.6	Emergencies and Adverse Weather	10-46
10.11.7	NOTAMs	10-46
10.11.8	Restrictions to Works Organizations	10-46
10.11.9	Personnel and Equipment	10-46
10.11.10	Access	10-46
10.11.11	Aerodrome Markers, Markings and Lights	10-46
10.11.12	Protection of Electrical Services	10-46
10.11.13	Special Requirements	10-46
10.11.14	Administration	10-46
10.11.15	Authority	10-47
10.11.16	Drawings	10-47
10.11.17	Distribution List	10-47
Section 10.12	Functions of a Works Safety Officer	10-47
10.12.1	Works Safety Officer	10-48
Section 10.13	Aircraft Parking	10-49
10.13.1	Introduction	10-49
10.13.2	Apron Congestion	10-49
10.13.3	Apron Safety Management	10-49
10.13.4	Apron management service	10-49
Section 10.14	Wildlife Hazard Management	10-51
10.14.1	Introduction	10-51
10.14.2	Wildlife strike hazard reduction	10-52
Section 10.15	Aerodrome Maintenance	10-53
10.15.1	Maintenance Programme	10-53
10.15.2	Pavements	10-54
10.15.3	Removal of contaminants	10-55
10.15.4	Runway pavement overlays	10-56
10.15.5	Visual aids	10-56
10.15.6	Runway Surface Friction	10-56
10.15.7	Deterioration of Runway Grooves	10-57
10.15.8	Surface Irregularities	10-57
10.15.9	Drainage characteristics of the movement area and adjacent areas	10-57

10.15.10	Standards for Natural and Gravel Surface Runways	10-58
Section 10.16	Maintenance around navigational aids	10-58
10.16.1	Introduction	10-58
Section 10.17	Aerodrome safety procedures during low visibility operations	10-59
10.17.1	Introduction	10-59
Section 10.18	Aerodrome Technical Inspections	10-59
10.18.1	Introduction	10-59
Section 10.19	Surface movement guidance and control systems	10-59
10.19.1	General	10-59
10.19.2	Characteristics	10-60
Section 10.20	Autonomous runway incursion warning system	10-61
CHAPTER 11. STANDARDS FOR OTHER AERODROME FACILITIES		11-1
Section 11.1	General	11-1
11.1.1	Siting of equipment and installations on operational areas	11-1
11.1.2	Standards For Siting and Clearance Areas for Airways Facilities on Airports	11-2
11.1.3	General siting requirements	11-3
11.1.4	Navigation Aid Facilities	11-3
11.1.5	VOR Facilities	11-4
11.1.6	DME Facilities	11-5
11.1.7	Instrument Landing System	11-5
11.1.8	Localizer	11-7
11.1.9	Glide Path	11-7
11.1.10	Obstructions around Marker Beacons	11-7
11.1.11	Locator Beacons	11-8
11.1.12	Non-Directional Beacons (NDB)	11-8
11.1.13	Radar Sensor Sites	11-8
11.1.14	Communications Facilities	11-9
11.1.15	Ground earthing points	11-11
11.1.16	Testing of ground earthing points	11-11
11.1.17	Inspection of ground earthing points	11-11
11.1.18	Remedial action	11-11
11.1.19	Light aircraft tie-down facilities	11-11
CHAPTER 12. OPERATING STANDARDS FOR AERODROME REGISTRATION TYPE 2		12-1
Section 12.1	General	12-1
12.1.1	Introduction	12-1
12.1.2	Aerodrome Reporting Officer	12-1

12.1.3	Aerodrome serviceability inspections	12-2
12.1.4	Frequency of serviceability inspection	12-2
12.1.5	Record of inspections and remedial actions	12-3
12.1.6	Reporting changes	12-3
12.1.7	Aerodrome Works	12-3
12.1.8	Safety Inspection Report	12-3
Section 12.2	Sample Report Form for Aerodrome Registration Type 2	12-4
CHAPTER 13.	STANDARDS FOR SMALL AERODROMES USED FOR LIGHT AIRCRAFT OPERATIONS	13-1
Section 13.1	General	13-1
13.1.1	Introduction	13-1
Section 13.2	Part A - Aerodromes used for air transport, private or flying training activity	13-1
13.2.1	Aerodrome standards	13-1
13.2.2	Aerodrome Markings	13-3
13.2.3	Aerodrome Lighting	13-4
13.2.4	Wind Direction Indicator	13-5
13.2.5	Landing Direction Indicator	13-5
13.2.6	Signal panels and signal areas	13-5
13.2.7	Ground Signal and Signal Area	13-6
13.2.8	Runway and Runway Strip Conditions	13-6
13.2.9	Aerodrome Serviceability Reporting	13-7
13.2.10	Safety Inspection Report	13-8
Section 13.3	Part B - Aerodromes used for aerial agricultural activity	13-9
13.3.1	Aerodrome standards	13-9
13.3.2	Aerodrome Markings	13-9
13.3.3	Aerodrome Lighting	13-10
13.3.4	Wind Direction Indicator	13-10
13.3.5	Ground Signal and Signal Area	13-10
13.3.6	Runway and Runway Strip Conditions	13-10
13.3.7	Aerodrome Serviceability Reporting	13-10
CHAPTER 14. RESCUE AND FIREFIGHTING SERVICE		14-1
Section 14.1	General	14-1
Section 14.2	Level of protection	14-1
Section 14.3	Extinguishing agents	14-2
Section 14.4	Response time	14-5
Section 14.5	Emergency access roads	14-6
Section 14.6	Fire stations	14-6

Section 14.7	Communications and alerting systems	14-6
Section 14.8	Rescue and Firefighting vehicles	14-7
Section 14.9	Personnel	14-7
Section 14.10	Administration	14-8
CHAPTER 15. HELIPORT STANDARDS	15-1
Section 15.1	General	15-1
Section 15.2	Definitions	15-2
Section 15.3	Aeronautical data for heliports	15-4
15.3.1	Aeronautical Data	15-4
15.3.2	Heliport reference point	15-4
15.3.3	Heliport elevations	15-4
15.3.4	Heliport dimensions and related information	15-5
15.3.5	Declared distances	15-6
15.3.6	Coordination between aeronautical information services and heliport authorities	15-6
15.3.7	Rescue and firefighting	15-7
Section 15.4	Helicopter performance classifications	15-7
Section 15.5	Onshore heliports	15-9
15.5.1	Final approach and take-off area (FATO)	15-9
15.5.2	Helicopter clearways	15-11
15.5.3	Touchdown and lift-off areas (TLOF)	15-12
15.5.4	Safety areas	15-14
15.5.5	Helicopter taxiways and taxi-routes	15-15
15.5.6	Helicopter air taxi-routes	15-18
15.5.7	Helicopter stands	15-19
15.5.8	Location of a final approach and take-off area in relation to a runway or taxiway	15-23
Section 15.6	Elevated heliports	15-24
Section 15.7	Helidecks	15-24
15.7.1	Final approach and take-off area and touchdown and lift-off area .	15-24
Section 15.8	Shipboard heliports	15-26
15.8.1	Final approach & take-off area and touchdown & lift-off area	15-26
Section 15.9	Obstacle Environment	15-27
Section 15.10	Obstacle limitation surfaces and sectors	15-28
15.10.1	Approach surface	15-28
15.10.2	Transitional surface	15-29
15.10.3	Take-off climb surface	15-30
Section 15.11	Obstacle limitation surfaces and sectors – helidecks	15-36

15.11.1	Obstacle free sector/surface – helidecks	15-36
15.11.2	Limited obstacle sector/surface – helidecks	15-36
Section 15.12	Obstacle limitation requirements	15-40
15.12.1	Surface level heliports	15-40
15.12.2	Elevated heliports	15-41
15.12.3	Helidecks	15-42
15.12.4	Shipboard heliports	15-43
Section 15.13	Visual aids, markings and markers	15-47
15.13.1	Wind direction indicators	15-48
15.13.2	Winching area marking	15-48
15.13.3	Heliport identification marking	15-49
15.13.4	Maximum allowable mass marking	15-52
15.13.5	D-value marking	15-53
15.13.6	Final approach and take-off area perimeter marking or markers for surface level heliports	15-54
15.13.7	Final approach and take-off area designation markings for runway –type FATOs	15-56
15.13.8	Aiming point marking	15-56
15.13.9	Touchdown and lift-off area perimeter marking	15-57
15.13.10	Touchdown/positioning marking	15-57
15.13.11	Heliport name marking	15-59
15.13.12	Helideck obstacle-free sector (chevron) marking	15-60
15.13.13	Helideck and shipboard heliport surface marking	15-60
15.13.14	Helicopter ground taxiway markings and markers	15-61
15.13.15	Helicopter air taxi-route markings and markers	15-62
15.13.16	Helicopter stand markings	15-62
15.13.17	Flight path alignment guidance marking	15-63
Section 15.14	Visual aids – lights	15-65
15.14.1	Heliport beacon	15-66
15.14.2	Approach lighting system	15-67
15.14.3	Flight path alignment guidance lighting system	15-68
15.14.4	Visual alignment guidance system	15-69
15.14.5	Visual approach slope indicator	15-69
15.14.6	Final approach and take-off area lighting systems for onshore surface-level heliports	15-70
15.14.7	Aiming point lights	15-70
15.14.8	Touchdown and lift-off area lighting system	15-71
15.14.9	Helicopter stand floodlighting	15-73
15.14.10	Winching area floodlighting	15-74

15.14.11	Taxiway lights	15-74
15.14.12	Visual aids for denoting obstacles outside and below the obstacle limitation surfaces	15-74
15.14.13	Floodlighting of obstacles	15-75
Section 15.15	Rescue and firefighting	15-75
15.15.1	Applicability	15-76
15.15.2	Level of protection provided.....	15-76
15.15.3	Extinguishing agents	15-77
15.15.4	Response time	15-80
15.15.5	Rescue arrangements	15-80
15.15.6	Communication and alerting system	15-81
15.15.7	Personnel	15-81
15.15.8	Means of escape	15-81
Section 15.16	Heliport Emergency Response	15-81
15.16.1	Heliport Emergency Planning	15-81
Section 15.17	Heliport operating procedures	15-82
15.7.1	Heliport Safety/Reporting Officer	15-82
15.7.2	Heliport serviceability inspections	15-83
15.7.3	Frequency of serviceability inspection	15-83
15.7.4	Safety Inspection Report	15-84
15.7.5	Record of inspections and remedial actions	15-84
15.7.6	Training for Safety Personnel	15-84
APPENDIX	APP-1
Appendix 1:	Schedule of particulars to be included in an Aerodrome Manual	APP-1
Appendix 2:	List of Effective Pages	APP-3
Appendix 3:	Application Form for Aerodrome Certification	APP-5
Appendix 4:	Application Forms for Aerodrome Registration and Permit to Operate	APP-7
Appendix 5:	Aeronautical data accuracy and integrity requirements	APP-15
Appendix 6:	Specifications and location of obstacle lights	APP-19
Appendix 7:	For instrument heliports with non-precision and/or precision approaches and instrument departures	APP-29
ATTACHMENT A: SUPPLEMENTARY GUIDANCE MATERIAL TO MOS	ATT-1
1.	Runway end safety areas	ATT-1
2.	Drainage characteristics of the movement area and adjacent areas	ATT-2
3.	Runway condition report for reporting runway surface condition	ATT-5
4.	Runway surface evenness	ATT-6
5.	Rescue and Firefighting Services	ATT-9

6. Operators of vehicles	ATT-11
7. Intensity control of approach and runway lights	ATT-12
8. Autonomous runway incursion warning system (ARIWS)	ATT-12
9. Taxiway design guidance for minimizing the potential for runway incursion	ATT-15
10. Aerodrome mapping data	ATT-17
11. Location of threshold	ATT-18
12. Signal area	ATT-19
13. Lighting of unserviceable areas	ATT-19
14. Rapid exit taxiway indicator lights	ATT-20
15. The ACN-PCN ACR-PCR method of reporting pavement strength	ATT-20
16. Approach lighting systems	ATT-22
17. Clearways and stopways	ATT-28
18. Number, siting and orientation of runways	ATT-31
19. Slopes on a runway	ATT-33
20. Determination of surface friction characteristics for construction and maintenance purposes	ATT-35
21. Priority of installation of visual approach slope indicator systems	ATT-36

**ATTACHMENT B: CRITICAL DATA RELATED TO SAFETY OCCURRENCES
REPORTED AT AERODROMES FOR THE MONITORING
OF SAFETY** ATT-39

1. Runway excursions.....	ATT-39
2. Undershoot (land short of runway).....	ATT-40
3. Runway incursion.....	ATT-40
4. Landing or take-off on a taxiway	ATT-41
5. FOD-related events.....	ATT-42
6. Other excursions (i.e. from the taxiway or apron).....	ATT-42
7. Other incursions (i.e. on taxiway or apron).....	ATT-42
8. Birds/wildlife strike-related events.....	ATT-42
9. Ground collisions.....	ATT-43

CHAPTER 1. Introduction

Section 1.1 General

1.1.1 Background

- 1.1.1.1 Aerodrome safety is a vital link in aviation safety. Providing adequate suitable facilities and maintaining a safe operational environment for aircraft activities promotes aerodrome safety. By complying with the prescribed standards and procedures and taking a pro-active safety management system approach, aerodrome operators can demonstrate that they have discharged their safety obligations to the regulatory authority and to their clients who, ultimately, are the traveling public.
- 1.1.1.2 This document, titled: 'Manual of Standards for Aerodromes', hereafter referred to as the MOS, is made pursuant to Civil Aviation Regulations governing Aerodromes (CAR-Aerodromes) formerly known as AO 139. CAR-Aerodromes sets out the regulatory regime for aerodrome operators at aerodromes used by aeroplanes conducting international and national air transport operations. The aerodrome regulatory regime sets out when an aerodrome is to be certified or is to be registered, and this MOS contains the standards and operating procedures for certified and registered aerodromes used in air transport operations.
- 1.1.1.3 Aeroplanes with less than 10 passenger seats can conduct air transport operations from aerodromes that are not certified or registered, provided the specified facilities at those aerodromes are to the required standard, and the aircraft operator has, and makes available to crew members, the requisite aerodrome information to enable the pilot to safely land and take-off at such uncertified aerodromes. MOS 13 specifies the standards and procedures for aerodromes intended only for small aeroplanes (those with less than 10 passenger seats or in the case of freight operations, those not exceeding 5,700 kg MTOW) conducting air transport or private operations.
- 1.1.1.4 Subject to published conditions of use, aerodromes and their associated facilities shall be kept continuously available for flight operations during published hours of operation, irrespective of weather conditions. 'Published conditions of use' refers to aeronautical data promulgated by Philippines AIP or NOTAM or information broadcast by Air Traffic Control Units.
- 1.1.1.5 To assist aerodrome operators or potential operators, some general advice about specifications, procedures and other information of an educational or advisory nature may be issued from time to time by CAAP in the form of Advisory Circulars.
- 1.1.1.6 This Manual of Aerodrome Standards, as referred to in CAR-Aerodromes 2.1.020(1) and as defined therein, contains:
- (a) the requirements for the certification and registration of aerodromes; and
 - (b) aerodrome standards, recommended practices and guidance material pertaining to the planning, operation and maintenance of aerodrome services, facilities and equipment to be complied with by aerodrome operators.

- 1.1.1.7 The scope of this manual is confined to the safety, regularity and efficiency aspects of aerodrome facilities, equipment and operational procedures. It does not cover such aspects as those related to aeronautical meteorology, the administration of aerodrome finances and the servicing of passengers and cargo. It also excludes air traffic services and aeronautical information services, although the coordination between those services and the aerodrome operator has been incorporated as an integral part of aerodrome operations.
- 1.1.1.8 Aerodrome standards may change from time to time to meet identified safety needs, technological changes and changes in international standards and practices. It is recognized that there may be difficulties and limitations in applying new standards to existing aerodrome facilities and installations. This aspect is addressed in some detail in Chapter 2.
- 1.1.1.9 Standards are identified by the words 'must' or 'shall'. Appendices and tables form part of the main document and have the same status as the primary text. This MOS may also require standards from other documents to be followed, and where this is so, the referred standards become part of this MOS.
- 1.1.1.10 Under particularly unusual circumstances, the application of a standard or procedure may not be possible or necessary. Such a standard or procedure will be phrased as "if practicable", "where physically practicable", "where determined necessary" or similar words. Whilst such phrases may imply compliance is not mandatory, aerodrome operators are required to provide justification for non-compliance. The final decision as to the applicability of the standard to a particular aerodrome facility or procedure rests with CAAP.
- 1.1.1.11 Where there is flexibility in compliance with a specification, words such as "should" or "may" are used. This does not mean that the specification can be ignored, but it means that there is no need to seek CAAP approval if an aerodrome operator chooses to adopt an alternate means to achieve a similar outcome. Any such decision and the alternative means adopted are to be formally recorded and the record maintained while the chosen means of conformance exists.
- 1.1.1.12 This MOS includes standards and procedural requirements relating to preventing the inadvertent entry of animals and people to the movement area. Those standards and procedures are intended for aviation safety only. This MOS does not specifically address aviation security, i.e. the safeguarding against acts of unlawful interference, and that subject matter is under separate regulation.
- 1.1.1.13 Where it is necessary or helpful to provide factual or background information, explanation or references, or to provide a means of achieving compliance, information may be provided in the form of a "note". A note does not constitute part of a standard.
- 1.1.2 Terminology used in MOS**
- 1.1.2.1 The status of other terms used jointly with standards and recommended practices in this MOS is explained as follows:

- (a) Appendices
Appendices contain materials grouped separately for convenience and forming part of the standards or practices.
- (b) Definitions
Definitions do not have independent status but each one is an essential part of each standard or practice in which the term is used, since a change in the meaning of the term would affect the specifications.
- (c) Tables and Figures
Tables and Figures add to or illustrate a standard or practice, form part of the associated standard or practice and have the same status.
- (d) Forewords
Forewords contain historical and explanatory material based on the action of the CAAP or ICAO.
- (e) Introductions
Introductions comprise explanatory material introduced at the beginning of parts, chapters, or sections of this MOS to assist in the understanding of the application of the text, but do not constitute part of the standards or practices.
- (f) Notes
Notes are included in the text, where appropriate, to give factual information or references bearing on the standards or practices in question, but do not constitute part of the standards or practices.
- (g) Attachments
Attachments comprise material supplementary to the standards or practices, or are included as a guide to their application, but do not constitute part of the standards or practices.

1.1.3 Document Set

1.1.3.1 The document hierarchy consists of:

- (a) Civil Aviation Authority Act of 2008 (Republic Act No. 9497) of the Republic of the Philippines, as amended
- (b) CAR-Aerodromes
- (c) Manual of Standards for Aerodromes (MOS);
- (d) Relevant Administrative Orders
- (e) Memorandum Circulars;
- (f) CAAP Advisory Circulars (ACs); and
- (g) Safety Directives.

1.1.3.2 The Republic Act No. 9497 establishes the broad intent of the government of the Republic of the Philippines with regard to regulation of civil aviation.

1.1.3.3 CAR-Aerodromes establishes the regulatory framework rules (regulations) within which all aerodrome service providers must operate.

- 1.1.3.4 The MOS comprises specifications (standards) prescribed by CAAP, for uniform application, determined to be necessary for the safety of air navigation.
- 1.1.3.5 In the event of any perceived disparity of meaning between MOS and CAR-Aerodromes, primacy of intent is to be with CAR-Aerodromes.
- 1.1.3.6 Service providers must document internal actions (rules) in their own operational manuals, to ensure the compliance with, and maintenance of, relevant standards.
- 1.1.3.7 Advisory Circulars (AC) are intended explain elements of the regulatory framework to participants in the aviation industry. Additionally an AC may provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the requirements of aerodrome standards.
- 1.1.3.8 AC may explain certain regulatory requirements by providing interpretive and explanatory materials. As an AC provides only explanatory material, it is expected that service providers will document relevant information in their own operational manuals to put into effect information drawn from Advisory Circular.
- 1.1.4 Differences between ICAO SARPs and MOS specifications**
- 1.1.4.1 Notwithstanding the above, where there is a difference between a standard prescribed in the ICAO Annexes to the Chicago Convention and one prescribed in this MOS, the MOS standard shall prevail.
- 1.1.5 Differences published in AIP**
- 1.1.5.1 Differences from ICAO Standards, Recommended Practices and Procedures are published in AIP Philippines Gen 1.7.
- 1.1.6 MOS documentation change management**
- 1.1.6.1 This document is issued and amended under the authority of the Director General.
- 1.1.6.2 Requests for any change to the content of the MOS may be initiated from:
- (a) staff of technical areas within CAAP;
 - (b) staff of aerodrome operators;
 - (c) ATS service providers and staff;
 - (d) aviation industry service providers, such as airlines, and their staff; and
 - (e) interested consultants, auditors and others.
- 1.1.6.3 The need to change standards in the MOS may be generated by a number of causes. These may be to:
- (a) for safety promotion;

- (b) ensure standardization;
- (c) respond to changed legislative or CAAP requirements;
- (d) respond to ICAO prescription; or
- (e) accommodate new initiatives or technologies.

1.1.7 Related documents

1.1.7.1 These standards should be read in conjunction with:

- (a) Civil Aviation Regulations governing Aerodromes (CAR-Aerodromes);
- (b) Civil Aviation Regulations - Air Navigation Services (CAR-ANS);
- (c) Philippine Civil Aviation Regulations (PCARs);
- (d) ICAO Annex 4 Aeronautical Charts;
- (e) ICAO Annex 6 Part I International Commercial Air Transport – Aeroplanes;
- (f) ICAO Annex 14 - Aerodromes;
Volume I – Aerodrome Design and Operations (Seventh Edition)
Volume II – Heliports
- (g) Annex 19 – Safety Management;
- (h) ICAO Annex 15 Aeronautical Information Services;
- (i) ICAO Doc 9157/AN901: Aerodrome Design Manual;
Part 1 – Runways
Part 2 – Taxiways, Aprons and Holding Bays
Part 3 – Pavements
Part 4 – Visuals Aids
Part 5 – Electrical Systems
Part 6 – Frangibility
- (j) ICAO Doc 9150: Stolport Manual;
- (k) ICAO Airport Planning Manual (Doc 9184);
Part 1 – Master Planning
Part 2 – Land Use and Environment Control
Part 3 – Guidelines for Consultant/Construction Services
- (l) ICAO Doc 9261: Heliport Manual;
- (m) ICAO Airport Services Manual (Doc 9137);
Part 1 – Rescue and Fire Fighting
Part 2 – Pavement Surface Conditions
Part 3 – Wildlife Control and Reduction

Part 4 – Fog Dispersal

Part 5 – Removal of Disabled Aircraft

Part 6 – Control of Obstacles

Part 7 – Airport Emergency Planning

Part 8 – Airport Operational Services

Part 9 – Airport Maintenance Practices

- (n) ICAO Doc 9332: Manual on the ICAO Bird Strike Information System (IBIS);
- (o) ICAO Doc 9426: Air Traffic Services Planning Manual;
- (p) ICAO Doc 9467: Manual of Surface Movement Guidance and Control Systems (SMGCS);
- (q) ICAO Doc 9643: Manual on Simultaneous Operations on Parallel or Near- Parallel Instrument Runways;
- (r) ICAO Doc 9683: Human Factors Manual;
- (s) ICAO Doc 9734: Safety Oversight Manual;
- Part A –The Establishment and Management of a State's Safety Oversight System;
- (t) ICAO Doc 9774/A969: Manual on Certification of Aerodromes;
- (u) ICAO Doc 9870: Manual on the Prevention of Runway Incursions;
- (v) ICAO Doc 9830: Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual;
- (w) Cir 305: Operation of New Larger Aeroplanes at Existing Aerodromes;
- (x) Cir 329: Assessment, Measurement and Reporting of Runway Surface Conditions;
- (y) ICAO Safety Management Manual (Doc 9859/AN460);
- (z) ICAO Procedures for Air Navigation Services -- PANS-Aerodromes (Doc 9981); and
- (aa) ICAO Procedures for Air Navigation Services — Aeronautical Information Management (PANS-AIM) (Doc 10066); and
- (bb) Federal Aviation Administration (FAA) Advisory Circular 150/ 5300-13.

Section 1.2 Common reference systems

1.2.1 Horizontal reference system

- 1.2.1.1 World Geodetic System – 1984 (WGS-84) shall be used as the horizontal (geodetic) reference system. Reported aeronautical geographical coordinates (indicating latitude and longitude) shall be expressed in terms of the WGS-84 geodetic reference datum.

Note: - Comprehensive guidance material concerning WGS-84 is contained in the World Geodetic System – 1984 (WGS-84) Manual (Doc 9674).

1.2.2 Vertical reference system

- 1.2.2.1 Mean sea level (MSL) datum, which gives the relationship of gravity related height (elevation) to a surface known as the geoid, shall be used as the vertical reference system.

Note: - 1. The geoid globally most closely approximates MSL. It is defined as the equipotential surface in the gravity field of the Earth which coincides with the undisturbed MSL extended continuously through the continents.

Note: - 2. Gravity-related heights (elevations) are also referred to as orthometric heights.

1.2.3 Temporal reference system

- 1.2.3.1 The Gregorian calendar and Coordinated Universal Time (UTC) shall be used as the temporal reference system.
- 1.2.3.2 When a different temporal reference system is used, this shall be indicated in GEN 2.1.2 of the Aeronautical Information Publication (AIP).

Note. See PANS-AIM (Doc 10066), Appendix 2.

Section 1.3 Airport design and Master Plan

Section 1.3.1 Airport design (Applicable until 02 November 2022)

- 1.3.1.1 Architectural and infrastructure-related requirements for the optimum implementation of international civil aviation security measures shall be integrated into the design and construction of new facilities and alterations to existing facilities at an aerodrome.

Note: - Guidance on all aspects of the planning of aerodromes including security considerations is contained in ICAO Document 9184 Airport Planning Manual, Part 1.

- 1.3.1.2 The design of aerodromes shall take into account land-use and environmental control measures.

Note: - Guidance on land-use planning and environmental control measures are described in the ICAO Doc 9184 Airport Planning Manual, Part 2.

- 1.3.1.3 For aerodromes open to public use, the aerodrome operator shall coordinate with the Office of Transportation Security (OTS), Department of Transportation (DOTr), for all matters to ensure international civil aviation security requirements are incorporated into the design and construction of new facilities and alterations to existing facilities.

- 1.3.1.4 No aerodrome shall be constructed within twenty four kilometers of an

operational aerodrome used by turbo-jet aircraft or within ten kilometers of any other operational aerodrome.

Section 1.3.2 Airport design and Master plan (Applicable as of 03 November 2022)

Introductory Note: - A master plan for the long-term development of an aerodrome displays the ultimate development in a phased manner and reports the data and logic upon which the plan is based. Master plans are prepared to support modernization of existing aerodromes and creation of new aerodromes, regardless of size, complexity, and role. It is important to note that a master plan does not constitute a confirmed implementation programme. It provides information on the types of improvements to be undertaken in a phased manner. Guidance on all aspects of the planning of aerodromes is contained in the Airport Planning Manual (Doc 9184), Part 1.

- 1.3.2.1 A master plan containing detailed plans for the development of aerodrome infrastructure should be established for aerodromes deemed by CAAP.

Note: - 1. A master plan represents the development plan of a specific aerodrome. It is developed by the aerodrome operator based on economic feasibility, traffic forecasts, current and future requirements provided by, among others, aircraft operators (see MOS 1.3.2.3).

Note: - 2. A master plan may be required when the lack of capacity at an airport, due to conditions such as, but not limited to expected traffic growth, changing weather and climatic conditions or major works to address safety or environmental concerns, would put the connectivity of a geographical area at risk or cause severe disruption to the air transport network.

- 1.3.2.2 The master plan should:

- (a) contain a schedule of priorities including a phased implementation plan; and
- (b) be reviewed periodically to take into account current and future aerodrome traffic.

- 1.3.2.3 Aerodrome stakeholders, particularly aircraft operators, should be consulted in order to facilitate the master planning process using a consultative and collaborative approach.

Note: - 1. Provision of advanced planning data to facilitate the planning process include future aircraft types, characteristics and numbers of aircraft expected to be used, the anticipated growth of aircraft movements, number of passengers and amount of cargo projected to be handled.

Note: - 2. See Annex 9, Chapter 6 on the need for aircraft operators to inform aerodrome operators concerning the former's service, schedule and fleet plans to enable rational planning of facilities and services in relation to the traffic anticipated.

Note: - 3. See ICAO's Policies on Charges for Airports and Air Navigation Services (Doc 9082), Section 1, regarding consultation with users concerning provision of advance planning data and protection of commercially sensitive data.

- 1.3.2.4 Architectural and infrastructure-related requirements for the optimum

implementation of international civil aviation security measures shall be integrated into the design and construction of new facilities and alterations to existing facilities at an aerodrome.

- 1.3.2.5 The design of aerodromes shall take into account land-use and environmental control measures.

Note: - Guidance on land-use planning and environmental control measures are described in the ICAO Doc 9184 Airport Planning Manual, Part 2.

- 1.3.2.6 For aerodromes open to public use, the aerodrome operator shall coordinate with the Office of Transportation Security (OTS), Department of Transportation (DOTr), for all matters to ensure international civil aviation security requirements are incorporated into the design and construction of new facilities and alterations to existing facilities.

- 1.3.2.7 No aerodrome shall be constructed within twenty four kilometers of an operational aerodrome used by turbo-jet aircraft or within ten kilometers of any other operational aerodrome.

Section 1.4 Definition of Terms

Accident. An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time as it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:

- (a) a person is fatally or seriously injured as a result of:

- being in the aircraft, or
- direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
- direct exposure to jet blast,

except when the injuries are from natural causes, self-inflicted or inflicted by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew; or

- (b) the aircraft sustains damage or structural failure which:

- adversely affects the structural strength, performance or flight characteristics of the aircraft, and
- would normally require major repair or replacement of the affected component, except for engine failure or damage, when the damage is limited to a single engine, (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes), or for minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or

- (c) the aircraft is missing or is completely inaccessible.

Note: - 1. For statistical uniformity only, an injury resulting in death within thirty days of the date of the accident is classified, by ICAO, as a fatal injury.

Note: - 2. An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located.

Note: - 3. The type of unmanned aircraft system to be investigated is addressed in 5.1.

Note: - 4. Guidance for the determination of aircraft damage can be found in Attachment G.

Aerodrome. A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Aerodrome beacon. An aeronautical beacon used to indicate the location of an aerodrome from the air.

Aerodrome certificate. A certificate issued by the appropriate authority under applicable regulations for the operation of an aerodrome.

Aerodrome elevation. The elevation of the highest point of the landing area.

Aerodrome identification sign. A sign placed on an aerodrome to aid in identifying the aerodrome from the air.

Aerodrome mapping data (AMD). Data collected for the purpose of compiling aerodrome mapping information for aeronautical uses.

Note: - Aerodrome mapping data are collected for purposes that include the improvement of the user's situational awareness, surface navigation operations, training, charting and planning.

Aerodrome mapping database (AMDB). A collection of aerodrome mapping data organized and arranged as a structured data set.

Aerodrome reference point. The designated geographical location of an aerodrome.

Aerodrome reference temperature. The monthly mean of the maximum daily temperature for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature).

Aerodrome traffic density.

- (a) Light. Where the number of movements in the mean busy hour is not greater than 15 per runway or typically less than 20 total aerodrome movements per hour.
- (b) Medium. Where the number of movements in the mean busy hour is of the order of 16 to 25 per runway or typically between 20 to 35 total aerodrome movements per hour.

- (c) Heavy. Where the number of movements in the mean busy hour is of the order of 26 or more per runway or typically more than 35 total aerodrome movements per hour.

Aerodrome works. Construction or maintenance works carried out at an aerodrome, on or adjacent to the movement area, that may create obstacles or restrict the normal take-off and landing of aircraft.

Aeronautical beacon. An aeronautical ground light visible at all azimuths, either continuously or intermittently, to designate a particular point on the surface of the earth.

Aeronautical ground light. Any light specially provided as an aid to air navigation, other than a light displayed on an aircraft.

Aeronautical study. An investigation of an aeronautical problem to identify possible solutions and select a solution that is acceptable without degrading safety.

Aeroplane reference field length. The minimum field length required for take-off at maximum certificated take-off mass, sea level, standard atmospheric conditions, still air and zero runway slope, as shown in the appropriate aeroplane flight manual prescribed by the certifying authority or equivalent data from the aeroplane manufacturer. Field length means balanced field length for aeroplanes, if applicable, or take-off distance in other cases.

Note: - MOS Attachment A, Section 17 provides information on the concept of balanced field length and the Airworthiness Manual (Doc 9760) contains detailed guidance on matters related to take-off distance.

Aircraft classification number (ACN). [†] A number expressing the relative effect of an aircraft on a pavement for a specified standard sub-grade category.

Note: - The aircraft classification number is calculated with respect to the center of gravity (CG) position which yields the critical loading on the critical gear. Normally the aftmost CG position appropriate to the maximum gross apron (ramp) mass is used to calculate the ACN. In exceptional cases the forwardmost CG position may result in the nose gear loading being more critical.

Aircraft classification rating (ACR). ^{††} A number expressing the relative effect of an aircraft on a pavement for a specified standard sub-grade category.

Aircraft parking position. A designated area on an apron intended to be used for parking an aircraft, also known as an aircraft stand.

Aircraft stand. See aircraft parking position definition.

Airside The movement area of an aerodrome, adjacent terrain and buildings or portions thereof, to which access is controlled.

Apron. A defined area on a land aerodrome intended to accommodate aircraft for the purposes of loading or unloading passengers, mail or cargo, fueling, parking, or maintenance.

Apron management service. A service provided to regulate the activities and the movement of aircraft and vehicles on the apron

Arresting System. A system designed to decelerate an aeroplane overrunning the runway.

Autonomous runway incursion warning system (ARIWS). A system which provides autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or a vehicle operator.

Balanced field length. The situation where the distance to accelerate and stop is equal to the take-off distance required when an aeroplane experiences an engine failure at the critical engine failure recognition speed (V₁).

Balked landing. A landing maneuver that is unexpectedly discontinued at any point below the obstacle clearance altitude/height (OCA/H).

Barrette. Three or more aeronautical ground lights closely spaced in a transverse line so that from a distance they appear as a short bar of light.

Calendar. Discrete temporal reference system that provides the basis for defining temporal position to a resolution of one day (ISO 19108*).

ISO Standard 19108, Geographic information — Temporal schema

Certified aerodrome. An aerodrome whose operator has been granted an aerodrome certificate.

Clearway. A defined rectangular area on the ground or water under the control of an appropriate authority; at the end of the take-off run available on the ground or water under the control of the aerodrome operator, selected or prepared as a suitable area over which an aeroplane may make a portion of its initial climb to a specified height.

Critical aeroplane. The aeroplane or aeroplanes identified from among the aeroplanes the aerodrome is intended to serve as having the most demanding operational requirements with respect to the determination of movement area dimensions, pavement bearing strength and other physical characteristics in the design of aerodromes.

Critical obstacle. The obstacle within the take-off climb area and/or the approach area, which subtends the greatest vertical angle when measured from the inner edge of the take-off climb surface and/or the approach surface.

Cross-wind component. The surface wind component at right angles to the runway centerline.

Cyclic redundancy check (CRC). A mathematical algorithm applied to the digital expression of data that provides a level of assurance against loss or alteration of data.

Data accuracy. A degree of conformance between the estimated or measured value and the true value.

Data quality. A degree or level of confidence that the data provided meet the requirements of the data user in terms of accuracy, resolution and integrity (or equivalent assurance level), traceability, timeliness, completeness and format.

Data integrity (assurance level). A degree of assurance that an aeronautical data and its value has not been lost or altered since the origination or authorized amendment.

Datum. Any quantity or set of quantities that may serve as a reference or basis for the calculation of other quantities (ISO 19104**).

*** ISO Standard 19104, Geographic information — Terminology*

Declared distances

- (a) **Take-off run available (TORA).** The length of runway declared available and suitable for the ground run of an aeroplane taking off.
- (b) **Take-off distance available (TODA).** The length of the take-off run available plus the length of the clearway, if provided.
- (c) **Accelerate-stop distance available (ASDA).** The length of the take-off run available plus the length of the stopway, if provided.
- (d) **Landing distance available (LDA).** The length of runway which is declared available and suitable for the ground run of an aeroplane landing.

Dependent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centerlines are prescribed.

Displaced threshold. A threshold not located at the extremity of a runway

Effective intensity. The effective intensity of a flashing light is equal to the intensity of a fixed light of the same color, which will produce the same visual range under identical conditions of observation.

Elevation. The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from the mean sea level.

Ellipsoid height (Geodetic height). The height related to the reference ellipsoid, measured along the ellipsoidal outer normal through the point in question.

Fixed light. A light having constant luminous intensity when observed from a fixed point.

Foreign Object Debris (FOD). An inanimate object within the movement area which has no operational or aeronautical function and which has the potential to be a hazard to aircraft operations.

Frangible object. An object of low mass designed to break, distort or yield on impact so as to present the minimum hazard to aircraft.

Note: - Guidance on design for frangibility is contained in the Aerodrome Design Manual (Doc 9157), Part 6.

Geodetic datum. A minimum set of parameters required to define location and orientation of the local reference system with respect to the global reference system/frame.

Geoid. The equipotential surface in the gravity field of the Earth which coincides with the undisturbed mean sea level (MSL) extended continuously through the continents.

Note: - The geoid is irregular in shape because of local gravitational disturbances (wind tides, salinity, current, etc.) and the direction of gravity is perpendicular to the geoid at every point.

Geoid undulation. The distance of the geoid above (positive) or below (negative) the mathematical reference ellipsoid.

Note: - In respect to the World Geodetic System — 1984 (WGS-84) defined ellipsoid, the difference between the WGS-84 ellipsoidal height and orthometric height represents WGS-84 geoid undulation.

Gregorian calendar. Calendar in general use; first introduced in 1582 to define a year that more closely approximates the tropical year than the Julian calendar (ISO 19108***).

Note: - In the Gregorian calendar, common years have 365 days and leap years 366 days divided into twelve sequential months.

**** ISO Standard 19108, Geographic information — Temporal schema*

Hazard beacon. An aeronautical beacon used to designate a danger to air navigation.

Holding bay. A defined area where aircraft can be held, or bypassed, to facilitate efficient surface movement of aircraft.

Hot spot. A location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary.

Human factor principles. Principles which apply to the aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Incident. An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.

Note: - The types of incidents which are of main interest to the International Civil Aviation Organization for accident prevention studies are listed in Attachment C.

Independent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centerlines are not prescribed.

Independent parallel departures. Simultaneous departures from parallel or near-parallel instrument runways.

Instrument approach procedures. The procedures to be followed by aircraft in letting down from cruising level and landing at an aerodrome. (A series of predetermined maneuvers by reference to flight instruments for the orderly transfer of an aircraft from the beginning of the initial approach to a landing, or to a point from which a landing may be made.)

Instrument meteorological conditions (IMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions.

Instrument runway. One of the following types of runway intended for the operation of aircraft using instrument approach procedures:

- (a) **Non-precision approach runway.** A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type A and a visibility not less than 1 000 m.
- (b) **Precision approach runway, category I.** A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) not lower than 60 m (200 ft) and either a visibility not less than 800 m or a runway visual range not less than 550 m.
- (c) **Precision approach runway, category II.** A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) lower than 60 m (200 ft) but not lower than 30 m (100 ft) and a runway visual range not less than 300 m.
- (d) **Precision approach runway, category III.** A runway served by visual aids and nonvisual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) lower than 30 m (100 ft), or no decision height and a runway visual range less than 300 m no runway visual range limitations.

Note: - 1. Visual aids need not necessarily be matched to the scale of non-visual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

Note: - 2. Refer to PCARs Part 8 for instrument approach operation types.

Integrity (aeronautical data). The degree of assurance that an aeronautical data and its value has not been lost or altered since the data origination or authorized amendment.

Integrity classification (aeronautical data). Classification based upon the potential risk resulting from the use of corrupted data. Aeronautical data is classified as:

- (a) routine data: there is a very low probability when using corrupted routine data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe;
- (b) essential data: there is a low probability when using corrupted essential data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe; and
- (c) critical data: there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe.

Intermediate holding position. A designated holding position intended for traffic control at which taxiing aircraft and vehicles shall stop and hold until further clearance to proceed, when so instructed by the aerodrome control tower.

Joint user aerodrome. An aerodrome under the control of a part of the Defense Force in respect of which a formal memorandum is in force to facilitate civil aircraft operations.

Landing area. That part of a movement area intended for the landing or take-off of aircraft.

Landing direction indicator. A device to indicate visually the direction currently designated for landing and for take-off

Laser-beam critical flight zone (LCFZ). Airspace in the proximity of an aerodrome but beyond the LFFZ where the irradiance is restricted to a level unlikely to cause glare effects.

Laser-beam free flight zone (LFFZ). Airspace in the immediate proximity to the aerodrome where the irradiance is restricted to a level unlikely to cause any visual disruption.

Laser-beam sensitive flight zone (LSFZ). Airspace outside, and not necessarily contiguous with, the LFFZ and LCFZ where the irradiance is restricted to a level unlikely to cause flash-blindness or after-image effects.

Light failure. A light shall be deemed to be unserviceable when the main beam average intensity is less than 50% of the value specified in the appropriate figure showing the isocandela diagram. For light units where the designed main beam average intensity is above the value shown in the isocandela diagram, the 50% value shall be related to that design value. (When assessing the main beam, specified angles of beam elevation, toe-in and beam spread shall be taken into consideration).

Lighting system reliability. The probability that the complete installation operates within the specified tolerances and that the system is operationally usable.

Maneuvering area. That part of the aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

Marker. An object displayed above ground level in order to indicate an obstacle or delineate a boundary.

Marking. A symbol or group of symbols displayed on the surface of the movement area in order to convey aeronautical information.

Mass. The terms mass and weight used in aerodrome standards have the same meaning.

Movement. Either a take-off or a landing by an aircraft.

Movement area. That part of the aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the maneuvering area and the apron(s).

Near parallel runways. Non-intersecting runways whose extended centerlines have an angle of convergence/divergence of 15° or less.

Non-instrument runway. A runway intended for the operation of aircraft using visual approach procedures or an instrument approach procedure to a point beyond which the approach may continue in visual meteorological conditions.

Note: - Visual meteorological conditions (VMC) are described in PCARs Part 8.

Non-precision approach runway See **Instrument runway**.

Normal flight zone (NFZ). Airspace not defined as LFFZ, LCFZ or LSFZ but which must be protected from laser radiation capable of causing biological damage to the eye.

Notices to airmen (NOTAM). A notice issued by the relevant authority containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

- (a) are located on an area intended for the surface movement of aircraft; or
- (b) extend above a defined surface intended to protect aircraft in flight; or
- (c) stand outside those defined surfaces and have been assessed as being a hazard to air navigation.

Obstacle free zone (OFZ). The airspace above the inner approach surface, inner transitional surfaces, balked landing surfaces, and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low mass and frangible mounted one that is required for air navigation purposes.

Obstacle limitation surfaces (OLS). A series of planes associated with each runway at an aerodrome that defines the intended limits to which objects may

project into the airspace around the aerodrome so that aircraft operations at the aerodrome may be conducted safely.

Orthometric height. Height of a point related to the geoid, generally presented as an MSL elevation.

Outer main gear wheel span (OMGWS). The distance between the outside edges of the main gear wheels.

Pavement classification number (PCN). [†] A number expressing the bearing strength of a pavement for unrestricted operations.

Pavement classification rating (PCR). ^{††} A number expressing the bearing strength of a pavement.

Precision approach runway See **Instrument runway**.

Primary runway(s). Runway(s) used in preference to others whenever conditions permit.

Protected flight zones. Airspace specifically designated to mitigate the hazardous effects of laser radiation.

Radio aids. Also known as non-visual aids. These aids may consist of NDB, VOR, LOC, DME, ILS or GPS.

Road. An established surface route on the movement area meant for the exclusive use of vehicles.

Road holding position. A designated position at which vehicles may be required to hold.

Runway. A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

Runway condition assessment matrix (RCAM). [§] A matrix allowing the assessment of the runway condition code, using associated procedures, from a set of observed runway surface condition(s) and pilot report of braking action.

Runway condition code (RWYCC). [§] A number describing the runway surface condition to be used in the runway condition report.

Note: - The purpose of the runway condition code is to permit an operational aeroplane performance calculation by the flight crew. Procedures for the determination of the runway condition code are described in the PANS-Aerodromes (Doc 9981).

Runway condition report (RCR). [§] A comprehensive standardized report relating to runway surface conditions and its effect on the aeroplane landing and take-off performance.

Runway end safety area (RESA). An area symmetrical about the extended runway centerline and adjacent to the end of the runway strip primarily intended to reduce the risk of damage to an aeroplane undershooting or overrunning the runway.

Runway-holding position. A designated position intended to protect a runway, an obstacle limitation surface, or an ILS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the aerodrome control tower.

Note: - In radiotelephony phraseologies, the expression “holding point” is used to designate the runway-holding position.

Runway guard light. A light system intended to caution pilots or vehicle drivers that they are about to enter an active runway.

Runway strip. A defined area including the runway, and stopway if provided, intended:

- (a) to reduce the risk of damage to aircraft running off a runway; and
- (b) to protect aircraft flying over it during take-off or landing operations.

Runway surface condition(s).[§] A description of the condition(s) of the runway surface used in the runway condition report which establishes the basis for the determination of the runway condition code for aeroplane performance purposes.

Note: - 1. The runway surface conditions used in the runway condition report establish the performance requirements between the aerodrome operator, aeroplane manufacturer and aeroplane operator.

Note: - 2. Aircraft de-icing chemicals and other contaminants are also reported but are not included in the list of runway surface condition descriptors because their effect on runway surface friction characteristics and the runway condition code cannot be evaluated in a standardized manner.

Note: - 3. Procedures on determining runway surface conditions are available in the PANS-Aerodromes (Doc 9981).

- (a) **Dry runway.** A runway is considered dry if its surface is free of visible moisture and not contaminated within the area intended to be used.
- (b) **Wet runway.** The runway surface is covered by any visible dampness or water up to and including 3 mm deep within the intended area of use.
- (c) **Slippery wet runway.** A wet runway where the surface friction characteristics of a significant portion of the runway has been determined to be degraded.
- (d) **Contaminated runway.** A runway is contaminated when a significant portion of the runway surface area (whether in isolated areas or not) within the length and width being used is covered by one or more of the substances listed in the runway surface condition descriptors.

Note: - Procedures on determination of contaminant coverage on runway are available in the PANS-Aerodromes (Doc 9981).

- (e) **Runway surface condition descriptors.** The element on the surface of the runway:

Note: - The description for standing water below, is used solely in the context of the runway condition report and are not intended to supersede or replace any existing WMO definitions.

- i) **Standing water.** Water of depth greater than 3 mm

Note: - Running water of depth greater than 3 mm is reported as standing water by convention.

Runway turn pad. A defined area on a land aerodrome adjacent to a runway intended for the purpose of completing a 180-degree turn on a runway.

Runway visual range (RVR). The range over which the pilot of an aircraft on the centerline of the runway can see the runway surface markings or the lights delineating the runway or identifying its centerline.

Safety programme. An integrated set of regulations and activities aimed at improving safety.

Safety management system (SMS). A systematic approach to managing safety including the necessary organizational structure, accountabilities, policies and procedures.

Segregated parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

Serious incident. An incident involving circumstances indicating that there was a high probability of an accident and associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time as it comes to rest at the end of the flight and the primary propulsion system is shut down.

Note 1.— The difference between an accident and a serious incident lies only in the result.

Note 2.— Examples of serious incidents can be found in Attachment C.

Serious injury. An injury which is sustained by a person in an accident and which:

- (a) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; or
- (b) results in a fracture of any bone (except simple fractures of fingers, toes or nose); or
- (c) involves lacerations which cause severe haemorrhage, nerve, muscle or tendon damage; or
- (d) involves injury to any internal organ; or
- (e) involves second or third degree burns, or any burns affecting more than 5 per cent of the body surface; or
- (f) involves verified exposure to infectious substances or injurious radiation.

Shoulders. An area adjacent to the edge of a pavement so prepared as to provide a transition between the pavement and the adjacent surface.

Sign.

- (a) Fixed message sign. A sign presenting only one message
- (b) Variable message sign. A sign capable of presenting several predetermined messages or no message, as applicable.

Signal area. An area on an aerodrome used for the display of ground signals.

Station declination. An alignment variation between the zero degree radial of a VOR and true north, determined at the time the VOR station is calibrated.

Stopway. A defined rectangular area on the ground at the end of the take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off.

Switch-over time (light). The time required for the actual intensity of a light measured in a given direction to fall from 50% and recover to 50% during a power supply changeover, when the light is being operated at intensities of 25% or above.

Take-off runway. A runway intended for take-off only.

Taxi-holding position. See definition of runway holding position and intermediate holding position.

Taxiway. A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome from another, including:

- (a) **Aircraft stand (parking position) taxilane.** A portion of an apron designated as a taxiway and intended to provide access to aircraft parking positions only.
- (b) **Apron taxiway.** A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.
- (c) **Rapid exit taxiway.** A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

Taxiway intersection. A junction of two or more taxiways.

Taxiway strip. An area including a taxiway intended to protect an aircraft operating on the taxiway and to reduce the risk of damage to an aircraft accidentally running off the taxiway.

Threshold. The beginning of that portion of the runway usable for landing.

Time limited works. Aerodrome works that may be carried out if normal aircraft operations are not disrupted and the movement area can be restored to normal safety standards in not more than 30 minutes.

Touchdown zone. The portion of a runway, beyond the threshold, where it is intended landing aeroplanes first contact the runway.

Usability factor. The percentage of time during which the use of a runway or

system of runways is not restricted because of cross-wind component

Note: - Cross-wind component means the surface wind component at right angles to the runway centerline.

Visibility. The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlit objects by day and prominent lit objects by night.

Visual meteorological conditions (VMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, equal or better than specified minima.

Weight. The terms weight and mass used in aerodrome standards have the same meaning.

Section 1.5 Abbreviations and Symbols

1.5.1 Abbreviations

ABN	Aerodrome beacon with color and flashing rate.
ACN	Aircraft classification number
ACN†	Aircraft classification number
ACR†	Aircraft classification rating
ADP	Airside driver permit
AIP	Aeronautical information publication
AL	Approach lights (other than high intensity).
APAPI	Abbreviated precision approach path indicator
ASPSL	Arrays of segmented point source lighting
aprx	Approximately
ARIWS	Autonomous runway incursion warning system
ASDA	Accelerate-stop distance available
ATS	Air traffic services
AT-VASIS	Abbreviated T visual approach slope indicator system
C	Degree Celsius
CBR	California bearing ratio
cd	Candela
CIE	Commission Internationale de l'Éclairage
cm	Centimeter
CRC	Cyclic redundancy check
DIFFS	Deck integrated firefighting system
DME	Distance measuring equipment
DPWH	Department of Public Works and Highways

E	Modulus of elasticity
FATO	Final approach and take-off area
FAS	Fixed application system
FMS	Fixed monitor system
FFAS	Fixed foam application system
FOD	Foreign object debris
FMS	Fixed monitor system
ft	Foot
GNSS	Global navigation satellite system
HAPI	Helicopter approach path indicator
HFM	Helicopter flight manual
HIAL-CAT I	High intensity approach lights-CAT I.
HIAL-CAT II or III	High intensity approach lights-CAT II or III.
HIOL	High intensity obstacle lights (flashing white).
HIRL	High intensity runway lights (unidirectional, five or six stages of intensity; lower intensity stages may be omni-directional).
Hz	Hertz
ILS	Instrument landing system
IMC	Instrument meteorological conditions
K	Degree Kelvin
kg	Kilogram
km	Kilometer
km/h	Kilometer per hour
kt	Knot
l	Liter
lb	Pounds
LDAH	Landing distance available heliports
l/min	Liter per minute
LOA	Limited obstacle area
LCFZ	Laser-beam critical flight zone
LDA	Landing distance available
LFFZ	Laser-beam free flight zone
LIOL	Low intensity obstacle lights (steady red).
LIRL	Low intensity runway lights (omni-directional, single stage of intensity).
LOS	Limited obstacle sector

LP	Luminescent panel
LSFZ	Laser-beam sensitive flight zone
m	Meter
MAPt	Missed approach point
max	Maximum
MIOL	Medium intensity obstacle lights (flashing red).
MIRL	Medium intensity runway lights (omni-directional, three stages of intensity).
MLS	Microwave landing system
mm	Millimeter
mn	Minimum
MN	Meganewton
MPa	Megapascal
MSL	Mean sea level
MTOM	Maximum take-off mass
NFZ	Normal flight zone
NM	Nautical mile
NU	Not usable
NVIS	Night Vision Imaging System
OCA/H	Obstacle clearance altitude/height
OFS	Obstacle free sector
OFZ	Obstacle free zone
OLS	Obstacle limitation surface
OMGWS	Outer main gear wheel span
PAPI	Precision approach path indicator
PFAS	Portable foam application system
PCN	Pavement classification number
PCN†	Pavement classification number
PCR††	Pavement classification rating
PinS	Point-in-space
PTBL	Portable or temporary lights (flares or battery).
RCLL	Runway centerline lights.
RESA	Runway end safety area
RFFS	Rescue and firefighting service
R/T	Radio Telephony or radio communications

RTIL	Runway threshold identification lights (flashing white).
RTOD	Rejected take-off distance
RTODAH	Rejected take-off distance available heliports
RTZ	Runway touchdown zone lights
RVR	Runway visual range
SDBY PWR AVBL	Standby power available
SFL	Sequenced flashing lights
SMS	Safety management system
t	Metric Tonne (1000 kg)
TLOF	Touchdown and lift-off area
TODA	Take-off distance available
TODAH	Take-off distance available heliports
TORA	Take-off run available
T-VASIS	T visual approach slope indicator system
VMC	Visual meteorological conditions
VOR	Very high frequency omnidirectional radio range
UCW	Undercarriage width
VSS	Visual segment surface
WHMP	Wildlife hazard management programme
WIP	Work in progress

1.5.2**Symbols**

°	Degree
=	Equals
‘	Minute of arc
μ	Friction coefficient
>	Greater than
<	Less than
%	Percentage
±	Plus or minus
†	Applicable until 27 November 2024
††	Applicable as of 28 November 2024
§	Applicable as of 4 November 2021

Section 1.6**Certification of Aerodromes**

Note. — The intent of these specifications is to ensure that compliance with the specifications in the MOS can be effectively enforced. The most effective and transparent means of ensuring compliance with applicable specifications is the availability of a separate safety oversight entity and a well-defined safety

oversight mechanism with support of appropriate legislation to be able to carry out the function of safety regulation of aerodromes. When an aerodrome is granted a certificate, it signifies to aircraft operators and other organizations operating on the aerodrome that, at the time of certification, the aerodrome meets the specifications regarding the facility and its operation, and that it has the capability to maintain these specifications for the period of validity of the certificate. The certification process also establishes the baseline for continued monitoring of compliance with the specifications. Information on the status of certification of aerodromes need to be provided to CAAP-AIS for promulgation in the Aeronautical Information Publication (AIP). See MOS 5.3.1 and PANS-AIM (Doc 10066), Appendix 2, AD 1.5.

CHAPTER 2. Application of standards to aerodromes

Section 2.1 General

2.1.1 Legislative background and applicability

2.1.1.1 Civil Aviation Regulations relating to aeroplanes conducting air transport operations stipulate that they shall conduct operations from aerodromes meeting the requirements of CAR-Aerodromes.

2.1.1.2 CAR-Aerodromes 2.1.020 requires aerodrome operators to comply with standards and procedures for aerodromes used in air transport operations. The standards and procedures are set out in this document and are applicable to the extent appropriate for aerodrome operators.

2.1.1.3 Operators of aeroplanes with less than 10 passenger seats may conduct air transport operations to aerodromes that are not certified, provided specified aerodrome facilities and reporting arrangements meet appropriate standards. The aerodrome facilities standards and procedures required are specified in this document.

2.1.2 Changes to standards

2.1.2.1 Standards are subject to change from time to time. In general, unless specifically directed by CAAP or subject to 2.1.2.3, existing aerodrome facilities do not need to be immediately modified in accordance with new standards until the facility is replaced or upgraded.

2.1.2.2 Unless otherwise directed by CAAP, an existing facility that does not meet the standard specified in this manual must continue to comply with the standard that was applicable to it.

2.1.2.3 At a certified or registered aerodrome, an existing aerodrome facility that does not comply with this MOS must be identified and recorded, in the Aerodrome Manual where applicable. The data identified must include the date or period when that facility was first introduced or last upgraded and an indication from the aerodrome operator of a plan or timescale to bring the facility in compliance with the MOS. As part of a CAAP audit, evidence to demonstrate efforts to implement a plan or timescale may be required.

2.1.2.4 This MOS applies to a new facility that is brought into operation, and to an existing facility that is being replaced or improved. Subject to agreement with the CAAP, changes to an existing facility of a minor or partial nature may be exempted.

2.1.3 Aeronautical studies

2.1.3.1 Where an aerodrome operator is not able to comply with any standard or recommended practice stipulated in MOS, an aeronautical study may be conducted to assess the impact of deviations from the standards and recommended practices. The purpose of such studies is to present assessments of alternative means of ensuring the safety of aircraft operations,

to estimate the effectiveness of each alternative and to recommend procedures to compensate for the deviation.

- 2.1.3.2 An aeronautical study is mostly frequently undertaken during the planning of a new airport or new airport facility, or in regard to certification of an existing aerodrome. It may also be carried out when aerodrome standards or recommended practices cannot be met as a result of development.
- 2.1.3.3 An aeronautical study is a study of an aeronautical problem carried out by an aerodrome operator to identify possible solutions and select a solution that is acceptable without degrading safety. The CAAP will review these studies on a case by case basis and determine the acceptability of each case to be satisfied that an equivalent level of safety will be attained.
- 2.1.3.4 Technical analysis must provide justification for a deviation on the grounds that an equivalent level of safety can be attained by other means, and that compliance with the standard as it exists is impossible. It is generally applicable in situations where the cost of correcting a problem that violates a standard is excessive but where the unsafe effects of the problem can be overcome by some procedural or other means which offer both practical and reasonable solutions.
- 2.1.3.5 In conducting a technical analysis, an aerodrome operator should draw upon the practical experience and specialized knowledge of staff and/or consultants. The aerodrome operator may also consult other specialists in relevant areas. When considering alternative procedures in the deviation approval process, it is essential to bear in mind the safety objective of the aerodrome certification regulations and the applicable standards and recommended practices so that the intent of the regulations is not circumvented.
- 2.1.3.6 In some instances, the only reasonable means of providing an equivalent level of safety is to adopt suitable procedures and to require, as a condition of certification, that cautionary advice be published in the appropriate aeronautical publications.
- 2.1.3.7 The determination to require a published caution will be primarily dependent on two considerations:
- (a) a pilot's need to be made aware of potentially hazardous conditions; and
 - (b) the responsibility of the aerodrome operator to publish deviations from standards and recommended practices that would otherwise be assumed under a certified aerodrome status.

2.1.4 Exemptions to standards

- 2.1.4.1 When an aerodrome operator is unable to establish compliance with any standard or practice specified in this MOS, the aerodrome operator may apply for exemption from the relevant standard or practice.
- 2.1.4.2 Application for an exemption must be supported, in writing, by cogent reasons including any aeronautical study conducted and the associated results, and an indication of when compliance with the current standards can be expected.

- 2.1.4.3 Those standards which include phrases such as “if practicable”, “where physically practicable”, etc., still require an exemption to standards if an aerodrome operator considers full compliance is not practicable.
- 2.1.4.4 CAAP may exempt by notice in writing, after taking into account all safety-related aspects and operating circumstances, any aerodrome operator from compliance with any standard or practice prescribed in this MOS.
- 2.1.4.5 Any exemption granted by CAAP shall be subject to any condition or procedure specified in the exemption instrument as being necessary in the interest of safety.
- 2.1.4.6 Exemptions to standards granted to an aerodrome operator must be recorded in the Aerodrome Manual unless CAAP approves an alternative recording process. The manual must contain details of the exemption, reason for the request, any resultant limitations imposed, and similar relevant information.
- 2.1.4.7 An exemption granted to an existing facility continues to apply until its expiry date.
- 2.1.4.8 If an aerodrome manual is not required, a formal exemption instrument issued by CAAP must be retained by the aerodrome operator and produced on request.

2.1.5 Conflict with other standards

- 2.1.5.1 Compliance with the standards and procedures specified in this MOS does not absolve aerodrome operators from obligations in respect of standards prescribed by other government or statutory authorities. Where another statutory standard conflicts with this MOS, the matter must be referred to CAAP for resolution.

2.1.6 Aerodrome Reference Code

Introductory Note. — The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome. The code is not intended to be used for determining runway length or pavement strength requirements. The code is composed of two elements which are related to the aeroplane performance characteristics and dimensions. Element 1 is a number based on the aeroplane reference field length and element 2 is a letter based on the aeroplane wingspan. The code letter or number within an element selected for design purposes is related to aeroplane characteristics for which the facility is provided. When applying CAAP MOS for Aerodromes, Chapter 1-14, first identify the aeroplanes which the aerodrome is intended to serve and then determine the two elements of the code.

- 2.1.6.1 An aerodrome reference code — code number and letter — which is selected for aerodrome planning purposes shall be determined in accordance with the characteristics of the aeroplane for which an aerodrome facility is intended.
- 2.1.6.2 The aerodrome reference code numbers and letters shall have the meanings

assigned to them in Table 2.1-1.

- 2.1.6.3 The code number for element 1 shall be determined from column 1 of the table below. The code number corresponding to the highest value of the aeroplane reference field length for which the runway is intended.

Note 1: - The determination of the aeroplane reference field length is solely for the selection of a code number and is not intended to influence the actual runway length provided.

Note 2: - Guidance on determining the runway length is given in the Aerodrome Design Manual, (Doc 9157), Part 1 — Runways..

- 2.1.6.4 The code letter for element 2 shall be determined from Table 2.2-1 by selecting the code letter which corresponds to the greatest wingspan of the aeroplane for which the facility is intended.

Note: - Guidance in determining the aerodrome reference code is given in the Aerodrome Design Manual (Doc.9157), Parts 1 & 2.

- 2.1.6.5 For certified aerodromes, information about the aerodrome reference code letter for each runway and taxiway shall be set out in the Aerodrome Manual.

- 2.1.6.6 Unless otherwise agreed by CAAP, aerodrome operators shall maintain the aerodrome facilities in accordance with the applicable standards set out in this MOS in relation to the aerodrome reference code for the facilities.

Code element 1	
Code number	Aeroplane reference field length
1	Less than 800 m
2	800 m up to but not including 1200 m
3	1200 m up to but not including 1800 m
4	1800 m and over
Code element 2	
Code number	Wingspan
A	Up to but not including 15 m
B	15 m up to but not including 24 m
C	24 m up to but not including 36 m
D	36 m up to but not including 52 m
E	52 m up to but not including 65 m
F	65 m up to but not including 80 m

Table 2.1-1: Aerodrome reference code
(see 2.1.6.1 to 2.1.6.4)

Note: - 1. Guidance on planning for aeroplanes with wing spans greater than 80 m is given in the Aerodrome Design Manual (Doc.9157), Parts 1 & 2.

Note: - 2. Procedures on conducting aerodrome compatibility study to accommodate aeroplanes with folding wing tips spanning two code letters are given in the Procedures for Air Navigation Services Aerodromes (PANS-Aerodromes, Doc 9981). Further guidance can be found in the manufacturer's aircraft characteristics for airport planning manual.

2.1.7 Aerodrome Reference Codes and aeroplane characteristics

2.1.7.1 A list of representative aeroplanes, chosen to provide an example of each possible aerodrome reference code number and letter combination, is shown in Table 2.1-2.

AEROPLANE TYPE	REF CODE	AEROPLANE CHARACTERISTICS					
		ARFL (m)	Wingspan (m)	OMGWS (m)	Length (m)	MTOW (kg)	(Kpa)
DHC-2 Beaver	1A	381	14.6	3.3	10.3	2490	240
Beechcraft: 58 (Baron)	1A	401	11.5	3.1	9.1	2449	392
Britten Norman Islander	1A	353	14.9	4.0	10.9	2850	228
Cessna: 172	1A	272	10.9	2.7	8.2	1066	-
206	1A	274	10.9	2.6	8.6	1639	-
310	1A	518	11.3	3.7	9.7	2359	414
404	1A	721	14.1	4.3	12.1	3810	490
Partenavia P68	1A	230	12.0	2.6	9.4	1960	-
Piper: PA 31 (Navajo)	1A	639	12.4	4.3	9.9	2950	414
PA 34	1A	378	11.8	3.4	8.7	1814	-
Beechcraft 200	1B	592	16.6	5.6	13.3	5670	735
Cessna: 208A (Caravan)	1B	296	15.9	3.7	11.5	3310	-
402C	1B	669	13.45	5.6	11.1	3107	490
441	1B	544	15.1	4.6	11.9	4468	665
DHC 6 Twin Otter	1B	695	19.8	4.1	15.8	5670	220
Let L-410UVP	1B	565	19.48	3.65	14.47	6600	-
Let L-410UVP-E	1B	565	19.98	3.65	14.47	6600	-
DHC-7	1C	689	28.4	7.8	24.6	19505	620
DHC-5E	1D	290	29.3	10.2	24.1	22316	-
Beechcraft 1900	2B	1098	16.6	5.8	17.6	7530	-
CASA C-212	2B	866	20.3	3.5	16.2	7700	392
Embraer EMB110	2B	1199	15.3	4.9	15.1	5670	586
ATR 42-200	2C	1010	24.6	4.9	22.7	16150	728
Cessna 550	2C	912	15.8	6.0	14.4	6033	700
DHC-8: 100	2C	948	25.9	8.5	22.3	15650	805
300	2C	1122	27.4	8.5	25.7	18642	805

AEROPLANE TYPE	REF CODE	AEROPLANE CHARACTERISTICS					
		ARFL (m)	Wingspa n (m)	OMGWS (m)	Length (m)	MTOW (kg)	(Kpa)
NAMCYS-11-100	2C	1130	26.3	8.6	32.0	24500	-
NAMCYS-11A-500	2C	1130	26.3	8.6	32.0	24500	-
Bae 146-100	2C	1190	26.34	4.72	26.16	38100	-
Lear Jet 55	3A	1292	13.4	2.5	16.8	9298	-
Canadair : CL600	3B	1737	18.9	4.0	20.9	18642	1140
CRJ-200	3B	1527	21.21	4.0	26.77	21523	1117
Dassault- Breguet: Falcon	3B	1515	19.3	5.3	20.2	20640	1300
Embraer EMB 145	3B	1500	20	4.8	29.9	19200	-
Bae:							
146-200	3C	1615	26.3	5.5	26.2	42185	1138
146-300	3C	1615	26.3	5.5	31.0	44225	945
Bombardier Global Express	3C	1774	28.7	4.9	30.3	42410	-
CN-235 100	3C	1406	25.81	3.9	21.4	22930	-
Embraer EMB 120	3C	1420	19.8	7.3	20.0	11500	828
McDonnell Douglas:							
DC-3	3C	1204	28.8	5.8	19.6	14100	358
DC9-20	3C	1551	28.5	6.0	31.8	45360	972
Fokker:							
F27-500	3C	1670	29.0	7.9	25.1	20412	540
F28-4000	3C	1640	25.1	5.8	29.6	32205	779
F50	3C	1760	29.0	8.0	25.2	20820	552
F100	3C	1695	28.1	5.0	35.5	44450	920
Airbus A300 B2	3D	1676	44.8	10.9	53.6	142000	1241
Airbus A319-100	4C	2080	34.1	7.6	33.84	64000	-
Airbus A320-200	4C	2180	34.1	7.6	37.6	77000	1360
Boeing:							
B717-200	4C	2130	28.4	6.0	37.8	51710	-
B737-200	4C	2295	28.4	6.4	30.6	52390	1145
B737-300	4C	2749	28.9	6.4	30.5	61230	1344
B737-400	4C	2499	28.9	6.4	36.5	63083	1400
B737-800	4C	2256	35.8	6.4	39.5	70535	-
McDonnell Douglas:							
DC9-30	4C	2134	28.5	6.0	37.8	48988	-
DC9-80/MD80	4C	2553	32.9	6.2	45.1	72575	1390
Airbus:							
A300-600	4E	2332	44.8	10.9	54.1	165000	1260
A310-200	4D	1845	43.9	10.9	46.7	132000	1080

AEROPLANE TYPE	REF CODE	AEROPLANE CHARACTERISTICS					
		ARFL (m)	Wingspan (m)	OMGWS (m)	Length (m)	MTOW (kg)	(Kpa)
Boeing:							
B707-300	4D	3088	44.4	7.9	46.6	151315	1240
B757-200	4D	2057	38.0	8.7	47.3	108860	1172
B767-200ER	4D	2499	47.6	10.8	48.5	156500	1310
B767-300ER	4D	2743	47.6	10.8	54.9	172365	1310
McDonnell							
Douglas:							
DC8-63	4D	3179	45.2	7.6	57.1	158757	1365
DC10-30	4D	3170	50.4	12.6	55.4	251744	1276
MD11	4D	2207	51.7	12.0	61.2	273289	1400
Lockheed:							
L1011-100/200	4D	2469	47.3	12.8	54.2	211378	1207
Boeing:							
B747-SP	4E	2710	59.6	12.4	56.3	318420	1413
B747-300	4E	3292	59.6	12.4	70.4	377800	1323
B747-400	4E	3383	64.9	12.4	70.4	394625	1410
B777-200	4E	2500	60.9	12.8	63.73	287800	1400
Airbus A380	4F	2800	79.75	12.5	72.6	560000	-

Note: - List of selected aeroplane characteristics can be found in Attachment D to Chapter 4 of PANS-Aerodromes (Doc 9981).

Table 2.1-2: Aerodrome reference codes and aeroplane characteristics

2.1.7.2 For a particular aeroplane, the table also provides data on the aeroplane reference field length (ARFL), wingspan and outer main gear wheel span used in determining the aerodrome reference code. The data and performance characteristics for actual individual aircraft shall be obtained from information published by the aeroplane manufacturer.

2.1.8 Providing for future larger aeroplanes

2.1.8.1 Nothing in this MOS is intended to inhibit the planning or provision of aerodrome facilities for larger aeroplanes that may be accommodated by the aerodrome at a later date. However, where movement area facilities are built for future larger aeroplanes, the aerodrome operator must liaise with the CAAP to determine interim notification of Reference Code and maintenance arrangements.

2.1.8.2 For master planning of aerodromes the appropriate aeroplane and aeroplane characteristics are to be selected. This MOS has included ICAO Code F specifications for aerodrome facilities intended for aeroplanes larger than B 747 wide body aircraft.

Note: - 1. ICAO Circular 305 AN/177, "Operation of New Larger Aeroplanes at Existing Aerodromes" issued June 2004 may provide useful information when considering arrangements for safety matters associated with large aeroplane ground operations.

Note: - 2. Provisions for the accommodation of more demanding aircraft at existing aerodromes can be found in the PANS-Aerodromes (Doc 9981). Guidance on some possible effects of future aircraft on these specifications is given in the Aerodrome Design Manual (Doc 9157), Part 2.

2.1.9 Non-instrument and instrument runways

2.1.9.1 Runways are classified as non-instrument (also known as visual or circling approach) and instrument runways. Instrument runways are further categorized as: non-precision, precision Category I, Category II, and Category IIIA, IIIB and IIIC.

2.1.9.2 Aerodrome operators must liaise with CAAP before initiating any changes to the runway classification or instrument category as such a change will involve changes to the standards of a number of other aerodrome facilities.

2.1.9.3 This MOS contains specifications for precision approach runways category II and III, for aerodrome facilities intended for aeroplanes with Reference Code numbers 3 and 4 only. No specification is prescribed for code 1 or 2 precision approach runways, as it is unlikely that such facilities will be required. Aerodrome operators must liaise with CAAP to ascertain mandatory requirements if consideration is being given to installing ILS Category II or III facilities for Reference Code 1 or 2 aeroplanes.

2.1.10 Non-precision approach runways

2.1.10.1 A non-precision approach runway is defined in MOS 1. Non-precision approach procedures are designed by CAAP and are published in the AIP.

2.1.10.2 Straight-in or runway aligned procedures are identified by the runway number in the title of the approach chart (e.g. RWY 18 GPS or RWY 08 VOR/DME). Non-runway aligned approach procedures will not have the runway number in the title (e.g. GPS-S, GPS-N or NDB).

2.1.10.3 The results of accident enquiries have demonstrated that straight-in approaches are much safer than circling approaches, especially at night. With the advent of GPS, non-precision approach (NPA) runways can be provided without any ground based navigation aid. Aerodrome operators of non-instrument runways may upgrade their runways to NPA runways wherever it is practicable to do so.

2.1.10.4 However, the benefit of having an NPA runway can only be realized if the runway meets the applicable NPA runway standards. These may include:

- (a) increased runway strip width;
- (b) increased inner horizontal, conical and approach obstacle imitation surfaces to be surveyed for obstacles;
- (c) spacing of runway edge lights; and
- (d) the availability of the wind direction indicator, near the threshold, if possible, or an acceptable alternate method for obtaining wind information such as an automatic weather information service.

- 2.1.10.5 Before an NPA procedure is published the procedure designer has to arrange for the design to be commissioned by flight check. Besides checking the operational aspects of the design, the flight check will also validate the adequacy of the runway, visibility of the wind direction indicator and clearances from all existing obstacles. A NPA procedure is only approved for publication when all requirements are met. Otherwise a direction on the use of the procedure may be annotated on the chart, including in the worst case a direction that straight-in landing is not permitted.

2.1.11 Specific Procedures for Aerodrome Operations

Note: - This section introduces PANS-Aerodromes (Doc 9981) for the use of aerodromes undertaking an assessment of its compatibility for the type of traffic or operation the aerodrome is intending to accommodate. The material in the PANS-Aerodromes addresses operational issues faced by existing aerodromes and provides the necessary procedures to ensure the continued safety of operations. Where alternative measures, operational procedures and operating restrictions have been developed, these are detailed in the aerodrome manual and reviewed periodically to assess their continued validity. The PANS- Aerodromes does not substitute nor circumvent the provisions contained in the MOS. It is expected that infrastructure on an existing aerodrome or a new aerodrome will fully comply with the requirements in this Annex. See CAR-ANS Part 15, 15.5.2.2.1 (c) on States' responsibilities on listing of differences with the related ICAO Procedures in the Aeronautical Information Publication.

- 2.1.11.1 When the aerodrome accommodates an aeroplane that exceeds the certificated characteristics of the aerodrome, the compatibility between the operation of the aeroplane and aerodrome infrastructure and operations shall be assessed and appropriate measures be developed and implemented in order to maintain an acceptable level of safety during operations.

Note: - Procedures to assess the compatibility of the operation of a new aeroplane with an existing aerodrome can be found in the PANS-Aerodromes (Doc 9981).

- 2.1.11.2 Information concerning alternative measures, operational procedures and operating restrictions implemented at an aerodrome arising from 2.1.11.1 shall be promulgated.

Note: - 1. See PANS-AIM (Doc 10066), Appendix 2, AD 2.20 on the provision of detailed description of local traffic regulations.

Note: - 2. See PANS-Aerodromes (Doc 9981), Chapter 3, Section 3.6 on promulgation of safety information.



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CHAPTER 3. Applying for an aerodrome certificate

Section 3.1 General

3.1.1 Introduction

3.1.1.1 Under the provisions of CAR-Aerodromes 2.2.005,

- (a) An aerodrome shall only be operated by a person who holds a valid certificate issued by CAAP for that aerodrome if it is used for:
 - (i) any international air transport operation; or
 - (ii) If an aerodrome operator plans to have an international air transport operations, the operator must apply for an aerodrome certificate.

Note: - Specific procedures on the stages of certifying an aerodrome are given in MOS 3.2 in accordance with PANS-Aerodromes (Doc 9981). Further guidance on aerodrome certification can be found in the Manual on Certification of Aerodromes (Doc 9774).

3.1.1.2 The applicant shall be the owner of the aerodrome site, or have obtained permission from the owner to use the site as an aerodrome.

3.1.1.3 CAAP aerodrome certification process only addresses the aviation safety aspects of the aerodrome. It is the responsibility of the applicant to ensure that use of the site as an aerodrome is in compliance with other national, provincial and local statutory requirements. The aerodrome certificate does not absolve the applicant from observing such requirements.

3.1.1.4 Before submitting an application, an aerodrome operator (or intending aerodrome operator) must prepare an Aerodrome Manual, in accordance with the requirements set out in CAR-Aerodromes 2.2.065. The standards for compliance with the regulatory requirements are set out in various chapters in this manual. MOS Appendix 1 provides the specification for the format and contents of an aerodrome manual.

3.1.1.5 The initial application must be made on the form attached at MOS Appendix 2. The completed form shall be submitted to the Director General, CAAP Manila, together with a copy of the Aerodrome Manual.

3.1.2 Processing an Aerodrome Certificate application

3.1.2.1 Applications shall be submitted in sufficient time to allow for detailed consideration and inspection of the aerodrome before the desired date of issue of the certificate.

3.1.2.2 Engineering and survey reports of the physical characteristics of the movement area, pavement strength and surface, obstacle limitation surfaces, etc., shall be provided by the applicant as required by CAAP.

3.1.2.3 As part of the certification process, CAAP shall ensure that an aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services,

equipment, operating procedures, organization and management including a safety management system, is submitted by the applicant for approval/acceptance prior to granting the aerodrome certificate.

Note: - The intent of a safety management system is to have in place an organized and orderly approach in the management of aerodrome safety by the aerodrome operator. CAR-Safety Management 2nd Edition contains the safety management provisions applicable to certified aerodromes. Overarching guidance on safety management systems is provided in the Safety Management Manual (SMM) (Doc 9859) and in the Manual on Certification of Aerodromes (Doc 9774). Procedures on the management of change, conduct of safety assessment, reporting and analyses of safety occurrences at aerodromes; runway safety; and continuous monitoring to enforce compliance with applicable specifications so that hazards are identified and risks are assessed and mitigated, are specified in the PANS-Aerodromes (Doc 9981).

- 3.1.2.4 CAAP staff or other authorized persons may carry out audits, surveys, inspections, checks or tests of any aspect of the aerodrome or require substantiation of any information provided by the applicant. However, it shall be clearly understood that the CAAP inspection or testing procedures must use a sampling process. CAAP activity does not absolve the applicant from the responsibility to provide accurate information.
- 3.1.2.5 Special assessments may be necessary if there are aerodrome facilities that do not comply with the applicable standards. This may involve more time and resources and may result in restrictions being imposed on aircraft operations.
- 3.1.2.6 Certification process from the Aerodrome Certification Programme are detailed in MOS 3.2.

3.1.3 Granting of an Aerodrome Certificate

- 3.1.3.1 Before an aerodrome certificate is granted, CAAP must be satisfied that:
 - (a) the aerodrome's physical characteristics, facilities, services and equipment are in accordance with the standards specified for a certified aerodrome;
 - (b) an acceptable aerodrome manual has been prepared for the aerodrome in accordance with CAR-Aerodromes 2.2.065 and 2.2.070;
 - (c) the aerodrome's operating procedures set out in the aerodrome manual make satisfactory provision for the safety of aircraft;
 - (d) there are sufficient experienced trained or qualified personnel to conduct the safety functions of the aerodrome;
 - (e) the applicant would, if the certificate is granted, be able properly to operate and maintain the aerodrome;
 - (f) an acceptable aerodrome safety management system has been developed, documented and implemented; and
 - (g) a full-scale emergency exercise has been conducted as part of the aerodrome operator's Airport Emergency Plan (AEP).
- 3.1.3.2 Aerodrome certificates are granted on the condition that the aerodrome and the

aerodrome operator will, at all times, be and remain in compliance with applicable regulations and standards. CAR-Aerodromes 2.2.025 empowers CAAP, if considered necessary in the interests of aviation safety, to attach additional conditions to a certificate to account for particular circumstances.

3.1.3.3 Once granted, an aerodrome certificate (issued 'in perpetuity') will remain in force unless it is suspended or cancelled. A temporary certificate has a finite term (not more than 6 months) and will become invalid on the specified date, unless it is suspended or cancelled prior to that date.

3.1.3.4 When an aerodrome operator is granted a certificate, it signifies to aircraft operators and other organizations operating on the aerodrome that, at the time of certification, the aerodrome meets the specifications regarding the facility and its operation, and that it has, according to CAAP, the capability to maintain these specifications. The certification process also establishes the baseline for continuing monitoring of compliance with the specifications.

3.1.4 Aerodrome operator organization

3.1.4.1 Aerodrome organization management and operational structure

- (a) An effective management structure is essential for the operation of aerodromes. Duties and responsibilities of managers and senior executives must be clearly defined in writing, and chains of command systematically established.
- (b) The number and nature of personnel appointments at an aerodrome will vary depending on the size and complexity of aerodrome operations. The aerodrome operator shall ensure that the management organization is adequate and properly matched to the operating environment and commitments.
- (c) It is important that the operational management has suitable experienced and competence with proper status in the organization. The positions held by key operations and maintenance personnel shall be listed in the Aerodrome Manual.
- (d) Where maintenance activities or aircraft ground handling services are performed by external contractors or agencies and not directly by the aerodrome operator, a member of the management team must be appointed/designated to establish, coordinate arrangements and to provide continuous liaison with the maintenance contractors or handling agencies. It is responsibility of the aerodrome operator to ensure that his contractors and/or agencies are competent to perform their duties having regard to their experience, equipment, organization, staffing, training and other arrangements.

3.1.4.2 Aerodrome operational staff and competency

- (a) Under CAR-Aerodromes 2.2.093 (1), an aerodrome operator shall employ an adequate number of qualified and skilled personnel to perform all critical activities for the operation and maintenance of the aerodrome.
- (b) CAR-Aerodromes 2.2.093 (2), requires that the aerodrome operator employ only those persons possessing competency certification in accordance with CAR-Aerodromes 2.2.210.
- (c) In addition, CAR-Aerodromes 2.2.093 (3), stipulates that an aerodrome

operator shall implement programmes to upgrade the competency of the personnel referred to in CAR-Aerodromes 2.2.093 (1).

- (d) Aerodrome operational staff refers to staff engaged in the day to day operation of the aerodrome whose duties have a bearing on aircraft safety. They include apron control staff, rescue and firefighting personnel, bird control staff, airfield lighting and aircraft pavement maintenance personnel, aircraft movement area inspection staff, etc., who in the course of their duties are concerned with ensuring that the aerodrome is safe for use by aircraft, or are required to have access to the aerodrome maneuvering areas or apron.
- (e) Pursuant to CAR-Aerodromes requirements mentioned in paragraphs (a) to (c) above, an aerodrome operator shall satisfy the CAAP that the aerodrome has an adequate number of operational staff for the aerodrome operations. This requirement will not be assessed against a set formula, as there will clearly be a wide variation according to particular circumstances.
- (f) Arrangements for the supervision of operational staff must be sensibly related to the size of the organization and the nature of the operation, and must be in the hands of persons having the experience and qualities necessary to ensure that the maintenance are of high professional standards. The duties and responsibilities of these supervisory personnel and their supporting staff shall be well-defined.
- (g) Pursuant to CAR-Aerodromes 2.2.115, all operational personnel shall be properly trained to perform their duties in an efficient and effective manner. Apart from initial training, refresher training shall also be provided at regular intervals to ensure that a high standard is maintained. Training provisions including any competency test required of staff shall be detailed in the Aerodrome Manual. A record of all such training and tests shall be kept up to date.

3.1.5 Amendment of an Aerodrome Certificate

3.1.5.1 The CAAP shall provide that the requirements of regulations MOS 3.1.3.1, 3.3.3.1(e), and 3.3.4 have been met, amend an aerodrome certificate when:

- (a) there is a change in the ownership or management of the aerodrome;
- (b) there is a change in the use or operation of the aerodrome;
- (c) there is a change in the boundaries of the aerodrome; or
- (d) the holder of the aerodrome certificate requests an amendment.

3.1.6 Continued validity of an aerodrome certificate

3.1.6.1 For certified airports, validation must include assessment of the effective implementation of aerodrome operator's SMS in terms of monitoring and analyzing safety occurrences and trends and taking appropriate action in a timely manner.

Note: - Details of SMS assessment is contained in Aerodrome SMS Requirements for Aerodrome Operators (SMSRAO), and Aerodrome SMS Acceptance and Surveillance Program (SMSASP).

3.1.6.2 SMS effective implementation is part of a continued validity requirements for certified airports which is covered in the surveillance program and where all aspects of the

aerodrome certification and operation are taken into account (See Appendix E: Checklist of SMSASP).

- 3.1.6.3 An overall assessment of the continued validity of the aerodrome certificate must be indicated in the surveillance report laying out the complied conditions/requirement as per CAR-Aerodromes: 2.2.015, MOS: 3.1.3 and also described in ARCID Certification Program: Section 5.

Section 3.2 Aerodrome certification process

The aerodrome certification process shall be conducted in a phased approach comprising of the following phases (details of the process is included in the CAAP Manual of Aerodrome Regulatory Procedures –MARP):

3.2.1 Phase 1: Initial Certification

- 3.2.1.1 Application for aerodrome certification.

- 3.2.1.2 Assessment of application and attachments, development of aerodrome manual, and conduct of technical inspection.

Note: - Attachments will include but not limited to legal requirements, organizational competence, liaising/agreement with relevant authorities, and aerodrome manual (if already available).

3.2.2 Phase 2: Aerodrome Manual Review And Acceptance

- 3.2.2.1 Analysis of the aerodrome manual and acceptance.

- 3.2.2.2 CAAP and Operator plan the time and date, and prepare for on-site verification audit.

3.2.3 Phase 3: On-Site Verification

- 3.2.3.1 Conduct of on-site verification.

- 3.2.3.2 Submission of Corrective Action Plans (CAPs).

- 3.2.3.3 Analysis and validation of CAPs implementation.

3.2.4 Phase 4: Issuance Of Aerodrome Certificate

- 3.2.4.1 Granting of Interim (Temporary) or Final Aerodrome Certificate.

3.2.5 PHASE 5: Initial Surveillance

- 3.2.5.1 Within six (6) months after the issuance of temporary aerodrome certificate and 1 month prior to the expiration of the certificate, AAI will conduct the surveillance inspection to determine progress on all CAPs and to assess whether the Aerodrome operator maybe granted a permanent Aerodrome Certificate.

- (a) When an aerodrome's corrective action plan does not ensure that appropriate corrective action has been taken within acceptable timelines, and after coordination with the operator, increased oversight of the operator is necessary. The scope of increased oversight may cover specific subjects or be all-

encompassing.

- (b) The AAI should notify the aerodrome operator in writing:
 - (i) that it is being placed under increased oversight and outline the subjects concerned and from which date;
 - (ii) the reasons for the increased oversight and what it consists of; and
 - (iii) what actions are required by the aerodrome.
- (c) When an aerodrome is placed under increased oversight, CAAP should:
 - (i) carry out appropriate oversight actions on the subjects concerned;
 - (ii) follow very carefully the implementation of the corrective actions plan; and
 - (iii) allocate sufficient time/resources to the oversight of the concerned aerodrome.
- (d) The oversight actions carried out under increased oversight are the same as those carried out normally, but are more exhaustive and address all the subjects concerned.
- (e) When increased oversight is concluded on an aerodrome for a specific subject, AAI shall advise the aerodrome operator in writing, stating the end of the procedure and the reason.
- (f) The aerodrome certificate can be amended, suspended or revoked according to the outcome of the increased oversight.

Section 3.3 Aerodrome Manual

3.3.1 General

- 3.3.1.1 As part of the certification process, an aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system, must be submitted by the applicant for approval/acceptance prior to granting the aerodrome certificate.

Note: - Contents of an aerodrome manual, including procedures for its submission and approval/acceptance, verification of compliance and granting of aerodrome certificate, are also available in the PANS-AERODROMES (Doc 9981).

3.3.2 Scope of the Aerodrome Manual

- 3.3.2.1 The aim and objectives of the aerodrome manual and how it is to be used by operating staff and other stakeholders shall be stated in the manual.
- 3.3.2.2 The aerodrome manual contains all the relevant information to describe the management and operational structure. It is the means by which all aerodrome operating staff are fully informed as to their duties and responsibilities with regard to safety, including information and instructions related to those matters specified in the applicable regulation. It describes the aerodrome services and facilities, all operating procedures, and any restrictions in place.

3.3.3 Format of an Aerodrome Manual

- 3.3.3.1 Aerodrome Manual shall comprise of a document covering all matters that need to be addressed, as well as relevant supporting documents and manuals for aerodrome operations that are referred to in the Aerodrome Manual. MOS Appendix 1, Schedule of particulars to be included in an aerodrome manual, provides the minimum requirement to be included in an aerodrome manual. The Aerodrome Manual may be supplemented by other documents and manuals, airport circulars, notices and instructions issued by the aerodrome operator to his staff and contractors or agents on airport operational matters from time to time. The contents of these supplementary materials shall be incorporated into the main Aerodrome Manual if they are permanent in nature.
- 3.3.3.2 The Aerodrome Manual is a 'living document' and subject to frequent amendment. As such it shall be contained in a binder designed to facilitate easy amendment. The page and paragraph numbering system shall also be designed to allow for easy addition and deletion of information. Information regarding each amendment record, the amendment history and a list of effective pages shall be included in each copy of the Aerodrome Manual.
- 3.3.3.3 As a working and reference document for aerodrome operational staff, the Aerodrome Manual must be user-friendly. The information and instructions contained therein must be clear, concise and unambiguous. Aerodrome operators shall ensure that the Aerodrome Manuals prepared for their aerodromes address the required contents comprehensively and clearly. The CAAP reserves the right to reject an Aerodrome Manual and/or to request supplementary information to be provided within the Aerodrome Manual if it, or any part of it, is found to be unacceptable, incomplete or inadequate.
- 3.3.3.4 The aerodrome manual accurately reflects the aerodrome's SMS and shows, in particular, how the aerodrome intends to measure its performance against safety targets and objectives.
- 3.3.3.5 All aerodrome safety policies, operational procedures and instructions are contained in detail or cross referenced to other formally accepted or recognized publications.
- Note: - At larger aerodromes, the size and complexity of operations and related procedures may imply that these procedures cannot be included in a single document. For example, the aerodrome operator may develop and maintain an SMS manual to communicate its approach to the management of safety throughout the aerodrome. In such circumstances it is acceptable to identify within the aerodrome manual references to such provisions. It is essential that any referenced information, documentation and procedures be subjected to exactly the same systems of consultation and promulgation as the aerodrome manual. A computerized database containing the referenced procedures and information could be suitable for that purpose. For many smaller aerodromes the aerodrome manual can be both simple and brief as long as it covers procedures essential for safe day-to-day operations.*

3.3.4 Contents of the Aerodrome Manual

Note: - A list of other possible topics for inclusion in the aerodrome manual is given in MOS Appendix 1.

- 3.3.4.1 The aerodrome manual shall contain, as a minimum, the following sections, including some of their requirements:
- (a) a table of contents;
 - (b) a list of the corrigenda/amendments: this section shall log the updates and/or corrections made to the aerodrome manual;
 - (c) a distribution list;
 - (d) aerodrome administrative data: an organizational chart shall be provided, as well as the aerodrome operator's safety responsibilities;
 - (e) a description of the aerodrome: this includes maps and charts. The physical characteristics of the aerodrome shall be documented, as well as the information regarding the RFF level, ground aids, primary and secondary electrical power systems and main obstacles. Sufficiently detailed charts of the aerodrome shall also be included (showing the aerodrome's boundaries and different areas (manoeuvring area, apron, etc.). All deviations from the regulatory provisions authorized by the State shall be listed together with their validity and references to the related documents (including any safety assessments);
 - (f) a description of the intended operations, including:
 - (i) the critical aeroplanes the aerodrome is intended to serve;
 - (ii) the category of runway(s) provided (non-instrument, instrument including non-precision and precision);
 - (iii) the different runways and their associated levels of service;
 - (iv) the nature of aviation activities (commercial, passenger, air transport, cargo, aerial work, general aviation);
 - (v) The type of traffic permitted to use the aerodrome (international/national, IFR/VFR, scheduled/nonscheduled); and
 - (vi) the minimum RVR that aerodrome operations can be permitted.
 - (g) a description of each of the aerodrome operator's procedures related to the safety of aeronautical operations at the aerodrome. For each procedure:
 - (i) the responsibilities of the aerodrome operator are clearly described;
 - (ii) the tasks that are to be achieved by the aerodrome operator or its subcontractors are listed;
 - (iii) the means and procedures required to complete these tasks are described or appended, together with the necessary details such as the frequency of application and operating modes; and
 - (h) a description of the operator's SMS
 - (i) the SMS section of the manual is developed, and the related procedures and documents are enclosed, as well as the safety policy of the aerodrome operator signed by the accountable executive;
 - (ii) the aerodrome SMS shall be commensurate with the size of the aerodrome and with the level and complexity of the services provided.

Note 1. - The complexity and size of the aerodrome may necessitate the SMS

to be included in a separate manual

Note 2. - CAR-Safety Management 2nd Edition specifies a framework for the implementation of an SMS at an aerodrome.

- 3.3.4.2 Responsibilities attributed to other aerodrome stakeholders shall be clearly identified and listed.

3.3.5 Updating of the Aerodrome Manual

- 3.3.5.1 Responsibility for maintaining the accuracy of the aerodrome manual is clearly defined in the manual.
- 3.3.5.2 The manual is updated using a defined process and includes a record of all amendments, effective dates and amendment approvals.
- 3.3.5.3 The method of enabling all aerodrome operating staff to have access to the relevant parts of the manual is defined and can be demonstrated and a method of tracking amendments and ensuring their receipt shall be established when using an electronic means of distribution.
- 3.3.5.4 Any amendments or additions shall be communicated to CAAP in accordance with the continued oversight requirements established by CAAP.

3.3.6 Maintenance and Control of Aerodrome Manual

- 3.3.6.1 CAR-Aerodromes 2.2.060 requires an aerodrome operator to:
- (a) produce an Aerodrome Manual for his aerodrome and provide the CAAP with a copy thereof which is kept complete and current;
 - (b) keep at least one complete and current copy of the Aerodrome Manual at the aerodrome and, if the aerodrome is not his principal place of business, keep another such copy of the Aerodrome Manual at his principal place of business;
 - (c) make the Aerodrome Manual available for inspection by any authorized person;
 - (d) conduct of periodic review of the Aerodrome Manual and make such amendments as may be necessary to maintain the accuracy of the information in the Aerodrome Manual and to keep its contents up to date;
 - (e) notify the CAAP, as soon as practicable, of any amendment made to the Aerodrome Manual; and
 - (f) make such amendment or addition to the Aerodrome Manual as the CAAP may require for:
 - (i) maintaining the accuracy of the Aerodrome Manual;
 - (ii) ensuring the safe and efficient operation of aircraft at the aerodrome; or
 - (iii) ensuring the safety of air navigation.
- 3.3.6.2 Additional copies of the Aerodrome Manual may be made available so that aerodrome staff and other organizations at the aerodrome may have access to a copy of the manual, or a relevant part of it.

- 3.3.6.3 When additional copies or sections of the manual are required, the aerodrome manual controller is responsible for distribution to those persons.

3.3.7 Issue and distribution of an Aerodrome Manual

- 3.3.7.1 The Aerodrome Manual is an important safety document and must be issued under the authority of the aerodrome operator and signed by the senior executive of the organization. Any amendments to the Aerodrome Manual shall be approved by the aerodrome operator, or his delegate, to do so.

- 3.3.7.2 Copies of relevant sections of the Aerodrome Manual shall be made available to each supervisory member of the aerodrome operating staff including those employed by the operator's contractors or agents, where relevant, so that each member of the aerodrome operating staff:

- (a) is aware of the contents of every part of the aerodrome manual relevant to his/her duties; and
- (b) is aware of the requirement to undertake duties in conformity with the relevant provisions of the Aerodrome Manual.

- 3.3.7.3 For this manual, aerodrome operating staff shall mean all persons, whether or not employed directly by the aerodrome operator, who in the course of their duties are:

- (a) concerned with ensuring that the aerodrome is safe for use by aircraft; or
- (b) required to have access to the aerodrome Maneuvering area or apron.

- 3.3.7.4 In addition sufficient copies of the Aerodrome Manual shall be placed at the aerodrome operator's library and at the workplace of other relevant operating staff concerned.

- 3.3.7.5 Apart from submission of the Aerodrome Manual to CAAP and internal distribution of copies to relevant operating staff, copies of the Aerodrome Manual (or relevant parts of it) shall also be made available to other external parties who have a part to play in aerodrome safety procedures. In particular, the airport emergency section of the Aerodrome Manual shall also be extended to all external parties (e.g. Civil Defense, State Police, external Fire Departments or health agencies) involved in the aerodrome emergency plan.

- 3.3.7.6 The Aerodrome Manual shall be a controlled document. An aerodrome operator shall appoint a document controller to be responsible for updating and distributing its Aerodrome Manual. Each copy of the Aerodrome Manual shall be numbered and a list of their holders maintained by the document controller. Amendments shall be recorded on the amendment page in each copy.

3.3.8 Amendment of an Aerodrome Manual

- 3.3.8.1 Each holder of the Aerodrome Manual shall be responsible for ensuring that his copy is kept up to date. For copies intended for common use, a person shall be designated to look after amendment of those copies.

- 3.3.8.2 Manuscript amendments by hand to the Aerodrome Manual are not generally acceptable. Changes or additions shall be subject of an additional or replacement

page suitably dated. If the amendment affects the action of external parties, an acknowledgement slip shall be requested from each external party concerned when amendments are circulated to confirm that each party concerned has received and taken notice of the amendment.

- 3.3.8.3 The aerodrome operator shall make prompt amendments to the Aerodrome Manual when there are updates to any part of the contents of the Aerodrome Manual or, when required by the CAAP upon review of the Aerodrome Manual or any proposed updates or amendments. Such amendments required by the CAAP shall be binding on the aerodrome operator.

3.3.9 Initiating NOTAM for a new certified aerodrome

- 3.3.9.1 The CAAP officer or inspector responsible for the certification process will prepare and forward to the NOTAM Office details setting out all the aerodrome information which will be included in AIP, including the date when the aerodrome will be certified.



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CHAPTER 4. Applying for an Aerodrome Registration Type 1, Aerodrome Registration Type 2 and Permit to Operate (PTO)

Section 4.1 Registered Aerodrome Type 1

4.1.1 Introduction

4.1.1.1 Under the provisions of CAR-Aerodromes 2.3.005,

(1) An aerodrome shall only be operated by a person who holds a valid Aerodrome Registration Type 1 issued by CAAP for that aerodrome if it is:

(a) open for public use in domestic operations with an annual aircraft movement above 5,000 and annual passenger movement above 300,000.

4.1.1.2 The applicant shall be the owner of the aerodrome site, or have obtained permission from the owner to use the site as an aerodrome.

4.1.1.3 The CAAP aerodrome registration process only addresses the aviation safety aspects of the aerodrome. It is the responsibility of the applicant to ensure that use of the site as an aerodrome is in compliance with other national, provincial and local statutory requirements. The aerodrome registration does not absolve the applicant from observing such requirements.

4.1.1.4 Before submitting an application, an aerodrome operator (or intending aerodrome operator) must prepare an Aerodrome Manual, in accordance with the requirements set out in CAR-Aerodromes 2.2.065. The standards for compliance with the regulatory requirements are set out in various chapters in this manual. MOS Appendix 1 provides the specification for the format and contents of an aerodrome manual.

4.1.1.5 The initial application must be made on the form attached at MOS Appendix 2. The completed form shall be submitted to the Director General, CAAP Manila, together with a copy of the Aerodrome Manual.

4.1.2 Processing an Aerodrome Registration Type 1 application

4.1.2.1 Applications shall be submitted in sufficient time to allow for detailed consideration and inspection of the aerodrome before the desired date of issue of the Registration Type 1.

4.1.2.2 Engineering and survey reports of the physical characteristics of the movement area, pavement strength and surface, obstacle limitation surfaces, etc., shall be provided by the applicant as required by CAAP. Further details are contained in Section 5.1.2.

4.1.2.3 aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system, aerodrome emergency plan and maintenance plan is submitted by the applicant for approval/acceptance prior to granting the Aerodrome Registration Type 1.

Note 1: - CAAP staff or other authorized persons may carry out audits, surveys, inspections, checks or tests of any aspect of the aerodrome or require substantiation of any information provided by the applicant. However, it shall be clearly understood that the CAAP inspection or testing procedures must use a sampling process. CAAP activity does not absolve the applicant from the responsibility to provide accurate information.

Note 2: - The intent of a safety management system is to have in place an organized and orderly approach in the management of aerodrome safety by the aerodrome operator. CAR-Safety Management 2nd Edition contains the safety management provisions applicable to certified aerodromes. Guidance on harmonized safety management system is given in the Safety Management Manual (SMM) (Doc 9859) and in the Manual on Certification of Aerodromes (Doc 9774). Procedures on the management of change, conduct of safety assessment, reporting and analyses of safety occurrences at aerodromes and continuous monitoring to enforce compliance with applicable specifications so that identified risks are mitigated can be found in the PANS-AERODROMES (Doc 9981).

Note 3: - Details of SMS assessment is contained in Aerodrome SMS Requirements for Aerodrome Operators (SMSRAO), and Aerodrome SMS Acceptance and Surveillance Program (SMSASP).

4.1.2.4 Special assessments may be necessary if there are aerodrome facilities that do not comply with the applicable standards. This may involve more time and resources and may result in restrictions being imposed on aircraft operations.

4.1.2.5 Aerodrome Registration Type 1 process is detailed in MOS 4.1.8.

4.1.3 Granting of an Aerodrome Registration Type 1

4.1.3.1 Before an Aerodrome Registration Type 1 is granted, CAAP must be satisfied that:

- (a) the aerodrome's physical characteristics, facilities, services and equipment are in accordance with the standards specified for a Registration Type 1 aerodrome;
- (b) an acceptable aerodrome manual has been prepared for the aerodrome in accordance with CAR-Aerodromes 2.2.065 and 2.2.070;
- (c) the aerodrome's operating procedures set out in the aerodrome manual make satisfactory provision for the safety of aircraft;
- (d) there are sufficient experienced competent personnel to conduct the safety functions of the aerodrome;
- (e) the applicant would, if the certificate is granted, be able properly to operate and maintain the aerodrome;
- (f) an acceptable aerodrome safety management system has been developed, documented and implemented; and
- (g) a full-scale test of the aerodrome emergency plan has been conducted.

4.1.3.2 Aerodrome Registration Type 1 is granted on the condition that the aerodrome and the aerodrome operator will, at all times, be and remain in compliance with applicable regulations and standards. CAR-Aerodromes 2.3.025 empowers CAAP, if considered necessary in the interests of aviation safety, to attach additional

conditions to an Aerodrome Registration Type 1 to account for particular circumstances.

4.1.3.3 Once granted, an Aerodrome Registration Type 1 (issued 'in perpetuity') will remain in force unless it is suspended or cancelled. A temporary Aerodrome Registration Type 1 has a finite term (not more than 6 months) and will become invalid on the specified date, unless it is suspended or cancelled prior to that date.

4.1.3.4 When an aerodrome operator is granted an Aerodrome Registration Type 1, it signifies to aircraft operators and other organizations operating on the aerodrome that, at the time of certification, the aerodrome meets the specifications regarding the facility and its operation, and that it has, according to CAAP, the capability to maintain these specifications. The registration process also establishes the baseline for continuing monitoring of compliance with the specifications.

4.1.4 Aerodrome operator organization (See MOS 3.1.4)

4.1.5 Amendment of an Aerodrome Registration Type 1

4.1.5.1 The CAAP shall, provided that the requirements of regulations MOS 4.1.3.1, 4.1.3.1(e), and 3.3.5 have been met, in accordance with CAR- 2.3.050 amend an aerodrome registration when:

- (a) there is a change in the use or operation of the aerodrome
- (b) there is a change in the boundaries of the aerodrome; or
- (c) the holder of the Aerodrome Registration Type 1 certificate requests an amendment.

4.1.6 Transfer of an Aerodrome Registration Type 1

4.1.6.1 In case of change in ownership or management of the aerodrome, the new aerodrome operator or manager shall apply for a transfer of the Aerodrome Registration Type 1 in accordance with CAR Aerodromes 2.3.060.

4.1.7 Continued validity of an Aerodrome Registration Type 1

4.1.7.1 For Aerodrome Registered Type 1 airports, validation must include assessment of the effective implementation of aerodrome operator's SMS in terms of monitoring and analyzing safety occurrences and trends and taking appropriate action in a timely manner.

4.1.7.2 SMS effective implementation is part of a continued validity requirements for Registered Type 1 airports which is covered in the surveillance program and where all aspects of the aerodrome registration and operation are taken into account (See Appendix E: Checklist in the ARCID Surveillance Policy Procedures and Programme).

4.1.7.3 An overall assessment of the continued validity of the aerodrome Registered Type 1 must be indicated in the surveillance report laying out the complied conditions/requirement as per CAR-Aerodromes: 2.3.015, MOS: 3.1.3 and also

described in updated ARCID Certification Program: Section 5.

4.1.8 Aerodrome Registration Type 1 process

The Aerodrome Registration Type 1 process shall be conducted in a phased approach comprising of the following phases (details of the process is included in the CAAP Manual of Aerodrome Regulatory Procedures – MARP):

4.1.8.1 Phase 1: Initial Registration Type 1

- (a) Application for Aerodrome Registration Type 1.
- (b) Assessment of application and attachments, development of aerodrome manual, and conduct of technical inspection.

Note: - Attachments will include but not limited to legal requirements, organizational competence, liaising/agreement with relevant authorities, and aerodrome manual (if already available).

4.1.8.2 Phase 2: Aerodrome Manual Review and Acceptance

- (a) Analysis of the aerodrome manual and acceptance:
- (b) CAAP and Operator plan the time and date, and prepare for on-site verification audit.

4.1.8.3 Phase 3: On-Site Verification

- (a) Conduct of on-site verification;
- (b) Submission of Corrective Action Plans (CAPs); and
- (c) Analysis and validation of CAPs implementation.

4.1.8.4 Phase 4: Issuance of Aerodrome Registration Type 1

- (a) Granting of Interim (Temporary) or Final Aerodrome Registration Type 1.

4.1.8.5 Phase 5: Initial Surveillance

- (a) Within six (6) months after the issuance of temporary Aerodrome Registration Type 1 and 1 (one) month prior to the expiration of the Registration Type 1, AAI will conduct the surveillance inspection to determine progress on all CAPs and to assess whether the Aerodrome operator maybe granted a permanent Aerodrome Registration Type 1.
 - (i) When an aerodrome's corrective action plan does not ensure that appropriate corrective action has been taken within acceptable timelines, and after coordination with the operator, increased oversight of the operator is necessary. The scope of increased oversight may cover specific subjects or be all-encompassing.
 - (ii) The AAI should notify the aerodrome operator in writing:
 - that it is being placed under increased oversight and outline the subjects concerned and from which date;
 - the reasons for the increased oversight and what it consists of; and
 - what actions are required by the aerodrome.

- (iii) When an aerodrome is placed under increased oversight, CAAP should:
 - carry out appropriate oversight actions on the subjects concerned;
 - follow very carefully the implementation of the corrective actions plan; and
 - allocate sufficient time/resources to the oversight of the concerned aerodrome.
- (iv) The oversight actions carried out under increased oversight are the same as those carried out normally, but are more exhaustive and address all the subjects concerned.
- (v) When increased oversight is concluded on an aerodrome for a specific subject, the AAI shall advise the aerodrome operator in writing, stating the end of the procedure and the reason.
- (vi) The aerodrome certificate can be amended, suspended or revoked according to the outcome of the increased oversight.

4.1.9 Aerodrome Manual

4.1.9.1 General

As part of the process for the Aerodrome Registration Type 1 process, an aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system, must be submitted by the applicant for approval/acceptance prior to granting the Aerodrome Registration Type 1.

Note: - Contents of an aerodrome manual, including procedures for its submission and approval/acceptance, verification of compliance and granting of aerodrome certificate, are also available in the PANS-AERODROMES (Doc 9981)

4.1.9.2 Scope of the Aerodrome Manual

The scope of the aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.2.

4.1.9.3 Format of an Aerodrome Manual

The format of the aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.3.

4.1.9.4 Contents of the Aerodrome Manual

The contents of the aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.4.

4.1.9.5 Updating of the Aerodrome Manual

Updating of the aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.5.

4.1.9.6 Maintenance and Control of Aerodrome Manual

Maintenance and control of aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.6.

4.1.9.7 Issue and distribution of an Aerodrome Manual

Issue and distribution of an aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.7.

4.1.9.8 Amendment of an Aerodrome Manual

Amendment of an aerodrome manual for Aerodrome Registration Type 1 are detailed in MOS 3.3.8.

4.1.9.9 Initiating NOTAM for a new registered Type 1 aerodrome

The CAAP officer or inspector responsible for the Aerodrome Registration Type 1 will prepare and forward to the NOTAM Office details setting out all the aerodrome information which will be included in AIP, including the date when the aerodrome will be registered Type 1.

Section 4.2 Registered Aerodrome Type 2

4.2.1 Introduction

4.2.1.1 Under the provisions of CAR-Aerodromes 2.3.095,

An aerodrome shall only be operated by a person who holds a valid Aerodrome Registration Type 2 issued by CAAP for that aerodrome if it is:

- (a) an aerodrome open for public or private use in domestic operations with an annual aircraft movement of 5,000 and below, or annual passenger movement of 300,000 and below, or
- (b) a heliport using aircraft with 10 or more passenger seats; or
- (c) an aerodrome not covered by the PTO requirements.

4.2.1.2 An Aerodrome Registration Type 2 will have aerodrome information published in AIP, and changes to aerodrome information or conditions affecting aircraft operations can be notified through the NOTAM system.

Note: - CAAP will only approve instrument runways at aerodromes open to public use if the aerodrome is either certified or registered.

4.2.1.3 The applicant for Aerodrome Registration Type 2 must be the owner of the aerodrome site, or have obtained permission from the owner to use the site as an aerodrome.

4.2.1.4 The CAAP aerodrome Registration Type 2 process only addresses the aviation

safety aspect of the aerodrome. It is the responsibility of the applicant to ensure that use of the site as an aerodrome is in compliance with other requirements. The holder of an Aerodrome Registration Type 2 does not absolve the applicant from observing such requirements.

- 4.2.1.5 An aerodrome manual is not required for a registered Type 2 aerodrome, but the application must be accompanied by:
- (a) aeronautical information about the aerodrome as specified in CAR-Aerodromes 2.3.015; and
 - (b) a statement confirming an appropriate safety inspection has been performed and the relevant standards are met; and
 - (c) the names and contact details of the reporting officer(s) for the aerodrome.

4.2.2 Approving an Aerodrome Registration Type 2 application

- 4.2.2.1 An Aerodrome Registration Type 2 is approved on the condition that:
- (a) the aerodrome meets appropriate standards;
 - (b) the aerodrome operator has the capacity to properly maintain the aerodrome; and
 - (c) the reporting officer has been trained to the standards detailed in Chapter 10.
- 4.2.2.2 When the Aerodrome Registration Type 2 application is approved, CAAP will prepare and forward to the NOTAM Office a permanent NOTAM setting out all the aerodrome information which will be included in AIP. CAAP will also confirm, to the applicant, in writing, that the aerodrome is or will be issued an Aerodrome Registration Type 2, together with a copy of the NOTAM message.

4.2.3 Maintenance of an Aerodrome Registration Type 2

- 4.2.3.1 Aerodromes issued with an Aerodrome Registration Type 2 will be included in the CAAP aerodrome surveillance program. A scheduled visit by an aerodrome inspector can be expected periodically. Appropriate notice of the scheduled visit will be given. Unscheduled visits may occur at any time, such as when prompted by reported safety concerns.
- 4.2.3.2 An Aerodrome Registration Type 2 will remain in force until it is suspended or cancelled.
- 4.2.3.3 An Aerodrome Registration Type 2 may be suspended if CAAP is not satisfied with:
- (a) the accuracy of aerodrome information provided;
 - (b) the on-going maintenance of the aerodrome; or
 - (c) the ability of the reporting officer to conduct on-going aerodrome serviceability inspection and reporting functions.

Note: - 1. Keeping records of aerodrome serviceability inspections, aerodrome works and NOTAM issued will assist in demonstrating that the aerodrome has

been operated properly.

Note: - 2. Standards for ongoing operations and maintenance of a Aerodrome Registration Type 2 are specified in Chapter 12.

4.2.3.4 An Aerodrome Registration Type 2 may be cancelled:

- (a) on request of the aerodrome operator; or
- (b) by CAAP after the Aerodrome Registration Type 2 was suspended and the identified safety concerns are not corrected to the satisfaction of CAAP, within an acceptable period.

4.2.4 Aerodrome Safety Inspection Report

4.2.4.1 Operators with Aerodrome Registration Type 2 are required to have an Aerodrome Safety Inspection Report prepared by a CAAP inspector or an approved person as specified in the regulations. This inspection and report must be done either annually, or at a longer interval as agreed by CAAP.

Section 4.3 Permit to operate (PTO)

4.3.1 Introduction

4.3.1.1 Pursuant to CAR-Aerodromes 2.4, operators of airstrips and/or heliports conducting air transport operations or private operations using aircraft with less than 10 passenger seats are required to secure Permit to Operate.

4.3.1.2 The Permit to Operate for aerodromes and heliports is granted as privilege by CAAP to applicants/operators of aerodrome and heliport who meet the minimum standards and requirements prescribed in this Manual.

4.3.2 Approving an application for a PTO

4.3.2.1 The aerodrome meets the applicable standards specified in the MOS 4.2.4 for non-certificated or registered aerodromes;

4.3.2.2 The airstrip or heliport operating procedures make satisfactory provision (MOS 4.2.5) for the safety of aircraft; and

4.3.2.3 The applicant would, if the PTO is issued, be able to properly operate and maintain the aerodrome.

4.3.3 Conditions on Permit to Operate

4.3.3.1 An aerodrome shall only be operated by a person who holds a valid PTO issued by the CAAP for that aerodrome subject to the following conditions:

- (a) The aerodrome is operated in compliance with the applicable provisions of CAR-Aerodromes and the Manual of Standards for Aerodromes (MOS) detailed in MOS 4.2.5.
- (b) The aerodrome is subject to Safety Inspections:
 - (i) If the inspection is an Air Operator Certificate (AOC) requirement;

- (ii) As required under CAAP aerodrome surveillance programme;
- (iii) When safety issues arise or when there is reason to believe that safety is compromised; and
- (iv) Upon aerodrome operator's request.
- (c) The aerodrome operator shall notify CAAP/AANSOO when aerodrome operation will be permanently closed.
- (d) If CAAP decides to issue a PTO subject to a condition, CAAP gives the applicant a written notice stating the reasons for the decision.
- (e) A condition must be set out on the PTO.
- (f) An aerodrome operator must not contravene a condition of the operator's PTO.

4.3.4 Technical specifications and operating standards

4.3.4.1 Physical specifications, obstacle environment, visual aids and RFFS

- (a) Airstrips (Refer to MOS 13)

The requirements that pertain to physical characteristics of an airstrip shall include as applicable at least the following:

 - (i) the required physical dimensions and obstacle limitation surfaces (OLS) specified in MOS Tables 13.1-1 and 13.1-3 (for agricultural airstrips);
 - (ii) runway length, clearways, stopways and runway strip;
 - (iii) visual aids:
 - markings, markers, signs, ground signal and signal areas, directional indicators, distance to go markers (optional)
 - (iv) runway and runway strip conditions (MOS Table 13.1-2);
 - (v) drainage;
 - (vi) fencing;
 - (vii) RFFS:
 - Level of protection-primary (water and foam) and complementary (DCP) agents, discharge rates, rescue equipment and tools, first aid kit, etc
 - Response time and exercises
- (b) Heliport (Refer to MOS 15)
 - (i) Types (surface level and elevated heliports, helidecks, shipboard heliports).
 - (ii) Areas (FATO, TLOF, Safety).
 - (iii) Markings (D-value, t-value, H identification, touchdown/positioning, heliport name, etc.).
 - (iv) aeronautical data (Refer to MOS 15.3).
 - (v) OLS (approach/take-off surfaces, 45° side protected slope, obstacle markings).

- (vi) Personnel safety (safety net, ingress/egress).
- (vii) RFFS:
 - Level of protection-primary (water and foam) and complementary (DCP) agents, discharge rates, rescue equipment and tools, first aid kit, etc.

4.3.5

Operating Procedures

- (a) Documented operating procedures are best presented in a manual. The manual is not exhaustive and aerodrome operator may adopt, based on the complexity/applicability of its contents to actual operation.
- (b) Operating procedures are minimum arrangements required of the aerodrome operator to ensure the safe operation of the aerodrome. These include the following:
 - (i) Appointment of Reporting Officer duly signed by heliport operator with corresponding duties and responsibilities (see MOS 15.17.1);
 - (ii) aerodrome serviceability inspection;
 - (iii) reporting procedures;
 - (iv) emergency arrangements (response times and exercises, etc.);
 - (v) coordination with ATC (if applicable); and
 - (vi) Training of Safety Personnel.

CHAPTER 5. Aerodrome information for AIP

Section 5.1 General

5.1.1 Introduction

5.1.1.1 This chapter contains specifications relating to the provision of aerodrome data to the Aeronautical Information Service (AIS) for publication in accordance with Annex 15 to the Convention on International Civil Aviation.

5.1.1.2 The Aeronautical Information Service (AIS) is a unit of the CAAP responsible for collecting, collating, editing and publishing aeronautical information. Aeronautical information is published by the AIS as an integrated Aeronautical Information package consisting of the following elements:

- (a) Aeronautical Information Publication (AIP) – A publication issued by and with the authority of the AIS and containing aeronautical information of a lasting character essential to air navigation.
- (b) AIP Amendment – Permanent changes to the information contained in the AIP.
- (c) AIP Supplement – Temporary changes to the information contained in the AIP which are published by means of special pages.
- (d) NOTAM – A notice distributed by telecommunication means containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
- (e) Pre-flight information bulletin (PFIB) – A presentation of current NOTAM information of operational significance, prepared prior to flight.
- (f) Aeronautical Information Circular (AIC) – a notice containing information which relates to flight safety, air navigation, technical, administrative or legislative matters.

5.1.1.3 Aerodrome information is to be published in the Aeronautical Information Publication (AIP) - Philippines. CAR-Aerodromes requires the applicant for an aerodrome certificate or registration to provide information relating to the aerodrome for publication in AIP. This information must be included in the applicant's Aerodrome Manual, if applicable, and include the status of aerodrome certification.

5.1.1.4 This chapter sets out the aerodrome information which needs to be provided and the standards to which such aerodrome information must be gathered and presented for a certified or registered aerodrome.

5.1.1.5 The importance of providing accurate aerodrome information for the safety of aircraft operations cannot be over-emphasized. Accordingly, care and diligence must be exercised in obtaining the aerodrome information to be published. This will involve the use of appropriately qualified persons to measure, determine or calculate aerodrome operational information.

- 5.1.1.6 After the information is published, maintaining its accuracy is also of critical importance. Standards for maintaining accuracy of published aerodrome information in AIP, including NOTAMS, are set out in MOS 10.

5.1.2 Aeronautical Data

- 5.1.2.1 Determination and reporting of aerodrome-related aeronautical data shall be in accordance with the accuracy and integrity classification required to meet the needs of the end-users of aeronautical data.

Note: - Specifications concerning the accuracy and integrity classification related to aerodrome-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1.

- 5.1.2.2 Aerodrome mapping data shall be made available to the aeronautical information services for aerodromes deemed relevant by CAAP where safety and/or performance-based operations suggest possible benefits.

Note 1. - Aerodrome mapping databases related provisions are contained in CAR-ANS Part 15, 15.5 and PANS-AIM (Doc 10066), Chapter 5.

Note 2. - Guidance material concerning the application of aerodrome mapping databases is provided in MOS Attachment A, Section 10.

- 5.1.2.3 Where made available in accordance with 5.1.2.2, the selection of the aerodrome mapping data features to be collected shall be made with consideration of the intended applications.

Note 1: - It is intended that the selection of the features to be collected match a defined operational need.

Note 2. - Aerodrome mapping databases can be provided at one of two levels of quality - fine or medium. These levels and the corresponding numerical requirements are defined in RTCA Document DO- 272B and European Organization for Civil Aviation Equipment (EUROCAE) Document ED-99B - User Requirements for Aerodrome Mapping Information.

- 5.1.2.4 Digital data error detection techniques shall be used during the transmission and/or storage of aeronautical data and digital data sets.

Note. — Detailed specifications concerning digital data error detection techniques are contained in PANS-AIM (Doc 10066).

5.1.3 Aerodrome information to be provided for publication in AIP

- 5.1.3.1 Where an aerodrome manual is not required the information submitted must be in writing and include data relating to the items listed below. The data shall be measured or described, as appropriate, for each facility provided on an aerodrome.

Aerodrome diagram. An aerodrome diagram must be provided to illustrate, as appropriate:

- (a) layout of runways, taxiways and apron(s);
- (b) nature of the runway surfaces;
- (c) designations and length of runways;
- (d) designations of the taxiways, where applicable;
- (e) location of illuminated and non-illuminated wind direction indicators;
- (f) location of the aerodrome reference point;
- (g) the direction and distance to the nearest town;
- (h) location of terminal buildings; and
- (i) location of helipads.

Aerodrome operation. This information must include:

- (a) name, address, telephone and facsimile numbers of the aerodrome operator; including after hours contacts;
- (b) aerodrome usage, public or private; and
- (c) aerodrome charges, where notification is desired.

Aerodrome location. This information must include:

- (a) name of aerodrome;
- (b) World Aeronautical Chart (WAC) number, if known;
- (c) latitude and longitude, based on the aerodrome reference point;
- (d) magnetic variation;
- (e) time conversion-universal time coordinated (UTC) plus local time difference;
- (f) aeronautical location code indicator, if known;
- (g) aerodrome elevation; and
- (h) currency of Type A charts, if provided.

Movement area. This information must include for each runway designation:

- (a) aerodrome reference code number;
- (b) runway bearings - in degrees magnetic;
- (c) runway length and surface type;
- (d) runway pavement strength rating;
- (e) runway and runway strip width;
- (f) runway slope;
- (g) runway declared distances;

- (h) elevation of the midpoint of runway threshold, for instrument runways;
- (i) runway strip, RESA, stopway; and
- (j) clearway.

Clearway. Length to the nearest meter or foot, ground profile.

Lighting systems. This information must include:

- (a) lighting systems for runways;
- (b) approach lighting system;
- (c) visual approach slope indicator system;
- (d) aerodrome beacon;
- (e) lighting systems for taxiways;
- (f) any other lighting systems; and
- (g) visual aids.

Navigation aids. Details of any navigation aid provided by the aerodrome operator.

Rescue and fire-fighting services. The category of aerodrome-based rescue and fire-fighting services provided by CAAP or the aerodrome operator.

Ground services. This information must include:

- (a) fuel suppliers and their contact details, including after hours;
- (b) automatic weather information broadcast if provided by aerodrome operator; and
- (c) any other services available to pilots.

Special procedures. Include any special procedures unique to the aerodrome, which pilots need to be advised.

Notices. Include important cautionary or administrative information relating to the use of the aerodrome.

The boundaries of the air traffic control service.

5.1.4 Standards for determining Aerodrome Information

5.1.4.1 Nature of runway surface. The runway surface type must be notified as either:

- (a) bitumen seal;
- (b) asphalt;
- (c) concrete;
- (d) gravel;

- (e) grass; or
- (f) natural surface.

Where only the central portion of runway is sealed, this must be advised accordingly.

- 5.1.4.2 Runway bearing and designation. The bearing of runways must be determined in degrees magnetic. Runways are normally designated in relation to their magnetic direction, rounded off to the nearest 10 degrees and stated in two figure combinations, e.g. RWY 06, RWY 24. To avoid potential identification confusion, the combination 13/31 shall not be used without prior CAAP approval.
- 5.1.4.3 Runway length. The aerodrome operator must provide the physical length of runways in whole numbers of meters and feet, with feet bracketed.
- 5.1.4.4 Taxiway designation, width and surface type. A single letter must be used without numbers to designate each main taxiway. Alpha-numeric designators may be used for short feeder taxiways. See also MOS 8. For taxiway width and surface type, refer to MOS 6.7.
- 5.1.4.5 Location and designation of standard taxi-routes.
- 5.1.4.6 Aerodrome reference point (ARP). The aerodrome reference point shall be established for an aerodrome. It shall be located near the initial or planned geometric center of the aerodrome and shall normally remain where first established. Its position shall be measured and reported to AIS-CAAP in degrees, minutes and seconds.
- 5.1.4.7 Aerodrome elevation. Must be at the highest point of the landing area, above mean sea level. Aerodrome elevation must be reported in feet, based on the Philippines mean sea level datum to an accuracy of one foot.
- 5.1.4.8 Runway reference code number. For each runway provide the reference code number as defined in MOS 2.
- 5.1.4.9 Apron - surface type, aircraft stands, refer to MOS 8.5.
- 5.1.4.10 Pavement strength

Part A (*Applicable until 27 November 2024*)

- (a) Aircraft less than 5,700 kg maximum take-off mass. The bearing strength of a pavement intended for aircraft of 5,700 kg mass or less, must be made available by reporting the following information:
 - (i) maximum allowable aircraft mass; and
 - (ii) maximum allowable tire pressure.

- (b) Aircraft greater than 5,700 kg maximum take-off mass. Report the bearing strength of pavements intended for aircraft greater than 5,700 kg mass, in accordance with the Aircraft Classification Number/ Pavement Classification Number System, (ACN/PCN) system; reporting all of the following information:
- (i) the pavement classification number (PCN);
 - (ii) pavement type for ACN-PCN determination;
 - (iii) subgrade strength category;
 - (iv) maximum allowable tire pressure category; and
 - (v) evaluation method.

Note: - If necessary, PCNs may be published to an accuracy of one-tenth of a whole number.

- (c) The PCN reported will indicate that an aircraft with an aircraft classification number (ACN) equal to or less than the reported PCN can operate on the pavement subject to any limitation on the tire pressure, or aircraft all-up weight for specified aircraft type(s).

Note: - Different PCNs may be reported if the strength of the pavement is subject to significant seasonal variation.

- (d) Information on pavement type for ACN-PCN determination, sub grade strength category, maximum tire pressure category and evaluation method must be reported using the following codes:
- (i) pavement type for ACN-PCN determination

Pavement type for ACN-PCN determination	Code
Rigid pavement	R
Flexible pavement	F

- (ii) subgrade strength category

Sub grade strength category:	Code
<i>High strength</i> : characterized by a K value of 150 MN/m ³ and representing all K values above 120 MN/m ³ for rigid pavements, and by CBR 15 and representing all CBR values above 13 for flexible pavements.	A
<i>Medium strength</i> : characterized by a K value of 80 MN/m ³ and representing a range in K of 60 to 120 MN/m ³ for rigid pavements, and by CBR 10 and representing a range in CBR of 8 to 13 for flexible pavements.	B
<i>Low strength</i> : characterized by a K value of 40 MN/m ³ and representing a range in K of 25 to 60 MN/m ³ for rigid by CBR 6 and representing a range in CBR of 4 to 8 for flexible pavements.	C
<i>Ultra low strength</i> : characterized by a K value of 20 MN/m ³ and representing all K values below 25 MN/m ³ for rigid pavements, and by CBR 3 and representing all CBR values below 4 for flexible pavements.	D

(iii) maximum allowable tire pressure category

Maximum allowable tire pressure category:	Code
<i>Unlimited</i> : no pressure limit	W
<i>High</i> : pressure limited to 1.75 MPa	X
<i>Medium</i> : pressure limited to 1.25 MPa	Y
<i>Low</i> : pressure limited to 0.50 MPa	Z

Note: - See MOS 10.15.2.1, Note 5 where the pavement is used by aircraft with tire pressures in the upper categories.

(iv) evaluation method

Evaluation method:	Code
<i>Technical evaluation</i> : representing a specific study of the pavement characteristics and application of pavement behavior technology.	T
<i>Using aircraft experience</i> : representing knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use.	U

- (e) The following examples illustrate how pavement strength data are reported under the ACN-PCN method:

Example 1: If the bearing strength of a rigid pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCN 80 and there is no tire pressure limitation, then the reported information would be: PCN 80/R/B/W/T.

Example 2: If the bearing strength of a flexible pavement, built on a high strength subgrade, has been assessed by using aircraft experience to be PCN 50 and the maximum tire pressure allowable is 1.25 MPa, then the reported information would be: PCN 50/F/A/Y/U.

Note: - Composite construction.

Example 3: If the bearing strength of a flexible pavement, built on a medium strength subgrade, has been assessed by technical evaluation to be PCN 40 and the tire pressure is to be limited to 0.80 MPa, then the reported information would be: PCN 40/F/B/0.80 MPa/T.

Example 4: If a pavement is subject to B747-400 all up mass limitation of 390,000 kg, then the reported information would include the following note:

Note: - The reported PCN is subject to a B747-400 all up mass limitation of 390,000 kg.

5.1.4.11 Runway width. Determine the physical width of each runway, and provide the information in whole numbers of meters.

5.1.4.12 Runway strip width. For non-instrument runways, provide the full width of graded strip. For an instrument runway, provide the full width of runway strip which must include the graded portion and the flyover portion (if any), in whole numbers of meters.

5.1.4.13 Runway slope. Determine the slope of runways, by taking the difference between the maximum and minimum elevation along the centerline and dividing the result by the runway length. Slope must be expressed as a percentage, to the nearest one tenth of a percent, indicating the direction of descent. Where there are significant multiple slope changes along the runway, slopes over individual segments must be provided over the length of the runway.

5.1.4.14 Runway Strip, RESA, Stopway - Length, width to the nearest meter or foot, surface type; and arresting system – location (which runway end) and description.

5.1.4.15 Declared distances.

- (a) Declared distances are the available operational distances notified to a pilot for take-off, landing or safely aborting a take-off. These distances are used to determine whether the runway is adequate for the proposed landing or take-off or to determine the maximum payload permissible for a landing or take-off.

off.

- (b) The following distances in meters with feet equivalent shown in brackets, must be determined for each runway direction.
- (i) take-off run available (TORA);
 - (ii) take-off distance available (TODA);
 - (iii) accelerate-stop distance available (ASDA);
 - (iv) landing distance available (LDA);
- (c) Calculation of declared distances. The declared distances must be calculated in accordance with the following:
- (i) **Take-off run available (TORA)** is defined as the length of runway available for the ground run of an aeroplane taking off. This is normally the full length of the runway; neither the SWY nor CWY are involved.
$$\text{TORA} = \text{Length of RWY}$$
 - (ii) **Take-off distance available (TODA)** is defined as the distance available to an aeroplane for completion of its ground run, lift-off and initial climb to 35 ft. This will normally be the full length of the runway plus the length of any CWY. Where there is no designated CWY, the part of the runway strip between the end of the runway and the runway strip end is included as part of the TODA.
$$\text{TODA} = \text{TORA} + \text{CWY}$$
 - (iii) **Accelerate-stop distance available (ASDA)** is defined as the length of the take-off run available plus the length of any SWY. Any CWY is not involved.
$$\text{ASDA} = \text{TORA} + \text{SWY}$$
 - (iv) **Landing distance available (LDA)** is defined as the length of runway available for the ground run of a landing aeroplane. The LDA commences at the runway threshold. Neither SWY nor CWY are involved.
$$\text{LDA} = \text{Length of RW (if threshold is not displaced.)}$$

Note: - See MOS 5.2 and MOS Attachment A Figure A-7 for illustrations of declared distances.

- 5.1.4.16 Determine and record the gradient from the end of TODA to the top of the critical obstacle within the take-off climb area, expressed as a percent. Where there is no obstacle, a value of 1.2% must be recorded.
- 5.1.4.17 Fences or levee banks. If a fence or levee bank is located so close to a runway strip end such that a take-off gradient is so large as to be meaningless; the take-off gradient can be based on the next obstacle within the take-off area. In this case, a note must be provided advising that the fence or levee bank has not been taken into account in the calculation of TODA gradients. The note must also advise the location and height of the fence or levee bank.
- 5.1.4.18 Survey of take-off area.

- (a) The selection of the critical obstacle must be based on the survey of the full take-off area in accordance with the applicable take-off OLS standards specified in MOS 7.
- (b) Where the location of the critical obstacle is some distance from the take-off inner edge, and results in a take-off gradient that requires a curved departure, an additional lower take-off gradient may be declared based on a shorter length of TKOF area surveyed. Curved take-off area data may only be determined and promulgated with prior CAAP approval.

5.1.4.19 Intersection departure take-off distances available. At an aerodrome where air traffic procedures include runway/taxiway intersection departures, the take-off distances available from each relevant taxiway intersection must be determined and declared. The method of determining the take-off distances available at an intersection is similar to that used at a runway end. This is to ensure that the same performance parameters (for example, line-up allowance) may be consistently applied for the line-up maneuver, whether entering the runway at the runway end or from some other intersection.

Declared distances for an intersection must be measured from a perpendicular line commencing at the taxiway edge that is farther from the direction of take-off. Where take-offs may be conducted in either direction, the starting point of the declared distances for each direction will be the perpendicular line commencing from the respective edges of the taxiway farther from the direction of take-off. This is illustrated in MOS 5.2. An example format for notifying intersection departure information is as follows:

RWY 16 – TKOF from TWY E: RWY remaining 2345 (7694) reduce all DECL DIST by 1312 (4305).

5.1.4.20 Aerodrome and runway elevations. The aerodrome elevation and geoid undulation at the aerodrome elevation position shall be measured to an accuracy of one-half meter or one foot and reported to AIS-CAAP.

For aerodromes used for non-precision approaches the elevation of each runway end and any significant high and low points along the runway shall be measured to an accuracy of one-half meter or one foot and reported to AIS- CAAP.

For precision instrument runways, the elevation of the midpoint of each runway threshold, (the elevation of the threshold) and the highest point of the touchdown zone shall be measured to an accuracy of one-half meter or one foot and reported to AIS-CAAP.

5.1.4.21 Aerodrome Obstruction Charts - Type A. Where a Type A Chart is prepared, information about the currency of the Chart in the form of a date of preparation or edition/issue number must be provided.

5.1.4.22 One direction runways. Where a runway direction cannot be used for takeoff or landing, or both, the appropriate declared distance(s) must be shown as 'nil', along with an appropriate note, for example: 'TKOF 14 and LAND 32 not AVBL due surrounding terrain'.

- 5.1.4.23 Lighting systems. Provide information of aerodrome lighting systems by using the related abbreviations detailed in MOS 1.5.1.
- Note: - Runway lights include runway edge, threshold and runway end lights, and, where stopways are provided, stopway lights.*
- 5.1.4.24 Visual aids - Approach procedures, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including taxi-holding positions and stop bars, and location and type of visual docking guidance systems;
- 5.1.4.25 Navigation aids. Where the aerodrome operator provides a navigation aid, the location coordinates and operating frequency must be provided. The location coordinates must be notified in degrees, minutes and tenths of a minute, based on the World Geodetic System – 1984 (WGS-84):
- (a) location and radio frequency of any VOR aerodrome checkpoint;
 - (b) distances to the nearest meter or foot of localizer and glide path elements comprising an instrument landing system (ILS) in relation to the associated runway extremities.
- 5.1.4.26 Notices. Significant local data may include the following:
- (a) animal or bird hazard;
 - (b) aircraft parking restrictions;
 - (c) aerodrome obstacles in the circuit area;
 - (d) aircraft to avoid over-flying certain areas such as mine blasting areas; and
 - (e) other aviation activity such as ultra-light, or glider operations in the vicinity
- 5.1.4.27 Pre-flight altimeter check location. One or more pre-flight altimeter check locations shall be established for an aerodrome.
- (a) A pre-flight check location should be located on an apron;
- Note: - 1. Locating a pre-flight altimeter check location on an apron enables an altimeter check to be made prior to obtaining taxi clearance and eliminates the need for stopping for that purpose after leaving the apron.*
- Note: - 2. Normally an entire apron can serve as a satisfactory altimeter check location.*
- (b) The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest meter or foot, of the area on which it is located. The elevation of any portion of a pre-flight altimeter check location shall be within 3 m (10 ft) of the average elevation for that location.
- 5.1.4.28 Aerodrome reference temperature. Aerodrome reference temperature shall be determined for an aerodrome in degrees Celsius. It shall be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature). This temperature shall

be averaged over a period of years.

5.1.4.29 Geographical coordinates. The geographical coordinates of:

- (a) each threshold;
- (b) appropriate taxiway centerline points; and
- (c) each aircraft stand

shall be measured and reported to AIS-CAAP in degrees, minutes, seconds and hundredths of seconds.

5.1.4.30 The geographical coordinates of obstacles in Area 2 (the part within the aerodrome boundary) and in Area 3 shall be measured and reported to AIS- CAAP in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation, type, marking and lighting (if any) of obstacles shall also be reported.

Note: - Manual of Standards for Aeronautical Information Services (MOS-AIS), Appendix 8 provides requirements for obstacle data determination in Area 2 and 3.

5.1.5 Condition of the movement area and related facilities

5.1.5.1 Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information services units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date and changes in conditions reported without delay.

Note: - The nature, format and conditions of the information to be provided are specified in the Manual of Standards for Aeronautical Information Services (MOS-AIS) and MOS-ATS. Specific procedures pertaining to works in progress on the movement area and to the reporting of such works are specified in the PANS-Aerodromes (Doc 9981).

5.1.5.2 The condition of the movement area and the operational status of related facilities shall be monitored and reports on matters of operational significance affecting aircraft and aerodrome operations shall be provided in order to take appropriate action, particularly in respect of the following:

- (a) construction or maintenance work;
- (b) rough or broken surfaces on a runway, a taxiway or an apron;
- (c) water on a runway, a taxiway or an apron; *[applicable 4 November 2021]*
- (d) other contaminants on a runway, taxiway or apron;
- (e) other temporary hazards, including parked aircraft;
- (f) failure or irregular operation of part or all of the aerodrome visual aids; and
- (g) failure of the normal or secondary power supply

Note: — 1. Until 3 November 2021, other contaminants may include mud, dust, sand, volcanic ash, oil and rubber. PCARs 8.7, Attachment B provides guidance on the

description of runway surface conditions. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

Note: — 2. As of 4 November 2021, other contaminants may include mud, dust, sand, volcanic ash, oil and rubber. Procedures for monitoring and reporting the conditions of the movement area are included in the PANS-Aerodromes (Doc 9981).

Note: — 3. As of 4 November 2021, the Aeroplane Performance Manual (Doc 10064) provides guidance on aircraft performance calculation requirements regarding description of runway surface conditions in MOS 5.1.5.2 c) and d).

Note: — 4. As of 4 November 2021, origin and evolution of data, assessment process and the procedures are prescribed in the PANS-Aerodromes (Doc 9981). These procedures are intended to fulfil the requirements to achieve the desired level of safety for aeroplane operations prescribed by PCAR Part 8 and PCAR Part 5 and to provide the information fulfilling the syntax requirements for dissemination specified in CAR-ANS Part 15, MOS-AIS and the MOS-ATS.

5.1.5.3

To facilitate compliance with:

- (a) (Until 3 November 2021) MOS 5.1.5.1 and MOS 5.1.5.2, inspections of the movement area shall be carried out each day at least once where the code number is 1 or 2 and at least twice where the code number is 3 or 4.

Note: — Guidance on carrying out daily inspections of the movement area is given in the Airport Services Manual (Doc 9137), Part 8 and in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

- (b) (As of 4 November 2021): MOS 5.1.5.1 and MOS 5.1.5.2, inspections of the movement area shall be carried out each day:
- (i) for the movement area, at least once where the aerodrome reference code number is 1 or 2 and at least twice where the aerodrome reference code number is 3 or 4; and
 - (ii) for the runway(s), inspections in addition to a) whenever the runway surface conditions may have changed significantly due to meteorological conditions.

Note: - 1. Procedures on carrying out daily inspections of the movement area are given in the PANS-Aerodromes (Doc 9981). Further guidance are available in the Airport Services Manual (Doc 9137), Part 8, in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and in the Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830).

Note: - 2. The PANS-Aerodromes (Doc 9981) contains clarifications on the scope of a significant change in the runway surface conditions.

5.1.5.4

Personnel assessing and reporting runway surface conditions required in:

- (a) MOS 5.1.5.2 and 5.1.7.1 should be trained and competent to meet criteria set by CAAP (Until 3 November 2021).

Note: - Guidance on criteria is included in the Airport Services Manual (Doc 9137), Part 8, Chapter 7.

- (b) MOS 5.1.5.2 and MOS 5.1.7.1 shall be trained and competent to perform their

duties (As of 4 November 2021).

Note: — 1. Guidance on training of personnel is given in Attachment A, Section 6 (applicable 4 November 2021).

Note: — 2. Information on training for personnel assessing and reporting runway surface conditions is available in the PANS-Aerodromes (Doc 9981).

5.1.6 Obstacle Data

Standards for obstacle identification, restriction and limitation are detailed in MOS 7. It also provide details of and responsibilities for Aerodrome Obstacle Charts applicable to the aerodrome.

5.1.7 Runway surface condition(s) for use in the runway condition report

Introductory Note: - The philosophy of the runway condition report is that the aerodrome operator assesses the runway surface conditions whenever water is present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. This report, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information may be taken into consideration. The PANS-Aerodromes (Doc 9981) contains procedures on the use of the runway condition report and assignment of the RWYCC in accordance with the runway condition assessment matrix (RCAM). See also MOS Attachment A Section 3.

Water on a runway [applicable until 3 November 2021]

5.1.7.1 Whenever water is present on a runway, a description of the runway surface conditions should be made available using the following terms:

DAMP — the surface shows a change of colour due to moisture.

WET — the surface is soaked but there is no standing water.

STANDING WATER — for aeroplane performance purposes, a runway where more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by water more than 3 mm deep.

5.1.7.2 Whenever an operational runway is contaminated, an assessment of the contaminant depth and coverage over each third of the runway shall be made and reported.

Note: - See MOS Attachment A Section 20.

5.1.7.3 Information that a runway or portion thereof is slippery wet shall be made available.

Note: — The determination that a runway or portion thereof may be slippery when wet is not based solely on the friction measurement obtained using a continuous friction measuring device. Supplementary tools to undertake this assessment are described in the Airport Services Manual (Doc 9137), Part 2.

Runway surface condition(s) for use in the runway condition report [applicable as of 4

November 2021]

Introductory Note: — The philosophy of the runway condition report is that the aerodrome operator assesses the runway surface conditions whenever water is present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. This report, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information may be taken into consideration. See Attachment A, Section 6, for further details. The PANS-Aerodromes (Doc 9981) contains procedures on the use of the runway condition report and assignment of the RWYCC in accordance with the runway condition assessment matrix (RCAM).

5.1.7.4 The runway surface condition shall be assessed and reported through a runway condition code (RWYCC) and a description using the following terms:

DRY

STANDING WATER

WET

Note: — 1. The runway surface conditions are those conditions for which, by means of the methods described in the PANS-Aerodromes (Doc 9981), the flight crew can derive appropriate aeroplane performance.

Note: — 2. The conditions, either singly or in combination with other observations, are criteria for which the effect on aeroplane performance is sufficiently deterministic to allow assignment of a specific runway condition code.

5.1.7.5 Whenever an operational runway is contaminated, an assessment of the contaminant depth and coverage over each third of the runway shall be made and reported.

Note: — Procedures on depth and coverage reporting are found in the PANS-Aerodromes (Doc 9981).

5.1.7.6 Information that a runway or portion thereof is slippery wet shall be made available.

Note: — 1. The surface friction characteristics of a runway or a portion thereof can be degraded due to rubber deposits, surface polishing, poor drainage or other factors. The determination that a runway or portion thereof is slippery wet stems from various methods used solely or in combination. These methods may be functional friction measurements, using a continuous friction measuring device, that fall below a minimum standard as defined by CAAP, observations by aerodrome maintenance personnel, repeated reports by pilots and aircraft operators based on flight crew experience, or through analysis of aeroplane stopping performance that indicates a substandard surface. Supplementary tools to undertake this assessment are described in the PANS-Aerodromes (Doc 9981).

Note: — 2. See MOS Section 5.1.5.1 and MOS 5.3 concerning the provision of information to, and coordination between, appropriate authorities.

5.1.8 Runway friction level

- 5.1.8.1 Notification shall be given to relevant aerodrome users when the friction level of a paved runway or portion thereof is less than the minimum friction level specified in MOS 6.2.10.

Note: — 1. Guidance on conducting a runway surface friction characteristics evaluation programme that includes determining and expressing the minimum friction level is provided in MOS Attachment A, Section.20 (Applicable until 3 November 2021).

Note: — 2. Guidance on determining and expressing the minimum friction level is provided in Assessment, Measurement and Reporting of Runway Surface Conditions (Cir 355) (Applicable as of 4 November 2021).

Note: — 3. Procedures on conducting a runway surface friction characteristics evaluation programme are provided in the PANS-Aerodromes (Doc 9981) (Applicable as of 4 November 2021).

Note: — 4. Information to be promulgated in a NOTAM includes specifying which portion of the runway is below the minimum friction level and its location on the runway (Applicable as of 4 November 2021).

5.1.9 Strength of pavements

Part B (Applicable as of 28 November 2024)

- 5.1.9.1 The bearing strength of a pavement shall be determined.

- 5.1.9.2 The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5 700 kg shall be made available using the aircraft classification rating – pavement classification rating (ACR-PCR) method by reporting all of the following information:

- (a) the pavement classification rating (PCR) and numerical value;
- (b) pavement type for ACR-PCR determination;
- (c) subgrade strength category;
- (d) maximum allowable tire pressure category or maximum allowable tire pressure value; and
- (e) evaluation method.

Note: - Guidance on reporting and publishing of PCRs is contained in the Aerodrome Design Manual (Doc 9157, Part 3).

- 5.1.9.3 The pavement classification rating (PCR) reported shall indicate that an aircraft with an aircraft classification rating (ACR) equal to or less than the reported PCR can operate on the pavement subject to any limitation on the tire pressure, or aircraft all-up mass for specified aircraft type(s).

Note: - Different PCRs may be reported if the strength of the pavement is subject to significant seasonal variation.

- 5.1.9.4 The ACR of an aircraft shall be determined in accordance with the standard procedures associated with the ACR-PCR method.

Note: - The standard procedures for determining the ACR of an aircraft are given in the Aerodrome Design Manual (Doc 9157), Part 3. For convenience, dedicated software is available on the ICAO website, for computing any aircraft ACRs at any mass on rigid and flexible pavements for the four standard subgrade strength categories detailed in 5.1.9.6 b) below.

5.1.9.5 For the purpose of determining the ACR, the behaviour of a pavement shall be classified as equivalent to a rigid or flexible construction.

5.1.9.6 Information on pavement type for ACR-PCR determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the following codes:

a) *Pavement type for ACR-PCR determination:*

	Code
Rigid pavement	R
Flexible pavement	F

Note: - If the actual construction is composite or non-standard, include a note to that effect (see example 2 below).

b) *Subgrade strength category:*

	Code
i) <i>High strength:</i> characterized by $E=200$ MPa, and representing all E values equal to or above 150 MPa for rigid and flexible pavements.	A
ii) <i>Medium strength:</i> characterized by $E=120$ MPa and representing a range in E values equal to or above 100 MPa and strictly less than 150 MPa, for rigid and flexible pavements.	B
iii) <i>Low strength:</i> characterized by $E=80$ MPa and representing a range in E values equal to or above 60 MPa and strictly less than 100 MPa, for rigid and flexible pavements.	C
iv) <i>Ultra-low strength:</i> characterized by $E=50$ MPa and representing all E values strictly less than 60 MPa, for rigid and flexible pavements.	D

c) *Maximum allowable tire pressure category:*

	Code
<i>Unlimited:</i> no pressure limit	W
<i>High:</i> pressure limited to 1.75 MPa	X
<i>Medium:</i> pressure limited to 1.25 MPa	Y
<i>Low:</i> pressure limited to 0.50 MPa	Z

Note: - See Note 5 to (10.15.2.1) where the pavement is used by aircraft with tire pressures in the upper categories.

d) *Evaluation method:*

- | | Code |
|--|------|
| i. <i>Technical evaluation:</i> representing a specific study of the pavement characteristics and the types of aircraft which the pavement is intended to serve. | T |
| ii. <i>Using aircraft experience:</i> representing a knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use. | U |

e) *The following examples illustrate how pavement strength data are reported under ACR-PCR method. Further guidance on this topic is contained in the Aerodrome Design Manual (Doc 9157), Part 3 - Pavements.*

Example: - 1. If the bearing strength of a rigid pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCR 760 and there is no tire pressure limitation, then the reported information would be:

PCR 760 / R / B / W / T

Example: - 2. If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCR 550 and the maximum tire pressure allowable is 1.25 MPa, then the reported information would be:

PCR 550 / F / A / Y / U

Note: - Composite construction.

- 5.1.9.7 Criteria should be established to regulate the use of a pavement by an aircraft with an ACR higher than the PCR reported for that pavement in accordance with MOS 5.1.9.2 and 5.9.1.3.

Note: - MOS ATT. A Section 15, details a simple method for regulating overload operations while the Manual (Doc 9157), Part 3, includes the descriptions of more detailed procedures for evaluation of pavements and their suitability for restricted overload operations.

- 5.1.9.8 The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5 700 Kg shall be made available by reporting the following information:

- a) maximum allowable aircraft mass; and
- b) maximum allowable tire pressure.

Example: 4 800 kg/0.60 MPa.

Section 5.2 Illustration of Declared Distances

5.2.1 Introduction

5.2.1.1 Declared distances are the available operational distances notified to a pilot for take-off, landing or safely aborting a take-off. These distances are used to determine whether the runway is adequate for the proposed landing or take-off or to determine the maximum payload permissible for a landing or take-off.

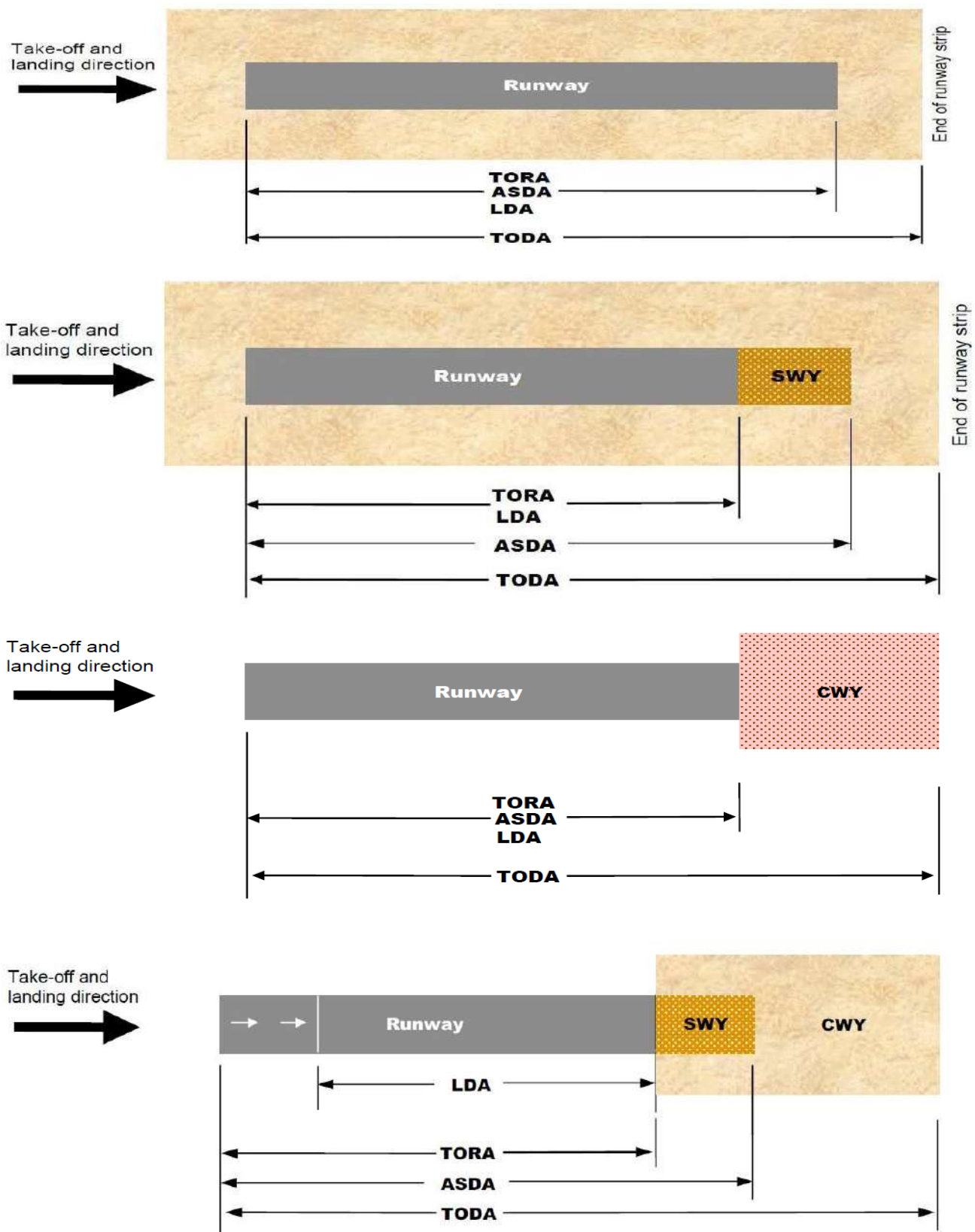
5.2.1.2 Declared distances are a combination of the runway (i.e. full strength pavement) with any provided stopway and/or clearway. The calculations discussed below assume that the runway strip and runway end safety area requirements are fully compliant with the relevant standards.

5.2.2 Calculation of Declared Distances

5.2.2.1 The declared distances to be calculated for each runway direction are:

- (a) **Take-off run available (TORA)** defined as the length of runway available for the ground run of an aeroplane taking off. It will normally be the full length of the runway. Neither stopway nor clearway are involved.
- (b) **Take-off distance available (TODA)** defined as the distance available to an aeroplane for completion of its ground run, lift-off and initial climb to 35 ft. It will normally be the full length of the runway plus the length of any clearway. Where there is no designated clearway, the part of the runway strip between the end of the runway and the runway strip end is included as part of the TODA. This practice has been notified to ICAO and details published in AIP. Any stopway is not involved.
- (c) **Accelerate-stop distance available (ASDA)** defined as the length of the take-off run available plus the length of any stopway. Any clearway is not involved.
- (d) **Landing distance available (LDA)** defined as the length of runway available for the ground run of a landing aeroplane. The LDA commences at the runway threshold. Neither stopway nor clearway are involved.

5.2.2.2 The above definitions of the declared distances are illustrated in the diagrams below. Additional illustration can be seen in Figure A-7, MOS Attachment A Section 19:



5.2.3 Obstacle-free Take-off Gradient

5.2.3.1 TODA is only usable where the minimum obstacle-free gradient from the end of the clearway is equal to or less than the climb performance of the aeroplane.

5.2.3.2 When calculating TODA it is necessary to also calculate the minimum obstacle-free take-off gradient. This is the gradient associated with the critical obstacle.

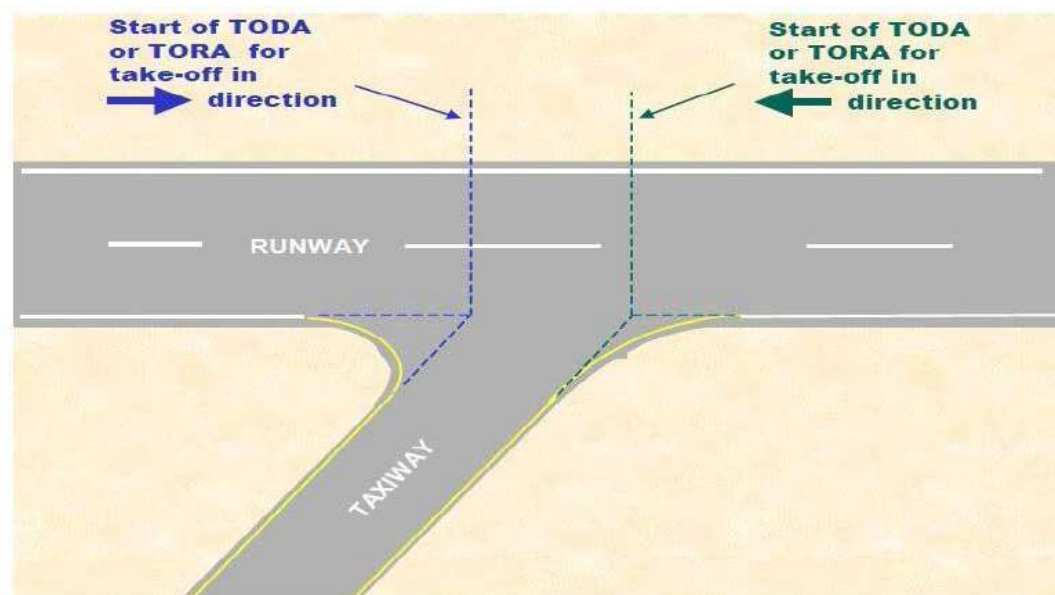
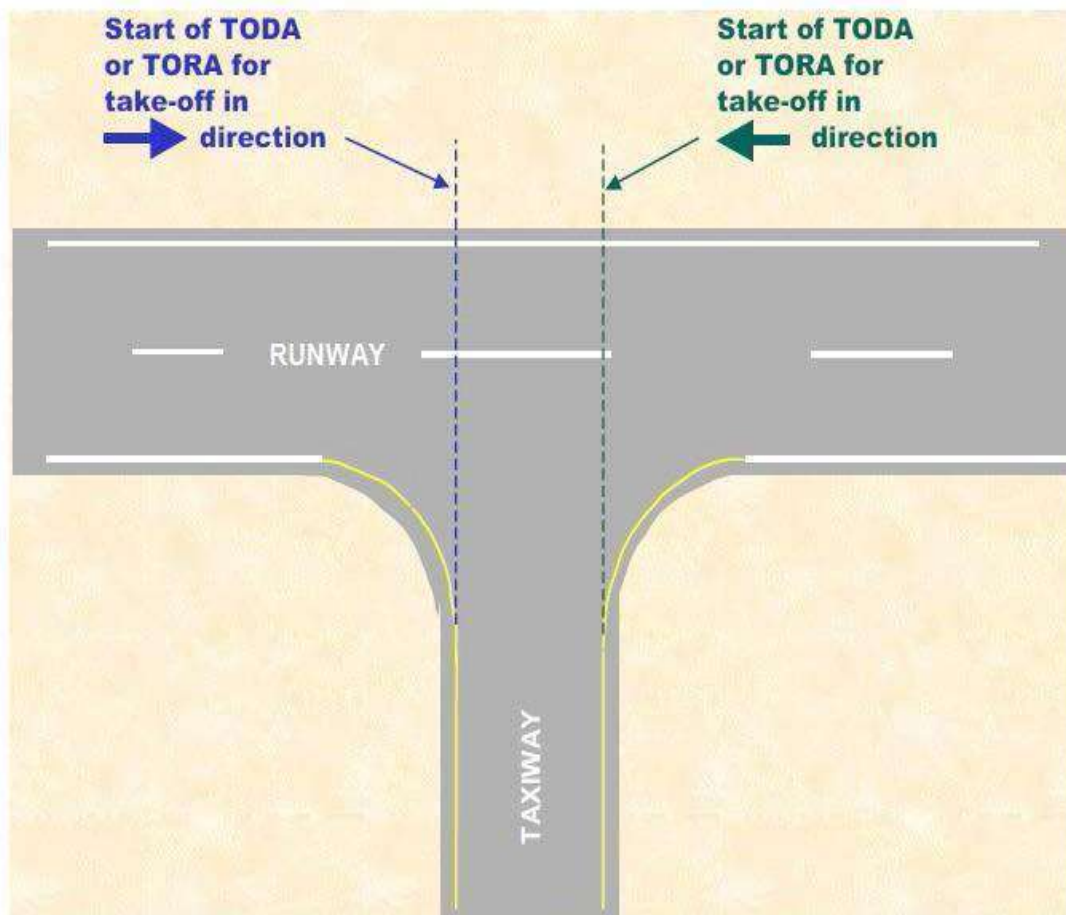
5.2.4 Critical Obstacle

5.2.4.1 The critical obstacle is the obstacle within the take-off climb area which subtends the greatest vertical angle with the horizontal, at the highest point on the clearway, when measured from the inner edge of the take-off climb surface.

5.2.4.2 In assessing the critical obstacle, close in objects such as fences, transient objects on roads and railways, and navigational installations should also be considered. Standards relating to obstacle restrictions and limitations are included in MOS 7.

5.2.5 Declared Distances for Intersection Departures

5.2.5.1 The following diagrams illustrate the method of calculating the take-off distance available or take-off run available where departures are allowed from taxiway intersections (intersection departures):



5.3 Coordination between aeronautical information services and aerodrome authorities

5.3.1 To ensure that aeronautical information services units obtain information to enable them to provide up-to-date pre-flight information and to meet the need for in-flight information, arrangements shall be made between aeronautical information services and aerodrome authorities responsible for aerodrome services to report to the responsible aeronautical information services unit, with a minimum of delay:

- (a) information on the status of certification of aerodromes and aerodrome conditions (ref. MOS 3, MOS 6.7.12, MOS 5.1.5, MOS 10.7.3, MOS 14 and MOS 5.3 or MOS 5.1.9);
- (b) the operational status of associated facilities, services and navigation aids within their area of responsibility;
- (c) any other information considered to be of operational significance.

5.3.2 Before introducing changes to the air navigation system, due account shall be taken by the services responsible for such changes of the time needed by aeronautical information services for the preparation, production and issue of relevant material for promulgation. To ensure timely provision of the information to aeronautical information services, close coordination between those services concerned is therefore required.

5.3.3 Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system, as specified in CAR-ANS Part 15, 15.6. The predetermined, internationally agreed AIRAC effective dates shall be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

Note. — Detailed specifications concerning the AIRAC system are contained in PANS-AIM (Doc 10066), Chapter 6.

5.3.4 The aerodrome services responsible for the provision of raw aeronautical information/data to the aeronautical information services shall do that, while taking into account accuracy and integrity requirements necessary to meet the needs of the end-user of aeronautical data.

Note: - 1. Specifications concerning the accuracy and integrity classification of aerodrome-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1.

Note 2. - Specifications for the issue of NOT AM are contained in CAR-ANS Part 15, 15.6 and PANS-AJM (Doc 10066, Appendices 3 and 4 respectively.

Note: - 3. AIRAC information is distributed by the AIS at least 42 days in advance of the AIRAC effective dates with the objective of reaching recipients at least 28 days in advance of the effective date.

Note: - 4. The schedule of the predetermined internationally agreed AIRAC common effective dates at intervals of 28 days and guidance for the AIRAC use are

contained in the CAR-ANS Part 15, 15.6 and AIP Gen 3.1-5.

5.4 Disabled aircraft removal

Note: — See 10.7.3 for information on disabled aircraft removal services.

5.4.1 The telephone/telex number(s) of the office of the aerodrome coordinator of operations for the removal of an aircraft disabled on or adjacent to the movement area should be made available, on request, to aircraft operators.

5.4.2 Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area shall be published in the AIP.

Note: — The capability to remove a disabled aircraft may be expressed in terms of the largest type of aircraft which the aerodrome is equipped to remove.

5.5 Rescue and firefighting

Note: — See MOS Chapter 14 for information on rescue and firefighting services.

5.5.1 Information concerning the level of protection provided at an aerodrome for aircraft rescue and firefighting purposes shall be made available.

5.5.2 The level of protection normally available at an aerodrome should be expressed in terms of the category of the rescue and firefighting services as described in MOS Chapter 14 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

5.5.3 Changes in the level of protection normally available at an aerodrome for rescue and firefighting shall be notified to the appropriate air traffic service unit and aeronautical information unit to enable those units to provide the necessary information to arriving and departing aircraft. When such a change has been corrected, the above units shall be advised accordingly.

Note: — Changes in the level of protection from that normally available at the aerodrome could result from a change in the availability of extinguishing agents, equipment to deliver the agents or personnel to operate the equipment, etc.

5.5.4 A change should be expressed in terms of the new category of the rescue and firefighting service available at the aerodrome.

5.6 Visual approach slope indicator systems

5.6.1 The following information concerning a visual approach slope indicator system installation shall be made available:

- (a) associated runway designation number;
- (b) type of system according to 5.3.5.2. For an AT-VASIS, PAPI or APAPI installation, the side of the runway on which the lights are installed, i.e. left or right, shall be given;
- (c) where the axis of the system is not parallel to the runway centre line, the angle

of displacement and the direction of displacement, i.e. left or right, shall be indicated;

- (d) nominal approach slope angle(s). For a T-VASIS or an AT-VASIS this shall be angle Θ according to the formula in Figure 5-18 and for a PAPI and an APAPI this shall be angle $(B + C) \div 2$ and $(A + B) \div 2$, respectively as in Figure 5-20; and
- (e) minimum eye height(s) over the threshold of the on-slope signal(s). For a T-VASIS or an AT-VASIS this shall be the lowest height at which only the wing bar(s) are visible; however, the additional heights at which the wing bar(s) plus one, two or three fly-down light units come into view may also be reported if such information would be of benefit to aircraft using the approach. For a PAPI this shall be the setting angle of the third unit from the runway minus 2', i.e. angle B minus 2', and for an APAPI this shall be the setting angle of the unit farther from the runway minus 2', i.e. angle A minus 2'.



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CHAPTER 6. Aerodrome physical characteristics

Section 6.1 General

6.1.1 Introduction

- 6.1.1.1 The standards in this chapter are the statutory requirements for physical characteristics that apply to the planning, design, construction and maintenance for facilities at certified and registered aerodromes.
- 6.1.1.2 The standards for aerodromes used by aircraft for private operations under VFR are set out in MOS 13.
- 6.1.1.3 The standards set out in this chapter govern characteristics such as the dimensions and shape of runways, taxiways, aprons and related facilities provided for the safe movement of aircraft.
- 6.1.1.4 The standards in this chapter are intended for the planning and construction of new or upgraded aerodrome facilities. Where an existing facility does not meet these standards, CAAP may approve the use of such facilities by an aircraft larger than that, which the facilities are designed for, with, or without, restrictions on the operations of such aircraft.
- 6.1.1.5 The aerodrome standards for glider facilities set out in MOS 6.7 are applicable to glider facilities provided at a certified aerodrome. The operation of glider aircraft at certified aerodromes is only to be undertaken with prior formal approval from CAAP.

Section 6.2 Runways

Note: - 1. Many factors affect the determination of the orientation, siting and number of runways.

Note: - 2. One important factor is the usability factor, as determined by the wind distribution, which is specified hereunder. Another important factor is the alignment of the runway to facilitate the provision of approaches conforming to the approach surface specifications of MOS 7. In MOS Attachment A, Section 18, information is given concerning these and other factors.

Note: - 3. When a new instrument runway is being located, particular attention needs to be given to areas over which aeroplanes will be required to fly when following instrument approach and missed approach procedures, so as to ensure that obstacles in these areas or other factors will not restrict the operation of the aeroplanes for which the runway is intended.

6.2.1 Number and orientation of runways

- 6.2.1.1 The number and orientation of runways at an aerodrome shall be such that the usability factor of the aerodrome is not less than 95% for the aeroplanes that the aerodrome is intended to serve.

- 6.2.1.2 The siting and orientation of runways at an aerodrome shall, where possible, be such that the arrival and departure tracks minimize interference with areas approved for residential use and other noise-sensitive areas close to the aerodrome in order to avoid future noise problems.

Note: - Guidance on how to address noise problems is provided in the Airport Planning Manual (Doc 9184), Part 2, and in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829).

- 6.2.1.3 In the application of 6.2.1.2, it shall be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:

- (a) 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a crosswind component not exceeding 24 km/h (13 kt) shall be assumed;
- (b) 24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1200 m or up to but not including 1500 m; and
- (c) 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1200 m.

Note: - In MOS Attachment A, Section 18, guidance is given on factors affecting the calculation of the estimate of the usability factor and allowances which may have to be made to take account of the effect of unusual circumstances.

- 6.2.1.4 The selection of data to be used for the calculation of the usability factor shall be based on reliable wind distribution statistics that extend over as long a period as possible, preferably of not less than five years. The observations used shall be made at least eight times daily and spaced at equal intervals of time.

Note: - These winds are mean winds. Reference to the need for some allowance for gusty conditions is made in MOS Attachment A, Section 18

6.2.2 Location of Runway Threshold

- 6.2.2.1 The threshold of a runway must be located:

- (a) if the runway's code number is 1, not less than 30 meters after; or
- (b) in any other case, not less than 60 meters after the point at which the approach surface meets the extended runway centerline.

Note: - 1. If obstacles infringe the approach surface, operational assessment may require the threshold to be displaced. The obstacle free approach surface to the threshold is not to be steeper than gradient specified for the appropriate type and code of runway as specified in MOS 7.

Note: - 2. Guidance on the siting of the threshold is given in MOS Attachment A, Section 11.

- 6.2.2.2 A threshold is generally to be located at the extremity of a runway, but it may be displaced permanently or temporarily to take account of factors which have a bearing on the location of the threshold. Where displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 meters in length is to be provided between the end of the unserviceable area and the displaced threshold. In such cases the requisite runway end safety area is to be provided.

Note: - Guidance on factors which may be considered in the determination of the location of a displaced threshold is given in MOS Attachment A, Section 11.

6.2.3 Length of Runway

- 6.2.3.1 Except as provided in 6.2.3.3, the actual runway length of a primary runway must be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and shall not be less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics for the relevant aeroplanes.

Note: - 1. This specification does not necessarily mean providing for operations by the critical aeroplane at its maximum mass.

Note: - 2. Both take-off and landing requirements need to be considered when determining the length of runway to be provided and the need for operations to be conducted in both directions of the runway.

Note: - 3. Local conditions that may need to be considered include elevation, temperature, runway slope, humidity and the runway surface characteristics.

Note: - 4. When performance data on aeroplanes for which the runway is intended are not known, guidance on the determination of the actual length of a primary runway by application of general correction factors is given in the Aerodrome Design Manual (Doc 9157), Part 1.

- 6.2.3.2 The length of a secondary runway shall be determined similarly to primary runways except that it needs only to be adequate for those aeroplanes which require to use that secondary runway in addition to the other runway or runways in order to obtain a usability factor of at least 95%.

- 6.2.3.3 Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 6.2.3.1 or 6.2.3.2, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided shall permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.

Note: - Guidance on use of stopways and clearways is given in MOS Attachment A, Section 17.

6.2.4 Runway Width

- 6.2.4.1 The width of a runway must not be less than that determined using Table 6.2-1.

Outer Main Gear Wheel Span (OMGWS)				
Code number	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
1 ^a	18 m	18 m	23 m	-
2 ^a	23 m	23 m	30 m	-
3	30 m	30 m	30 m	45 m
4	-	-	45 m	45 m

1^a Runway width may be reduced to 15 m or 10 m depending on the restrictions placed on small aeroplane operations. See MOS 13.

2^a The width of a precision approach runway shall be not less than 30 m where the code number is 1 or 2.

Note 1. - The combinations of code numbers and OMGWS for which widths are specified have been developed for typical aeroplane characteristics.

Note 2. - Factors affecting runway width are given in the Aerodrome Design Manual (Doc 9157), Part I.

Note 3. - See MOS 6.2.12 concerning the provision of runway shoulders, in particular for Code F aeroplanes with four (or more) engines.

Table 6.2-1: Minimum runway width.

6.2.5 Runway Turn pads

- 6.2.5.1 Where the runway end is not served by a taxiway or taxiway turnaround and the runway code letter is D, E or F, a runway turn pad shall be provided to facilitate 180-degree turns by aircraft, unless otherwise directed by CAAP. (See MOS Figure 6.2-1).

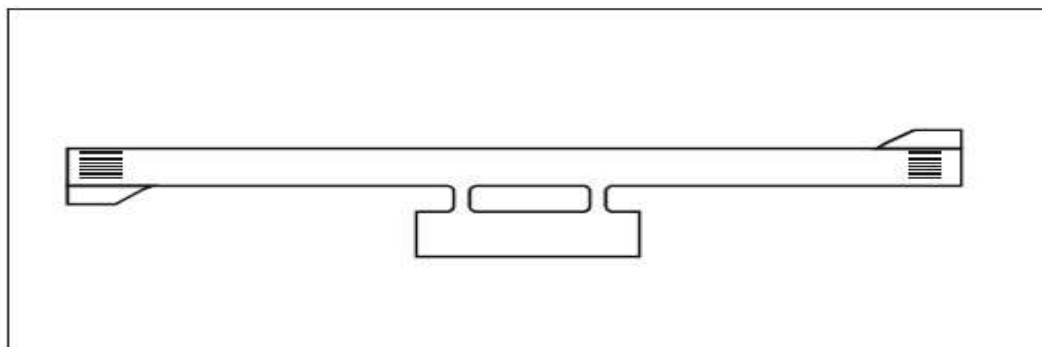


Figure 6.2-1. Typical turn pad layout

- 6.2.5.2 Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is A, B or C, a runway turn pad shall be provided to facilitate a 180-degree turn of aeroplanes.
- Note: - 1. Such areas may also be useful if provided along a runway to reduce taxiing time and distance for aeroplanes which may not require the full length of the runway.*
- Note: - 2. Guidance on the design of the runway turn pads is available in the Aerodrome Design Manual (Doc 9157), Part 1. Guidance on taxiway turnaround as an alternate facility is available in the Aerodrome Design Manual (Doc 9157), Part 2.*
- 6.2.5.3 The runway turn pad must be located on either the left or right side of the runway and adjoining the runway pavement at both ends of the runway and at some intermediate locations where deemed necessary.
- Note: - The initiation of the turn will be facilitated by locating the turn pad on the left side of the runway, since the left seat is the normal position of the pilot-in-command.*
- 6.2.5.4 The intersection angle of the runway turn pad with the runway shall not exceed 30°, and the nose wheel steering angle used in the design of the turn pad taxi guidance markings shall not exceed 45°.
- 6.2.5.5 The design of a runway turn pad shall be such that, when the cockpit of the aeroplane for which the turn pad is intended remains over the turn pad taxi guidance marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the turn pad is not less than the distance determined using MOS Table 6.2-2.

OMGWS

	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.5 m	2.25 m	3 m ^a or 4 m ^b	4 m

^a If the turn pad is intended to be used by aeroplanes with a wheel base less 18 m.

^b If the turn pad is intended to be used by aeroplanes with a wheel base equal or greater than 18 m.

Note. - Wheel base means the distance from the nose gear to the geometric center of the main gear.

Table 6.2-2: Minimum clearance distance between any undercarriage wheel and edge of runway turning area

6.2.5.6 The longitudinal and transverse slopes on runway turn pads shall be sufficient to prevent the accumulation of water on the surface and facilitate rapid drainage of surface water. The slopes shall be the same as those on the adjacent runway pavement surface.

6.2.5.7 The strength of a runway turn pad shall be at least equal to that of the adjoining runway which it serves, due consideration being given to the fact that the turn pad will be subjected to slow-moving traffic making hard turns and consequent higher stresses on the pavement.

Note: - Where a runway turn pad is provided with flexible pavement, the surface will need to be capable of withstanding the horizontal shear forces exerted by the main landing gear tires during turning maneuvers.

6.2.5.8 The surface of a runway turn pad shall not have surface irregularities that may cause damage to an aeroplane using the turn pad.

6.2.5.9 The surface of a runway turn pad shall be so constructed or resurfaced as to provide surface friction characteristics at least equal to that of the adjoining runway.

6.2.5.10 The runway turn pads shall be provided with shoulders of such width as is necessary to prevent surface erosion by the jet blast of the most demanding aeroplane for which the turn pad is intended, and any possible foreign object damage to the aeroplane engines.

Note: - As a minimum, the width of the shoulders will need to cover the outer engine of the most demanding aeroplane and thus must be wider than the associated runway shoulders.

6.2.5.11 The strength of runway turn pad shoulders shall be capable of withstanding the occasional passage of the aeroplane it is designed to serve without inducing structural damage to the aeroplane and to the supporting ground vehicles that may operate on the shoulder.

6.2.6 Spacing for Parallel Runways

6.2.6.1 Where parallel runways are to be provided the aerodrome operator shall consult with CAAP in regard to airspace and air traffic control procedures associated with operations on multiple runways.

6.2.6.2 Where parallel, non-instrument runways are intended for simultaneous use, the minimum separation distance between the runway centerlines must not be less than:

- (a) 210 m where the higher code number of the two runways is 3 or 4;
- (b) 150 m where the higher code number of the two runways is 2; and
- (c) 120 m where the code number of each of the two runways is 1.

Note: - Procedures for wake turbulence categorization of aircraft and wake turbulence separation minima are contained in the MOS for ATS Chapters 4.9 and

5.8 respectively.

6.2.6.3 Where parallel instrument runways are intended for simultaneous use, the minimum distance between the runway centerlines must not be less than:

- (a) for independent parallel approaches, 1,035 m;
- (b) for dependent parallel approaches, 915 m;
- (c) for independent parallel departures, 760 m; and
- (d) for segregated parallel operations, 760 m,

except that:

- (a) for segregated parallel operations the specified minimum distance:
 - i) may be decreased, by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and
 - ii) shall be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft; and
- (b) for independent parallel approaches, combinations of minimum distances and associated conditions other than those specified in the MOS-ATS may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

Note: - Procedures and facilities requirements for simultaneous operations on parallel or near-parallel instrument runways are contained in the MOS-ATS, 6.7 and the PANS-OPS (Doc 8168), Volume I, Part III, Section 2, and Volume II, Part I, Section 3; Part II, Section 1; and Part III, Section 3 and relevant guidance contained in the ICAO Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643).

6.2.7 Runway Longitudinal Slope

6.2.7.1 The overall runway slope is defined by dividing the difference between the maximum and minimum elevation along the runway centerline by the runway length, and must not be more than:

- (a) 1% if the runway code number is 3 or 4; or
- (b) 2% if the runway code number is 1 or 2.

6.2.7.2 Subject to paragraphs 6.2.7.3 and 6.2.7.4, the longitudinal slope along any part of a runway must not be more than:

- (a) 1.25% if the runway code number is 4; or
- (b) 1.5% if the runway code number is 3; or
- (c) 2.0% if the runway code number is 1 or 2.

Note: - A uniform slope for at least 300 m should be provided at each end of the runway, and at airports where large jet aeroplanes operate this distance should be increased to at least 600 m.

6.2.7.3 If the runway code number is 4, the longitudinal slope along the first and last

quarters of the runway must not be more than 0.8%.

6.2.7.4 If the runway code number is 3 and it is a precision approach category II or category III runway, the longitudinal slope along the first and last quarters of the runway must not be more than 0.8%.

6.2.7.5 If slope changes cannot be avoided, the change in longitudinal slope between any two adjoining parts of a runway must not be more than:

- (a) 1.5% if the runway's code number is 3 or 4; or
- (b) 2.0% if the runway's code number is 1 or 2.

Note: - Guidance on slope changes before a runway is given in MOS Attachment A, Section 19.

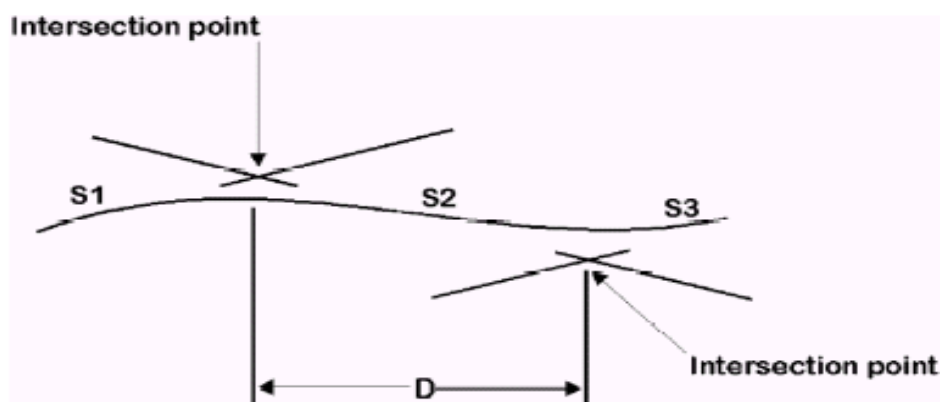
6.2.7.6 The transition from one longitudinal slope to another must be accomplished by a vertical curve, with a rate of change not more than:

- (a) 0.1% for every 30 m (minimum radius of curvature of 30,000 m) if the runway code number is 4; or
- (b) 0.2% for every 30 m (minimum radius of curvature of 15,000 m) if the runway's code number is 3; or
- (c) 0.4% for every 30 m (minimum radius of curvature of 7,500 m) if the runway code number is 1 or 2.

Note: - The rate of change of longitudinal slope may be relaxed outside the central one-third of the runway at intersections, either to facilitate drainage or to accommodate any conflicting slope requirements.

6.2.7.7 The distance between the points of intersection of two successive longitudinal slope changes must not be less than the greater of the following:

- (a) 45 m; or
- (b) the distance in meters worked out using the formula:
$$D = k (|S1 - S2| + |S2 - S3|)/100$$
where 'k' is:
 - (i) if the runway's code number is 4, 30,000 m; or
 - (ii) if the runway's code number is 3, 15,000 m; or
 - (iii) if the runway's code number is 1 or 2, 5,000 m; and
 - (iv) 'S1', 'S2' and 'S3' are the three successive slopes expressed as percentage values.

**Figure 6.2-2**

Example: In Figure 6.2-2, if the runway's code number is 3, and the slopes are S1 (+1%), S2 (-1.5%) and S3 (+1.5%), then the distance in meters between the two points of intersection must not be less than $15,000 \times (2.5 + 3)/100$, that is to say 825 m.

Note: - Guidance on implementing this specification is given in MOS Attachment A, Section 19.

6.2.8 Runway Sight Distance

6.2.8.1 The unobstructed line of sight along the surface of a runway, from a point above the runway, must not be less than the distance determined using Table 6.2-3.

Code letter	Minimum unobstructed line of sight
A	From a point 1.5 m above the runway to any other point 1.5 m above the runway for half the length of the runway.
B	From a point 2 m above the runway to any other point 2 m above the runway for half the length of the runway.
C, D, E or F	From a point 3 m above the runway to any other point 3 m above the runway for half the length of the runway.
<i>Note:</i> - Consideration will have to be given to providing an unobstructed line of sight over the entire length of a single runway where a full-length parallel taxiway is not available. Where an aerodrome has intersecting runways, additional criteria on the line of sight of the intersection area would need to be considered for operational safety. See the Aerodrome Design Manual (Doc 9157), Part 1.	

Table 6.2-3: Runway line of sight

6.2.8.2 If runway lighting is provided, the unobstructed line of sight from 3 m above any point on the runway surface to any other point on the runway surface must not be less than 600 m.

6.2.9 Transverse Slopes on Runways

6.2.9.1 The transverse slope on any part of a runway must be adequate to prevent the accumulation of water and must be in accordance with MOS Table 6.2-4

Note: - The standard may not apply at intersections where design may dictate a variation to the standards

	Code letter	
	A or B	C, D, E or F
Maximum slope	2.5%	2.0%
Preferred slope	2.0%	1.5%
Minimum slope	1.5%	1.0%

Table 6.2-4: Runway transverse slope

6.2.9.2 To promote the most rapid drainage of water, the runway surface shall, if practicable, be cambered except where a single cross-fall from high to low in the direction of the wind most frequently associated with rain will ensure more rapid drainage. In the case of one-way cross fall the transverse gradient shall be wherever practicable 1.5% where the code letter is C, D, E or F and 2% otherwise, and shall not be less than 1% except at runway or taxiway intersections if necessary for grading.

6.2.9.3 For a cambered surface the transverse slope on each side shall be symmetrical on each side of the centerline unless CAAP approves otherwise. The transverse slope shall be consistent throughout the length of the runway, although variation is acceptable at intersections with other runways and taxiways for grading to ensure adequate drainage is provided.

Note: - 1. On wet runways with crosswind conditions the problem of aquaplaning form poor drainage is apt to be accentuated. In MOS Attachment A, Section 20, information is given concerning this problem and other relevant factors.

Note: - 2. Guidance on transverse slope is given in the Aerodrome Design Manual (Doc9157), Part 3.

6.2.10 Runway Surface

6.2.10.1 The surface of a runway shall be constructed without irregularities that will impair the runway surface friction characteristics or otherwise adversely affect the take-off or landing of an aeroplane.

Note: - 1. The finish on the surface of a runway shall be such that, when tested with a 3 meter straight-edge placed anywhere on the surface, there is no deviation greater than 3 mm between the lower edge of the straight-edge and the surface of the runway pavement anywhere along the straight-edge.

Note: - 2. Surface irregularities may adversely affect the take-off or landing of an aeroplane by causing excessive bouncing, pitching, vibration, or other difficulties in the control of an aeroplane.

Note: - 3. Guidance on design tolerances and other information is given in MOS Attachment A Section 4. Additional guidance is included in the Aerodrome Design Manual (Doc 9157), Part 3.

- 6.2.10.2 A paved runway shall be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level set by CAAP and where practicable shall be evaluated to determine that the surface friction characteristics achieve the design objectives.

Note: - Guidance on surface friction characteristics of a new or resurfaced runway is given in MOS Attachment A, Section 20. Additional guidance is included in the Airport Services Manual, Part 2.

- 6.2.10.3 The surface of a paved runway must have an average surface texture depth of not less than 1.0 mm over the full runway width and runway length.

Note: - 1. A runway surface, meeting the ICAO minimum design objective for new surface specified in MOS Attachment A Section 20, derived using a continuous friction measuring device, is acceptable.

- *This normally requires some form of special surface treatment.*
- *Guidance on methods used to measure surface texture is given in the ICAO Airport Services Manual, Part 2.*

Note: - 2. Macrottexture and microtexture are taken into consideration in order to provide the required surface friction characteristics. Guidance on surface design is given in MOS Attachment A, Section 2.3.

Note: - 3. Guidance on methods used to measure surface texture is given in the Airport Services Manual (Doc 9137), Part 2.

Note: - 4. Guidance on design and methods for improving surface texture is given in the Aerodrome Design Manual (Doc 9157), Part 3.

- 6.2.10.4 If a runway surface cannot meet the standards of paragraph 6.2.10.1, a surface treatment must be provided. Acceptable surface treatments include grooving, porous friction course and bituminous seals.

- 6.2.10.5 Measurements of the surface friction characteristics of a new or resurfaced paved runway shall be made with a continuous friction measuring device using self-wetting features.

Note: - Guidance on surface friction characteristics of new runway surfaces is given in MOS Attachment A Section 20. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

- 6.2.10.6 When the surface is grooved or scored, the grooves or scorings shall be either perpendicular to the runway centerline or parallel to non-perpendicular transverse joints, where applicable.

Note: - Guidance on methods for improving the runway surface texture is given in the Aerodrome Design Manual (Doc 9157), Part 3.

- 6.2.10.7 The runway surface standards for grass or natural runways and unsealed gravel runways are the same as those for runways intended for small aeroplanes as set

out in Chapter 13.

6.2.11 Runway Bearing Strength

6.2.11.1 The pavement strength rating for a runway must be described using the ACN - PCN pavement rating system described in MOS 5.1.4.10.

6.2.11.2 CAAP does not specify a minimum requirement for runway bearing strength, however, the bearing strength of a pavement shall be capable of withstanding the traffic of aircraft the runway is intended to serve without any safety problems to aircraft. The published PCN value should be suitable for aircraft that regularly use the runway

6.2.11.3 The ACN of an aircraft shall be determined in accordance with the standard procedures associated with the ACN-PCN method.

Note: - The standard procedures for determining the ACN of an aircraft are given in the Aerodrome Design Manual (Doc 9157), Part 3. For convenience several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade categories in MOS 5.1.4.10 (d)(ii) and the results tabulated in that manual.

6.2.11.4 For the purposes of determining the ACN, the behavior of a pavement shall be classified as equivalent to a rigid or flexible construction.

6.2.12 Runway Shoulders

Note: - Guidance on characteristics and treatment of runway shoulders is given in MOS 6.2.17.2 to 6.2.17.5, and in the Aerodrome Design Manual (Doc 9157), Part 1.

6.2.12.1 Runway shoulders shall be provided for a runway where the code letter is D, E or F.

6.2.12.2 If a runway is 30 m wide and is used by aeroplanes seating 100 passengers or more, shoulders must be provided and the total width of the runway and its shoulders must not be less than 36 m.

6.2.13 Characteristics of Runway Shoulders

6.2.13.1 Runway shoulders must:

- (a) be of equal width on both sides;
- (b) slope downwards and away from the runway surface;
- (c) be resistant to aeroplane engine blast erosion;
- (d) be constructed so as to be capable of supporting an aeroplane, running off the runway, without causing structural damage to the aeroplane; and
- (e) be flush with the runway surface except during runway overlay works where a step down not exceeding 25 mm is permitted for a period not to exceed 7 days.

6.2.14 Surface of Runway Shoulder

6.2.14.1 The shoulders of a runway intended to serve jet-propelled aeroplanes with engines which may overhang the edge of the runway shall be surfaced with a bituminous seal, asphalt or concrete.

6.2.14.2 A runway shoulder shall be prepared or constructed so as to resist erosion and the ingestion of the surface material by aeroplane engines.

6.2.14.3 Runway shoulders for code letter F aeroplanes shall be paved to a minimum overall width of runway and shoulder of not less than 60 m.

Note. — Guidance on surface of runway shoulders is given in the Aerodrome Design Manual (Doc 9157), Part 1.

6.2.15 Width of runway shoulders

6.2.15.1 For aeroplanes with OMGWS from 9 m up to but not including 15 m, the runway shoulders shall extend symmetrically on each side of the runway so that the overall width of the runway and its shoulders is not less than:

- (a) 60 m where the code letter is D or E;
- (b) 60 m where the code letter is F with two- or three-engined aeroplanes; and
- (c) 75 m where the code letter is F with four (or more)-engined aeroplanes.

6.2.16 Slopes on runway shoulders

6.2.16.1 The surface of the shoulder that abuts the runway shall be flush with the surface of the runway and its transverse slope shall not exceed 2.5%.

6.2.17 Strength of runway shoulders

6.2.17.1 The portion of a runway shoulder between the runway edge and a distance of 30 m from the runway centre line shall be prepared or constructed so as to be capable, in the event of an aeroplane running off the runway, of supporting the aeroplane without inducing structural damage to the aeroplane and of supporting ground vehicles which may operate on the shoulder.

Note: - Guidance on strength of runway shoulders is given in the ICAO Doc 9157 Aerodrome Design Manual, Part 1.

6.2.17.2 The shoulder of a runway or stopway shall be prepared or constructed so as to minimize any hazard to an aeroplane running off the runway or stopway. Some guidance is given in the following paragraphs on certain special problems which may arise, and on the further question of measures to avoid the ingestion of loose stones or other objects by turbine engines.

6.2.17.3 In some cases, the bearing strength of the natural ground in the strip may be sufficient, without special preparation, to meet the requirements for shoulders. Where special preparation is necessary, the method used will depend on local soil conditions and the mass of the aeroplanes the runway is intended to serve. Soil tests will help in determining the best method of improvement (e.g. drainage, stabilization,

surfacing, light paving).

- 6.2.17.4 Attention shall also be made when designing shoulders to prevent the ingestion of stones or other objects by turbine engines. Similar considerations apply here to those which are discussed for the margins of taxiways in the Aerodrome Design Manual (Doc 9157), Part 2, both as to the special measures which may be necessary and as to the distance over which such special measures, if required, shall be taken.
- 6.2.17.5 Where shoulders have been treated specially, either to provide the required bearing strength or to prevent the presence of stones or debris, difficulties may arise because of a lack of visual contrast between the runway surface and that of the adjacent strip. This difficulty can be overcome either by providing a good visual contrast in the surfacing of the runway or strip, or by providing a runway side stripe marking.

Section 6.3 Runway strip

6.3.1 General

- 6.3.1.1 A runway and any associated stopways shall be centrally located within a runway strip.
- 6.3.1.2 A runway strip, in addition to the runway and stopway, must include a graded area around the runway and stopway which is intended to serve in the event of an aircraft running off the runway.

Note: - If the runway is an instrument runway and with prior CAAP approval, the runway strip may comprise a graded area around the runway and stopway and an area, known as the 'fly-over area', outside the graded area. Technically the 'flyover area' is an ungraded surface component in total runway strip width.



Runway strip consisting of fully graded area only – non-instrument runways



Runway strip consisting of both graded and fly-over area – instrument runways

Figure 6.3-2: Composition of Runway Strip

6.3.2 Runway Strip Length

6.3.2.1 The graded area of a runway strip must extend beyond the end of the runway, or any associated stopway, for at least:

- (a) 30 m if the runway's code number is 1 and it is a non-instrument runway; or
- (b) 60 m in any other case.

6.3.3 Runway Strip Width

6.3.3.1 The width of the graded area of a runway strip must be not less than that given in Table 6.3-5.

Aerodrome reference code	Runway strip width
1 ^{a b}	60 m
2 ^c	80 m
3 (where the runway width is 30 m)	90 m
3, 4 (where the runway width is 45 m or more)	150 m
^a Runway strip width may be reduced to 30 m depending on the restrictions placed on small aeroplane operations. See MOS 13.	
^b Runways used at night are required to have a runway strip with a minimum width of 80 m.	
^c Runways used in daylight by aeroplanes not exceeding 5,700 kg may have a runway strip with a minimum width of 60 m.	

Table 6.3-5: Graded runway strip width

6.3.3.2 A strip including a non-precision approach runway shall extend laterally to a distance of at least:

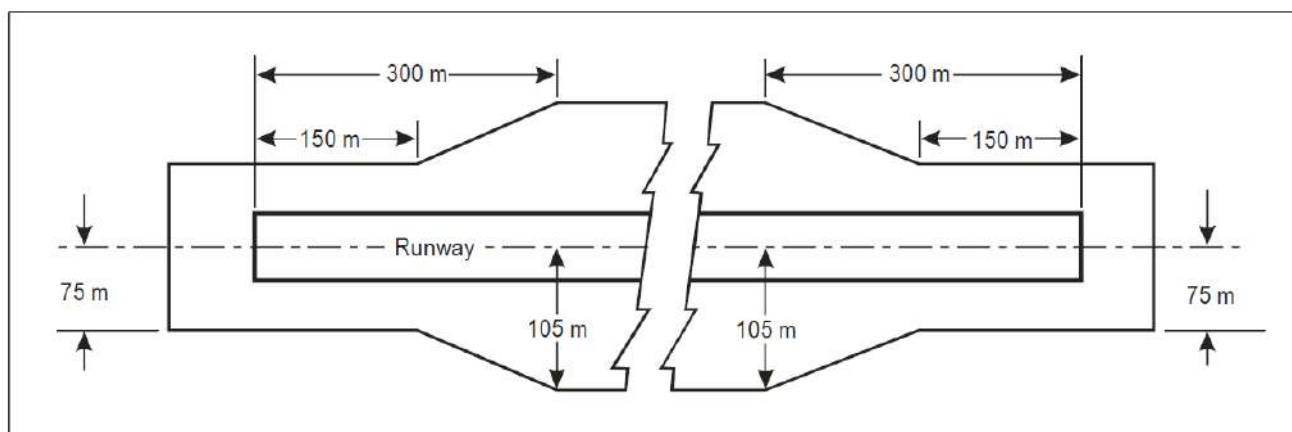
- 140 m where the code number is 3 or 4; and
- 70 m where the code number is 1 or 2;

on each side of the centerline of the runway and its extended centre line throughout the length of the strip.

6.3.3.3 A strip including a precision approach runway shall, wherever practicable, extend laterally to a distance of at least:

- 140 m where the code number is 3 or 4; and
- 70 m where the code number is 1 or 2;

on each side of the centerline of the runway and its extended centre line throughout the length of the strip.



Note: - Guidance on grading of a greater area of a strip including a precision approach runway where the code number is 3 or 4 is given in MOS Attachment A Section 2.

Figure 6.3-3: Grading of a Strip for Precision Approach Runways

6.3.3.4 A strip including a non-instrument runway shall extend on each side of the centerline of the runway and its extended centerline throughout the length of the strip, to a distance of at least:

- 75 m where the code number is 3 or 4;
- 40 m where the code number is 2; and
- 30 m where the code number is 1.

6.3.3.5 MOS 6.3.8.5, recommends that the portion of a strip of an instrument runway within at least 75 m from the centerline shall be graded where the code number is 3 or 4. For a precision approach runway, it may be desirable to adopt a greater width where the code number is 3 or 4. MOS Figure 6.3-3 shows the shape and dimensions of a wider strip that may be considered for such a runway. This strip has been designed using information on aircraft running off runways. The portion to be graded extends to a distance of 105 m from the centerline, except that the distance is gradually reduced to 75 m from the centerline at both ends of the strip, for a length of 150 m from the runway end.

6.3.3.6 If an aerodrome operator wishes to provide a lesser runway strip width to that specified in the standards or a runway strip width with graded and ungraded components, the aerodrome operator must provide CAAP with a safety case justifying why it is impracticable to meet the standard. The safety case must include documentary evidence that all relevant stakeholders have been consulted.

6.3.4 Longitudinal Slope on Graded Area of Runway Strip

6.3.4.1 As far as practicable the longitudinal slope along the graded area of the runway strip must not be more than:

- (a) 1.5% if the runway code number is 4;
- (b) 1.75% if the runway code number is 3; or
- (c) 2.0% if the runway's code number is 1 or 2.

6.3.5 Longitudinal Slope Changes on Graded Area of Runway Strip

- 6.3.5.1 Slope changes must be as gradual as practicable and abrupt changes or sudden reversal of slopes avoided, and must not exceed 2%.

6.3.6 Radio Altimeter Operating Area

- 6.3.6.1 A radio altimeter operating area, if provided, shall:

- (a) be established in the pre-threshold area of a precision approach runway.
- (b) extend before the threshold for a distance of at least 300 m.
- (c) extend laterally, on each side of the extended centerline of the runway, to a distance of 60 m, except that, when special circumstances so warrant, the distance may be reduced to no less than 30 m if an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft.
- (d) be avoided or kept to a minimum. Where slope changes cannot be avoided, the slope changes should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes should not exceed 2 % per 30 m.

Note: - Guidance on radio altimeter operating area is given in MOS Attachment A, Section 19.3, and in the Manual of All-Weather Operations, (Doc 9365), Section 5.2. Guidance on the use of radio altimeter is given in the PANS-OPS, Volume II, Part II, Section 1.

- 6.3.6.2 If a slope change cannot be avoided on a radio altimeter operating area, the rate of change between two consecutive slopes must not be more than 2% per 30 meters (minimum radius of curvature of 1,500 meters).

- 6.3.6.3 For precision approach Category II and III runways, slope changes within an area 60 m wide and 300 m long, symmetrical about the centerline, before the threshold, must be avoided.

Note: - This is because aeroplanes making Cat II and III approaches are equipped with radio altimeters for final height guidance in accordance with the terrain immediately prior to the threshold and excessive slope changes can cause errors in data.

6.3.7 Runway Strip Transverse Slope

- 6.3.7.1 The transverse slope of the graded area of the runway strip must not be more than:

- (a) 2.5%; if the runway's code number is 3 or 4; and
- (b) 3%; if the runway's code number is 1 or 2.

except that to facilitate drainage the slope for the first 3 m outward from the runway, shoulder or stopway edge must be negative as measured in the direction away from the runway and may be as great as 5%.

- 6.3.7.2 The transverse slopes of any portion of a strip beyond that to be graded shall not exceed an upward slope of 5 per cent as measured in the direction away from the runway.

Note: - 1. Where deemed necessary for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a runway strip and would be placed as far as practicable from the runway.

Note: - 2. The aerodrome RFF procedure would need to take into account the location of open-air water conveyances within the non-graded portion of a runway strip.

- 6.3.7.3 No part of a fly-over area must project through a plane:
- (a) that starts along each outer side of the graded area; and
 - (b) has an upward slope away from the graded area of more than 5%.

6.3.8 Grading of Runway Strips

- 6.3.8.1 The surface of a runway strip that abuts a runway, shoulder or stopway shall be flush with the surface of the runway, shoulder or stopway.

- 6.3.8.2 Effective drainage in the graded area must be provided to avoid water ponding. Open drains must not be constructed in the graded portion of a runway strip.

- 6.3.8.3 The portion of a strip to at least 30 m before the start of a runway must be prepared against blast erosion, in order to protect a landing aeroplane from the danger of an exposed edge.

Note: - 1. The area provided to reduce the erosive effects of jet blast and propeller wash may be referred to as a blast pad.

Note: - 2. Guidance on protection against aeroplane engine blast is available in the Aerodrome Design Manual (Doc 9157), Part 2.

- 6.3.8.4 Where the areas in 6.3.8.3 have paved surfaces, they shall be able to withstand the occasional passage of the critical aeroplane for runway pavement design.

- 6.3.8.5 That portion of a strip of an instrument runway within a distance of at least:

- (a) 75 m where the code number is 3 or 4; and
- (b) 40 m where the code number is 1 or 2;

from the centerline of the runway and its extended centerline shall provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Note: - Guidance on grading of a greater area of a strip including a precision approach runway where the code number is 3 or 4 is given in MOS 6.3.3.4.

- 6.3.8.6 That portion of a strip of a non-instrument runway within a distance of at least:

- (a) 75 m where the code number is 3 or 4;
- (b) 40 m where the code number is 2; and

(c) 30 m where the code number is 1;

from the centerline of the runway and its extended centerline shall provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

6.3.8.7 These standards for the surface of runway strips apply equally for runway strips at aerodromes intended for small aeroplanes set out in MOS 13.

6.3.9 Objects on runway strips

Note: - MOS 11.1.1.1 for information regarding siting of equipment and installations on runway strips

6.3.9.1 No fixed object, other than visual aids required for air navigation or those required for aircraft safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirement in (MOS 8 and 9), shall be permitted any part of a runway strip of a precision approach runway delineated by the lower edges of the inner transitional surfaces.

6.3.9.2 No mobile object shall be permitted on a runway strip while the runway is in use for take-off or landing.

Note.— See MOS 7.3.2.9 for characteristics of inner transitional surface.

6.3.9.3 All fixed objects permitted on the runway strip must be of low mass and frangibly mounted. An object situated on a runway strip which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.

Note: - 1. Consideration will have to be given to the location and design of drains on a runway strip to prevent damage to an aeroplane accidentally running off a runway. Suitably designed drain covers may be required. For further guidance, see the Aerodrome Design Manual (Doc 9157), Part 1.

Note: - 2. Where open-air or covered storm water conveyances are installed, consideration will have to be given to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle. See also Note 1.

Note: - 3. Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, notably birds. If needed, it can be covered by a net. Procedures on wildlife management are specified in the PANS-Aerodromes (Doc 9981). Further guidance can be found in the Airport Services Manual (Doc 9137), Part 3

6.3.9.4 Within the general area of the strip adjacent to the runway, measures shall be taken to prevent an aeroplane's wheel, when sinking into the ground, from striking a hard vertical face. Special problems may arise for runway light fittings or other objects mounted in the strip or at the intersection with a taxiway or another runway. In the case of construction, such as runways or taxiways, where the surface must also be flush with the strip surface, a vertical face can be eliminated by chamfering from the top of the construction to not less than 30 cm below the

strip surface level. Other objects, the functions of which do not require them to be at surface level, shall be buried to a depth of not less than 30 cm.

6.3.10 Runway strip strength

6.3.10.1 That portion of a strip of an instrument runway within a distance of at least:

- (a) 75 m where the code number is 3 or 4; and
- (b) 40 m where the code number is 1 or 2;

from the centerline of the runway and its extended centerline should be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Note: - Guidance on the preparation of runway strips is given in the ICAO Aerodrome Design Manual, Part 1.

6.3.10.2 That portion of a strip containing a non-instrument runway within a distance of at least:

- (a) 75 m where the code number is 3 or 4;
- (b) 40 m where the code number is 2; and
- (c) 30 m where the code number is 1;

from the centerline of the runway and its extended centerline should be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Section 6.4 Runway End Safety Area

6.4.1 Runway End Safety Area (RESA)

6.4.1.1 A runway end safety area shall be provided at each end of a runway strip where:

- (a) the code number is 3 or 4; and
- (b) the code number is 1 or 2 for instrument runway.

Note: - Guidance on runway end safety areas is given in MOS Attachment A, Section 1.

6.4.1.2 A runway end safety area shall be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one.

6.4.1.3 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m where:

- (a) the code number is 3 or 4; and
- (b) the code number is 1 or 2 and the runway is an instrument one.

If an arresting system is installed, the above length may be reduced, based on the

design specification of the system, subject to acceptance by CAAP.

Note: - Guidance on arresting system is given in MOS Attachment A Section 1.

- 6.4.1.4 A runway end safety area shall, as far as practicable, extend from the end of a runway strip to a distance of at least:
- (a) 240 m where the code number is 3 or 4; or a reduced length when an arresting system is installed;
 - (b) 120 m where the code number is 1 or 2 and the runway is an instrument one; or a reduced length when an arresting system is installed; and
 - (c) 30 m where the code number is 1 or 2 and the runway is a non-instrument one. The RESA standard shall apply to all runways including an existing runway when it is reduced or extended in length.
- 6.4.1.5 The width of a RESA must not be less than twice the width of the associated runway.
- 6.4.1.6 The width of a runway end safety area shall, wherever practicable, be equal to that of the graded portion of the associated runway strip.
- 6.4.1.7 The downward longitudinal slope of a RESA must not be more than 5%. Longitudinal slope changes shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.
- 6.4.1.8 The transverse slope of a RESA must not be more than 5% upwards or downwards. Transition between different slopes is to be as gradual as practicable.
- 6.4.1.9 No part of the RESA must project above the runway's approach or take-off climb surfaces.
- 6.4.1.10 An object situated within a RESA which may endanger aeroplanes shall be regarded as an obstacle and shall, as far as practicable, be removed.
- Note: -See MOS 11.1.1 for information regarding siting of equipment and installations on runway end safety areas.*
- 6.4.1.11 All fixed objects permitted on a RESA must be of low mass and frangibly mounted.
- 6.4.1.12 A RESA must be free of mobile objects that may endanger aircraft when the runway is being used for landing or taking off.
- 6.4.1.13 As far as practicable, a RESA must be prepared or constructed so 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 firefighting vehicles as required in MOS 14.5.1 to 14.5.3.

Note: - It is recommended that areas abutting the runway ends should be provided with a compacted gravel pavement with a depth at the runway end equal to half

the depth of the runway pavement, tapering to natural surface, the length of the taper being adjusted according to the bearing capacity of the natural surface. For areas beyond the gravel surface and outside the runway strip, graded but non-compacted natural surface with a grass cover is preferred. Guidance on the strength of RESA is given in Aerodrome Design Manual Part 1.

- 6.4.1.14 A RESA shall provide a cleared and graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane undershooting or overrunning the runway.

Note: - The surface of the ground in the runway end safety area does not need to be prepared to the same quality as the runway strip. See, however, MOS 6.4.1.14.

Section 6.5 Clearway

6.5.1 General

- 6.5.1.1 A clearway, consisting of an obstruction-free rectangular plane, may be provided at the end of a runway so that an aeroplane taking off may make a portion of its initial climb to 35 ft. (10.7 m) above the clearway, some of which may lie beyond the end of the runway.

Note: - In the Republic of the Philippines, the portion of runway strip between the end of the runway and runway strip satisfies clearway specifications and so is treated as a clearway for declared distance purposes.

6.5.2 Location of Clearways

- 6.5.2.1 A clearway must start at the end of the take-off run available on the runway.

6.5.3 Dimensions of Clearways

- 6.5.3.1 The length of a clearway must not be more than half the length of the take-off run available on the runway.
- 6.5.3.2 A clearway shall extend laterally on each side of the extended centerline of the runway to a distance of at least:
- (a) 75 m for instrument runways; and
 - (b) half of the width of the runway strip for non-instrument runways.

6.5.4 Slopes on Clearways

- 6.5.4.1 The surface below a clearway must not project above a plane with an upward slope of 1.25%, the lower limit of which is a horizontal line that:
- (a) is perpendicular to the vertical plane containing the runway centerline; and
 - (b) passes through a point located on the runway centerline at the end of the take-off run available.

Note: - Because of transverse or longitudinal slopes on a runway, shoulder or strip, in certain cases the lower limit of the clearway plane specified above may be below the corresponding elevation of the runway, shoulder or strip. It is not intended that these surfaces be graded to conform with the lower limit of the clearway plane nor is it intended that terrain or objects which are above the clearway plane beyond the end of the strip but below the level of the strip be removed unless it is considered they may endanger aeroplanes.

6.5.5 Objects on Clearways

6.5.5.1 A clearway must be free of fixed or mobile objects other than visual or navigational aids for the guidance of aeroplanes or vehicles.

6.5.5.2 All fixed objects permitted on the clearway must be of low mass and frangibly mounted.

Section 6.6 Stopway

Note: - The inclusion of detailed specifications for stopways in this section is not intended to imply that a stopway has to be provided. MOS Attachment A, Section 17, provides information on the use of stopways.

6.6.1 General

6.6.1.1 A stopway may be provided at the end of a runway on which an aeroplane may be stopped in the case of an aborted take-off.

6.6.2 Dimensions of stopways

6.6.2.1 Any decision to provide a length of stopway is an economic decision for the aerodrome operator, but any stopway provided must be located so that it is contained in, and finishes at least 60 m before the end of, the runway strip.

6.6.2.2 The width of a stopway must be equal to the width of the associated runway.

6.6.3 Surface of stopway

6.6.3.1 The surface of a paved stopway shall be so constructed or resurfaced as to provide surface friction characteristics at or above those of the associated runway.

6.6.3.2 The friction characteristics of an unpaved stopway shall not be substantially less than that of the runway with which the stopway is associated.

6.6.4 Slopes on stopways

6.6.4.1 Where practicable, slope and slope changes on a stopway must be the same as those for the associated runway, except that:

- (a) the limitation of a 0.8% slope for the first and last quarter of the length of a runway need not be applied to the stopway; and

- (b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be increased to 0.3% per 30 m (minimum radius of curvature of 10,000 m).

6.6.5 Bearing strength of stopway

- 6.6.5.1 The bearing strength of a stopway must be able to support at least one single pass of the critical aircraft without causing structural damage to the aircraft.

Note: - A stopway should be constructed to the full runway pavement depth where it abuts the runway, tapering to one half of the runway pavement depth over the first 15 m and continued at half the runway pavement depth thereafter, in order to affect a gradual transition in all weather conditions.

- 6.6.5.2 If the stopway does not meet the strength criteria defined in paragraph 6.6.5.1, then:

- (a) for aircraft having a maximum take-off mass in excess of 68,000 kg, any unsealed stopway distance may not be included in the published accelerate stop distance available;
- (b) for aircraft having a maximum take-off mass between 36,300 kg and 68,000 kg, a maximum length of 60 m of stopway may be included in the published accelerate stop distance available; and
- (c) for aircraft having a maximum take-off mass not exceeding 36,300 kg, a maximum length of stopway not exceeding 13% of the runway length may be included in the published accelerate stop distance available.

Section 6.7 Taxiways

Taxiways shall be provided to permit the safe and expeditious surface movement of aircraft.

Note: - 1. Unless otherwise indicated the requirements in this section are applicable to all types of taxiways.

Note: - 2. See MOS 8.6.14 for a standardized scheme for the nomenclature of taxiways which may be used to improve situational awareness and as a part of an effective runway incursion prevention measure.

Note: - 3. See MOS Attachment A, Section 9 for specific taxiway design guidance which may assist in the prevention of runway incursions when developing a new taxiway or improving existing ones with a known runway incursion safety risk.

Note: - 4. Guidance on layout and standardized nomenclature of taxiways is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Sufficient entrance and exit taxiways for a runway shall be provided to expedite the movement of aeroplanes to and from the runway and provision of rapid exit taxiways considered when traffic volumes are high.

6.7.1 Taxiway Width

- 6.7.1.1 The width of a straight section of a taxiway must not be less than the width determined using Table 6.7-1.

OMGWS				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Taxiway width	7.5 m	10.5 m	15 m	23 m

Table 6.7-1: Minimum width for straight section of taxiway

Note: - Guidance on width of taxiways is given in the Aerodrome Design Manual (Doc9157), Part 2.

6.7.2 Taxiway Edge Clearance

- 6.7.2.1 The design of a taxiway shall be such that, when the cockpit of the aeroplane for which the taxiway is intended remains over the taxiway centerline markings, the clearance distance between the outer main wheel of the aeroplane and the edge of the taxiway shall be not less than the distance determined using Table 6.7-2.

OMGWS				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.5 m	2.25 m	3 m ^{a, b} or 4 m ^c	4 m

Table 6.7-2: Minimum clearance between outer main gear wheels and edge of taxiway

^a On straight portions.

^b On curved portions if the taxiway is intended to be used by aeroplanes with a wheel base of less than 18 m if the turn pad is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.

^c On curved portions if the taxi way is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.

Note. - Wheel base means the distance from the nose gear to the geometric center of the main gear.

6.7.3 Taxiway Curves

- 6.7.3.1 Any change in the direction of a taxiway must be accomplished by a curve

whose minimum radius, determined by the taxiway design speed, must not be less than that determined using Table 6.7-3.

Taxiway Design Speed	Radius of Curve
20 km/h	24 m
30 km/h	54 m
40 km/h	96 m
50 km/h	150 m
60 km/h	216 m
70 km/h	294 m
80 km/h	384 m
90 km/h	486 m
100 km/h	600 m

Table 6.7-3: Radii for taxiway curves

Note: - The provision of rapid exit taxiways is a financial decision for the aerodrome operator. The aerodrome operator should seek specialist advice on the geometric design of rapid exit taxiways.

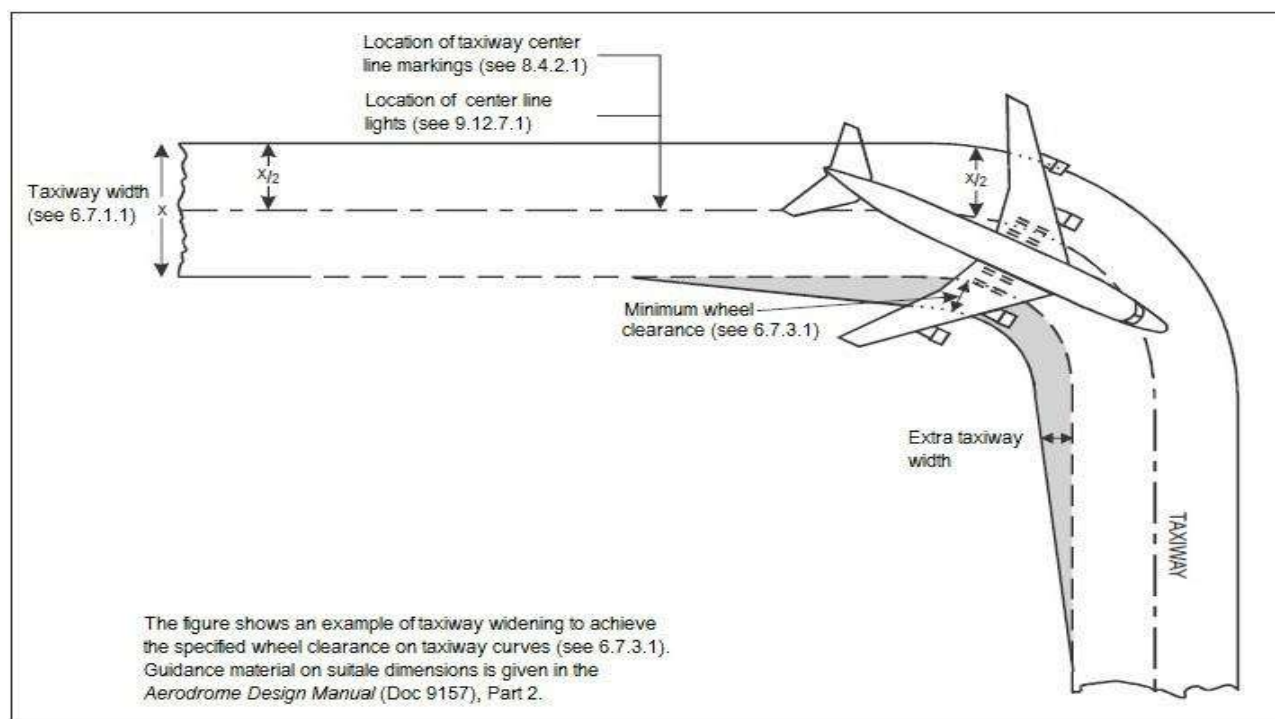
6.7.3.2

Changes in direction of taxiways shall be as few and small as possible. The radii of the curves shall be compatible with the maneuvering capability and normal taxiing speeds of the aeroplanes for which the taxiway is intended. The design of the curve shall be such that, when the cockpit of the aeroplane remains over the taxiway centerline markings, the clearance distance between the outer main wheels of the aeroplane and the edge of the taxiway shall not be less than those specified in 6.7.2.1.

Note: - 1. An example of widening taxiways to achieve the wheel clearance specified is illustrated in MOS Figure 6.7-1. Guidance on the values of suitable dimensions is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Note: - 2. The location of taxiway centerline markings and lights is specified in MOS 8.4.2.1 and 9.12.7.1.

Note: - 3. Compound curves may reduce or eliminate the need for extra taxiway width.

**Figure 6.7-1: Taxiway curve**

- 6.7.3.3 To facilitate the movement of aeroplanes, fillets shall be provided at junctions and intersections of taxiways with runways, aprons, and other taxiways. The design of the fillets shall ensure that the minimum wheel clearances specified in MOS 6.7.2.1 are maintained when aeroplanes are maneuvering through the junctions or intersections.

Note: - Considerations will have to be given to the aeroplane datum length when designing fillets. Guidance on the design of fillets and the definition of term aeroplane datum length are given in the Aerodrome Design Manual (Doc9157), Part 2.

6.7.4 Taxiway Longitudinal Slope

- 6.7.4.1 The longitudinal slope along any part of a taxiway must not be more than:

- 1.5%; if the taxiway's code letter is C, D, E or F; and
- 3.0%; if the taxiway's code letter is A or B

- 6.7.4.2 If slope changes cannot be avoided, the transition from one longitudinal slope to another must be accomplished by a curved surface, with a rate of change not more than:

- 1.0% per 30 m if the taxiway's code letter is C, D, E or F (minimum radius of curvature of 3,000 m); and
- 1.0% per 25 m if the taxiway's code letter is A or B (minimum radius of curvature of 2,500 m).

6.7.5 Taxiway Transverse Slope

6.7.5.1 The transverse slope on any part of a taxiway must be adequate to prevent the accumulation of water and must not be less than 1.0% and not more than:

- (a) 1.5% if the taxiway's code letter is C, D, E or F; and
- (b) 2.0% if the taxiway's code letter is A or B.

Note: - See MOS 6.9.3.2 regarding transverse slopes on an aircraft stand taxiway.

6.7.6 Taxiway Sight Distance

6.7.6.1 The unobstructed line of sight along the surface of a taxiway, from a point above the taxiway, must not be less than the distance determined using Table 6.7-4.

Code letter	Minimum line of sight
A	150 m from 1.5 m above taxiway
B	200 m from 2 m above taxiway
C, D, E or F	300 m from 3 m above taxiway

Table 6.7-4: Standard for taxiway line of sight

6.7.7 Taxiway Bearing Strength

6.7.7.1 CAAP does not specify a standard for taxiway bearing strength, however the bearing strength must be such that it does not cause any safety problems to the operating aircraft.

6.7.7.2 The strength of a taxiway shall be at least equal to that of the runway it serves, due consideration being given to the fact that a taxiway will be subjected to a greater density of traffic and, as a result of slow moving and stationary aeroplanes, to higher stresses than the runway it serves.

Note: - Guidance on the relation of the strength of taxiways to the strength of runways is given in the Aerodrome Design Manual (Doc 9157), Part 3.

6.7.8 Surface of Taxiways

6.7.8.1 The surface of a taxiway shall not have irregularities that cause damage to aeroplane structures.

6.7.8.2 The surface of a paved taxiway shall be so constructed or resurfaced as to provide suitable surface friction characteristics.

Note: - Suitable surface friction characteristics are those surface properties required on taxiways that assure safe operation of aeroplanes.

6.7.9 Taxiway Shoulders

Note: - Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the Aerodrome Design Manual (Doc 9157), Part 2.

- 6.7.9.1 If the taxiway code letter is C, D, E or F and it is used by jet propelled aeroplanes it must be provided with shoulders.

6.7.10 Width of Taxiway Shoulders

- 6.7.10.1 Straight portions of a taxiway where the code letter is C, D, E or F shall be provided with shoulders which extend symmetrically on each side of the taxiway so that the overall width of the taxiway and its shoulders on straight portions is not less than:

- (a) 44 m if the taxiway's code letter is F;
- (b) 38 m if the taxiway's code letter is E;
- (c) 34 m if the taxiway's code letter is D; and
- (d) 25 m if the taxiway's code letter is C.

- 6.7.10.2 On taxi way curves and on junctions or intersections where increased pavement is provided, the shoulder width shall be not less than that on the adjacent straight portions of the taxi way.

6.7.11 Surface of Taxiway Shoulders

- 6.7.11.1 The taxiway shoulders must be:

- (a) resistant to engine blast erosion and ingestion of the surface material by aeroplane engines if the taxiway is used by jet-propelled aircraft ; and
- (b) sealed to a width of at least 3 meters on both sides of the taxiway if the taxiway is intended to serve a wide body jet, such as a Boeing 747, Airbus A340 or A380 or similar aeroplane, whose engines overhang the shoulders.

6.7.12 Taxiway Strips

Note: - Guidance on characteristics of taxiway strips is given in the Aerodrome Design Manual (Doc 9157), Part 2.

- 6.7.12.1 A taxiway, other than an aircraft stand taxilane, must be located in a taxiway strip, the inner part of which is a graded area.

6.7.13 Width of Taxiway Strip

- 6.7.13.1 The width of the taxiway strip along the length of the taxiway on each side of the centerline of the taxiway must not be less than:

- (a) 51 m if the taxiway's code letter is F; or
- (b) 43.5 m if the taxiway's code letter is E; or
- (c) 37 m if the taxiway's code letter is D; or
- (d) 26 m if the taxiway's code letter is C; or
- (e) 20 m if the taxiway's code letter is B; or
- (f) 15.5 m if the taxiway's code letter is A.

6.7.14 Width of Graded Area of Taxiway Strip

- 6.7.14.1 The width of the graded area of a taxiway strip on each side of the centerline of the taxiway of not be less than that given by the following tabulation:
- (a) 10.25 m where the OMGWS is up to but not including 4.5 m;
 - (b) 11 m where the OMGWS is 4.5 m up to but not including 6 m;
 - (c) 12.50 m where the OMGWS is 6 m up to but not including 9 m;
 - (d) 18.50 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D;
 - (e) 19 m where the OMGWS is 9 m up to but not including 13 m, where the code letter is E; or
 - (f) 22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F.

Note. — Guidance on width of the graded portion of a taxiway is given in the Aerodrome Design Manual (Doc 9157), Part 2.

6.7.15 Slope of Taxiway Strip

- 6.7.15.1 The surface of the strip shall be flush at the edge of the taxiway or shoulder, if provided, and the graded area of a taxiway strip must not have an upward transverse slope that is more than:
- (a) 2.5% if the taxiway's code letter is C, D, E or F; or
 - (b) 3% if the taxiway's code letter is A or B;
- measured relative to the transverse slope of the adjacent taxiway surface and not the horizontal.

- 6.7.15.2 The downward transverse slope of the graded area of a taxiway strip must not exceed 5.0%, measured relative to the horizontal.

- 6.7.15.3 The transverse slopes on any portion of a taxiway strip beyond that to be graded shall not exceed an upward or downward slope of 5.0% as measured in the direction away from the taxiway.

Note: - 1. Where deemed necessary for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a taxiway strip and would be placed as far as practicable from the taxiway.

Note: - 2. The aerodrome RFF procedure would need to take into account the location of open-air storm water conveyances within the non-graded portion of a taxiway strip.

6.7.16 Objects on Taxiway Strip

Note: - See MOS 11.1.1.1 for information regarding general siting requirements of equipment and installations on taxiway strips.

- 6.7.16.1 The taxiway strip must provide an area clear of objects which may endanger taxiing aeroplanes

Note: - 1. Consideration will have to be given to the location and design of drains on a taxiway strip to prevent damage to an aeroplane accidentally running off a taxiway. Suitably designed drain covers may be required. For further guidance, see the Aerodrome Design Manual (Doc 9157), Part 2.

Note: - 2. Where open-air or covered storm water conveyances are installed, consideration will have to be given to ensure that their structure do not extend above the surrounding ground so as not to be considered an obstacle. See also Note 1 MOS 6.7.15.3.

Note: - 3. Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, notably birds. If needed, it can be covered by a net. Guidance on Wildlife Control and Reduction can be found in the Airport Services Manual (Doc 9137), Part 3.

6.7.16.2 A taxiway strip must be free of fixed objects other than visual or navigational aids used for the guidance of aircraft or vehicles.

6.7.16.3 Visual aids located within a taxiway strip must be sited at such a height that they cannot be struck by propellers, engine pods and wings of aircraft using the taxiway.

6.7.17 Taxiways on Bridges

6.7.17.1 Subject to Paragraph 6.7.16.2, the minimum width of the part of a taxiway bridge that is capable of supporting the traffic of aircraft that use the bridge must, when measured perpendicular to the taxiway centerline, not be less than the total width of the graded area of the taxiway strip described in 6.7.13.1.

6.7.17.2 The minimum width of the part of the taxiway bridge referred to in Paragraph 6.7.16.1 may be reduced to a width not less than the width of the associated taxiway, if an adequate method of lateral restraint is provided at the edges of that part, to prevent aircraft leaving that part.

Note: -If aeroplane engines overhang the bridge structure, protection of adjacent areas below the bridge from engine blast may be required.

6.7.17.4 A bridge shall be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of aeroplanes approaching the bridge.

6.7.18 Taxiway Minimum Separation Distances

6.7.18.1 Table 6.7-5 represents the minimum separation distances between:

- (a) Taxiway centerline and runway centerline:
 - (i) Instrument runways;
 - (ii) Non-instrument runways;
- (b) Taxiway centerline to taxiway centerline;
- (c) Taxiway, other than aircraft stand taxilane, centerline to object;
- (d) Aircraft stand taxilane centerline to aircraft stand taxilane centerline; and

(e) Aircraft stand taxilane centerline to object.

6.7.18.2

The separation distance between the centerline of a taxiway and the centerline of a runway, the centerline of a parallel taxiway or an object shall not be less than the appropriate dimension specified in MOS Table 6.7-5, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances will not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

Note: - 1. Guidance on factors which may be considered in the aeronautical study is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Note: - 2. ILS installations may also influence the location of due to interferences to ILS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS installations is contained in CAR-ANS 10, Volume I, Attachment B.

Note: - 3. The separation distances of MOS Table 6.7-5, column 10, do not necessarily provide the capability of making a normal turn from one taxiway to another parallel taxiway. Guidance for this condition is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Note: - 4. The separation distance between the centerline of an aircraft stand taxilane and an object shown in Table 6.7-5, column 12, may need to be increased when jet exhaust wake velocity may cause hazardous conditions for ground servicing.

Code letter	Distance between taxiway centre line and runway centre line (meters)								Taxiway centre line to taxiway centre line (meters)	Taxiway, other than aircraft stand taxilane, centre line to object (meters)	Aircraft stand taxilane centre line to aircraft stand taxilane centre line (meters)	Aircraft stand taxilane centre line to object (meters)
	Instrument runways				Non-instrument runways							
	Code number				Code number							
	1	2	3	4	1	2	3	4				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A	77.5	77.5	-	-	37.5	47.5	-	-	23	15.5	19.5	12
B	82	82	152	-	42	52	87	-	32	20	28.5	16.5
C	88	88	158	158	48	58	93	93	44	26	40.5	22.5
D	-	-	166	166	-	-	101	101	63	37	59.5	33.5
E	-	-	172.5	172.5	-	-	107.5	107.5	76	43.5	72.5	40
F	-	-	180	180	-	-	115	115	91	51	87.5	47.5

Note 1.— The separation distances shown in columns (2) to (9) represent ordinary combinations of runways and taxiways. The basis for development of these distances is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Note 2.— The distances in columns (2) to (9) do not guarantee sufficient clearance behind a holding aeroplane to permit the passing of another aeroplane on a parallel taxiway. See the Aerodrome Design Manual (Doc 9157), Part 2.

Table 6.7-5: Taxiway minimum separation distances

6.7.19 Rapid exit taxiways

taxiways. See MOS Figure 6.7-2. General requirements for taxiways also apply to this type of taxiway. Guidance on the provision, location and design of rapid exit taxiways is included in the Aerodrome Design Manual (Doc 9157), Part 2.

6.7.19.1 A rapid exit taxiway shall be designed with a radius of turn-off curve of at least:

- (a) 550 m where the code number is 3 or 4; and
- (b) 275 m where the code number is 1 or 2;

to enable exit speeds under wet conditions of:

- (c) 93 km/h where the code number is 3 or 4; and
- (d) 65 km/h where the code number is 1 or 2.

Note: - The locations of rapid exit taxiways along a runway are based on several criteria described in the Aerodrome Design Manual (Doc 9157), Part 2, in addition to different speed criteria.

6.7.19.2 The radius of the fillet on the inside of the curve at a rapid exit taxiway shall be sufficient to provide a widened taxiway throat in order to facilitate early recognition of the entrance and turn-off onto the taxiway.

6.7.19.3 A rapid exit taxiway shall include a straight distance after the turn-off curve sufficient for an exiting aircraft to come to a full stop clear of any intersecting taxiway.

6.7.19.4 The intersection angle of a rapid exit taxiway with the runway shall not be greater than 45° nor less than 25° and preferably should be 30°.

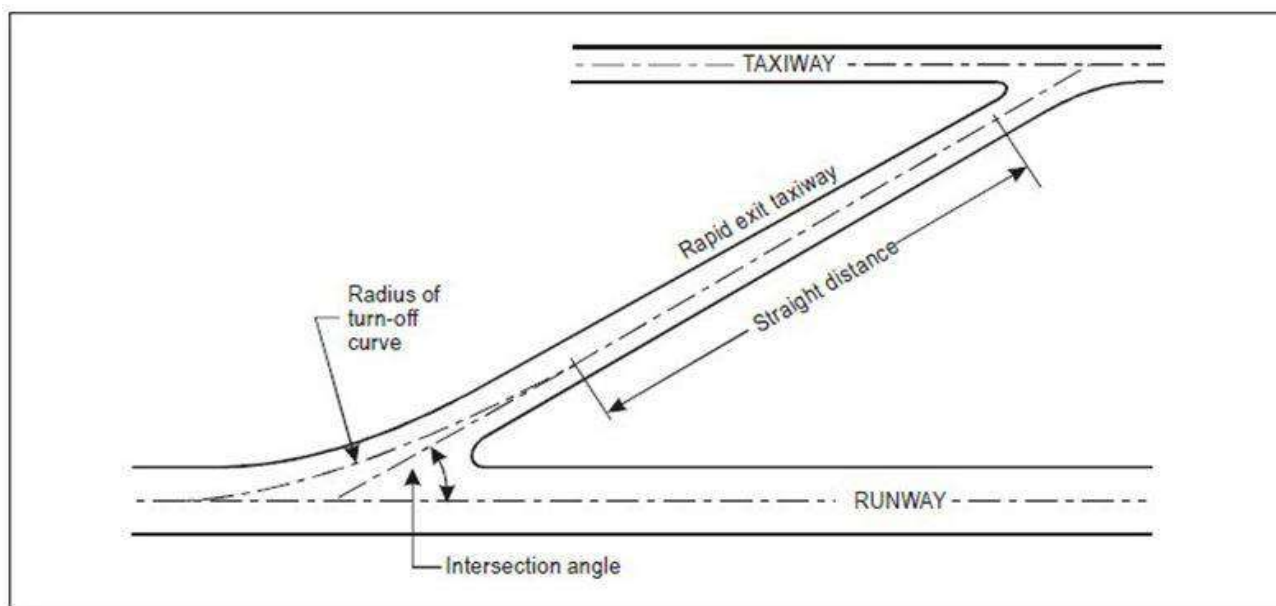


Figure 6.7-2. Rapid exit taxiway

Section 6.8 Holding Bays, Runway-Holding Positions, Intermediate Holding Positions and Road-Holding Positions

6.8.1 Introduction

6.8.1.1 For the purpose of this section:

- (a) a holding bay is defined as an area offset from the taxiway where aircraft can be held;
- (b) a runway-holding position is a designated position on a taxiway entering a runway;
- (c) an intermediate holding position is a designated position on a taxiway other than at a runway holding position; and
- (d) a road-holding position is a designated position at which vehicles may be required to hold before crossing a runway or taxiway.

6.8.2 Provision of a Holding Bay, Runway-holding Position, Intermediate Holding Position and Road-holding Position

6.8.2.1 The provision of a holding bay is the prerogative of the aerodrome operator, however if it is provided, it must be located such that any aeroplane on it will not infringe the inner transitional surface. Holding bay(s) shall be provided when the traffic density is medium or heavy.

6.8.2.2 A runway-holding position or positions must be established:

- (a) on a taxiway, at the intersection of a taxiway and a runway; or
- (b) at an intersection of a runway with another runway when the former runway is part of a standard taxi-route.

6.8.2.3 A runway-holding position shall be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operation of radio navigation aids.

6.8.2.4 Except for an exit taxiway, an intermediate holding position or positions must be established on a taxiway, if the air traffic control requires the aeroplane to hold at that position.

6.8.2.5 A road-holding position must be established at an intersection of a road with a runway. See also MOS 8.6.24 and 8.5.33 for signage and marking of a road-holding position respectively.

6.8.3 Location of Holding Bay, Runway-holding Position, Intermediate Holding Position or Road-holding Position

6.8.3.1 A holding bay, intermediate holding position or road-holding position must not be placed where an aircraft or vehicle using it would:

- (a) infringe the obstacle free zone, approach surface, take-off climb surface or ILS critical or sensitive areas, or, in other cases, the graded area of the runway strip; or

(b) interfere with the operation of radio navigation aids.

6.8.3.2 An intermediate holding position shall be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.

6.8.3.3 The location of a runway-holding position established in accordance with MOS 6.8.2.3 shall be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS critical/sensitive area or interfere with the operation of radio navigation aids.

6.8.4 Distance from Runway-holding Position, Intermediate Holding Position or Road-holding Position to Runway Centerline

6.8.4.1 The distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the center line of a runway shall be in accordance with Table 6.5-1 and, in the case of a precision approach runway, such that a holding aircraft or vehicle will not interfere with the operation of radio navigation aids or penetrate the inner transitional surface.

Note: - Guidance for the positioning of runway-holding positions is given Aerodrome Design Manual (Doc 9157), Part 2 .

6.8.4.2 At elevations greater than 700 m (2,300 ft) the distance of 90 m specified in MOS Table 6.5-1 for a precision approach runway code number 4 should be increased as follows:

- (a) up to an elevation of 2 000 m (6,600 ft); 1 m for every 100 m (330 ft) in excess of 700 m (23,00 ft);
- (b) elevation in excess of 2 000 m (6,600 ft) and up to 4000 m (13,320 ft); 13 m plus 1.5 m for every 100 m (330 ft) in excess of 2000 m (6,600 ft); and

6.8.4.3 If a holding bay, runway-holding position or road-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance specified in MOS Table 6.5-1 shall be further increased 5 m for every meter the bay or position is higher than the threshold.

Table 6.5-1: Minimum distance from the runway center line to a holding bay, runway- holding position or road-holding position

Code number	Type of runway				
	Non-instrument	Non-precision approach	Precision Category I	Precision Category II or III	Take-off
1	30 m	40 m	60 m ^b	-	30 m
2	40 m	40 m	60 m ^b	-	40 m
3	75 m	75 m	90 m ^{a, b}	90 m ^{a, b}	75 m
4	75 m	75 m	90 m ^{a, b}	90 m ^{a, b}	75 m

^a If a holding bay, runway-holding position or road-holding position is at a lower elevation compared to the threshold, the distance may be decreased 5 m for every meter the bay or holding position is lower than the threshold, contingent upon not infringing the inner transitional surface.

- b. This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive areas of ILS and MLS is contained in CAR-ANS Part 6 Attachment C and G respectively (see also MOS 6.8.4.1).

Note 1. — The distance of 90 m for code number 3 or 4 is based on an aircraft with a tail height of 20 m, a distance from the nose to the highest part of the tail of 52.7 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centerline, being clear of the obstacle free zone and not accountable for the calculation of OCA/H.

Note 2. — The distance of 60 m for code number 2 is based on an aircraft with a tail height of 8 m, a distance from the nose to the highest part of the tail of 24.6 m and a nose height of 5.2 m holding at an angle of 45° or more with respect to the runway centerline, being clear of the obstacle free zone.

Note 3. — For code number 4 where the width of the inner edge of the inner approach surface is more than 120 m, a distance greater than 90 m may be necessary to ensure that a holding aircraft is clear of the obstacle free zone. For example, a distance of 100 m is based on an aircraft with a tail height of 24 m, a distance from the nose to the highest part of the tail of 62.2 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centerline, being clear of the obstacle free zone.

Section 6.9 Aprons

6.9.1 Location of apron

- 6.9.1.1 An apron must be located so that aeroplanes parked on it do not infringe an obstacle limitation surface, and in particular, the transitional surface.
- 6.9.1.2 Aprons shall be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.
- 6.9.1.3 The total apron area shall be adequate to permit expeditious handling of the aerodrome traffic at its maximum anticipated density.

6.9.2 Clearance distances on aircraft stands

- 6.9.2.1 An aircraft stand shall be provided the following minimum clearances between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand and other objects using Table 6.9-1.

Code letter for aircraft	From centerline of aircraft parking position taxilane to object	From wing tip of aircraft on aircraft parking position to object
A	12.0 m	3.0 m
B	16.5 m	3.0 m
C	22.5 m	4.5 m
D	33.5 m	7.5 m
E	40.0 m	7.5 m*
F	47.5 m	7.5 m*
* The minimum separation distance is 10 meters if free moving parking is used.		

Table 6.9-1: Aircraft parking positions – Minimum separation distance

- 6.9.2.2 Subject to Paragraph 6.9.2.3, an aircraft on an aircraft parking position must be cleared from any object, other than an aerobridge, by a distance not less than that determined using Table 6.9-1.
- 6.9.2.3 Paragraph 6.9.2.2 does not apply to a Code D, E or F aircraft if a visual docking guidance system allows a reduced clear distance.
- 6.9.2.4 When special circumstances so warrant, these clearances may be reduced at a nose-in aircraft stand, where the code letter is D, E or F:
- (a) between the terminal, including any fixed passenger bridge, and the nose of an aircraft; and
 - (b) over any portion of the stand provided with azimuth guidance by a visual docking guidance system.

Note: - On aprons, consideration also has to be given to the provision of service roads and to maneuvering and storage area for ground equipment (see the Aerodrome Design Manual (Doc 9157), Part 2, for guidance on storage of ground equipment).

6.9.3 Slopes on Aprons

- 6.9.3.1 The slope on an aircraft parking position (aircraft stand) must not be more than 1%.
- 6.9.3.2 The slope on any other part of an apron, including those on an aircraft stand taxilane must be as level as practicable, without causing water to accumulate on the surface of the apron, but must not be more than 2%.
- 6.9.3.3 Subject to paragraph 6.9.3.4 the grading of an apron must be such that it does not slope down towards the terminal building.
- 6.9.3.4 Where a slope down towards the terminal building cannot be avoided, apron drainage must be provided to direct spilled fuel away from buildings and other structures adjoining the apron.
- 6.9.3.5 Where storm-water drains can also serve to collect spilt fuel from the apron area, flame traps or interceptor pits must be provided to isolate and prevent the spread of fuel into other areas.

6.9.4 Apron Bearing Strength

- 6.9.4.1 CAAP does not specify a standard for apron bearing strength, however the bearing strength must be such that it does not cause any safety problems to the operating aircraft.
- 6.9.4.2 Each part of an apron shall be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.

6.9.5 Apron Road

- 6.9.5.1 On an apron where a marked roadway is to be provided for surface vehicles, the location of the apron road must be such that, where practicable, vehicles traveling on it will be at least 3 m from any aircraft parked at the aircraft parking position.

Section 6.10 Jet Blast**6.10.1 General**

- 6.10.1.1 The aerodrome operator must protect people and property from the dangerous effects of jet blast. Information on specific jet engine blast velocities, including lateral and vertical contours for a given aircraft model, is provided in the Aircraft Characteristics - Airport Planning document that is prepared for most aircraft models by the aircraft manufacturer.

6.10.2 Jet Blast and Propeller Wash Hazards

- 6.10.2.1 The recommended maximum wind velocities which people, objects and buildings in the vicinity of an aeroplane may be subjected to should not be more than:
- (a) 60 km/h where passengers have to walk and people are expected to congregate;
 - (b) 80 km/h in minor public areas, where people are not expected to congregate;
 - (c) 50 km/h on public roads where the vehicular speed may be 80 km/h or more, and 60 km/h where the vehicular speed is expected to be below 80 km/h;
 - (d) 80 km/h for personnel working near an aeroplane or for apron equipment;
 - (e) desirably 60 km/h and not greater than 80 km/h for light aeroplane parking areas; and
 - (f) 100 km/h for buildings and other structures.

Note: - To offer protection from jet blast velocities the aerodrome operator may consider the provision of jet blast fences or the use of appropriate building material.

Section 6.11 Isolated aircraft parking position

- 6.11.1 An isolated aircraft parking position shall be designated or the aerodrome control tower shall be advised of an area or areas suitable for the parking of an aircraft which is known or believed to be the subject of unlawful interference, or which for other reasons needs isolation from normal aerodrome activities.
- 6.11.2 The isolated aircraft parking position should be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. Care shall be taken to ensure that the position is not located over underground utilities such as gas and aviation fuel and, to the extent feasible, electrical or communication cables.

CHAPTER 7. Obstacle restriction and limitation

Section 7.1 General

Note: - 1. The objectives of the specifications in this chapter are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

Note: - 2. Objects which penetrate the obstacle limitation surfaces contained in this chapter may in certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circling procedure or have other operational impact on flight procedure design. Criteria for flight procedure design are contained in the Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS, Doc 8168).

Note: - 3. The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in MOS 9.8.2.1 to 9.8.2.5.

7.1.1 Reserved

7.1.2 Introduction

7.1.2.1 The scope of this chapter is to define the standards that control airspace around an aerodrome.

7.1.2.2 An obstacle is defined as a fixed or mobile object that:

- (a) stands on, or stands above, the specified surface of an obstacle restriction area which comprises the runway strips, runway end safety areas, clearways and taxiway strips; or
- (b) any object that penetrates the obstacle limitation surfaces (OLS), a series of surfaces that set the height limits of objects, around an aerodrome; or
- (c) stands outside an OLS and has been assessed as being a hazard to air navigation.

7.1.2.3 Obstacle data requirements for the design of instrument procedures need to be determined in liaison with flight procedure designers.

7.1.2.4 Non-compliance with standards may result in CAAP issuing hazard notification notices as prescribed in CAR-Aerodromes.

7.1.3 Obstacle Restriction

7.1.3.1 Objects, except for approved visual and navigational aids, must not be located within the obstacle restriction area of the aerodrome without the specific approval of CAAP.

7.1.3.2 Equipment and installations required for air navigation purposes are to be of minimum practicable mass and height, frangibly designed and mounted, and sited in such a manner as to reduce the hazard to aircraft to a minimum.

7.1.3.3 Obstacles on the obstacle restriction area must be taken into account when determining the obstacle clear approach or take-off surfaces.

7.1.4 Obstacle Limitation Requirements

Note: - The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a runway, i.e. take-off or landing and type of approach, and are intended to be applied when such use is made of the runway. In cases where operations are conducted to or from both directions of a runway, then the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

7.1.4.1 An aerodrome operator must establish the OLS applicable to the aerodrome.

Note: - 1. A description and illustration of the obstacle limitation surfaces is provided in Section 7.3.

Note: - 2. See MOS 11.1.2 for information regarding siting of equipment and installations on operational areas.

Note: - 3. Guidance on obstacle limitation surfaces for precision approach runways is given in the Airport Services Manual (Doc 9137), Part 6.

7.1.4.2 The following OLS must be established for a non-instrument runway and a non-precision approach runway and a precision approach runway category I:

- (a) conical surface;
- (b) inner horizontal surface;
- (c) approach surface;
- (d) transitional surface; and
- (e) take-off climb surface if the runway is meant for take-off.

7.1.4.3 In addition to 7.1.4.2, the following obstacle limitation surfaces shall be established for a precision approach runway category I:

- (a) inner approach surface;
- (b) inner transitional surfaces; and
- (c) balked landing surface.

7.1.4.4 The heights and slopes of the surfaces (For non-instrument runways) shall not be greater than, and their other dimensions not less than, those specified in MOS Table 7.1-1.

7.1.4.5 The heights and slopes of the surfaces (For non-precision runways) shall not be greater than, and their other dimensions not less than, those specified in MOS

Table 7.1-1, except in the case of the horizontal section of the approach surface (see 7.1.4.6).

- 7.1.4.6 The approach surface shall be horizontal beyond the point at which the 2.5 % slope intersects:
- (a) a horizontal plane 150 m above the threshold elevation; or
 - (b) the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H);
- whichever is the higher.
- 7.1.4.7 The heights and slopes of the surfaces (For precision runways) shall not be greater than, and their other dimensions not less than, those specified in Table 7.1-1, except in the case of the horizontal section of the approach surface (see 7.1.4.8).
- 7.1.4.8 The approach surface shall be horizontal beyond the point at which the 2.5 % slope intersects:
- (a) a horizontal plane 150 m above the threshold elevation; or
 - (b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;
- whichever is the higher.
- 7.1.4.9 The following OLS must be established for a precision approach runway category II or III:
- (a) outer horizontal surface, if so directed by CAAP;
 - (b) conical surface;
 - (c) inner horizontal surface;
 - (d) approach surface;
 - (e) inner approach surface;
 - (f) transitional surface;
 - (g) inner transitional surface;
 - (h) balked landing surface; and
 - (i) take-off climb surface if the runway is meant for take-off.
- 7.1.4.10 The physical dimensions and slopes of the OLS surfaces, for approach runways, must be determined using Table 7.1-1.

Table 7.1-1: Dimensions and slopes of obstacle limitation surfaces — Approach runways

APPROACH RUNWAYS										
Surface and dimensions ^a	RUNWAY CLASSIFICATION									
	Non-instrumental				Non-precision approach			Precision approach category		
	1 [*]	2	3	4	1,2	3	4	I Code number	II Code number	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	—	—	—	—	—	—	—	90 m	120 m ^e	120 m ^e
Distance from threshold	—	—	—	—	—	—	—	60 m	60 m	60 m
Length	—	—	—	—	—	—	—	900 m	900 m	900 m
Slope	—	—	—	—	—	—	—	2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m ^f	150 m	140 m ^f	280 m	280 m ^g	140 m	280 m	280 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	—	—	—	—	—	3 600 m ^b	3 600 m ^b	12 000 m	3 600 m ^b	3 600 m ^b
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	—	—	—	—	—	8 400 m ^b	8 400 m ^b	—	8 400 m ^b	8 400 m ^b
Total length	—	—	—	—	—	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	—	—	—	—	—	—	—	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	—	—	—	—	—	—	—	90 m	120 m ^e	120 m
Distance from threshold	—	—	—	—	—	—	—	c	1 800 m ^d	1 800 m ^d
Divergence (each side)	—	—	—	—	—	—	—	10%	10%	10%
Slope	—	—	—	—	—	—	—	4%	3.33%	3.33%
* Runways used for air transport operations at night by aircraft with maximum take-off mass not exceeding 5,700 kg are required to meet Code 2 standards.					e. Where the code letter is F (Table 2.1-1), the width is increased to 140 m except for those aerodromes that accommodate a code letter F aeroplane equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre. Note— See Circulars 301 and 345, and Chapter 4 of the PANS-Aerodromes, Part I (Doc 9981) for further information.					
a. All dimensions are measured horizontally unless specified otherwise.					f. 90 m where width of runway is 30 m.					
b. Variable length (see MOS 7.1.4.6 or MOS 7.1.4.8).					g. 150 m if only used by aeroplanes requiring 30 m wide runway.					
c. Distance to the end of strip.										
d. Or end of runway whichever is less.										

- 7.1.4.11 The following obstacle limitation surface shall be established for a runway meant for take-off:
- (a) take-off climb surface.
- 7.1.4.12 The dimensions of the surface shall be not less than the dimensions specified in MOS Table 7.1-2, except that a lesser length may be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes.
- 7.1.4.13 The physical dimensions of the take-off climb OLS surfaces for take-off runways must be determined using MOS Table 7.1-2.

Take-off climb surface dimensions (in meters and percentages)	Take-off Runways Code number		
	1*	2	3 or 4
Length of inner edge	60	80	180 ^b
Minimum distance of inner edge from runway end ^c	30	60	60
Rate of divergence (each side)	10%	10%	12.5%
Final width	380	580	1200
			1800 ^d
Overall length	1600	2500	15000
Slope	5%	4%	2% ^e

Table 7.1-2: Take-off runways

- * Runways used for air transport operations at night by aircraft with maximum take-off mass not exceeding 5,700 kg are required to meet code 2 standards.
- a All dimensions are measured horizontally unless otherwise specified.
- b The length of the inner edge may be reduced to 90 m if the runway is intended to be used by aeroplanes having a mass less than 22,700 kg and operating in VMC by day. In this case the final width may be 600 m, unless the flight path may involve a change of heading in excess of 15°.
- c The take-off climb surface starts from the end of clearway if a clearway is provided.
- d 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC or VMC by night.
- e See MOS 7.1.4.14 & 7.1.4.15.

- 7.1.4.14 The operational characteristics of aeroplanes for which the runway is intended shall be examined to see if it is desirable to reduce the slope specified in MOS Table 7.1-2 when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of the take-off climb surface shall be made so as to provide protection to a height of 300 m.

Note: - When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in MOS Table 7.1-2 to be

reduced. The degree of this reduction depends on the divergence between local conditions and sea level standard atmospheric conditions, and on the performance characteristics and operational requirements of the aeroplanes for which the runway is intended.

7.1.4.15 If no object reaches the 2 % (1:50) take-off climb surface, new objects shall be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 % (1:62.5).

7.1.4.16 Where two OLS surfaces overlap, the lower surface must be used as the controlling OLS.

7.1.5 Procedures for Aerodrome Operators to deal with obstacles

7.1.5.1 The aerodrome operator must monitor the OLS applicable to the aerodrome and report to CAAP any infringement or potential infringement of the OLS.

Note: - Aerodrome operators need to liaise with appropriate planning authorities and companies that erect tall structures, to determine potential infringements. Every effort should be made to implement the OLS standards and limit the introduction of new obstacles.

7.1.5.2 When a new obstacle is detected, the aerodrome operator must ensure that the information is passed on to pilots, through NOTAM, in accordance with the standards for aerodrome reporting procedures set out in Chapter 10.

7.1.5.3 Information on any new obstacle must include:

- (a) the nature of the obstacle (for instance structure or machinery);
- (b) distance and bearing of the obstacle from the start of the take-off end of the runway if the obstacle is within the take-off area, or else from the ARP;
- (c) height of the obstacle in relation to the aerodrome elevation; and if it is a temporary obstacle, the time it exists as an obstacle.

7.1.6 Objects outside the OLS

7.1.6.1 Under CAR-Aerodromes any object which extends to a height of 110 m or more above local ground level must be notified to CAAP.

7.1.6.2 Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes. or it is assessed by CAAP to be otherwise.

Note: - This study may have regard to the nature of operations concerned and may distinguish between day and night operations.

7.1.7 Objects that could become obstacles

7.1.7.1 If a proposed object or structure is determined to be an obstacle, details of the proposal must be referred to CAAP to determine whether it will be a hazard to aircraft operations.

7.1.7.2 Shielded Obstacle. A new obstacle that is shielded by an existing obstacle may be assessed as not imposing additional restrictions to aircraft operations.

Note: - Information on the shielding principle is provided in MOS 7.4.

7.1.7.3 Marking and lighting of obstacles

(a) CAAP may direct that obstacles be marked and or lit and may impose operational restrictions on the aerodrome as a result of an obstacle.

(b) If directed by CAAP, lighting and/or marking of obstacles, including terrain, must be carried out in accordance with the standards set out in MOS Chapter 8 and Chapter 9.

7.1.7.4 Temporary and transient obstacles. Temporary obstacles and transient (mobile) obstacles, such as road vehicles, rail carriages or ships, in close proximity to the aerodrome and which penetrate the OLS for a short duration, must be referred to CAAP to determine whether they will be a hazard to aircraft operations.

7.1.7.5 Fences or levee banks. A fence or levee bank that penetrates the OLS must be treated as an obstacle.

Note: - See MOS Chapter 5 in regard to reporting of fences and levee banks.

7.1.7.6 Hazardous objects below the OLS. Where CAAP has identified an object which does not penetrate the OLS to be a hazard to aircraft operations, CAAP may require the object to be either:

(a) removed, if appropriate; or

(b) marked and/or lit.

Note: - For example, inconspicuous overhead wires or isolated objects in the vicinity of the aerodrome.

7.1.7.7 Objects which do not project through the approach surface but which will nevertheless adversely affect the optimum siting or performance of visual or non-visual aids shall, as far as practicable, be removed.

7.1.7.8 Anything which may, after aeronautical study, endanger aeroplanes on the movement area or in the air within the limits of the inner horizontal and conical surfaces shall be regarded as an obstacle and shall be removed in so far as practicable.

7.1.8 Monitoring of obstacles associated with instrument runways

7.1.8.1 Aerodrome operators must establish procedures to monitor the OLS and the critical obstacles associated with any additional requirements and have them included in the Aerodrome Manual if provided.

Section 7.2 Aerodrome Obstacle Charts

7.2.1 Type A Charts

7.2.1.1 The Type A chart is an ICAO specified chart that identifies information on all significant obstacles within the take-off area of an aerodrome up to 10 km from the end of the runway.

7.2.1.2 A Type A chart must be prepared for each runway that is used in international operations.

7.2.1.3 The obstacle data to be collected and the manner of presentation of the Type A chart must be in accordance with the standards and procedures set out in CAR- ANS Part 4.

Note: - A Type A chart meeting the accuracy requirements of CAR-ANS Part 4. is adequate.

7.2.1.4 Where no significant obstacle exists within the take-off flight path area, as specified by CAR-ANS Part 4, a Type A chart is not required but a statement must be included in the Aerodrome Manual.

7.2.1.5 At aerodromes with no international operations but used by aircraft above 5,700 kg engaged in air transport operations, the decision to prepare Type A charts, or discrete obstacle information instead of a Type A chart, is a matter for the aerodrome operator to be made in conjunction with the relevant airline.

7.2.1.6 Where a Type A chart has been prepared, or updated, a copy of the chart must be given to CAAP.

7.2.1.7 Where a Type A chart has been prepared and issued, the take-off area must be monitored and any changes to the Type A chart information must immediately be communicated to all users of the Type A chart.

Note: - 1. Changes to the Type A chart information but not to OLS take-off climb surface do not require NOTAM action.

Note: - 2. Where the change to Type A chart information is also the subject of NOTAM action, additional separate advice to Type A chart holders is not necessary.

7.2.1.8 A distribution list of current Type A chart holders must be maintained in the Aerodrome Manual.

7.2.1.9 A Type A chart must be updated when the number of changes to the chart, notified through NOTAM or separate advice, reaches a level which CAAP considers excessive.

7.2.2 Type B Charts

7.2.2.1 A Type B chart is an ICAO obstacle chart that provides obstacle data around the aerodrome.

- 7.2.2.2 A Type B chart, prepared in accordance with the standards and procedures set out in CAR-ANS Part 4, may be provided.

Note: - This may be required by operators of aircraft above 5,700 kg to identify obstacles around an aerodrome.

- 7.2.2.3 The decision to prepare a Type B chart must be made in consultation with CAAP.

- 7.2.2.4 Where required, the obstacle data to be collected and the manner of presentation of the Type B chart must be in accordance with the standards and procedures set out in CAR-ANS Part 4.

Section 7.3 Obstacle Limitation Surfaces

7.3.1 General

- 7.3.1.1 The Obstacle Limitation Surfaces (OLS) are conceptual (imaginary) surfaces associated with a runway, which identify the lower limits of the aerodrome airspace above which objects become obstacles to aircraft operations, and must be reported to CAAP.

Note: - The term OLS refers to each of the imaginary surfaces that together define the lower boundary of aerodrome airspace, as well as to refer to the combination of all the individual surfaces.

- 7.3.1.2 The OLS comprises some or all of the following:

- (a) outer horizontal surface;
- (b) conical surface;
- (c) inner horizontal surface;
- (d) approach surface;
- (e) inner approach surface;
- (f) transitional surface;
- (g) inner transitional surface;
- (h) balked landing surface; and
- (i) take-off climb surface.

7.3.2 Description of OLS

- 7.3.2.1 **Reference Elevation Datum.** A reference elevation datum is to be established as a benchmark for the horizontal and conical surfaces. The reference elevation datum is to be:

- (a) the same as the elevation of the ARP (rounded off to the next half meter below), provided this elevation is within three meters of the average elevations of all existing and proposed runway ends; otherwise
- (b) the average elevation (rounded off to the next half-meter below) of existing and proposed runway ends.

Note: - The reference elevation datum is not to be confused with the aerodrome elevation published in AIP. Aerodrome elevation is, by definition, the highest point on the landing area.

7.3.2.2 Outer Horizontal Surface. The outer horizontal surface is a plane located 150 m above the reference elevation datum and extending from the upper edge of the extended conical surface for a distance of 15,000 m (radius) from the aerodrome reference point (ARP).

Note: - Guidance on the need to provide an outer horizontal surface and its characteristics is contained in the Airport Services Manual (Doc 9137), Part 6.

7.3.2.3 Conical Surface. The conical surface comprises both straight and curved elements, which slope upwards and outwards from the edge of the inner horizontal surface to a specified height above the inner horizontal surface. The slope of the conical surface is to be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

7.3.2.4 Inner Horizontal Surface. The inner horizontal surface is a horizontal plane at a specified height above the reference elevation datum extending to an outer boundary comprising:

- (a) in the case of an aerodrome with a single runway, semi-circular curves of a specified radius centered on the middle of each of the runway strip ends and joined tangentially by straight lines on each side of the runway, parallel to the runway centerline;
- (b) in the case of an aerodrome with multiple runways, curves of a specified radius centered on the middle of each of the runway strip ends and the curves are joined by a tangential line as two curves intersect.

Note: - The shape of the inner horizontal surface need not necessarily be circular. Guidance on determining the extent of the inner horizontal surface is contained in the Airport Services Manual (Doc 9137), Part 6.

Note: - Guidance on determining the elevation datum is contained in the Airport Services Manual (Doc 9137), Part 6.

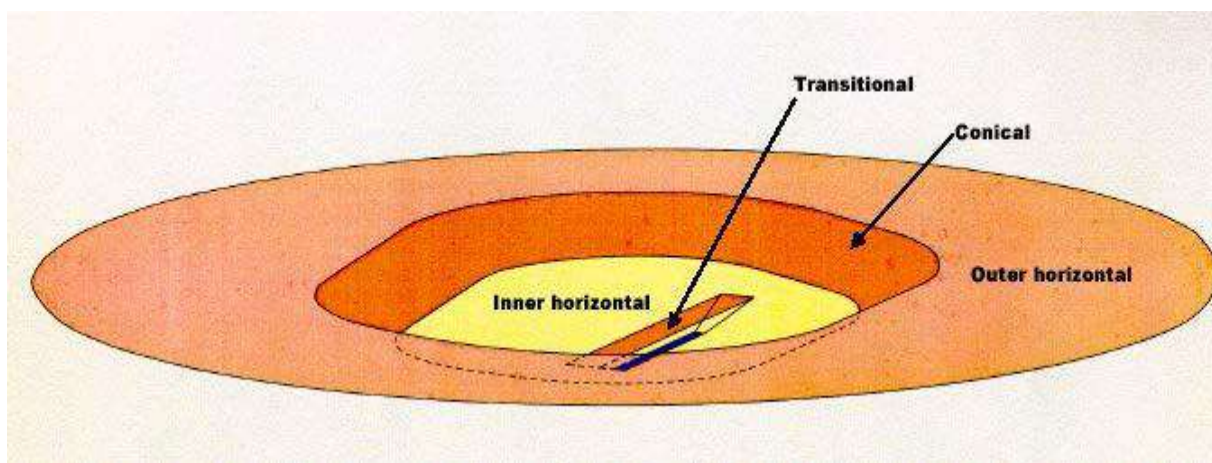


Figure 7.3-1: Relationship of outer horizontal, conical, inner horizontal and transitional surfaces

Outer edge inner Horizontal and inner edge of Conical

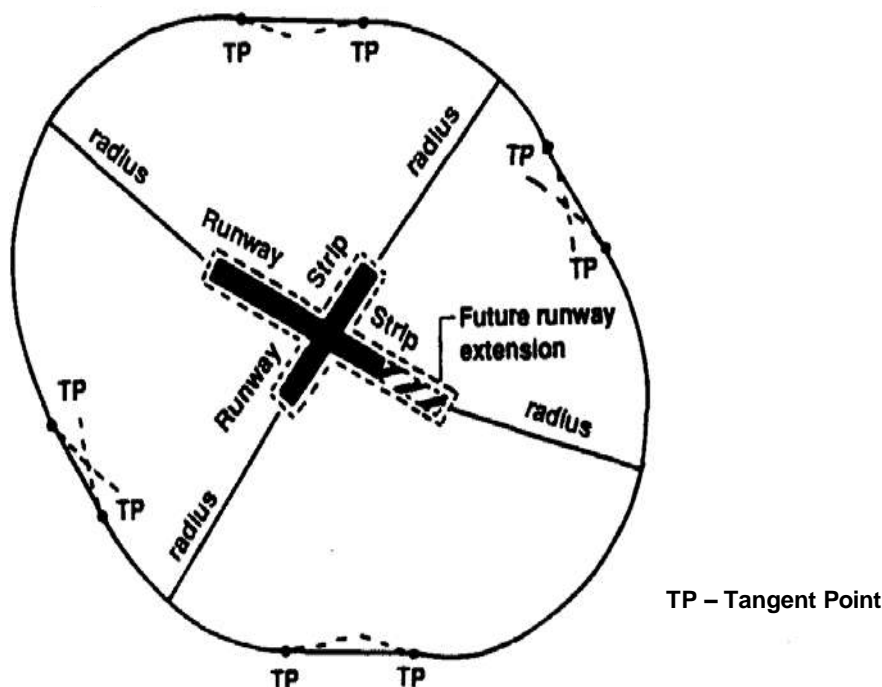


Figure 7.3-2: Boundary of inner horizontal surface

7.3.2.5

Approach Surface. The approach surface is an inclined plane or combination of planes which originate from the inner edge associated with each runway threshold, with two sides originating at the ends of the inner edge.

- The inner edge associated with each runway threshold has a specified length, and is located horizontally and perpendicularly to the runway centerline, at a specified distance before the threshold.
- The two sides diverge uniformly at a specified rate from the extended centerline of the runway.
- The approach surface may be divided into three sections and ends at an outer edge that is located at a specified overall distance from the inner edge and parallel to the inner edge.
- The elevation of the midpoint of the threshold is to be the elevation of the inner edge.
- The slope of each section of the approach surface is at a specified rate and is to be measured in the vertical plane containing the centerline of the runway.
- The above surfaces are to be varied when lateral offset, offset or curved approaches are utilized, specifically two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centerline of the lateral offset, offset or curved ground track.

Note: - See MOS Figure 7.3-3 & 7.3.5.

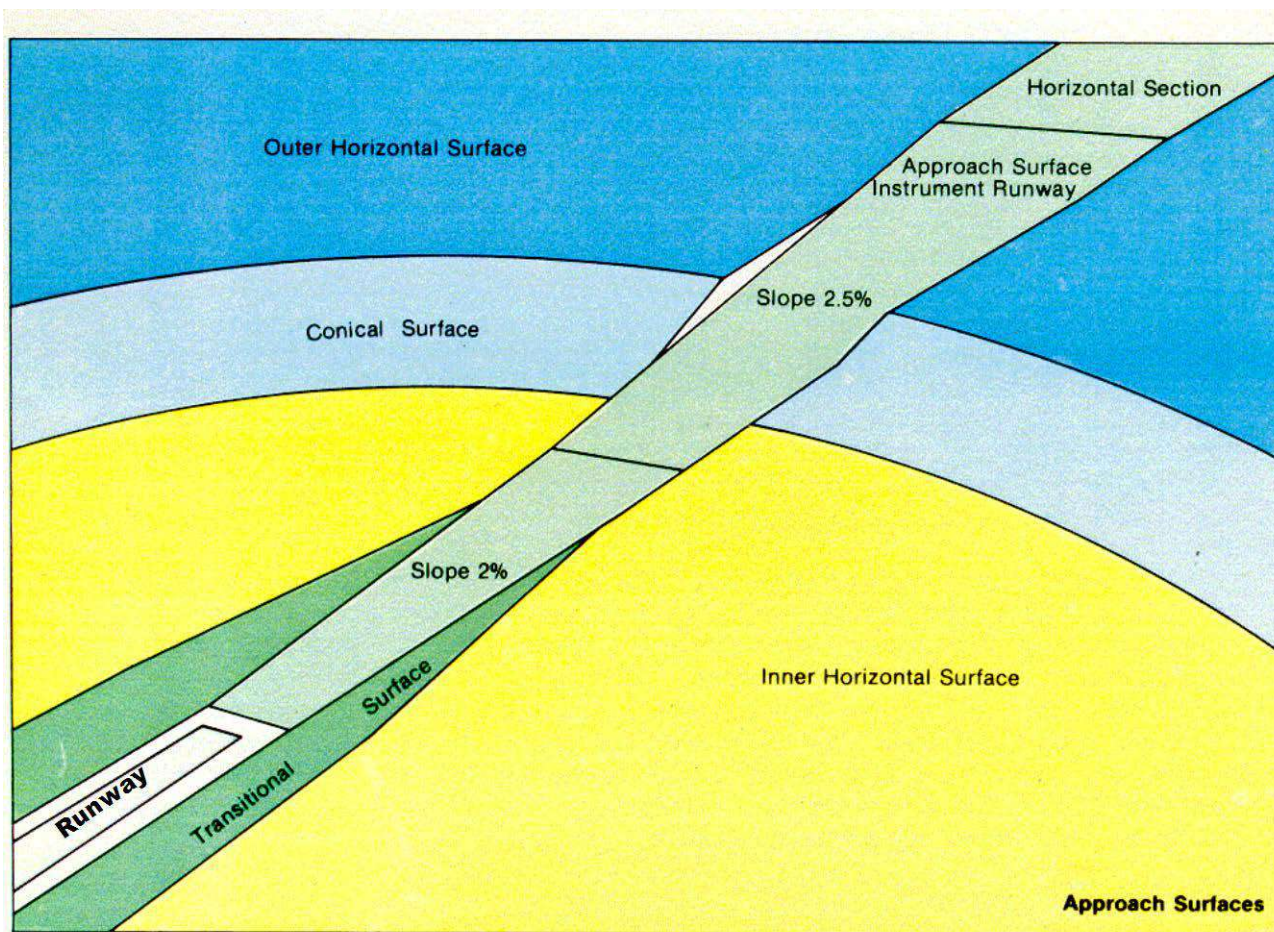


Figure 7.3-3: Approach surface for an instrument approach runway

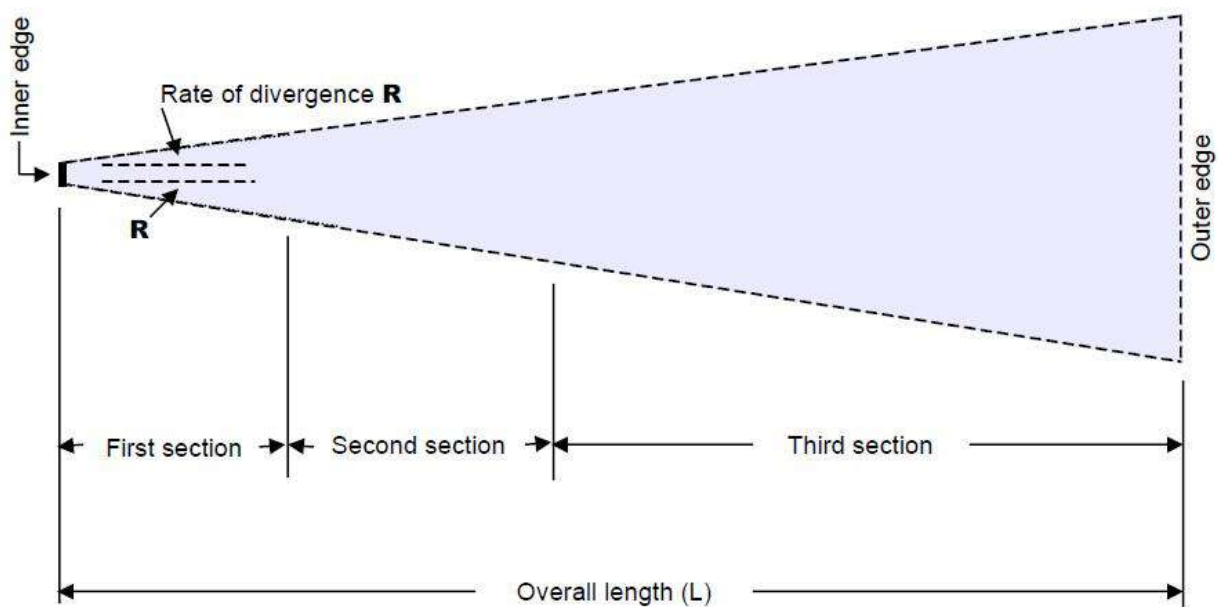


Figure 7.3-4: Plan view of approach surface

7.3.2.6 Transitional Surface. The transitional surface comprises inclined planes that originate at the lower edge from the side of the runway strip (the overall strip), and the side of the approach surface that is below the inner horizontal surface, and finishes where the upper edge is located in the plane of the inner horizontal surface. The transitional surface slopes upwards and outward at a specified rate and is to be measured in a vertical plane at right angles to the centerline of the runway.

- (a) The elevation of a point on the lower edge of the transition surface is to be:
- (i) along the side of the approach surface, equal to the elevation of the approach surface at that point; and
 - (ii) along the side of the runway strip, equal to the nearest point on the centerline of the runway or stopway.

Note: - For the purpose of drawing the transitional surface, the lower edge of the transitional surface along the runway strip may be drawn as a straight line joining the corresponding ends of the approach surfaces at each end of the runway strip. However when assessing whether an object may penetrate the transitional surface, the standard of the transitional surface applies.

7.3.2.7 Obstacle-Free Zone. The inner approach, inner transitional and balked landing surfaces together define a volume of airspace in the immediate vicinity of a precision approach runway, which is known as the obstacle-free zone. This zone must be kept free from fixed objects, other than lightweight frangibly mounted aids to air navigation that must be near the runway to perform their function, and from transient objects such as aircraft and vehicles when the runway is being used for precision approaches.

7.3.2.8 Inner Approach Surface. The inner approach surface is a rectangular portion of the approach surface immediately preceding the threshold.

- (a) The inner approach surface originates from an inner edge of a specified length, at the same location as the inner edge for the approach surface, and extends on two sides parallel to the vertical plane containing the runway centerline, to an outer edge which is located at a specified distance to the inner edge and parallel to the inner edge

7.3.2.9 Inner Transitional Surface. The inner transitional surface is similar to the transitional surface but closer to the runway. The lower edge of this surface originates from the end of the inner approach surface, extending down the side of the inner approach surface to the inner edge of that surface, thence along the runway strip to the inner edge of the balked landing surface and from there up the side of the balked landing surface to the point where the side intersects the inner horizontal surface.

- (a) The elevation of a point on the lower edge is to be:
- (i) along the side of the inner approach and balked landing surface, equal to the elevation of the particular surface at that point;
 - (ii) along the runway strip, equal to the elevation of the nearest point on the centerline of the runway or stopway.

Note: - As a result of (ii) the inner transitional surface along the strip will be curved if the runway profile is curved or a plane if the runway profile is a straight line. The intersection of the inner transitional surface with the inner horizontal surface will also be a curved or straight line depending on the runway profile.

- (b) The inner transitional surface slopes upwards and outwards at a specified rate and is to be measured in a vertical plane at right angles to the centerline of the runway.
- (c) The upper edge of the inner transitional surface is located in the plane of the inner horizontal surface.
- (d) The inner transitional surface shall be used as the controlling surface for navigational aids, aircraft and vehicle holding positions which have to be located near the runway.
- (e) The transitional surface shall be used for building height control.

7.3.2.10

Balked Landing Surface. The balked landing surface is an inclined plane originating at a specified distance after the threshold and extending between the inner transitional surfaces.

- (a) The balked landing surface originates from an inner edge of a specified length, located horizontally and perpendicularly to the centerline of the runway, with two sides from the ends of the inner edge diverging uniformly at a specified rate from the vertical plane containing the centerline of the runway, ending at an outer edge located in the plane of the inner horizontal surface.
- (b) The elevation of the inner edge is to be equal to the elevation of the runway centerline at the location of the inner edge.
- (c) The specified slope of the balked landing surface is to be measured in the vertical plane containing the centerline of the runway.

7.3.2.11

Take-Off Climb Surface. The take-off climb surface is an inclined plane (or other shape in the case of curved take-off) located beyond the end of the runway or clearway.

- (a) The origin of the take-off climb surface is the inner edge of a specified length, located at a specified distance from the end of the runway or the clearway. The plane from the inner edge slopes upward at a specified rate, with the two sides of the plane originating from the ends of the inner edge concurrently diverging uniformly outwards at a specified rate, to a specified final width, and continuing thereafter at that width for the remainder of the specified overall length of the take-off climb surface until it reaches the outer edge which is horizontal and perpendicular to the take-off track.
- (b) The elevation of the inner edge is to be equal to the highest point on the extended runway centerline between the end of the runway and the inner edge, except that when a clearway is provided the elevation is to be equal to the highest point on the ground on the centerline on the clearway.
- (c) The slope of the take-off climb surface is to be measured in the vertical plane containing the centerline of the runway.

- (d) In the case of a take-off flight path involving a turn, the take-off climb surface shall be a complex surface containing the horizontal normals to its centerline, and the slope of the centerline shall be the same as that for a straight take-off flight path.

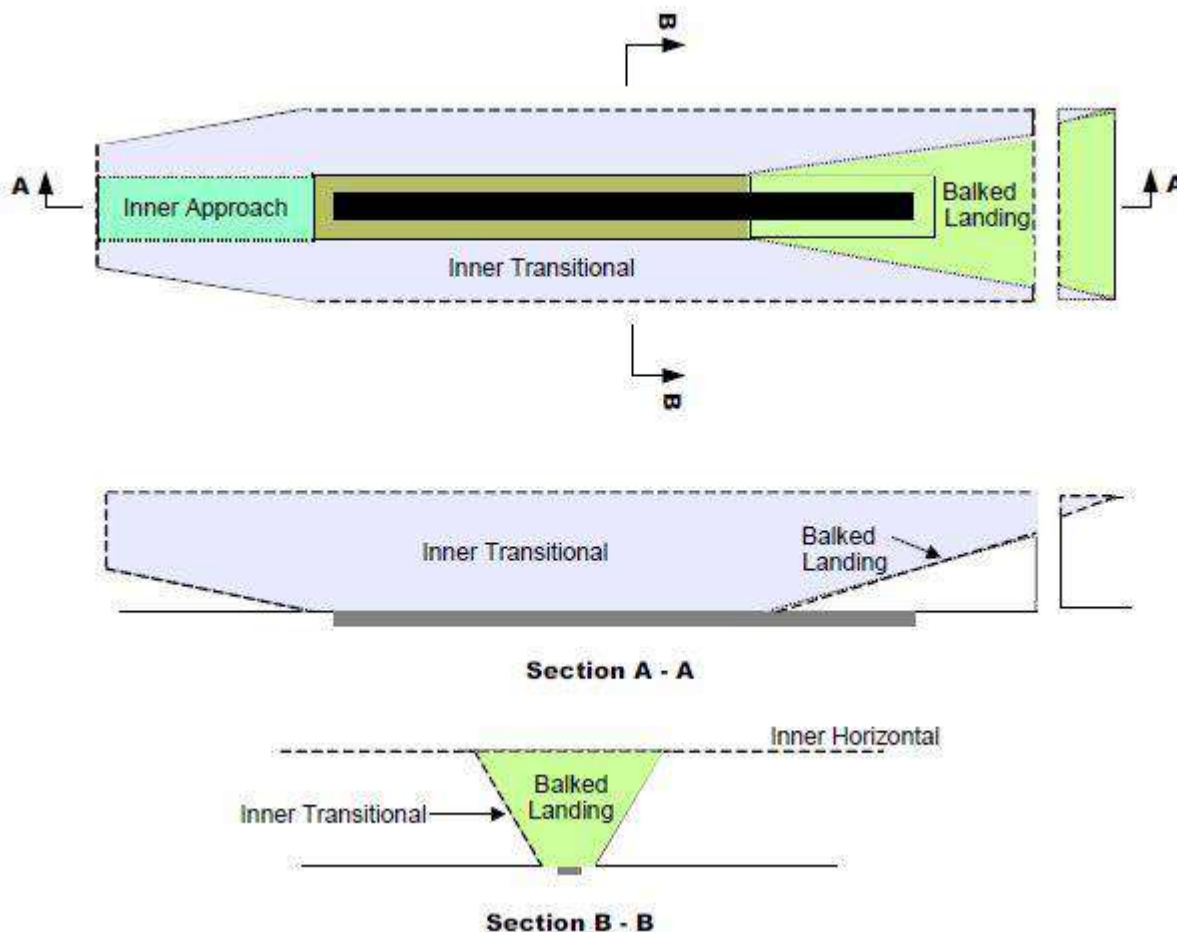


Figure 7.3-5: Inner approach, inner transitional and balked landing obstacle limitation surfaces

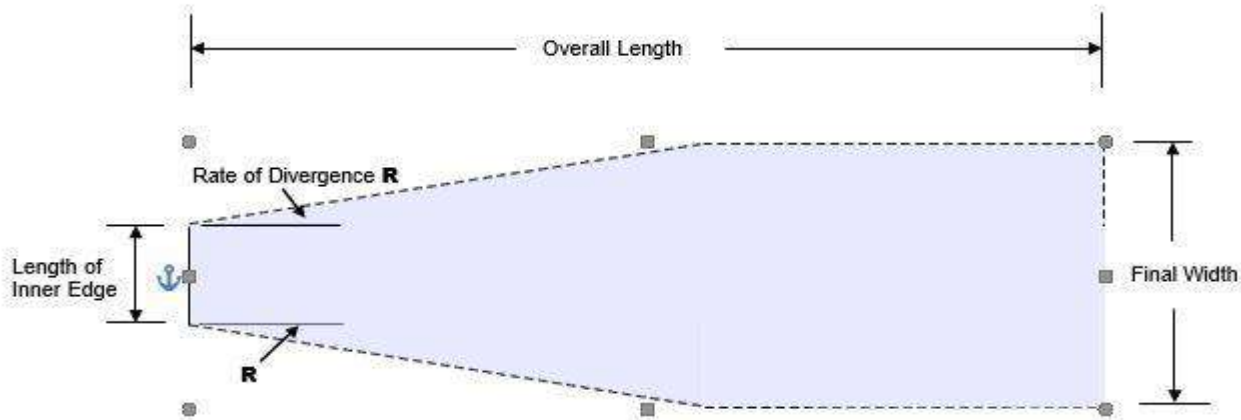


Figure 7.3-6: Plan view of take-off climb surface

Section 7.4 Principles of Shielding

7.4.1 General

- 7.4.1.1 A new obstacle located in the vicinity of an existing obstacle which has been assessed and deemed to be shielded may be considered as not being a hazard to aircraft.
- 7.4.1.2 Unless specifically directed by CAAP, a shielded obstacle does not require removal, lowering, marking or lighting and should not impose any additional restrictions to aircraft operations.
- 7.4.1.3 The CAAP shall assess and determine whether an obstacle is shielded. The aerodrome operator is to notify CAAP of the presence of all obstacles.
- 7.4.1.4 Only existing permanent obstacles may be considered when assessing shielding of new obstacles.

7.4.2 Shielding Principles

- 7.4.2.1 In assessing whether an existing obstacle shields an obstacle, CAAP will be guided by the principles of shielding detailed in MOS Figure 7.4-1.
- 7.4.2.2 **Obstacles penetrating the approach and take-off climb surfaces**
- 7.4.2.3 The highest existing obstacle within the approach and take-off climb area is called the critical obstacle. Where a number of obstacles exist, the critical obstacle is the one which subtends the greatest vertical angle measured from the midpoint of the inner edge of the approach or take-off climb surface being considered.
- 7.4.2.4 As illustrated below, a new obstacle may be assessed as not imposing additional restrictions if:
- (a) when located between the inner edge end and the critical obstacle, the new obstacle is below a plane sloping downwards at 10% from the top of the critical obstacle toward the inner edge; or
 - (b) when located beyond the critical obstacle from the inner edge end, the new obstacle is not higher than the height of the permanent obstacle; and
 - (c) where there is more than one critical obstacle within the approach and take-off climb area, and the new obstacle is located between two critical obstacles, the height of the new obstacle is not above a plane sloping downwards at 10% from the top of the next critical obstacle.
- 7.4.2.5 New objects or extensions of existing objects shall not be permitted above an approach surface within 3 000 m of the inner edge or above a transitional surface except when, the new object or extension would be shielded by an existing immovable object.

Note: - Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

- 7.4.2.6 New objects or extensions of existing objects shall not be permitted above the approach surface beyond 3 000 m from the inner edge, the conical surface or inner horizontal surface except when, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.
- 7.4.2.7 Existing objects above any of the surfaces required by MOS 7.1.3.2 (Non-precision approach runways) shall as far as practicable be removed except when, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.
- Note: - Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.*
- 7.4.2.8 New objects or extensions of existing objects shall not be permitted above a take-off climb surface except when, the new object or extension would be shielded by an existing immovable object.
- Note: - Same Note as 7.4.2.5.*
- 7.4.2.9 Existing objects that extend above a take-off climb surface shall as far as practicable be removed except when, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.
- Note: - Because of transverse slopes on a strip or clearway, in certain cases portions of the inner edge of the take-off climb surface may be below the corresponding elevation of the strip or clearway. It is not intended that the strip or clearway be graded to conform with the inner edge of the take-off climb surface, nor is it intended that terrain or objects which are above the take-off climb surface beyond the end of the strip or clearway, but below the level of the strip or clearway, be removed unless it is considered they may endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.*
- 7.4.2.10 **Obstacles penetrating the inner and outer horizontal and conical surfaces**
- 7.4.2.11 The new obstacle may be accepted if it is in the vicinity of an existing obstacle, and does not penetrate a 10% downward sloping conical shaped surface from the top of the existing obstacle, i.e. the new obstacle is shielded radially by the existing obstacle.

- 7.4.2.12 New objects or extensions of existing objects shall not be permitted above the conical surface or the inner horizontal surface except when, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.
- 7.4.2.13 Existing objects above any of the surfaces required by 7.1.3.2 (Non- instrument runways) shall as far as practicable be removed except when, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.
- Note: - Same Note as 7.2.4.7.*
- 7.4.2.14 In considering proposed construction, account shall be taken of the possible future development of an instrument runway and consequent requirement for more stringent obstacle limitation surfaces.
- 7.4.2.15 **Obstacles Penetrating the Transitional Surfaces.**
- 7.4.2.16 A new obstacle may be assessed as not imposing additional restrictions if it does not exceed the height of an existing obstacle that is closer to the runway strip and the new obstacle is located perpendicularly behind the existing obstacle relative to the runway centerline.
- 7.4.2.17 Fixed objects shall not be permitted above the inner approach surface, the inner *transitional* surface or the balked landing surface, except for frangible objects which because of their function must be located on the strip. Mobile objects shall not be permitted above these surfaces during the use of the runway for landing.
- 7.4.2.18 New objects or extensions of existing objects shall not be permitted above an approach or transitional surface except when, the new object or extension would be shielded by an existing immovable object.
- Note: - Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.*
- 7.4.2.19 Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface shall as far as practicable be removed except when, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.
- Note: - Same Note as 7.4.2.7.*

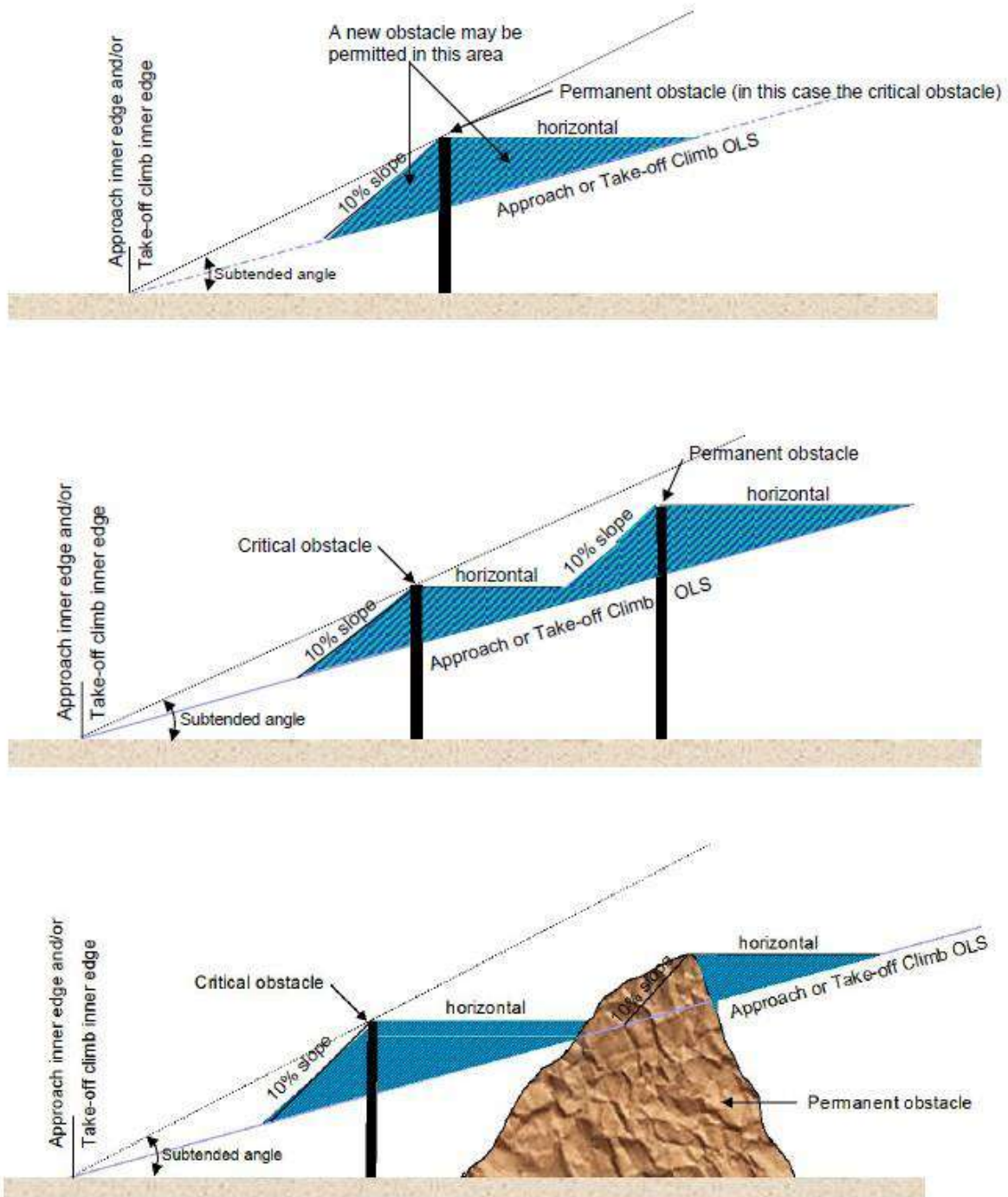


Figure 7.4-1: Shielding of obstacles penetrating the approach and take-off climb surfaces



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CHAPTER 8. Aerodrome visual aids: markers, markings, signals and signs.

Section 8.1 General

8.1.1 Introduction

8.1.1.1 This chapter specifies the standards for markers, markings, signals and signs. Visual aids not conforming to these standards must not be used unless approved in writing by CAAP.

8.1.1.2 Although the specifications given here are in metric measurements, existing visual aids, which were made to Imperial measurements, may continue to be used until replacement is required for other reasons. However, new visual aids must be made and located in accordance with the metric measurements.

8.1.2 Permanently closed aerodrome

8.1.2.1 All markers, markings and signs on a permanently closed aerodrome must be obscured or removed, except for unserviceability markers or markings, where required.

8.1.3 Colors

8.1.3.1 Colors used for ground markings, signs and panels shall conform to MOS 9.2 specifications, or alternatively the Australian Standard AS 2700-1996, entitled "Color Standards for General Purposes" in accordance with the following:

Colour	AS Colour Code	AS Colour Name
Blue	B41	Blue Bell
Green	G35	Lime Green
Orange	X15	Orange
Red	R13	Signal Red
Yellow	Y14	Golden Yellow
White	N14	White
Black	N61	Black

Table 8.1-1: Standard colors

8.1.4 Visibility

8.1.4.1 Markings must be clearly visible against the background upon which they are placed. Where required, on a surface of light color, a contrasting black surround must be provided.

8.1.4.2 Where provided, the width of surround color must ensure an adequate visibility contrast. In the case of line markings, the width of surround on either side of the marking must not be less than half the line width. In the case of block markings, (e.g. threshold markings, runway markings or similar) the width of the surrounding contrast color must be at least 10 centimeters.

- 8.1.4.3 At aerodromes where operations take place at night, pavement markings shall be made with reflective materials designed to enhance the visibility of the markings.

Note: - Guidance on reflective materials is given in the Aerodrome Design Manual (Doc 9157), Part 4.

8.1.5 Non-load-bearing surfaces

- 8.1.5.1 Shoulders for taxiways, runway turn pads, holding bays and aprons and other non-load-bearing surfaces which cannot readily be distinguished from load-bearing surfaces and which, if used by aircraft, might result in damage to the aircraft shall have the boundary between such areas and the load-bearing surface marked by a taxi side stripe marking.

Note: - The marking of runway sides is specified in MOS 8.3.6.

- 8.1.5.2 A taxi side stripe marking shall be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

- 8.1.5.3 A taxi side stripe marking shall consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same color as the taxiway center line marking.

Note: - Guidance on providing additional transverse stripes at an intersection or a small area on the apron is given in the Aerodrome Design Manual (Doc 9157), Part 4.

Section 8.2 Markers

8.2.1 Introduction

- 8.2.1.1 Markers must be lightweight and frangible and may be either cones or gables. Other forms of markers to identify extensive work areas may be used, subject to CAAP agreement. When displayed, they must be secured against movement by wind, propeller blast and jet engine efflux in a manner that does not cause damage to an aircraft.

Note: - 1. Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.

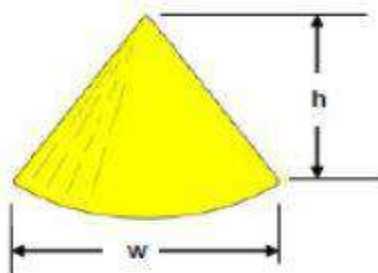
Note: - 2. Guidance on frangibility of markers is given in the Aerodrome Design Manual (Doc 9157), Part 6.

- 8.2.1.2 Cones used as runway markers must have a height of 0.3 m and a base diameter of 0.4 m. All other cone markers must be 0.5 m in height, with a base diameter of 0.75 m. Cone markers must be painted in the following colors:

Marker	Colour
Runway marker	white
Taxiway marker	yellow
Apron edge marker	yellow
Runway strip marker	white
Helicopter apron edge marker	blue
Unserviceability marker	white, with central 25 cm red band
Runway strip marker (displaced threshold.)	split white and suitable background colour

Table 8.2-1 Marker Color

- 8.2.1.3 Boundary / gable markers must be 3 m long, 1.0 m wide, and 0.5 m high. Gable markers are to be white.
- 8.2.1.4 Boundary markers shall be provided at an aerodrome where the landing area has no runway.
- 8.2.1.5 Boundary markers shall be spaced along the boundary of the landing area at intervals of not more than 200 m, if the type shown in MOS Figure 8.2-2 is used, or approximately 90 m, if the conical type is used with a marker at any corner.
- 8.2.1.6 Boundary markers shall be of a form similar to that shown in MOS Figure 8.2- 2, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers shall be colored to contrast with the background against which they will be seen. A single color, orange or red, or two contrasting colors, orange and white or alternatively red and white, shall be used, except where such colors merge with the background.
- 8.2.1.7 Fluorescent orange PVC cones or 'witches' hats' approximately 0.5 m high, may be used to convey visual information about aerodrome works to the works organization. Witches hats must not be used to convey information to pilots about changes to the movement area. For marking any part of a movement area standard cones must be used.



Taxiway and Apron Edge Marker
(Yellow)



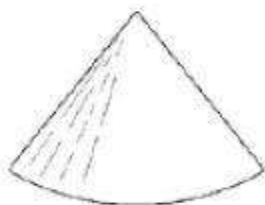
Unserviceable Marker
(White and Red)



Runway Strip Marker
(Displaced Threshold)
(Split White and Background
Color)



Helicopter Apron Edge Marker
(Blue)



Runway Strip Marker
(White)



Work Limits Marker
(Orange)
 $h = 0.50\text{m}$
 $w = 0.75\text{m}$ (Cones Only)

For cones used as runway edge markers $h = 0.3\text{m}$, $w = 0.4\text{m}$

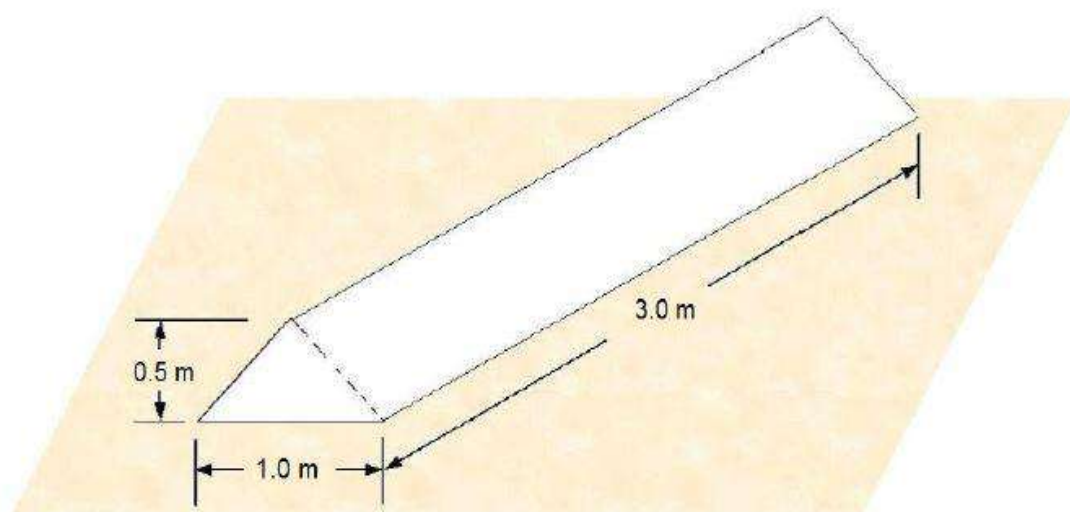


Figure 8.2-2: Gable marker

8.2.1.8 **Stopway edge markers.** Stopway edge markers shall be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

8.2.1.9 The stopway edge markers shall be sufficiently different from any runway edge markers used to ensure that the two types of markers cannot be confused.

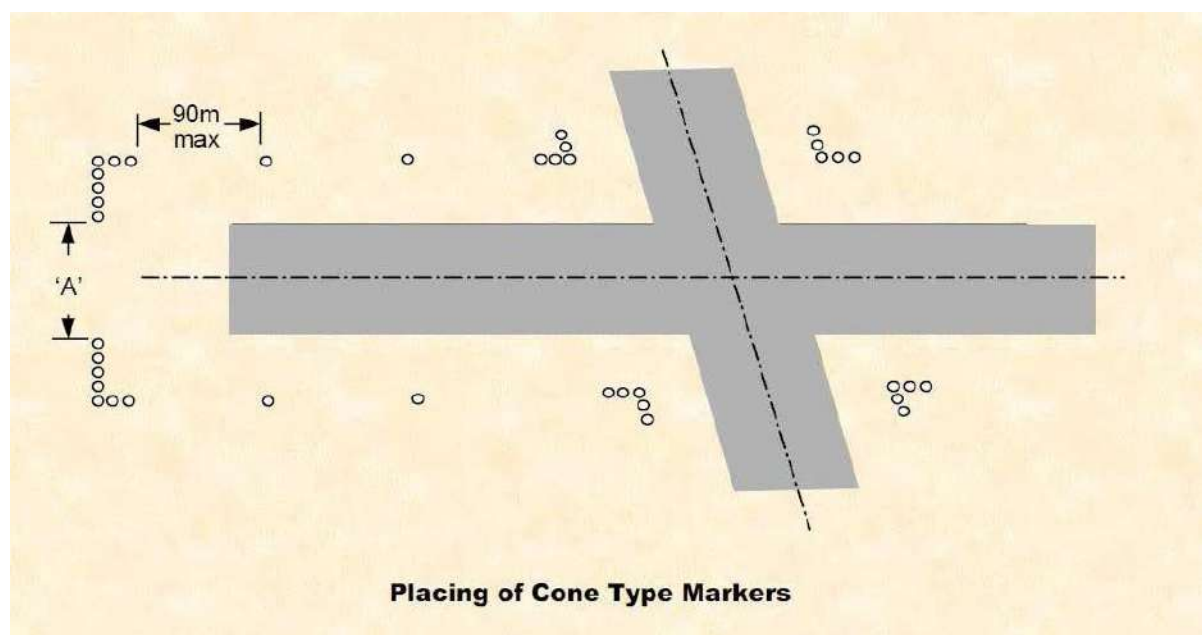
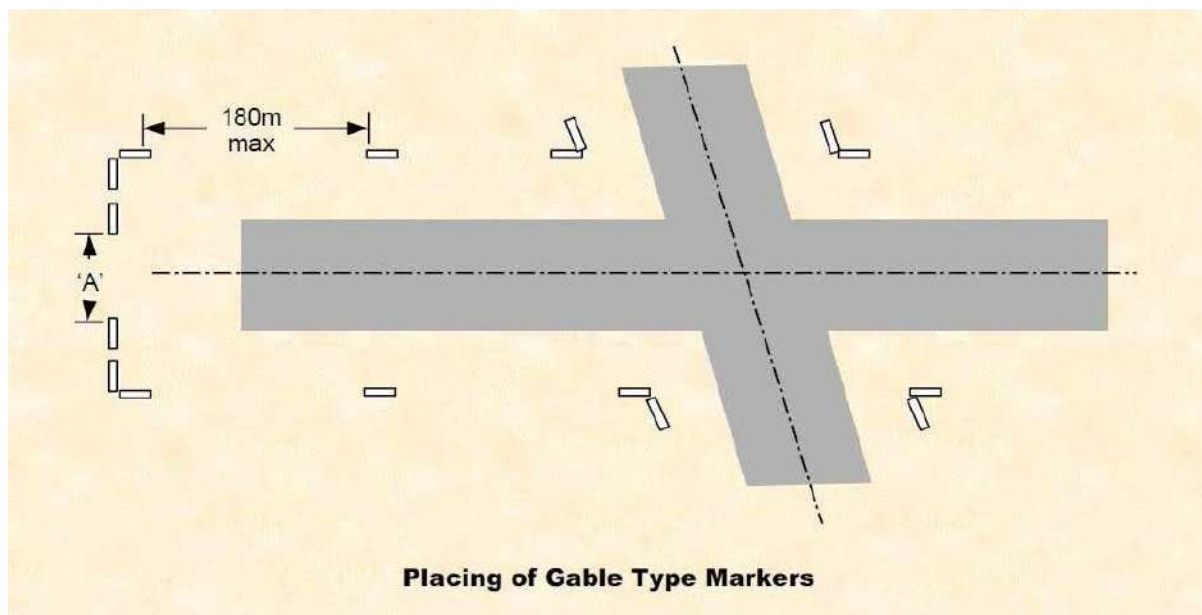
Note: - Markers consisting of small vertical boards camouflaged on the reverse side, as viewed from the runway, have proved operationally acceptable.

8.2.2 The use of markers on a runway strip

8.2.2.1 Where the limits of the graded portion of a runway strip need to be defined, runway strip markers must be placed along the edges of the graded portion of the runway strip.

8.2.2.2 Runway strip markers must be white, and may be gable, cone or flush. Gable markers are preferred, and flush markers must only be used where runway strips overlap. The spacing of gable or cone runway strip markers must not exceed 180 m or 90 m respectively, as shown below.

8.2.2.3 With prior approval by CAAP, 200 liter (44 gallon) steel drums or tires may be used as runway strip markers at aerodromes used by aeroplanes with less than 10 passenger seats (See Chapter 13), provided that steel drums be cut in half along their length and placed on the ground open side down. Drum and tire runway strip markers must be painted white. The use of these markers is not approved for a certificated aerodrome.

**Figure 8.2-3: Runway strip markers**

Width of graded strip	Dimension 'A'
30 m	10 m minimum
45 m	20 m minimum
60 m	20 m minimum
90 m	30 m minimum
150 m	60 m minimum

8.2.3 The use of markers on an unsealed runway

- 8.2.3.1 On unsealed runways, runway markers must be provided along both sides of the runway where there is a lack of contrast between the runway and runway strip, and the whole of the runway strip is not maintained to normal runway grading standards. The longitudinal spacing of runway markers must not exceed 90 m.
- 8.2.3.2 Runway markers may be replaced by runway strip markers if the whole of the runway strip is maintained to normal runway grading standard. The thresholds must be marked either by normal threshold markings or runway cone markers in a pattern similar to that prescribed for runway strip ends.
- 8.2.3.3 Where an unsealed runway has a permanently displaced threshold at one end, two sets of strip markers must be provided at that end. Each set must be bi-colored. The set associated with the permanently displaced threshold is to be painted so that the half facing the direction of approach (the first direction) appears white. The other half must be painted to match the background, and be inconspicuous to a pilot operating in the other direction (the second direction). Markers associated with the runway strip end are to appear white in the second direction and inconspicuous in the first direction.
- 8.2.3.4 The bi-colored end markers associated with the displaced threshold must be cones. Those associated with the runway strip end may be cones or gables.
- 8.2.3.5 Markers shall be provided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.
- 8.2.3.6 Where runway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape should be placed so as to delimit the runway clearly.
- 8.2.3.7 The flat rectangular markers shall have a minimum size of 1 m by 3 m and shall be placed with their long dimension parallel to the runway centerline. The conical markers shall have a height not exceeding 50 cm.

8.2.4 Unpaved taxiway markers

- 8.2.4.1 Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers shall be provided.
- 8.2.4.2 Where taxiway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of conical shape shall be placed so as to delimit the taxiway clearly.

8.2.5 The use of markers on an unsealed apron

- 8.2.5.1 Where the edges of unpaved aprons might not be visually clear to pilots, apron edge markers must be provided.
- 8.2.5.2 Where provided, the apron edge markers must be yellow cones and must be spaced to enable pilots to clearly delineate the edge of the unsealed apron area.

Section 8.3 Runway Markings

8.3.1 General

- 8.3.1.1 Runway markings must be white on all concrete, asphalt or sealed runway surfaces. Pre-runway-end markings must be yellow.

Note: - 1. It has been found that, on runway surfaces of light color, the conspicuity of white markings can be improved by outlining them in black.

Note: - 2. It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practicable by the use of a suitable kind of paint.

Note: - 3. Markings may consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.

- 8.3.1.2 At runway intersections, markings of the more important runway must take precedence over, or interrupt the markings of, the other runway. At an intersection with a taxiway, the runway markings, except for runway side strip markings, must interrupt the taxiway markings.

Note: - See MOS 8.4.2.3 regarding the manner of connecting runway and taxiway centerline markings.

- 8.3.1.3 To reduce the risk of uneven braking action, care must be taken that markings produce a non-skid surface of similar coefficient of friction to the surrounding surface.

- 8.3.1.4 The order of importance of runways for the display of runway markings shall be as follows:

- (a) 1st - precision approach runway;
- (b) 2nd - non-precision approach runway; and
- (c) 3rd - non-instrument runway.

8.3.2 Pre-runway end markings

- 8.3.2.1 Pre-runway end markings are used where an area exceeding 60 m in length before the runway end has a sealed, concrete or asphalt surface which is not suitable for normal aircraft usage.

- 8.3.2.2 Marking must consist of yellow chevrons, spaced 30 m apart, comprising lines 0.9 m wide and angled 45° to the runway centerline. The markings must terminate at the runway end marking.

- 8.3.2.3 This area will not normally be used for landing or take-off. If declared as a stopway, an aircraft stopping on the runway due to an abandoned take-off from the other direction only may use the area. Use of such areas for inclusion in accelerate-stop declared distances can cause confusion for pilots and operators, and may be declared only if the stopway can be included in an area of runway strip and with prior approval of CAAP.

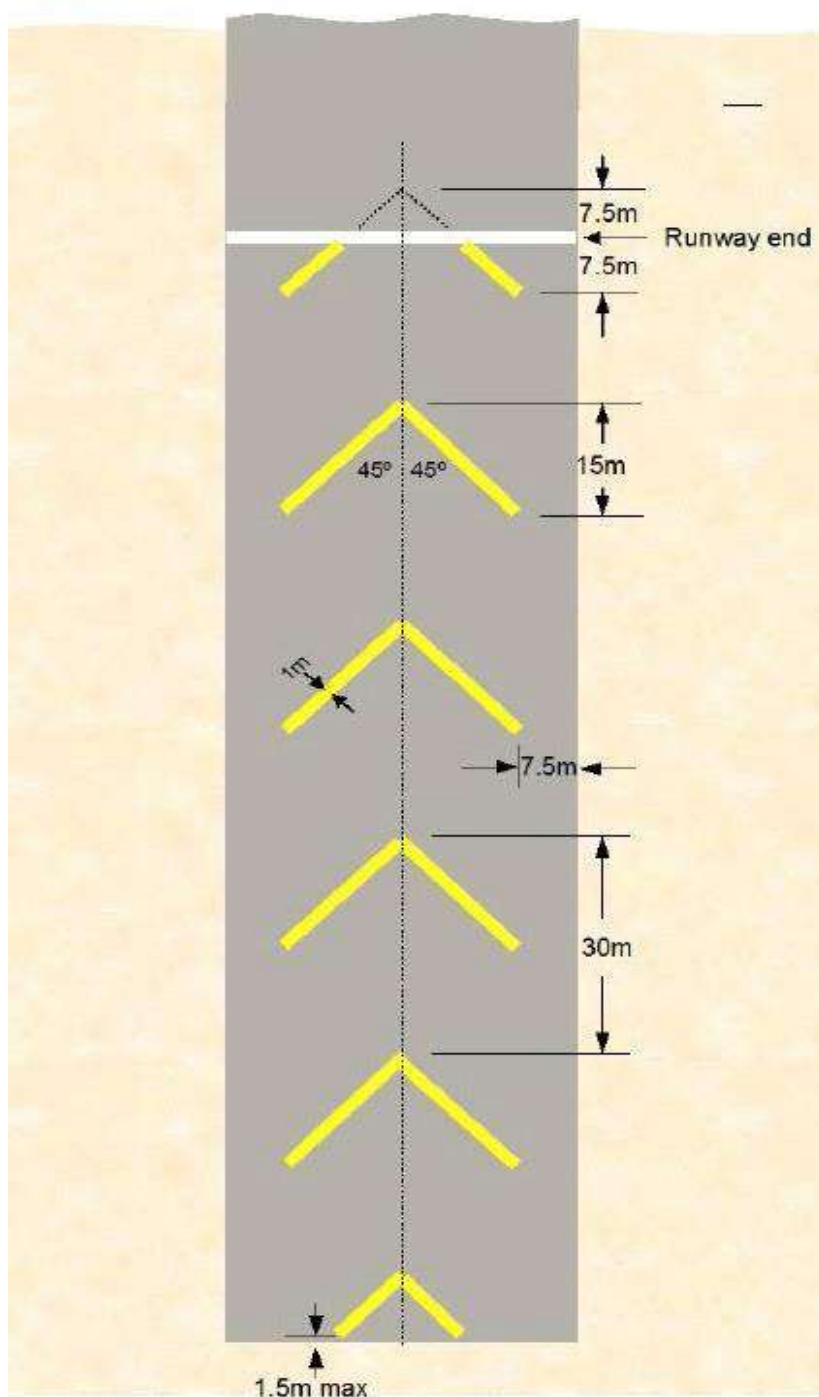


Fig 8.2-1 Runway pre-end markings

8.3.3

Runway centerline markings

8.3.3.1

Runway centerline markings must be provided on all sealed, concrete or asphalt runways, to provide directional guidance during landing or take-off. Runway centerline marking may be omitted in the case of 18 m wide runways where side stripe markings are provided.

- 8.3.3.2 A runway centerline marking shall be located along the centerline of the runway between the runway designation markings as shown in MOS Figure 8.3-2, except when interrupted in compliance with MOS 8.3.1.2.
- 8.3.3.3 Runway centerline marking must consist of a line of uniformly spaced gaps and white stripes as shown in Figure 8.3-2 below. The combined length of a stripe and a gap (G) must be not less than 50 m and not more than 75 m. The length of each stripe must be at least equal to the length of each gap, or 30 m, whichever is greater. The first stripe is to commence 12 m from the runway designation number as shown below.
- 8.3.3.4 The width (W) of the runway centerline marking must be:
- (a) 0.3 m on all non-instrument runways, and instrument non-precision approach runways where the code number is 1 or 2;
 - (b) 0.45 m on
 - (i) instrument non-precision approach runways where the code number is 3 or 4; and
 - (ii) Category I precision approach runways; and
 - (c) 0.9 m on category II and category III precision approach runways.

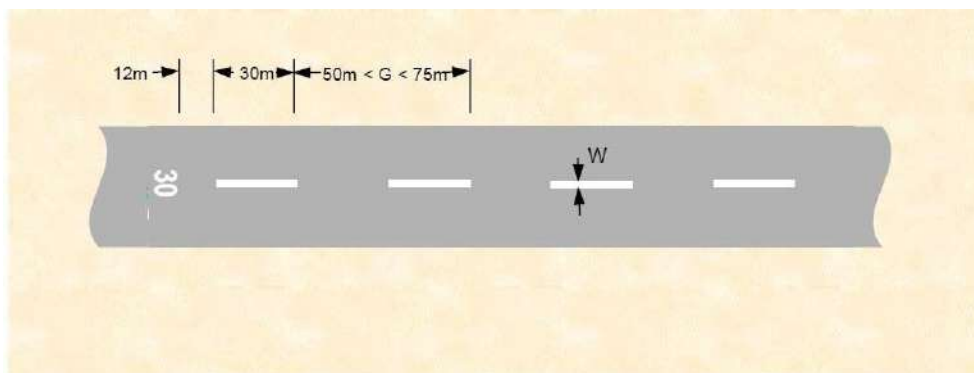


Figure 8.3-2: Runway centerline markings

8.3.4 Runway designation markings

- 8.3.4.1 Runway designation markings must be provided at the thresholds of all sealed, concrete or asphalt runways, and as far as practicable, at the thresholds of an unpaved runway.
- 8.3.4.2 A runway designation marking shall consist of a two-digit number and on parallel runways shall be supplemented with a letter. On a single runway, dual parallel runways and triple parallel runways the two-digit number shall be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach. On four or more parallel runways, one set of adjacent runways shall be numbered to the nearest one-tenth magnetic azimuth and the other set of adjacent runways numbered to the next nearest one-tenth of the magnetic azimuth. When the above rule would give a single digit number, it shall be preceded by a zero.

- 8.3.4.3 In the case of parallel runways, each runway designation number shall be supplemented by a letter as follows, in the order shown from left to right when viewed from the direction of approach:
- for two parallel runways: "L" "R";
 - for three parallel runways: "L" "C" "R";
 - for four parallel runways: "L" "R" "L" "R";
 - for five parallel runways: "L" "C" "R" "L" "R" or "L" "R" "L" "C" "R"; and
 - for six parallel runways: "L" "C" "R" "L" "C" "R".
- 8.3.4.4 The numbers and letters shall be in the form and proportion shown in MOS Figure 8.3-8. The dimensions shall be not less than those shown in MOS Figure 8.3-8, but where the numbers are incorporated in the threshold marking, larger dimensions shall be used in order to fill adequately the gap between the stripes of the threshold marking.
- 8.3.4.5 The number selected for a runway designation marking must be acceptable to CAAP. When two or more runway ends have designations which may be confusing, either on the same or a nearby aerodrome, CAAP will determine the designations to be used. Runway designation numbers 13/31 are not to be used

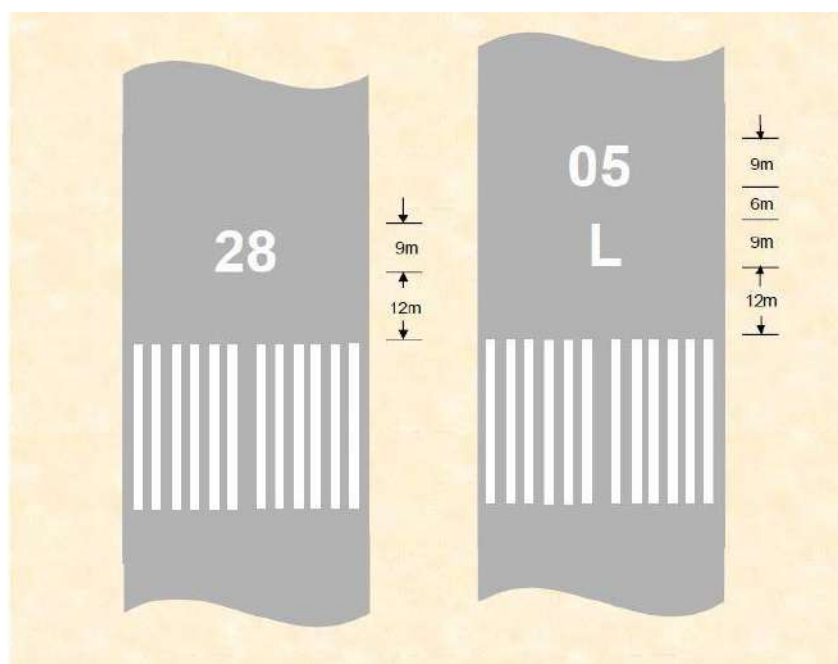


Figure 8.3-3: Runway designation markings

- 8.3.4.6 The shape and dimensions of the numbers and letters to be used as runway designation markings are shown in MOS Figure 8.3-3. The location of the marking on the runway is also shown. The dimensions shall be not less than those shown in MOS Figure 8.3-4, but where the numbers are incorporated in the threshold marking, larger dimensions shall be used in order to fill adequately the gap between the stripes of the threshold marking.

Note: - If the runway threshold is displaced from the extremity of the runway, a sign showing the designation of the runway may be provided for aeroplanes taking off.

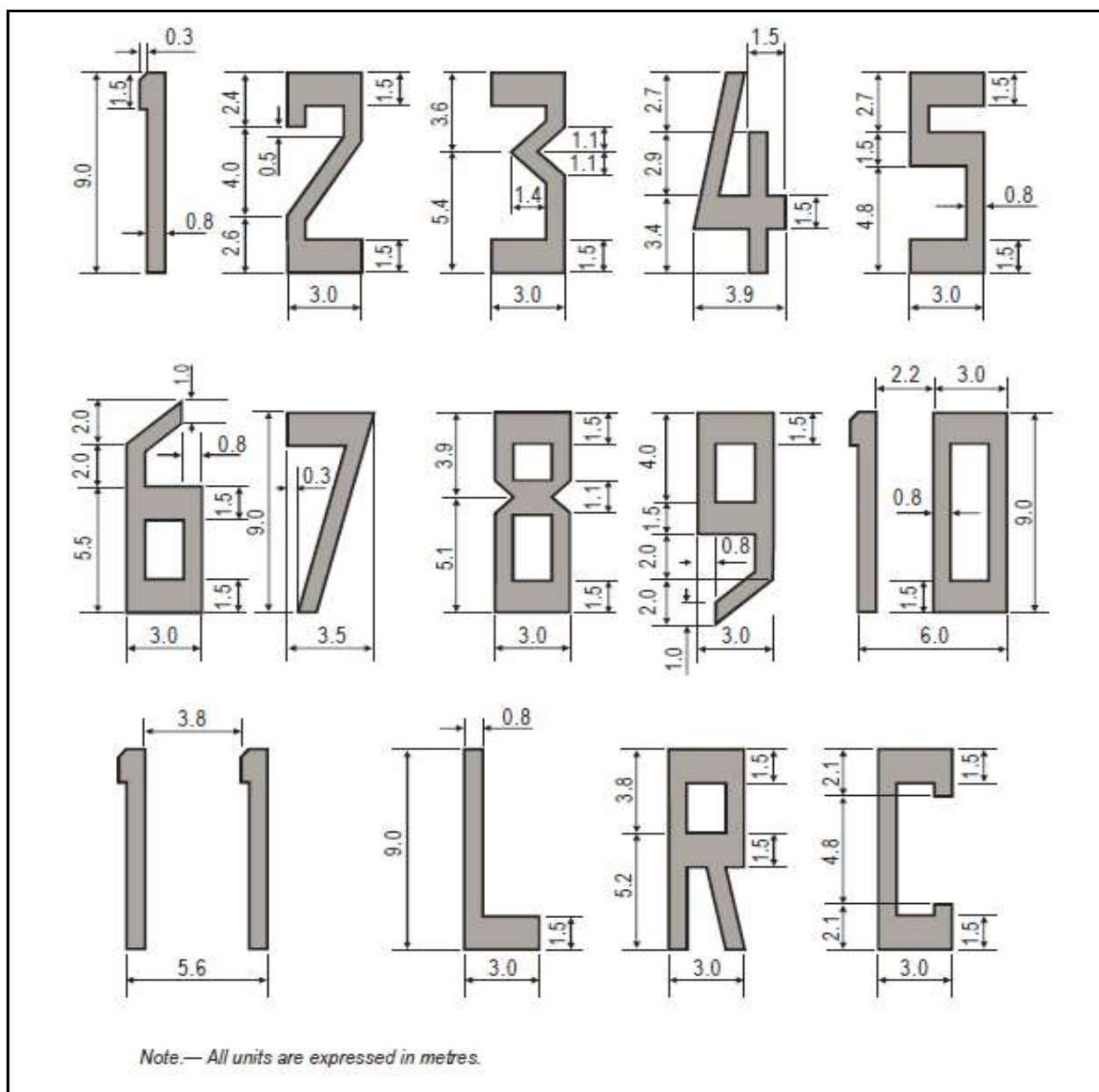


Figure 8.3-4: Shape and dimensions of runway numbers and letters

8.3.5

Runway transverse stripe

8.3.5.1

A runway transverse stripe markings must be provided on sealed, concrete or asphalt paved runways if directed by CAAP. The marking is a white line, 1.8 m wide, extending the full width of the runway. Where provided at the end of a runway, the outer edge of runway end marking will coincide with the edge of the runway full strength pavement. Where provided in conjunction with a permanently displaced threshold, the outer edge of the runway end marking shall be located at least 60 meters from the origin of the relevant approach surface.

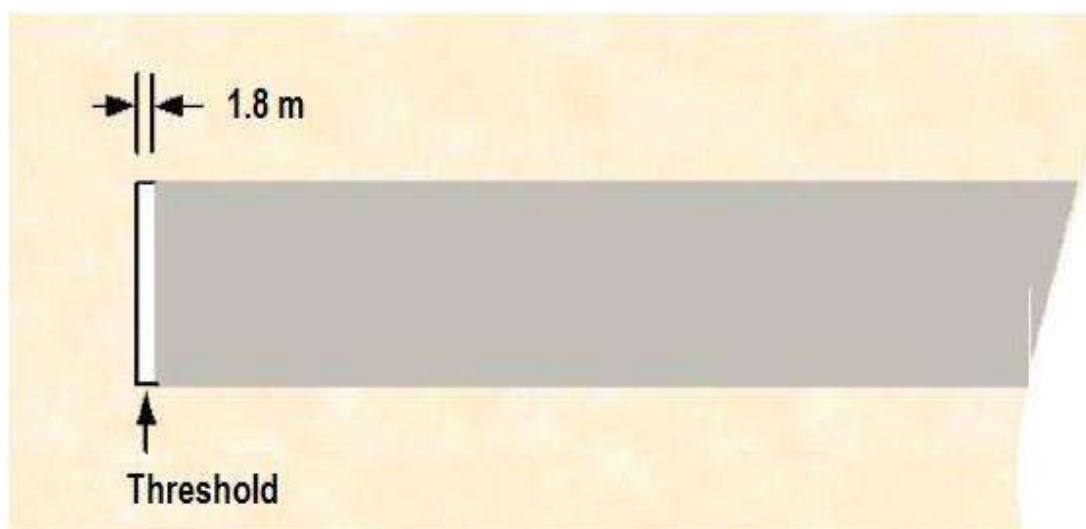


Figure 8.3-5: Runway transverse stripe marking

8.3.6 Runway side-stripe markings

- 8.3.6.1 Runway side-stripe markings must be provided at the edge of all sealed, concrete or asphalt runways to delineate the width of the runway. Except where broken for taxiways and other runways, runway side-stripe markings shall consist of one continuous white line.
- 8.3.6.2 The width of each runway side-stripe marking shall be 0.3 m, except for:
- (a) non precision approach runways where the code letter is 3 or 4, and all precision approach category I runways, where the width shall be 0.45 m; and,
 - (b) precision approach category II or III runways where the width shall be 0.9m
- 8.3.6.3 A runway side stripe shall have an overall width of at least 0.9 m on runways 30 m or more in width and at least 0.45 m on narrower runways.
- 8.3.6.4 The distance between outer edges of the side-stripes must be equal to the width of the runway. The side-stripes must be parallel to the runway centerline and extend along the full length of the runway that is available for aircraft take-off or landing maneuvers, excluding taxiing, except that the side-stripe markings must not extend across intersecting runways or taxiways.
- 8.3.6.5 For a runway without sealed shoulders, the side-stripe markings may be omitted if there is distinct contrast between the runway edges and the surrounding terrain.
- 8.3.6.6 The runway side-stripe marking shall be used to mark the edges of a runway turning node.
- 8.3.6.7 A runway side stripe marking shall be provided between the thresholds of a paved runway where there is a lack of contrast between the runway edges and the shoulders or the surrounding terrain.

- 8.3.6.8 A runway side stripe marking shall be provided on a precision approach runway irrespective of the contrast between the runway edges and the shoulders or the surrounding terrain.
- 8.3.6.9 A runway side stripe marking shall consist of two stripes, one placed along each edge of the runway with the outer edge of each stripe approximately on the edge of the runway, except that, where the runway is greater than 60 m in width, the stripes shall be located 30 m from the runway center line.
- 8.3.6.10 Where a runway turn pad is provided, the runway side stripe marking shall be continued between the runway and the runway turn pad.

8.3.7 Runway aiming point markings

- 8.3.7.1 An aiming point marking shall be provided at each approach end of a paved instrument runway where the code number is 2, 3 or 4.
- 8.3.7.2 An aiming point marking shall be provided at each approach end of:
- (a) a paved non-instrument runway where the code number is 3 or 4;
 - (b) a paved instrument runway where the code number is 1;
- when additional conspicuity of the aiming point is desirable.
- 8.3.7.3 An aiming point marking shall commence no closer to the threshold than the distance indicated in MOS Table 8.3-1, except that on a runway equipped with a visual approach slope indicator system the beginning of the marking shall be coincident with the visual approach slope origin.
- Note: - For the purpose of locating a marking, the origin of the visual approach slope may be considered to be aligned with the wing bar lights of a T-VASIS or PAPI installation.*
- 8.3.7.4 An aiming point marking shall consist of two stripes painted white. The dimensions and lateral spacing shall be as indicated in MOS Table 8.3-1. Where touchdown zone marking is provided the lateral spacing between aiming point and touchdown zone markings shall be equal.

Location and dimensions	Landing distance available			
	Less than 800 meters	800 m up to but not including 1200 m	1200 m up to but not including 2400 m	2400 m or more
Distance from threshold to beginning of marking	150 m	250 m	300 m	400 m
Length of stripe ^a	30 – 45 m	30 – 45 m	45 – 60 m	45 – 60 m
Width of stripe	4 m	6 m	6 – 10 m ^b	6 – 10 m ^b
Lateral spacing between inner sides of stripes	6m ^c	9m ^c	18 – 22.5 m	18–22.5 m
<p>a The greater dimensions of the specified ranges are to be used when increased conspicuity is required.</p> <p>b The lateral spacing may be varied within these limits to minimize the contamination by rubber deposits.</p> <p>c These figures are deduced in reference to the outer main gear span.</p>				

Table 8.3-1: Location and dimensions of aiming point marking**8.3.8 Runway touchdown zone markings**

- 8.3.8.1 Runway touchdown zone markings shall be provided at approach ends of all sealed, concrete or asphalt runways 30 m wide or greater, and in the touchdown zone of a paved precision approach runway where the code number is 2, 3 or 4.
- 8.3.8.2 A touchdown zone marking shall be provided in the touchdown zone of a paved non-precision approach or non-instrument runway where the code number is 3 or 4 and additional conspicuity of the touchdown zone is desirable.
- 8.3.8.3 Runway touchdown zone markings are comprised of pairs of white rectangular markings displayed equally about the runway centerline with the number of pairs related to the landing distance available, and where the marking is to be displayed at both the approach directions of a runway, the distance between the thresholds, as described in Table 8.3-2.

Landing distance available or distance between thresholds	Pairs of markings
Less than 900 m	1
900 m up to but not including 1200m	2
1200 m up to but not including 1500 m	3
1500 m up to but not including 2400 m	4
2400 m or more	6

Table 8.3-2 Touchdown zone marking spaces

- 8.3.8.4 A touchdown zone marking shall conform to pattern A shown in MOS Figure 8.3-7. The installation of a marking conforming to pattern B is not to proceed without prior approval from CAAP.
- 8.3.8.5 For pattern A markings the individual rectangular markings shall be not less than 22.5 m long and 3 m wide. For the pattern B markings, each stripe of each marking shall be not less than 22.5 m long and 1.8 m wide with a spacing of 1.5 m between adjacent stripes. The lateral spacing between the inner sides of the rectangles shall be equal to that of the aiming point marking where provided. If an aiming point marking is not provided, the lateral spacing between the inner sides of the rectangles shall correspond to the lateral spacing specified for an aiming point marking in MOS Table 8.3-1.
- 8.3.8.6 The pairs of markings shall be provided at a longitudinal spacing of 150 meters beginning from the threshold except that pairs of markings coincident with, or falling within 50 meters of, an aiming point marking shall be omitted.
- 8.3.8.7 On a non-precision approach runway where the code number is 2, an additional pair of touchdown zone marking stripes shall be provided 150 m beyond the beginning of the aiming point marking.

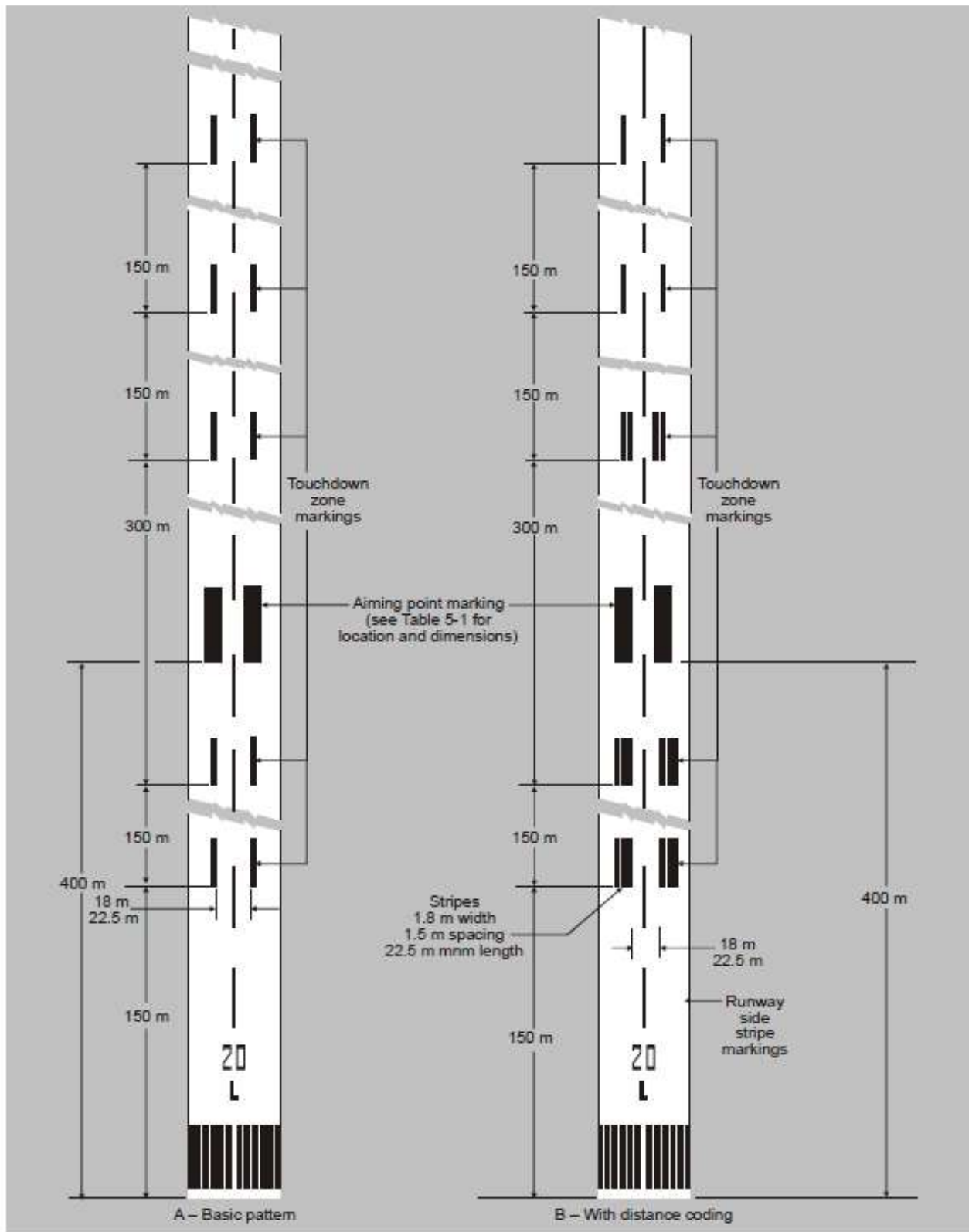


Figure 8.3-7: Runway fixed distance and touchdown zone markings

8.3.9 Runway threshold markings

8.3.9.1 A threshold marking shall be provided at the threshold of a paved instrument runway, and of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by international commercial air transport.

8.3.9.2 A threshold marking shall be provided at the threshold of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by other than international commercial air transport.

8.3.9.3 A threshold marking shall be provided, so far as practicable, at the thresholds of an unpaved runway.

Note: - The Aerodrome Design Manual (Doc 9157), Part 4, shows a form of marking which has been found satisfactory for the marking of downward slopes immediately before the threshold.

8.3.9.4 The stripes of the threshold marking shall commence 6 m from the threshold.

8.3.9.5 A runway threshold marking shall consist of a pattern of longitudinal stripes of uniform dimensions disposed symmetrically about the centerline of a runway as shown in MOS Figure 8.3-8(A) and (B) for a runway width of 45 m. The number of stripes shall be in accordance with the runway width as follows:

Runway width (meters)	Number of Stripes	Width of Stripe and Space (a) (meters)
15,18	4	1.5
23	6	1.5
30	8	1.5
45	12	1.7
60	16	1.7

except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in MOS Figure 8.3-8 (C).

8.3.9.6 The stripes shall extend laterally to within 3 m of the edge of a runway or to a distance of 27 m on either side of a runway centerline, whichever results in the smaller lateral distance. Where a runway designation marking is placed within a threshold marking there shall be a minimum of three stripes on each side of the centerline of the runway. Where a runway designation marking is placed above a threshold marking, the stripes shall be continued across the runway. The stripes shall be at least 30 m long and approximately 1.80 m wide with spacings of approximately 1.80 m between them except that, where the stripes are continued across a runway, a double spacing shall be used to separate the two stripes nearest the centerline of the runway, and in the case where the designation marking is included within the threshold marking this spacing shall be 22.5 m.

8.3.9.7 Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centerline, a transverse stripe as shown in MOS Figure 8.3-9 (B) shall be added to the threshold marking.

- 8.3.9.8 The permanent, or permanently displaced, threshold must be indicated by white 'piano key' markings, consisting of adjacent, uniformly spaced, 30 m long stripes of specified width as shown in MOS Figure 8.3-8.
- 8.3.9.9 Where practicable, this marking must also be used to indicate permanent or permanently displaced thresholds at gravel and natural surface runways.
- 8.3.9.10 Where the normal threshold marking is not practicable, runway markers may be used to delineate the ends of an unsealed runway.
- 8.3.9.11 Information on the location of thresholds is provided in MOS 6.

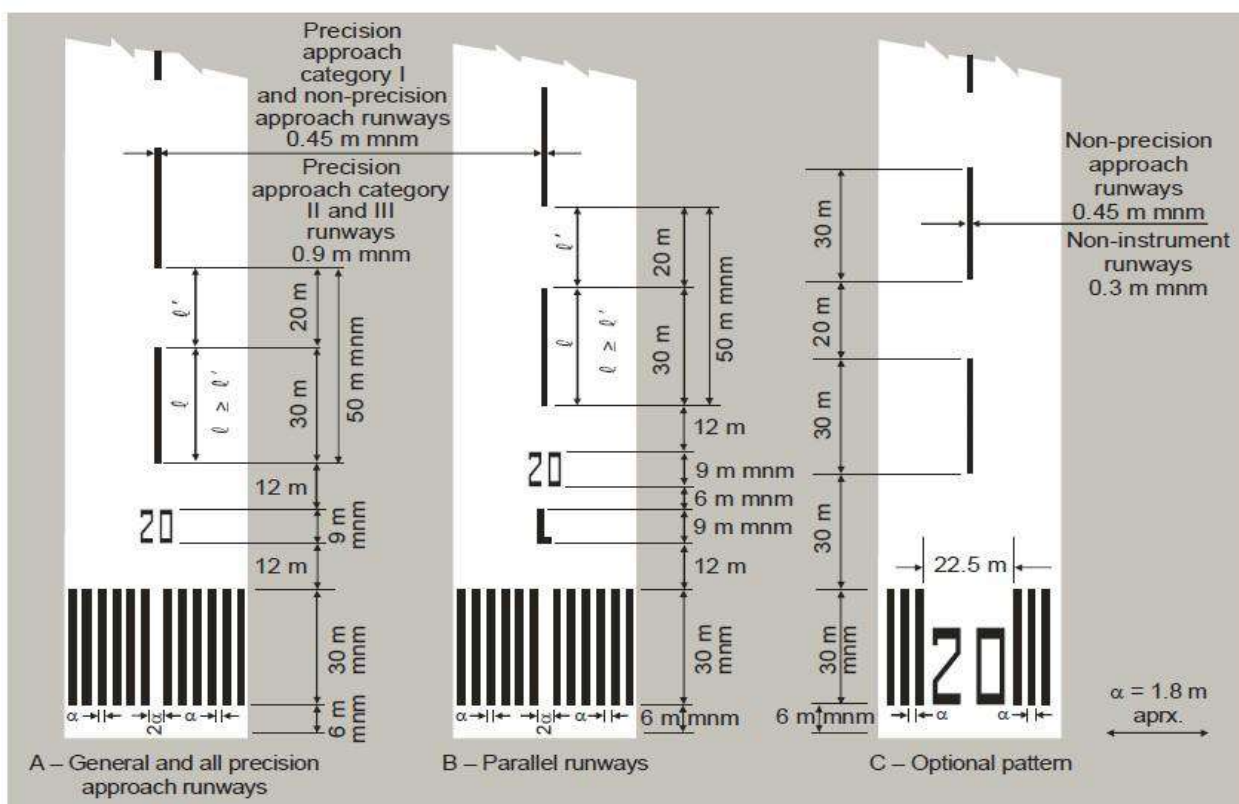


Figure 8.3-8: Runway designation, centerline and threshold markings

8.3.10 Runway end markings

- 8.3.10.1 If required by CAAP a runway end marking must be provided on sealed, concrete or asphalt runways. The end marking is treated as a component of the threshold marking. The marking is a transverse white stripe, 1.8 m wide, extending the full width of the runway.
- 8.3.10.2 The runway end marking is required at a temporarily or permanently displaced threshold.
- 8.3.10.3 Where the threshold is displaced for periods in excess of 30 days, but not permanently, the width of the runway end marking stripe may be reduced to 1.2 meters.

8.3.11 Runway turn pad marking

8.3.11.1 Where a runway turn pad is provided, a runway turn pad marking shall:

- (a) be provided for continuous guidance to enable an aeroplane to complete a 180-degree turn and align with the runway centerline.
- (b) be curved from the runway centerline into the turn pad. The radius of the curve shall be compatible with the maneuvering capability and normal taxiing speeds of the aeroplanes for which the runway turn pad is intended. The intersection angle of the runway turn pad marking with the runway centerline shall not be greater than 30°.
- (c) be extended parallel to the runway centerline marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.
- (d) guide the aeroplane in such a way as to allow a straight portion of taxiing before the point where a 180-degree turn is to be made. The straight portion of the runway turn pad marking shall be parallel to the outer edge of the runway turn pad.
- (e) be at least 15 cm in width and continuous in length.

8.3.11.2 The design of the curve allowing the aeroplane to negotiate a 180-degree turn shall be based on a nose wheel steering angle not exceeding 45°.

8.3.11.3 The design of the turn pad marking shall be such that, when the cockpit of the aeroplane remains over the runway turn pad marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the runway turn pad shall be not less than those specified in MOS 6.2.5.5.

Note: - For ease of maneuvering, consideration may be given to providing a larger wheel-to-edge clearance for codes E and F aeroplanes. See MOS 6.2.5.6.

8.3.12 Temporarily displaced threshold markings

8.3.12.1 Whenever a permanent threshold is temporarily displaced, a new system of visual cues must be provided, which may include provision of new markings, obscuring and alteration of existing markings, and the use of approved Runway Threshold Identification Lights (RTILs).

8.3.12.2 Where a threshold is temporarily displaced less than 300 m from the end of the runway, there is no additional survey requirement for obstacles. However, where this distance is exceeded, the aerodrome operator must refer the matter to CAAP.

8.3.12.3 Where a permanent threshold on any runway serving international air transport operations is displaced the location of the new threshold must be identified by the system of temporary markings specified below, and RTILs are to be installed.

8.3.12.4 Where practicable, RTILs shall also be used for displaced thresholds on runways not serving international air transport aircraft. When used, unless otherwise directed by CAAP, the requirements to use Vee bar markers are waived.

8.3.12.5

Where the permanent threshold is to be displaced for more than 30 days, the temporary threshold marking must comprise a white line, 1.2 m wide, across the full width of the runway at the line of the threshold, together with adjacent 10 m long arrowheads, comprising white lines 1 m wide. The existing runway centerline markings between the two thresholds must be converted to arrows as shown in MOS Figure 8.3-9 (B). The permanent threshold marking and associated runway designation number must be obscured and a temporary runway designation number provided 12 m beyond the new threshold. The number of arrow markings used is to be commensurate with the width of the runway.

Note: - 1. Where the runway fixed distance and touchdown zone markings can cause confusion with the new threshold location those markings may also be obscured.

Note: - 2. In the case where a threshold is temporarily displaced for only a short period of time, it has been found satisfactory to use markers in the form and color of a displaced threshold marking rather than attempting to paint this marking on the runway.

Note: - 3. When the runway before a displaced threshold is unfit for the surface movement of aircraft, closed markings, as described in MOS 8.9.1.5, are required to be provided.

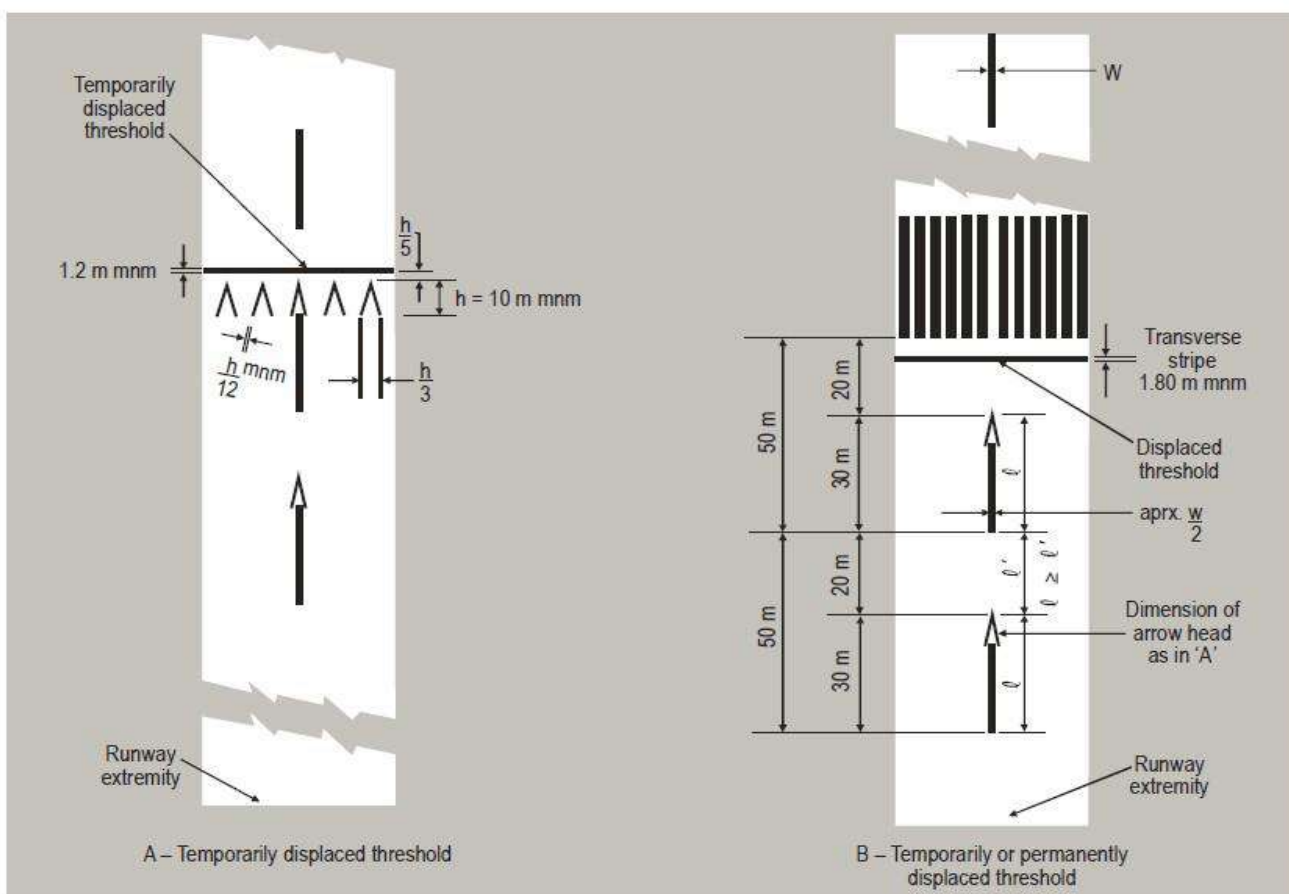


Figure 8.3-9: Temporarily displaced threshold markings (more than 30 days)

- 8.3.12.6 Where the permanent threshold is to be displaced for more than 5 days but not more than 30 days, or by more than 450 m, the new location must be indicated by suitable bar markers painted white and positioned on each side of the runway, together with flush, white, arrow markings, as shown in MOS Figure 8.3-9. The existing threshold markings must be obscured. For runways more than 18 m wide, or accommodating air transport aircraft, 2 bar markers and 2 arrow markings must be provided on each side of the runway. In other cases, a single bar and arrow on each side of the runway is acceptable.

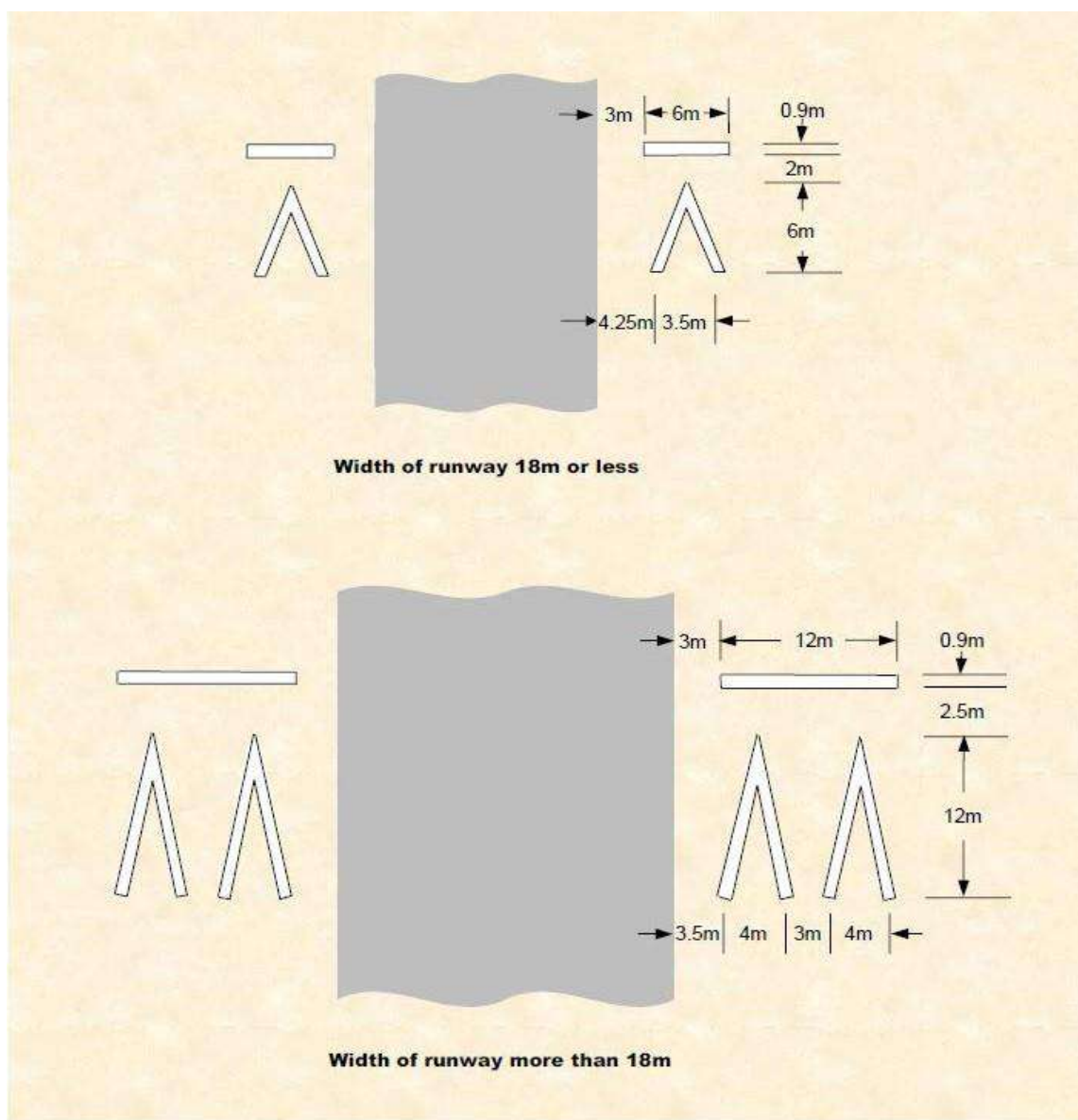


Figure 8.3-10: Temporarily displaced threshold markings (less than 30 days)

- 8.3.12.7 Where a threshold is to be temporarily displaced for 5 days or less, and the displacement is less than 450 m, the new threshold location must be indicated by the same bar and Vee markers but the permanent threshold markings may be retained.

- 8.3.12.8 Where a threshold at an air traffic controlled aerodrome is to be temporarily displaced for 5 days or less, and the displacement is more than 450 m, the new threshold location is to be indicated by the above markings but the permanent threshold markings may be retained.
- 8.3.12.9 Markings of typical threshold and displaced thresholds are illustrated in the following six figures.

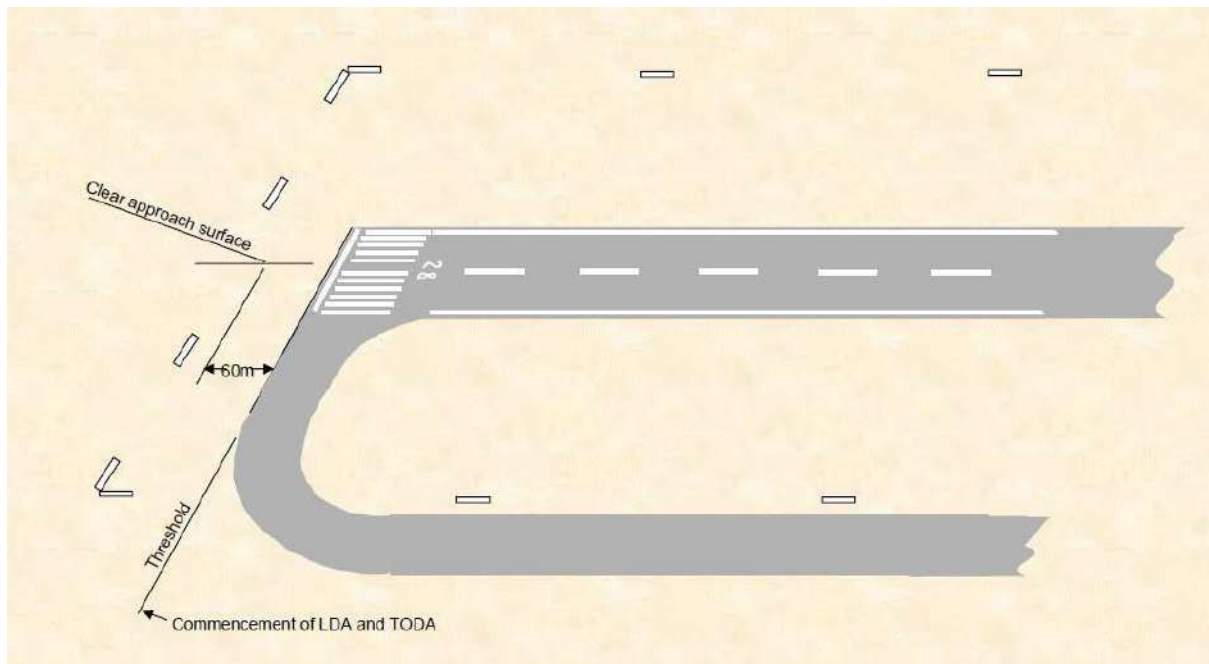


Figure 8.3-11: Markings for a typical runway with the threshold at the runway end

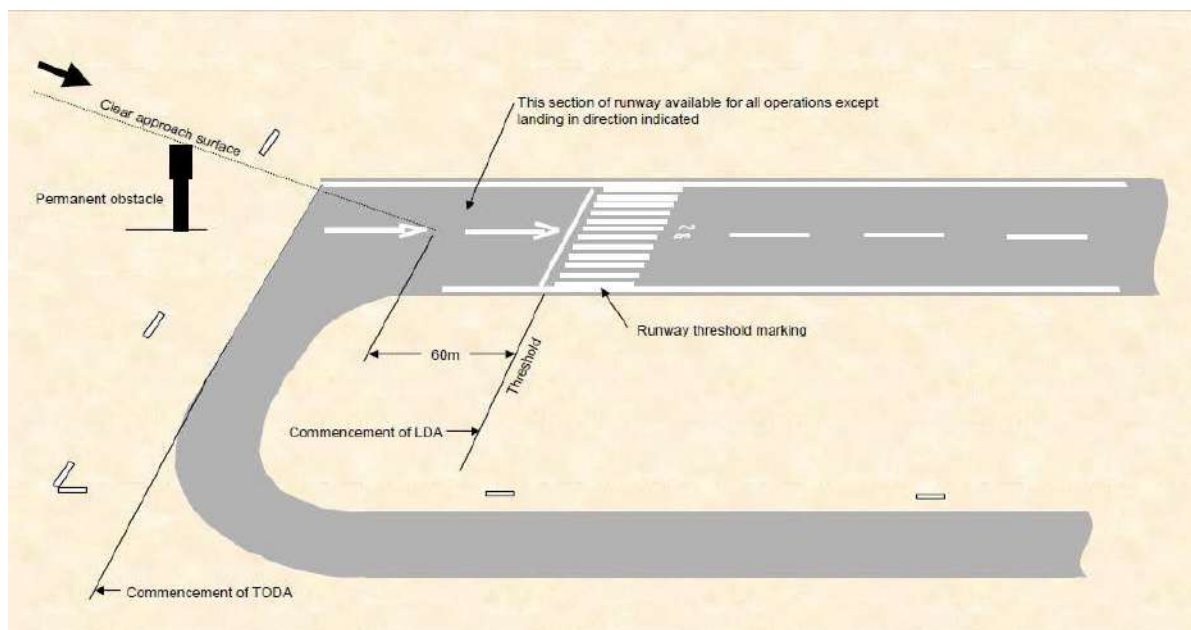


Figure 8.3-12: Markings for a typical runway with a permanently displaced threshold

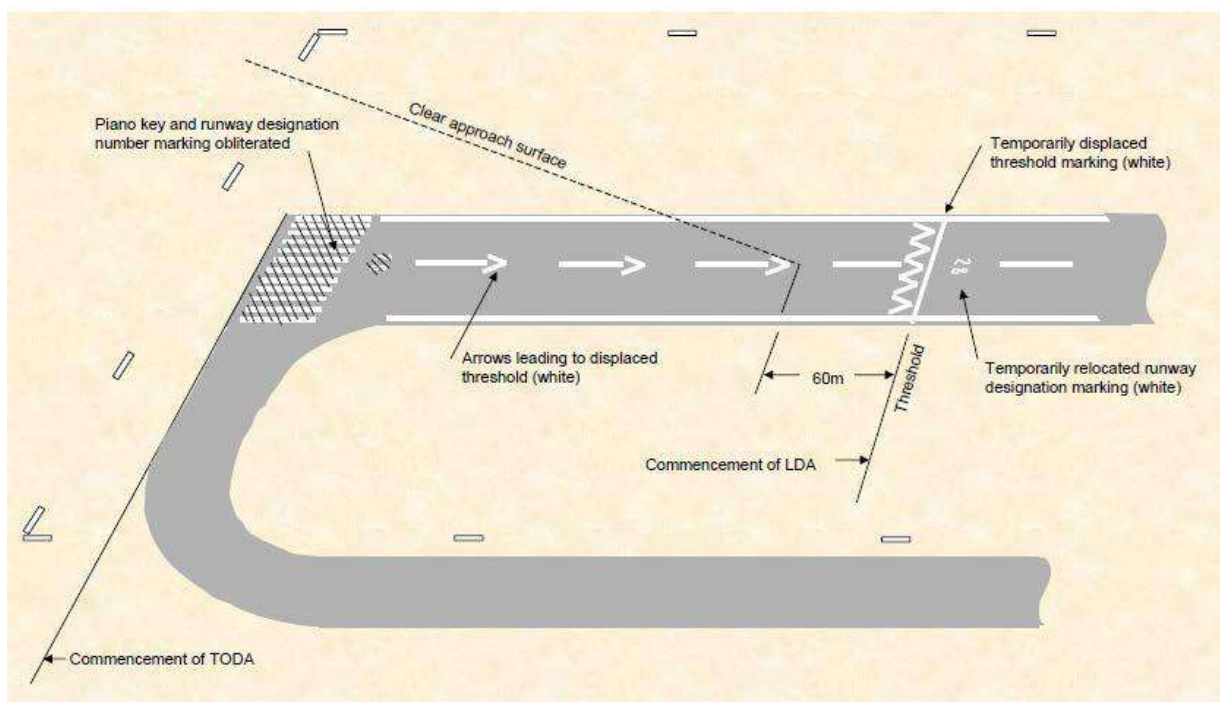


Figure 8.3-13: Markings for a temporarily displaced threshold due to obstacle infringement of the approach surface for a period in excess of 30 days

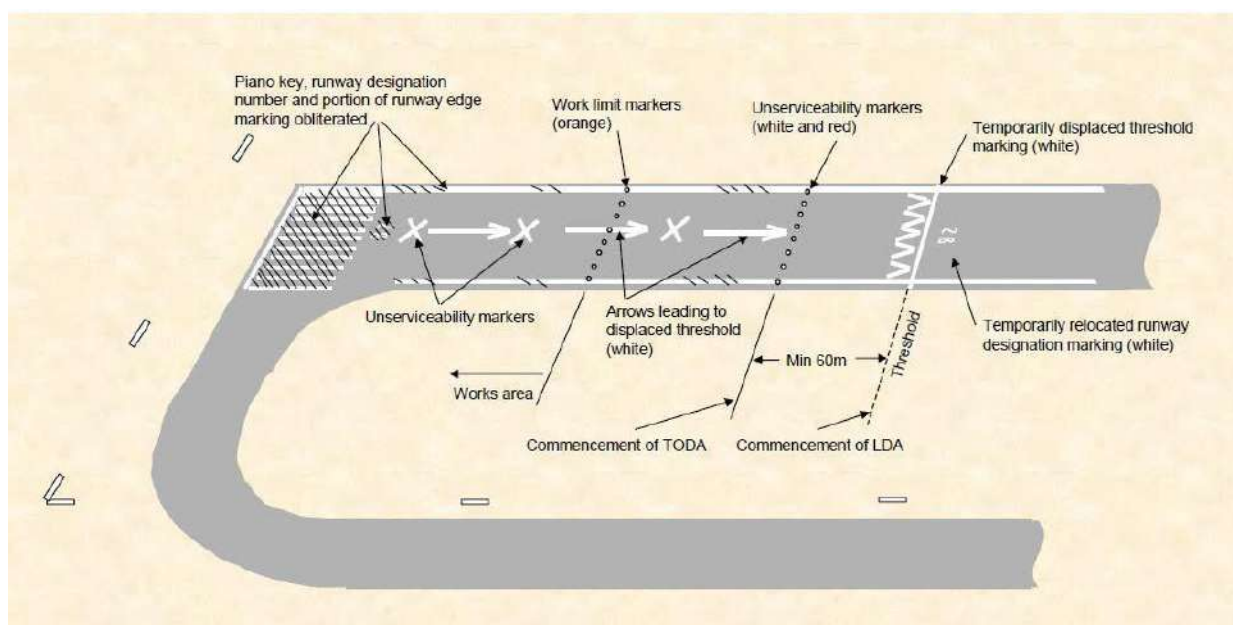


Figure 8.3-14: Markings for a temporarily displaced threshold due to works on the runway for a period in excess of 30 days

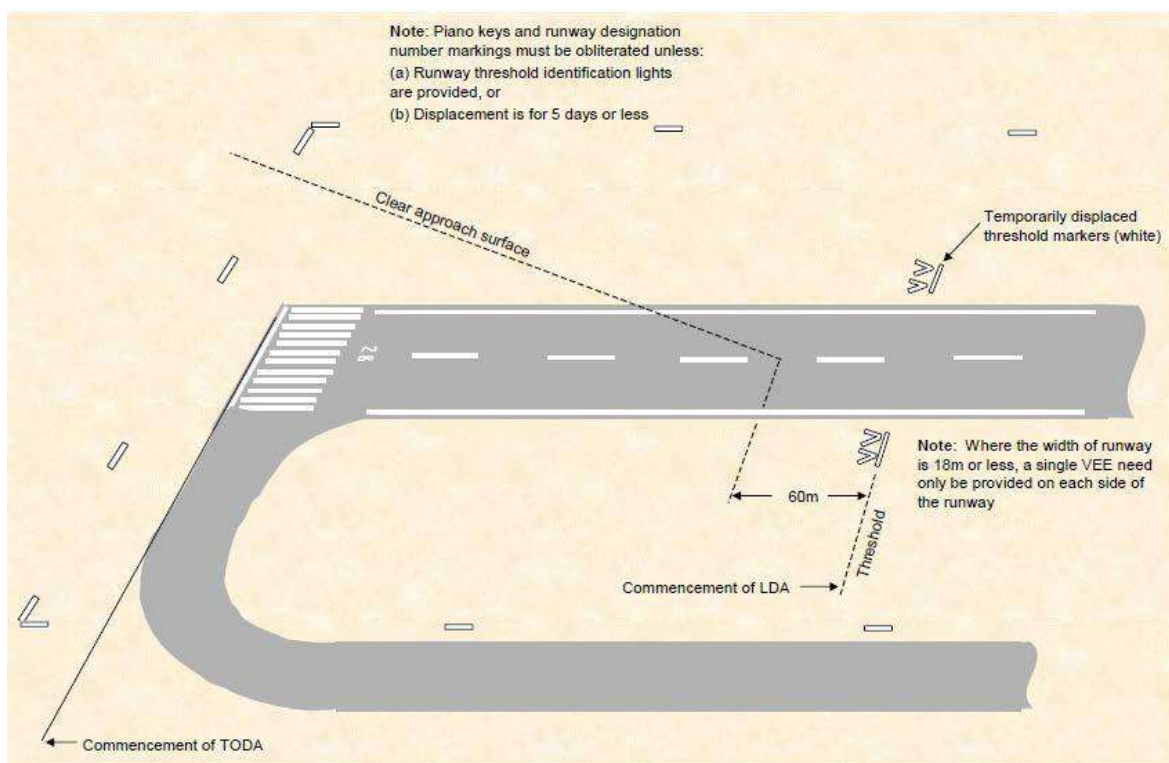


Figure 8.3-15: Markings for a temporarily displaced threshold due to obstacle infringement of approach surface for a period of 5 days or less and a displacement of less than 450 m

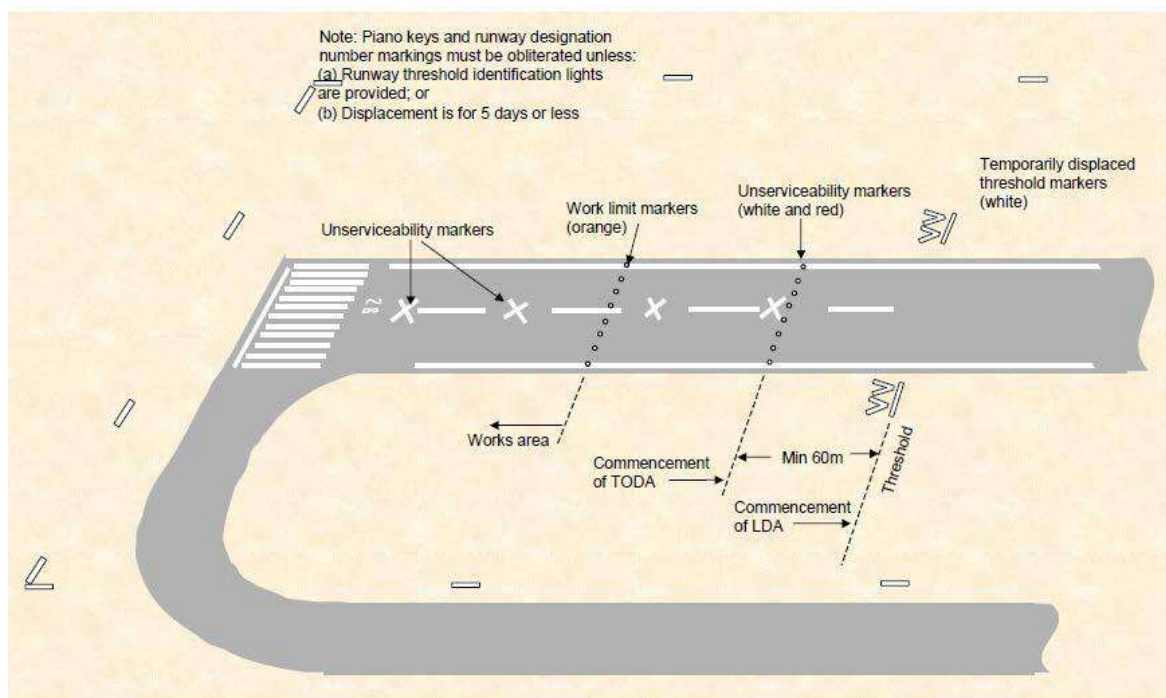


Figure 8.3-16: Markings for a temporarily displaced threshold due to works in progress on runway for a period of 5 days or less and a displacement of less than 450 m

Section 8.4 Taxiway Markings

8.4.1 Introduction

- 8.4.1.1 Taxiway markings must be provided on all paved taxiways, as specified below. Taxiway and other taxi-guidance markings must be painted yellow. Taxiway markings are to provide continuous guidance between the runway centerline and aircraft stands.
- 8.4.1.2 An unpaved taxiway shall be provided, so far as practicable, with the markings prescribed for paved taxiways.

8.4.2 Taxiway centerline marking

- 8.4.2.1 Taxiway centerline marking must be provided on all paved taxiway surfaces, in the form of a continuous yellow line 0.15 m wide, except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in MOS Figure 8.4-2. On straight sections, the taxiway centerline marking must be located in the center of the taxiway. On curved taxiways, the taxiway centerline marking must be located parallel to the outer edge of the pavement and at a distance of half of the taxiway width from it; i.e. the effect of any fillet widening at the inner edge of a curve is ignored. Where a taxi guideline marking is interrupted by another marking such as a taxi-holding position marking, a gap of 0.9 m must be provided between the taxiway centerline marking and any other marking.
- 8.4.2.2 The same form of taxiway centerline marking must be used on paved aprons as detailed below, under 'Apron Markings'.
- 8.4.2.3 Taxiway centerline marking on runways must not merge with the runway centerline, but run parallel to the runway centerline for a distance (D), not less than 60 m beyond the point of tangency where the runway code number is 3 or 4 and 30 m where the code number is 1 or 2. The taxi guideline marking must be offset from the runway centerline marking on the taxiway side, and be 0.9 m from the runway centerlines of the respective markings (See MOS Figure 8.4- 1).

Note: - 1. Markings with non-compliant separations do not have to be brought into compliance until the next remarking of the pavement.

Note: - 2. See also MOS Figures 8.4-2 for Taxiway markings and 9.12-1 for Taxiway lighting.

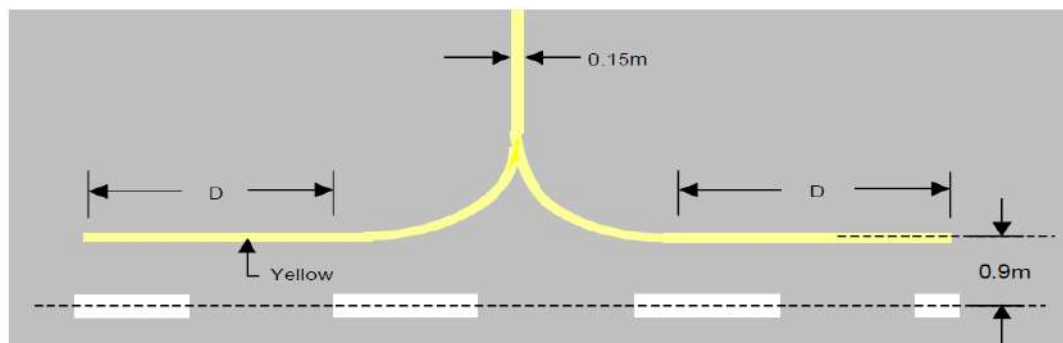


Figure 8.4-1: Taxi guideline markings meeting runway centerline markings

- 8.4.2.4 Where it has been determined necessary by CAAP to denote the proximity of a runway holding position, an enhanced taxiway marking shall be installed. When provided, enhanced taxiway centerline markings are to be installed at each taxiway/runway intersections and may form part of runway incursion prevention measures.
- 8.4.2.5 Where provided:
- (a) An enhanced taxiway centerline marking shall extend from the runway-holding position Pattern A marking defined in Figure 8.4-2, to a distance of up to 47m in the direction of travel away from the runway. See Figure 8.4-3(a).
 - (b) If the enhanced taxiway center line marking intersects another runway-holding position marking, such as for a precision approach category II or III runway that is located within 47m of the first runway-holding position marking, the enhanced taxiway center line marking shall be interrupted 0.9m prior to and after the intersected runway-holding position marking. The enhanced taxiway center line marking shall continue beyond the intersected runway-holding position marking for at least 3 dashed line segments or 47m from start to finish, whichever is greater. See Figure 8.4-3(b).
 - (c) If the enhanced taxiway centerline marking continues through a taxiway/taxiway intersection that is located within 47m of the runway-holding position marking, the enhanced taxiway centerline marking shall be interrupted 1.5m prior to and after the point where the intersected taxiway centerline crosses the enhanced taxiway centerline. The enhanced taxiway centerline marking shall continue beyond the taxiway/taxiway intersection for at least 3 dashed line segments or 47m from start to finish, whichever is greater. See Figure 8.4-3(c).
 - (d) Where two taxiway centerlines converge at or before the runway-holding position marking, the inner dashed line shall not be less than 3m in length. See Figure 8.4-3(d).
 - (e) Where there are two opposing runway-holding position markings and the distance between the markings is less than 94m, the enhanced taxiway centerline markings shall extend over this entire distance. The enhanced taxiway centerline markings shall not extend beyond either runway- holding position marking. See Figure 8.4-3(e).
- 8.4.2.6 Taxiway centerline marking shall be provided on a paved taxiway and apron where the code number is 3 or 4 in such a way as to provide continuous guidance between the runway centerline and aircraft stands.
- 8.4.2.7 Taxiway centerline marking shall be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway centerline and aircraft stands.
- 8.4.2.8 Taxiway centerline marking shall be provided on a paved runway when the runway is part of a standard taxi-route and:
- (a) there is no runway centerline marking; or
 - (b) where the taxiway centerline is not coincident with the runway centerline.

- 8.4.2.9 Where taxiway centerline marking is provided on a runway in accordance with 8.4.2.8, the marking shall be located on the centerline of the designated taxiway.
- 8.4.2.10 Enhanced taxiway centerline marking shall be as shown in MOS Figure 8.4-3.

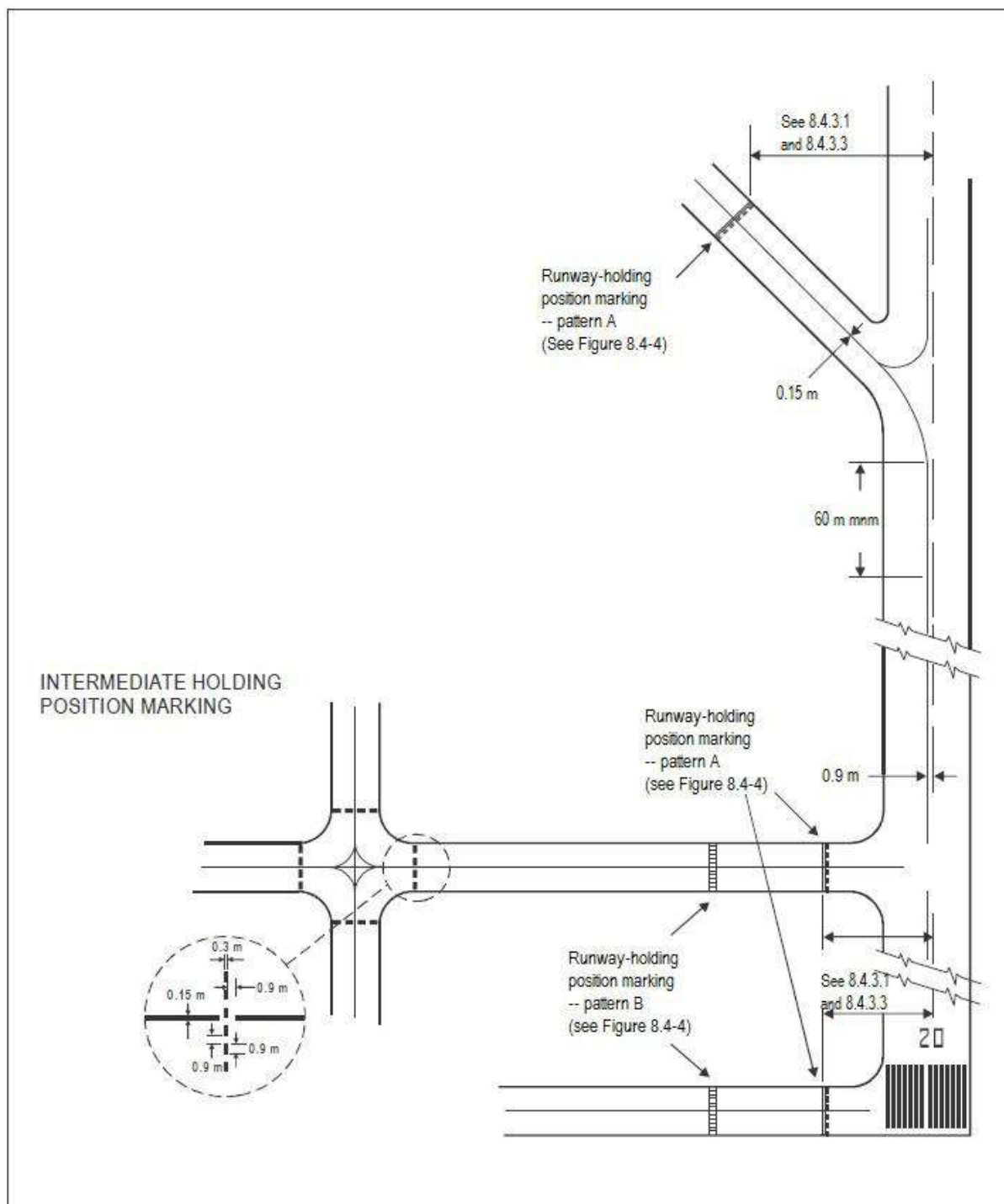


Figure 8.4-2: Taxiway Marking

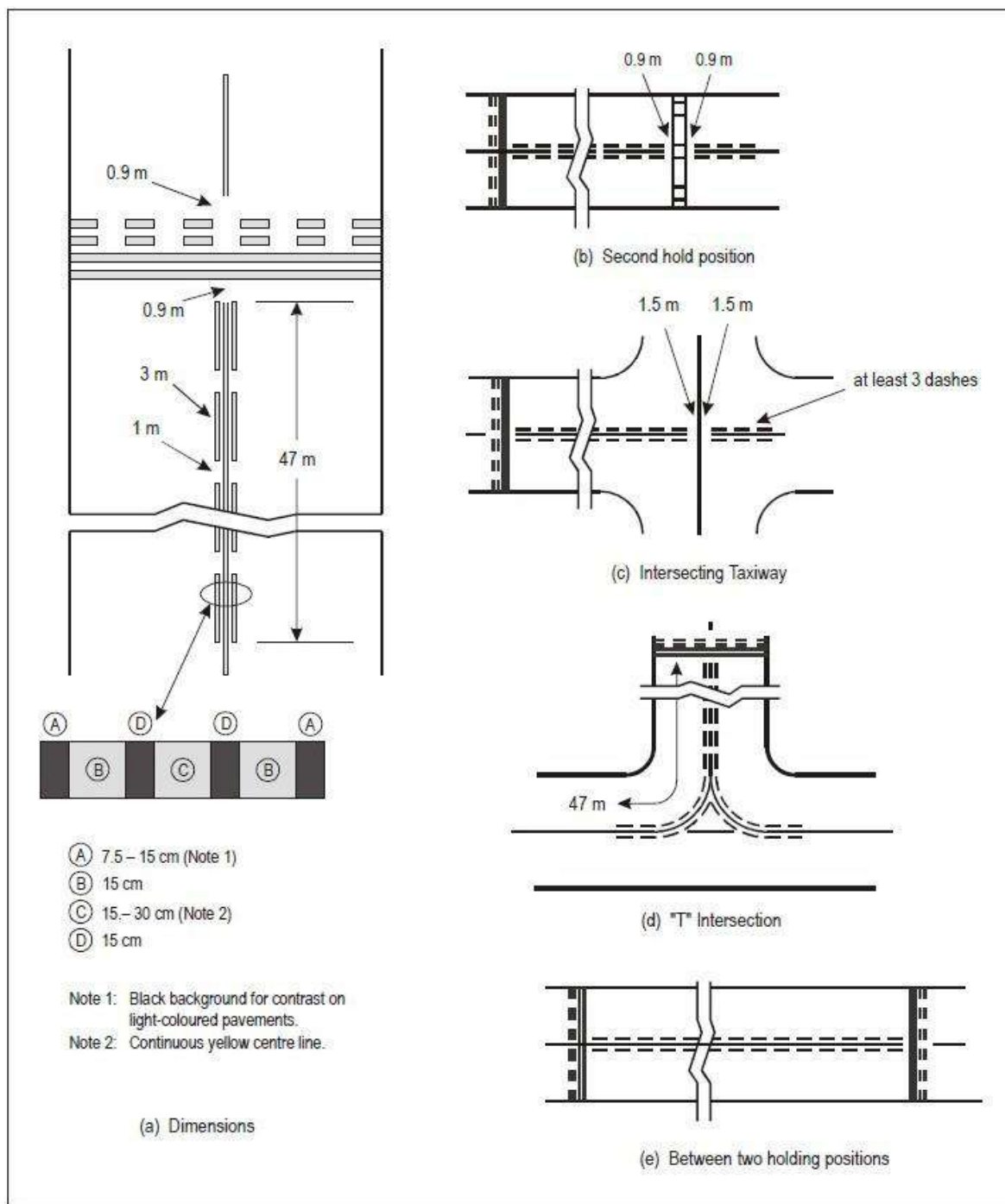


Figure 8.4-3. Enhanced taxiway centerline marking

8.4.3 Runway holding position markings

8.4.3.1 Runway holding position markings must be provided on all asphalt, sealed or concrete taxiways wherever these join or intersect with a runway. Standards for the location of runway holding positions are specified in MOS 6.

Note: - See MOS 8.6.7.1 concerning the provision of signs at runway-holding positions.

- 8.4.3.2 Until 26 November 2026, the dimensions of runway-holding position markings shall be as shown in Figure 8.4-3, pattern A1 (or A2) or pattern B1 (or B2), as appropriate.
- 8.4.3.3 As of 26 November 2026, the dimensions of runway-holding position marking shall be as shown in Figure 8.4-3, pattern A2 or pattern B2, as appropriate.
- 8.4.3.4 Runway holding positions must be marked using the Pattern A or Pattern B runway holding position markings, shown in Figure 8.4-2, as appropriate.
- 8.4.3.5 The runway-holding position marking displayed at a runway/runway intersection shall be perpendicular to the centerline of the runway forming part of the standard taxi-route. The pattern of the marking shall be as shown in Figure 8.4-4, pattern A2.
- 8.4.3.6 A runway holding position shall be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or a vehicle can infringe an obstacle limitation surface or interfere with the operation of a radio navigation aid.
- 8.4.3.7 Where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking shall be Pattern A as shown in MOS Figure 8.4-2. Pattern B marking must be used where two or three runway holding positions are provided at an intersection of a taxiway with a precision approach runway. The marking closest to the runway must be the Pattern A marking; the marking(s) farther from the runway must be Pattern B.
- 8.4.3.8 A runway-holding position marking shall be displayed along a runway-holding position.
Note: - See MOS 8.6.7 and 8.6.10 concerning the provision of signs at runway holding positions.
- 8.4.3.9 At an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway, the runway-holding position marking shall be as shown in Figure 8.4-2, Pattern A.
- 8.4.3.10 The runway-holding position marking displayed at a runway-holding position established in accordance with MOS 6.8.2.3 shall be as shown in Figure 8.4-2, Pattern A.
- 8.4.3.11 Where increased conspicuity of the runway-holding position is required, the dimensions of runway-holding position marking shall be as shown in Figure 8.4-4, pattern A2 or pattern B2, as appropriate.
Note: - An increased conspicuity of the runway-holding position can be required, notably to avoid incursion risks.
- 8.4.3.12 Where a pattern B runway-holding position marking is located on an area where it will exceed 60 m in length, the term "CAT II" or "CAT III" as appropriate shall be marked on the surface at the ends of the runway-holding position marking and at equal intervals of 45 m maximum between successive marks. The letters shall be not less than 1.8 m high and shall be placed not more than 0.9 m beyond the holding position marking.

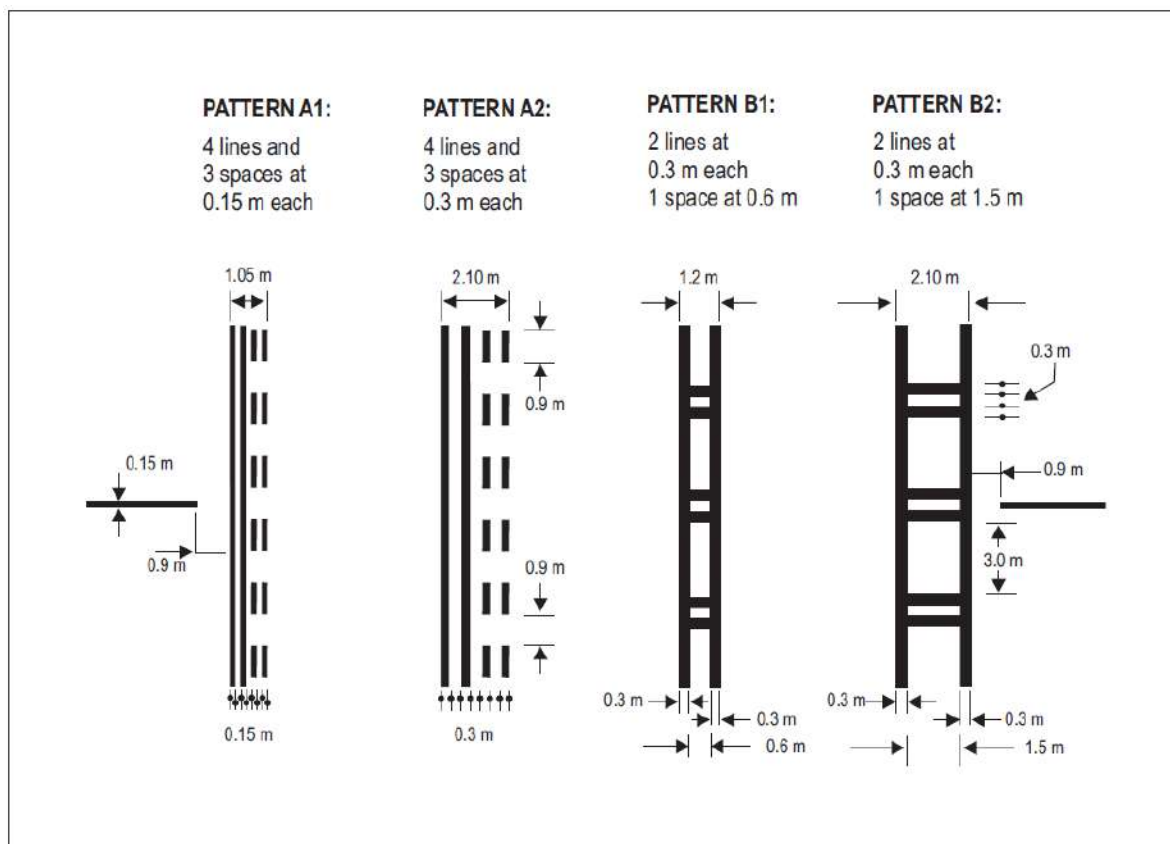


Figure 8.4-4: Runway-holding position markings

Note: - Patterns A1 and B1 are no longer valid after 2026.

8.4.4 Intermediate holding position markings

- 8.4.4.1 Intermediate holding position markings must be provided on all asphalt, sealed or concrete taxiway intersections or on any location of a taxiway where air traffic control requires the aircraft to hold. The intermediate holding position marking must be located in accordance with the standards specified in Chapter 6.
- 8.4.4.2 Intermediate holding position marking must consist of a single yellow broken line, 0.15 m wide, extending across the full width of the taxiway at right angles to the taxi guideline. Lines and gaps must each be 1.0 m long, as shown in Figure 8.4-5:
- 8.4.4.3 An intermediate holding position marking shall be displayed along an intermediate holding position.
- 8.4.4.4 Where an intermediate holding position marking is displayed at an intersection of two paved taxiways, it shall be located across the taxiway at sufficient distance from the near edge of the intersecting taxiway to ensure safe clearance between taxiing aircraft. It shall be coincident with a stop bar or intermediate holding position lights, where provided.

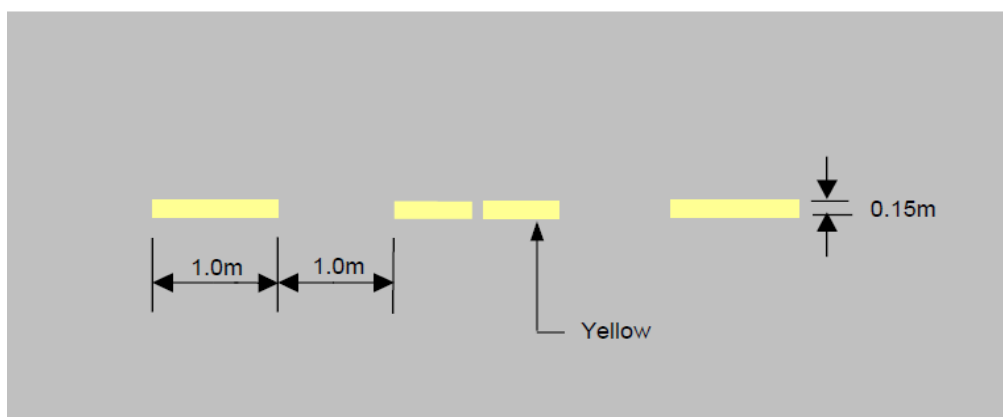


Figure 8.4-5: Intermediate holding position markings

8.4.5 Taxiway edge markings

- 8.4.5.1 Taxiway edge markings must be provided for paved taxiways where the edges of full strength pavement are not otherwise visually clear. Markings must consist of two continuous 0.15 m wide yellow lines, spaced 0.15 m apart and located at the taxiway edge, as shown in Figure 8.4-6.

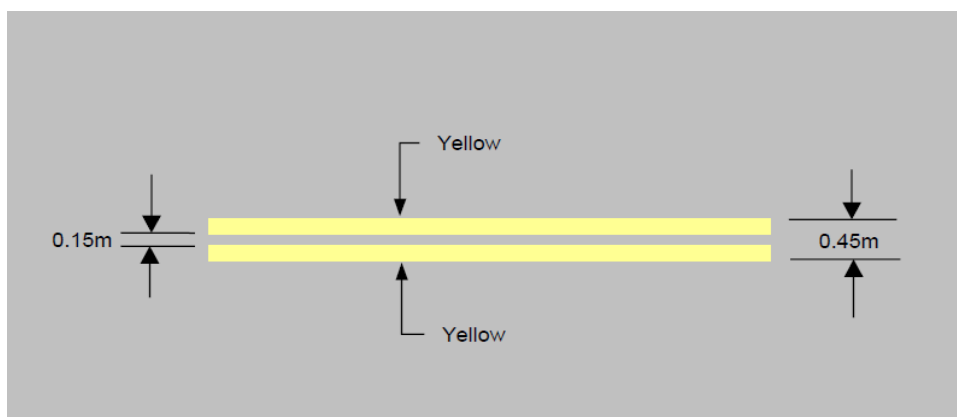


Figure 8.4-6: Taxiway edge markings

Note: - Whilst not mandatory, the additional provision of transverse or herringbone stripes on the sub strength surface has been found to be of assistance in avoiding the possibility for confusion on which side of the edge marking the sub strength pavement is located. This additional marking is an acceptable means of compliance with these standards.

8.4.6 Holding bay markings

- 8.4.6.1 Holding bay markings must be provided on all sealed, asphalt or concrete holding bays. Holding bay markings must comprise taxi guideline markings and intermediate holding position markings as shown in Figure 8.4-7. Markings must be located so that aircraft using the holding bay are cleared by aircraft on the associated taxiway by at least the distance specified in Chapter 6. The holding position marking must be painted in accordance with the intermediate holding position marking, unless that is also a runway holding position, in which case the Pattern A runway holding position marking applies.

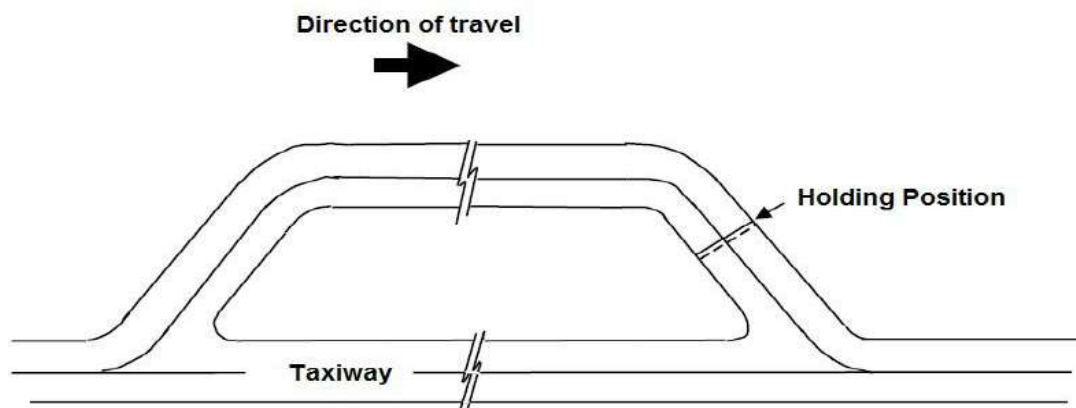


Figure 8.4-7: Holding bay markings

8.4.7 Taxiway pavement strength limit markings

- 8.4.7.1 These markings are used at the entrance of a taxiway of low strength pavement where the aerodrome operator decides to impose a weight limitation, for example, 'Max 5,700 kg'.
- 8.4.7.2 Where the taxiway pavement strength limit marking is provided, as shown in Figure 8.4-8, the letters and numbers must be painted yellow, must be 2.0 m in height, 0.75 m in width, with 0.15 m line width and at 0.5 m spaces. The marking must be readable from aircraft on the full strength pavement.

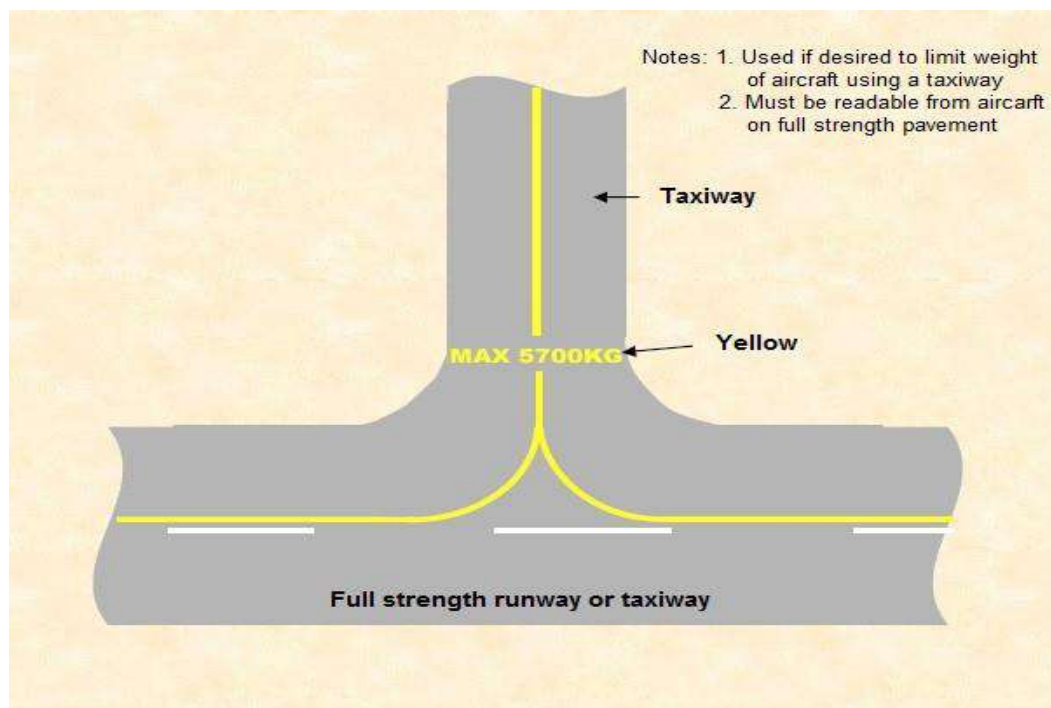


Figure 8.4-8: Taxiway pavement-strength limit markings

- 8.4.7.3 Edge markings of the associated main taxiway or apron, or the side stripe markings of the runway, must be interrupted across the width of the low strength taxiway entrance.

Section 8.5 Apron Markings

8.5.1 Introduction

- 8.5.1.1 Aprons accommodating aircraft of 5,700 kg Maximum All Up Mass (MAUM) and above, must be provided with taxi guidelines and primary aircraft parking position markings. Where the apron may be occupied by these and lighter aircraft at the same time, the aerodrome operator must also provide secondary aircraft parking position markings on the apron for the lighter aircraft.
- 8.5.1.2 Where aprons accommodate only aircraft of less than 5,700 kg MAUM, there is no mandatory requirement for taxi guidelines nor for marked aircraft parking positions. In these cases, the aerodrome operator may decide whether to provide markings, or to allow random parking at pilot discretion.
- 8.5.1.3 The design of apron markings must ensure that all relevant clearance standards are met, so that safe maneuvering and the precise positioning of aircraft is achieved. Care must be taken to avoid overlapping markings.

8.5.2 Apron taxi guideline markings

- 8.5.2.1 Apron taxi guideline markings must be of the same form as those used on the taxiway. The design of taxi guidelines on aprons is dependent on whether the aircraft is being directed by a marshaller or the pilot.
- 8.5.2.2 Where aircraft are to be directed by a marshaller, the 'nose wheel position principle' shall apply, i.e. the taxi guideline is designed so that when the aircraft nose wheel follows the guideline, all the required clearances are met.
- 8.5.2.3 Where aircraft are to be guided by the pilot, the 'cockpit position principle' shall apply; that is the taxi guideline is designed so that when a point on the centerline of the aircraft midway between the pilot and the co-pilot seats (or in the case of a single pilot aircraft, in the center of the pilot seat) follows the taxi guideline, all the required clearances are met.
- 8.5.2.4 Where there is a change in aircraft position control between the pilot and the marshaller, the taxi guideline must convert from one principle to the other. At aerobridges, the taxi guideline must be designed using the cockpit position principle.
- 8.5.2.5 Where an aircraft designator is required to cover several aircraft types and there is insufficient space for the marking, an abbreviated version of the designator may be used. As examples, the abbreviated designator for an A330-200 may be A332, BAe 146-200 may be B462, and B737-800 may be B738.
- Note: - ICAO Document 8643 provides a comprehensive list of aircraft designators.*

8.5.3 Apron edge markings

- 8.5.3.1 Apron edge markings must be provided where the limit of high strength pavement cannot be distinguished from the surrounding area, and aircraft parking is not restricted to fixed parking positions. Where marking is required, the apron edge must be identified by 2 continuous yellow lines 0.15 m wide, spaced 0.15 m apart.
- 8.5.3.2 The edge of gravel, grass or other natural surface aprons must be identified by cones, spaced at a maximum distance of 60 m and painted yellow except for dedicated helicopter aprons which must be light blue.

8.5.4 Apron Safety Line (Parking clearance line)

- 8.5.4.1 Parking clearance lines may be provided at an aircraft parking position to depict the area that must remain free of personnel, vehicles and equipment when an aircraft is taxiing (or being towed) into position, has started engines in preparation for departure or is to be pushed back.
- 8.5.4.2 Parking clearance lines may also be provided on light aircraft aprons with random parking, where it is desired to limit the parking to particular areas.
- 8.5.4.3 The parking clearance line must comprise a continuous red line 0.10 m or, if desired, 0.20 m wide. Where required, a continuous yellow or white line 0.10 m wide on either side can enhance the parking clearance line. The words 'PARKING CLEARANCE' must be painted in yellow on the side where the light aircraft are parked, and readable from that side. These words must be repeated at intervals not exceeding 50 m, using letters 0.3 m high, located 0.15 m from the line, as shown below. Apron safety lines shall be provided on a paved apron as required by the parking configurations and ground facilities.

Note: - Guidance on apron safety lines is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

- 8.5.4.4 Apron safety lines shall be located so as to define the areas intended for use by ground vehicles and other aircraft servicing equipment, etc., to provide safe separation from aircraft.
- 8.5.4.5 Apron safety lines shall include such elements as wing tip clearance lines and service road boundary lines as required by the parking configurations and ground facilities.
- 8.5.4.6 Apron safety lines shall be of a conspicuous color which shall contrast with that used for aircraft stand markings.



Figure 8.5-1: Parking clearance line

8.5.5 Aircraft Type Limit Line

- 8.5.5.1 Where adjoining portions of pavement cannot accommodate the same aircraft type, information to this effect must be provided, marking the boundary of the restricted pavement. The marking must consist of a broken yellow line, comprising strips 3 m long and 0.3 m wide, separated by 1 m spaces. The designator must be 0.15 m above the line, in letters and numbers 0.5 m high. The marking is to be repeated at intervals not exceeding 50 m.

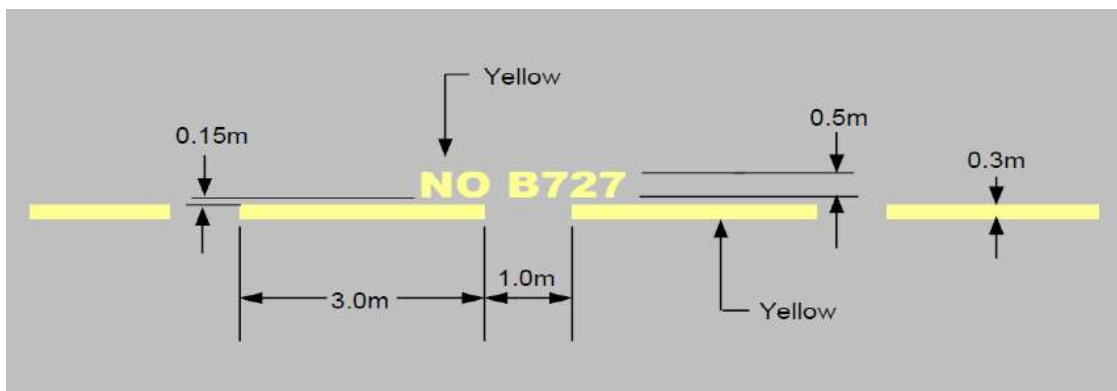


Figure 8.5-2: Aircraft type limit line

8.5.6 Parking weight limit line

- 8.5.6.1 Where adjoining portions of pavement cannot accommodate the same aircraft weight, this must be signified by marking an aircraft weight limitation on the weaker pavement. The marking must consist of a broken yellow line, comprising strips 3 m long and 0.3 m wide, separated by 1 m spaces. The designator must be 0.15 m above the line, in letters and numbers 0.5 m high. The marking is to be repeated at intervals not exceeding 50 m.

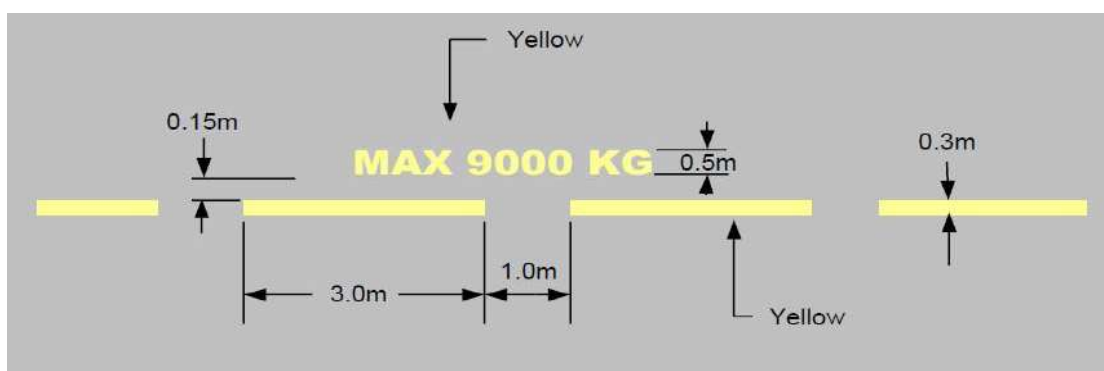


Figure 8.5-3: Parking weight limit line

8.5.7 Leased area line

- 8.5.7.1 Where the aerodrome operator wishes to identify leased areas on a sealed, concrete or asphalt apron, the marking must consist of a 0.15 m solid line, painted lime green.

8.5.8 Equipment clearance line

- 8.5.8.1 Equipment clearance lines must be used on congested aprons to assist service vehicles keep clear of Maneuvering aircraft. This marking must consist of red stripes, 1 m long and 0.15 m wide, separated by 1 m gaps. The designation 'EQUIPMENT CLEARANCE' must be painted on the side of the line occupied by the equipment and readable from that side. The designation must be repeated along the line at intervals of not more than 30 m. Letters must be 0.3 m high, 0.15 m from the line, painted red.

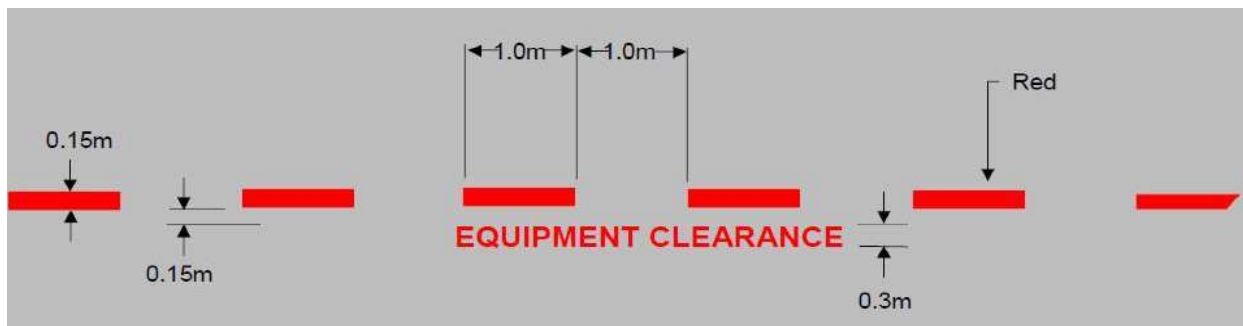


Figure 8.5-4: Equipment clearance line

8.5.9 Equipment storage markings

- 8.5.9.1 Equipment storage markings must consist of a continuous red painted line, 0.1 m wide.
- 8.5.9.2 The words 'EQUIPMENT STORAGE' must be painted in red on the side where equipment is stored, and readable from that side. Letters must be 0.3 m high and 0.15 m from the line, as shown below. This marking must be repeated at intervals not exceeding 50 m along the boundary.

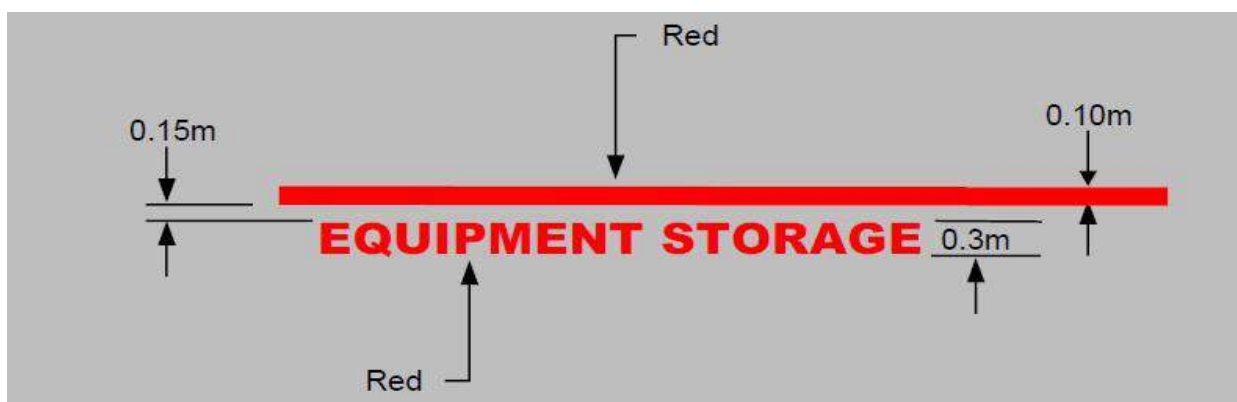


Figure 8.5-5: Equipment storage and apron road marking

8.5.10 Apron service road markings

- 8.5.10.1 Roads on apron areas must be marked to keep vehicle traffic clear of aircraft and taxiways, and to minimize the risk of vehicle-to-vehicle accidents.

- 8.5.10.2 Each lane of an apron service road must be of a minimum width to accommodate the widest vehicle in use at that location, e.g. emergency vehicles or ground support equipment.
- 8.5.10.3 The apron service road marking must consist of a continuous white painted line, 0.1 m wide.
- 8.5.10.4 Where a service road is located adjacent to taxiing aircraft the side marking must be shown with a continuous double white line as shown in MOS Figure 8.5-7. This indicates DO NOT CROSS. Each continuous white line must be 0.1 m wide. The separation between the two continuous white lines must not be less than 0.05 m.
- 8.5.10.5 Where a service road crosses a taxiway or apron taxilane, the service road marking may be presented in a zipper pattern as shown MOS Figure 8.5-6. Each segment of the zipper is not to be more than 50 cm in length. This type of edge marking makes the road more conspicuous to the pilots of aircraft operating on the taxiway or taxilane.

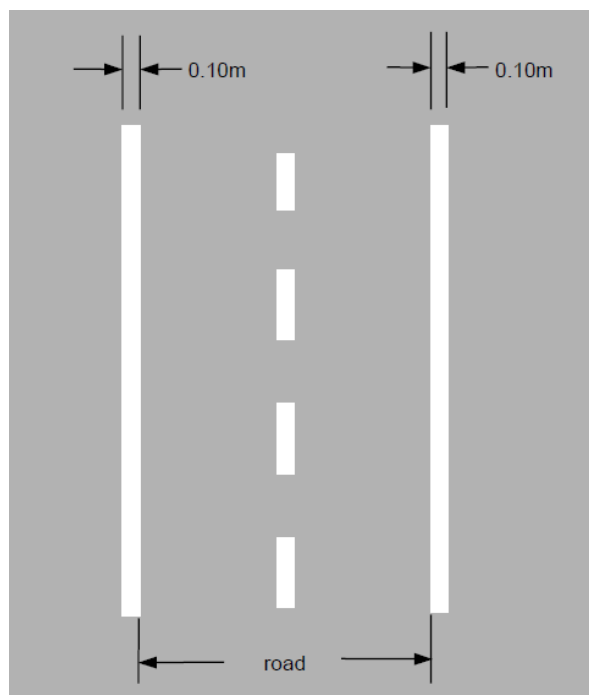


Figure 8.5-6: Apron service road

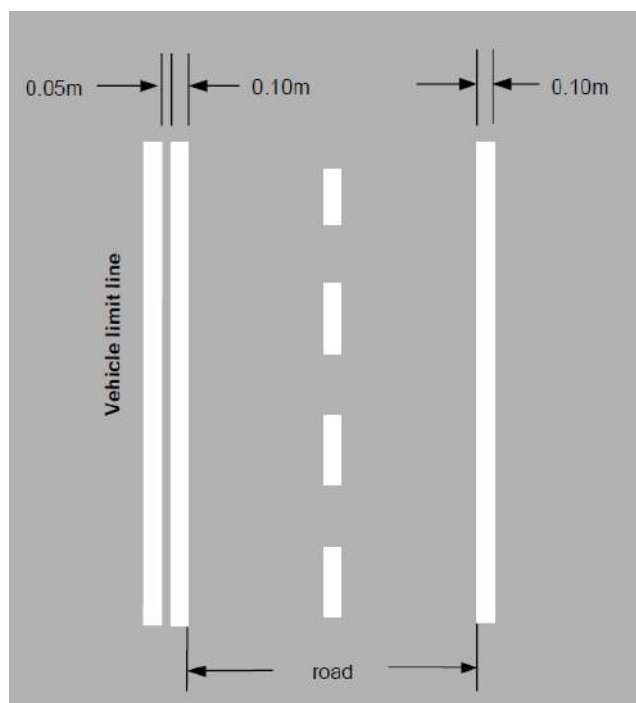


Figure 8.5-7: Apron service road alongside a vehicle limit line

8.5.11 Aircraft parking position markings

8.5.11.1 The aerodrome operator must mark all aircraft parking positions for use by aircraft of 5,700 kg MAUM and above, on concrete, sealed or asphalt apron surfaces.

8.5.11.2 Aircraft parking positions are classified as primary or secondary positions. Primary positions are designed for normal apron demand, whereas secondary positions either provide alternative positions for use during abnormal circumstances, or allow a larger number of smaller aircraft to be parked.

8.5.11.3 Aircraft parking position markings comprise lead-in lines, primary parking position markings, secondary parking position markings, lead-out lines and designation markings. Aircraft stand markings shall be provided for designated parking positions on a paved apron.

Note: - Guidance on the layout of aircraft stand markings is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

8.5.11.4 Aircraft stand markings on a paved apron shall be located so as to provide the clearances specified in Table 6.9-1, when the nose wheel follows the stand marking.

8.5.11.5 Aircraft stand markings shall include such elements as stand identification, lead-in line, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids.

8.5.11.6 An aircraft stand identification (letter and/or number) shall be included in the lead-in line a short distance after the beginning of the lead-in line. The height of the identification shall be adequate to be readable from the cockpit of aircraft using the stand.

8.5.11.7 Where two sets of aircraft stand markings are superimposed on each other in order to permit more flexible use of the apron and it is difficult to identify which stand marking should be followed, or safety would be impaired if the wrong marking was followed, then identification of the aircraft for which each set of markings is intended shall be added to the stand identification.

Note: - Example: 2A-B747, 2B-F28.

8.5.12 Lead-in line

8.5.12.1 Lead-in lines must be provided to each aircraft parking position on all sealed, concrete and asphalt aprons with aircraft parking position markings.

8.5.12.2 Lead-in lines to primary aircraft parking positions must be continuous, 0.15 m wide and painted yellow; they have the same characteristics as a taxi guideline.

8.5.12.3 At a secondary parking position, the lead-in line must be marked by a series of solid yellow circles 0.15 m in diameter, spaced at 1 m intervals. Where an abrupt change in direction occurs the line must be solid for a distance of 2 m before and after the turn.

- 8.5.12.4 Lead-in, turning and lead-out lines should normally be continuous in length and have a width of not less than 15 cm. Where one or more sets of stand markings are superimposed on a stand marking, the lines should be continuous for the most demanding aircraft and broken for other aircraft.
- 8.5.12.5 The curved portions of lead-in, turning and lead-out lines should have radii appropriate to the most demanding aircraft type for which the markings are intended.
- 8.5.12.6 Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed shall be added as part of the lead-in and lead-out lines.

8.5.13 Taxi lead-in line designation

- 8.5.13.1 Designation must be provided where an apron has more than one marked aircraft parking position. Taxi lead-in line designation markings must be located at the beginning of each diverging taxi guideline or lead-in line; aligned so that they can be seen by the pilot of an approaching taxiing aircraft. There are three types of taxi lead-in line designations:
- (a) parking position number designation;
 - (b) aircraft type limit designation; and
 - (c) aircraft weight limit designation.
- 8.5.13.2 The parking position number designation indicates the aircraft parking position to which the line leads. Where a lead-in line leads to several positions, the designation must include the first and last numbers of the positions served. For instance, a guideline leading to the six positions numbers 1 to 6, is depicted as 1–6 as shown in Figure 8.5-9. The designations must comprise characters 2 m high, painted yellow, as shown in Figure 8.5-8.

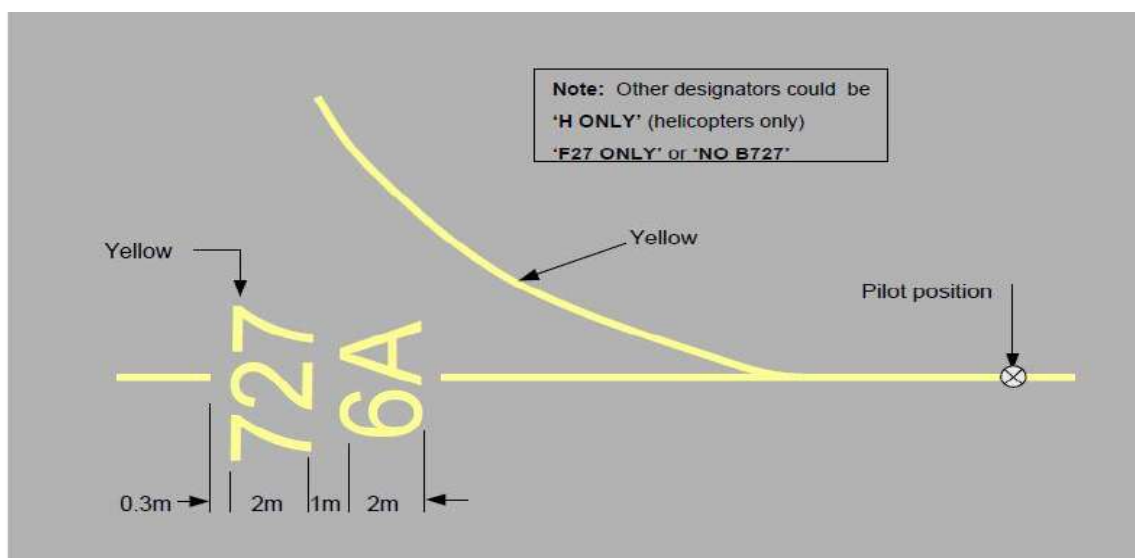


Figure 8.5-8: Parking position number designation

- 8.5.13.3 The aircraft type limit designations indicate which parking positions are capable of accommodating particular aircraft types. The designation must be painted in yellow characters 2 m high, with 0.3 m spacing from the lead-in line, as shown in Figure 8.5-9. Appropriate aircraft type limit designations must be provided at the lead-in line for each position to which restrictions apply. Where a diverging lead-in line leads to an apron parking position suitable only for helicopters; the designation 'H ONLY' must be provided.

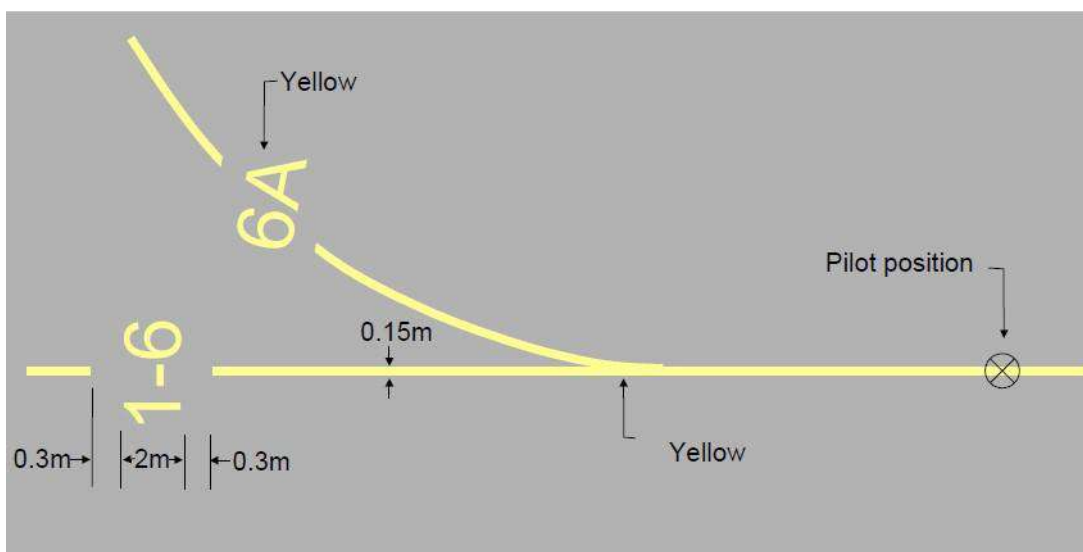


Figure 8.5-9: Aircraft type limit designation

- 8.5.13.4 The aircraft weight limit designations inform pilots of a weight limitation to a parking position. They specify the maximum weight allowable in the form, '9,000 kg'. The designation must be painted in yellow characters 2 m high, separated by 0.3 m spaces from the lead-in line, as shown in Figure 8.5-10.

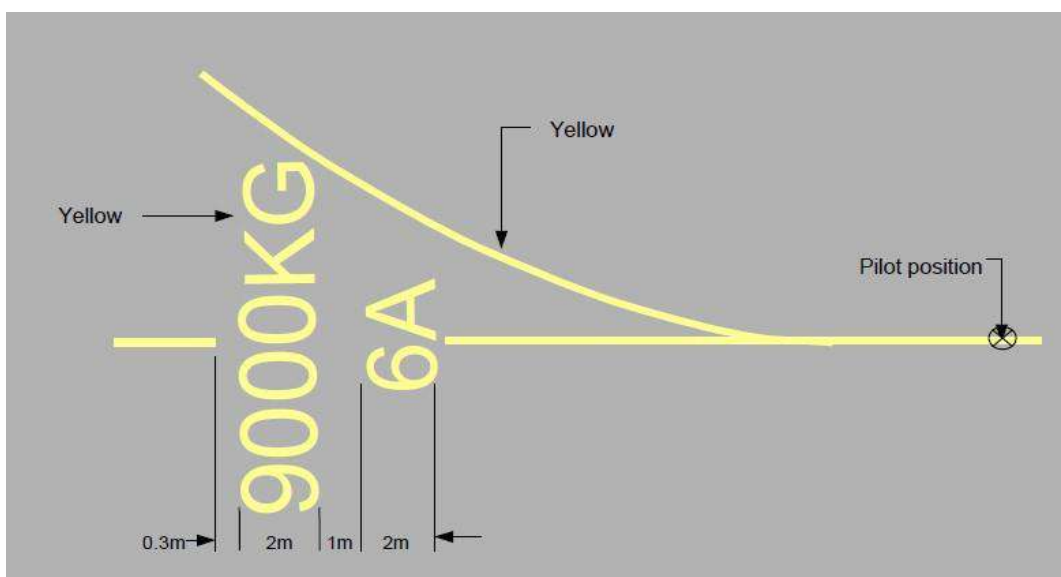


Figure 8.5-10: Aircraft upper weight limit designation

8.5.14 Pilot turn line

- 8.5.14.1 Where required, a pilot turn line must be placed at right angles to the lead-in line, located on the left side as viewed by the pilot, and must be 6 m long, 0.3 m wide and painted yellow. The aircraft type designation must be painted in yellow letters, 1 m high and spaced 0.15 m below the bar, facing the direction of incoming aircraft. The designation must be offset from the lead-in line as follows:

Aircraft code letter	Offset
C	5 m
D	10 m
E	10 m

Table 8.5-1

- 8.5.14.2 A turn bar shall be located at right angles to the lead-in line, abeam the left pilot position at the point of initiation of any intended turn. It shall have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.

Note: - The distances to be maintained between the turn bar and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

- 8.5.14.3 If more than one turn bar and/or stop line is required, they must be coded.

8.5.15 Primary aircraft parking position markings

- 8.5.15.1 Primary aircraft parking position markings comprise two straight yellow lines; the alignment line must be 0.15 m wide, and shows the required orientation of the parked aircraft. The stop line must be 0.3 m wide, and shows the pilot or marshaller the point at which the aircraft is to be stopped. The position of the stop line depends on whether the aircraft is under the control of the apron marshaller or the pilot.

8.5.16 Marshaller stop line

- 8.5.16.1 The stop line must be located where the aircraft nose wheel is to stop; and on the right hand side of, and at right angles to, the alignment line, as seen by the marshaller facing the incoming aircraft.

- 8.5.16.2 The aircraft type designation must be yellow, in letters 0.3 m high, and spaced 0.15 m below the stop line. The lettering must be legible to the marshaller facing the incoming aircraft, as shown below.

- 8.5.16.3 A stop line shall be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It shall have a length and width of not less than 6 m and 15 cm, respectively.

Note: - The distances to be maintained between the stop line and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

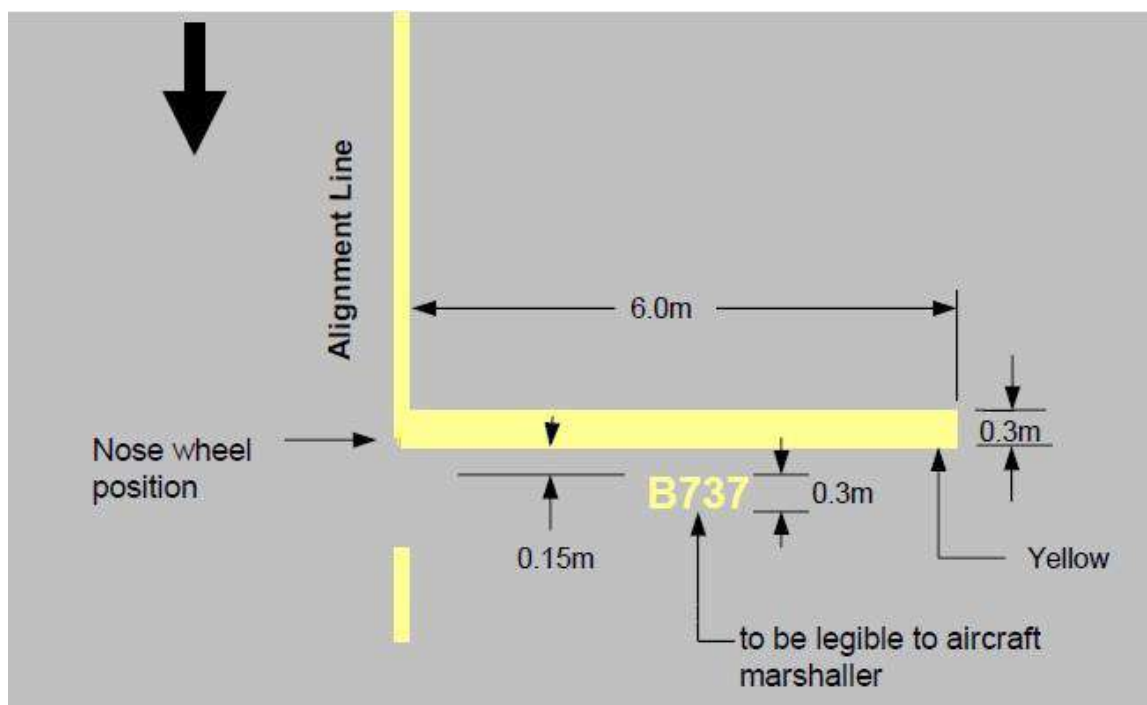


Figure 8.5-11: Marshaller stop line

8.5.17 Pilot stop line

- 8.5.17.1 If required, a pilot stop line must be located so that when the aircraft is stopped, the line is immediately to the left of the pilot. The pilot stop line must be 6 m long and offset from the alignment line as follows:

Reference Code Letter	Offset X
C	5 m
D	10 m
E	10 m

Table 8.5-2

- 8.5.17.2 Where aircraft of all codes are to be accommodated at the one parking position, the offset for code letter C must be used and the marking extended in length to 11 m.
- 8.5.17.3 The aircraft type designation must be written in yellow letters 1 m high and spaced 0.15 m below the pilot stop line, as shown below.

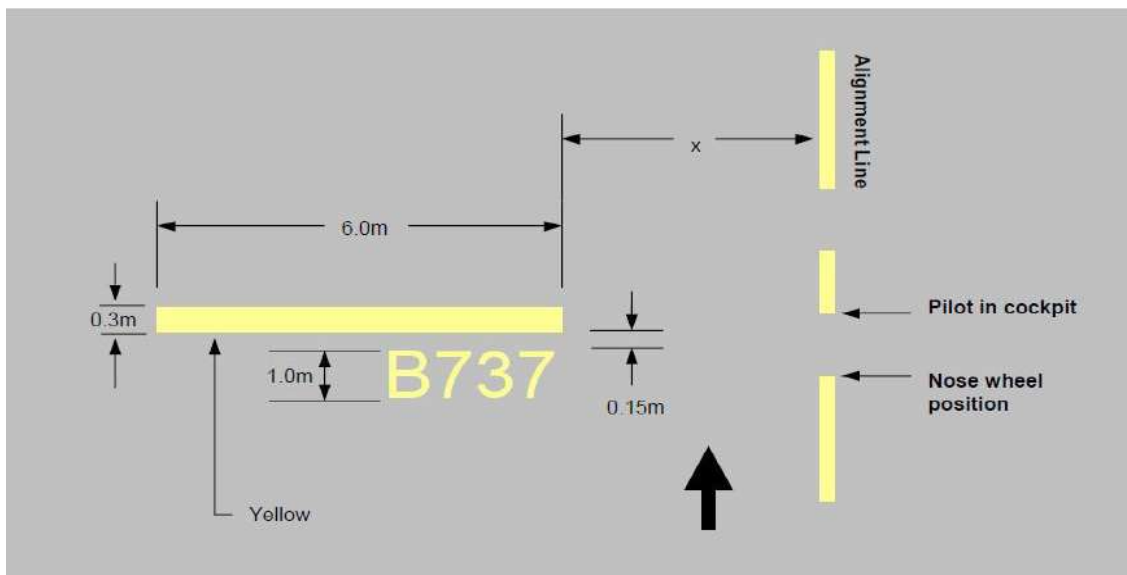


Figure 8.5-12: Pilot stop line (no marshaller)

8.5.18 Alignment Line

- 8.5.18.1 The alignment line must extend from the location of the nose wheel in the parked position, backwards under the body of the aircraft for a distance 'X' in Table 8.5-3. The line must also extend forward, commencing at a point 3 m past the most forward nose wheel position and extending for a distance 'Y', in the table. A one (1) m long section of the alignment line must be placed in the center of the 3 m gap, as shown in Figure 8.5-13.

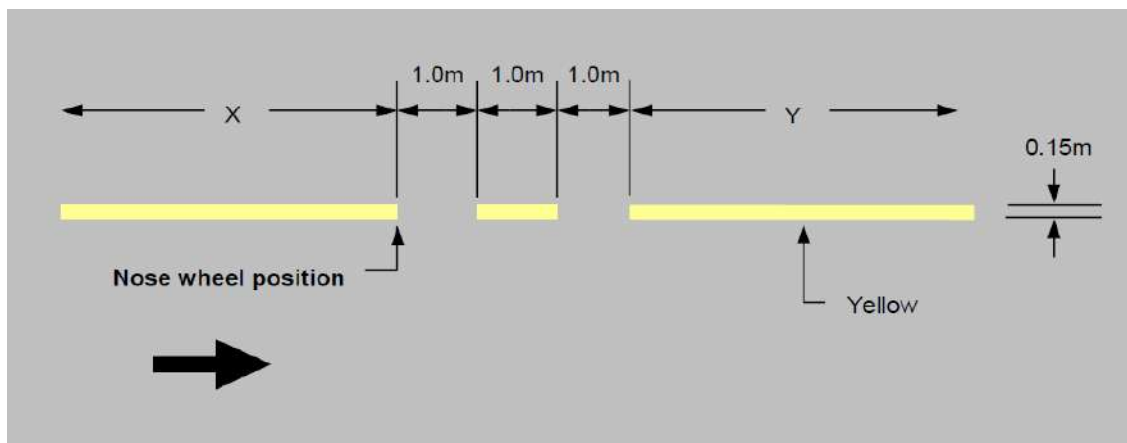


Figure 8.5-13: Alignment line

Reference Code Letter	Distance Y	Distance X
A & B	9 m	5 m
C, D & E	18 m	10 m

Table 8.5-3

8.5.18.2 An alignment bar shall be placed so as to be coincident with the extended centerline of the aircraft in the specified parking position and visible to the pilot during the final part of the parking maneuver. It shall have a width of not less than 15 cm.

8.5.19 Secondary aircraft parking position markings

8.5.19.1 These alternative markings are used during abnormal circumstances, or to allow a larger number of smaller aircraft to use the same apron area as a smaller number of larger aircraft using the primary positions. Secondary markings may be either keyhole markings or triangle markings, painted yellow, except where the secondary position markings overlap the primary position markings. In the latter case, the markings must be painted white.

8.5.20 Keyhole marking

8.5.20.1 Where the secondary position is designed for aircraft with wingspan 15 m or greater, it must be identified with a keyhole marking, comprising an alignment line oriented in the desired alignment, and a terminating ring; with a parking position designator, as shown in Figure 8.5-14.

Note: - For aircraft having a wingspan of 15 m or greater:

- (a) *Nose wheel position is center of the circle.*
- (b) *Use white paint if likely to be confused with primary position markings.*

8.5.20.2 The marking must be located so that the center of the ring is at the final nose wheel position. Where required, any aircraft type or weight limit designation must be located at the commencement of the associated dotted lead-in line.

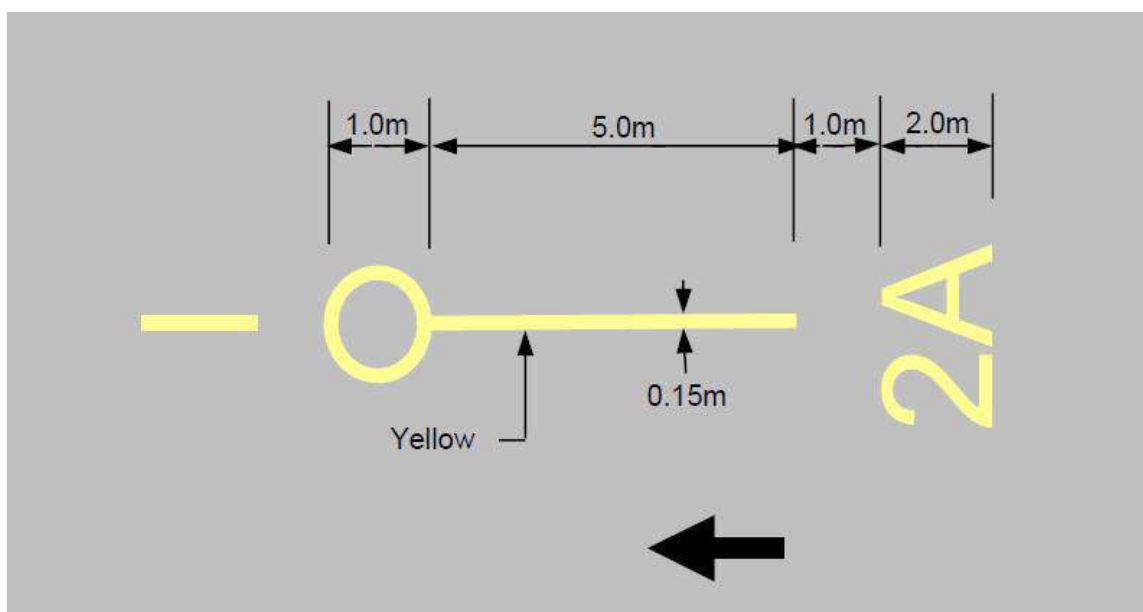


Figure 8.5-14: Keyhole marking

8.5.21 Triangle marking

8.5.21.1 Where the secondary position is designed for aircraft with a wingspan of less than 15 m, it must be identified with a triangle marking comprising an alignment line, and a triangle, as shown in Figure 8.5-15. The triangle must be so located that its center is the final nose wheel position.

Note: - For aircraft having a wingspan less than 15 m:

- (a) *Nose wheel position is center of the circle.*
- (b) *Use white paint if likely to be confused with primary position markings.*

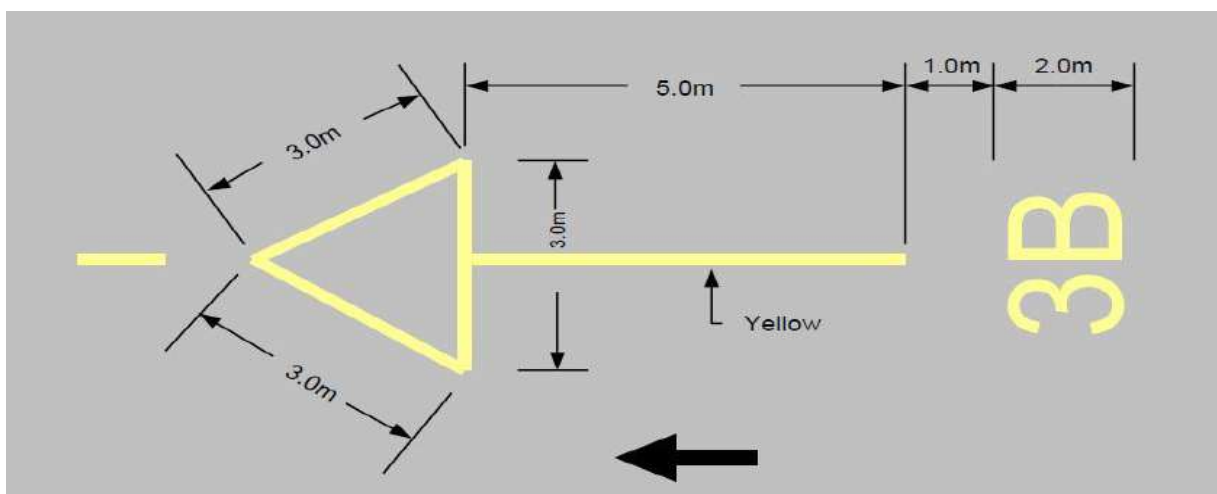


Figure 8.5-15: Triangle marking

8.5.22 Lead-out line

8.5.22.1 Lead-out lines must comprise a broken line, painted yellow with stripes 1 m long and 0.15 m wide, spaced at 1 m intervals. The lead-out line must commence from the alignment line at least 3 m from the nose wheel position, as shown in Figure 8.5-16.

8.5.22.2 The lead-out line must extend to a point from where the pilot can clearly see the taxi guideline. If arrow indicators are inserted, the first arrow must be at least 15 m from the alignment line, with subsequent arrows at 30 m spacing.

8.5.23 Designation markings

8.5.23.1 Designation markings are used to provide supplementary information, on all asphalt, sealed and concrete aprons where there is more than one aircraft parking position.

8.5.23.2 Primary parking positions must be numbered sequentially with no omissions.

8.5.23.3 Secondary positions must be identified with the same numbers as the associated primary position, together with an alphabetical suffix.

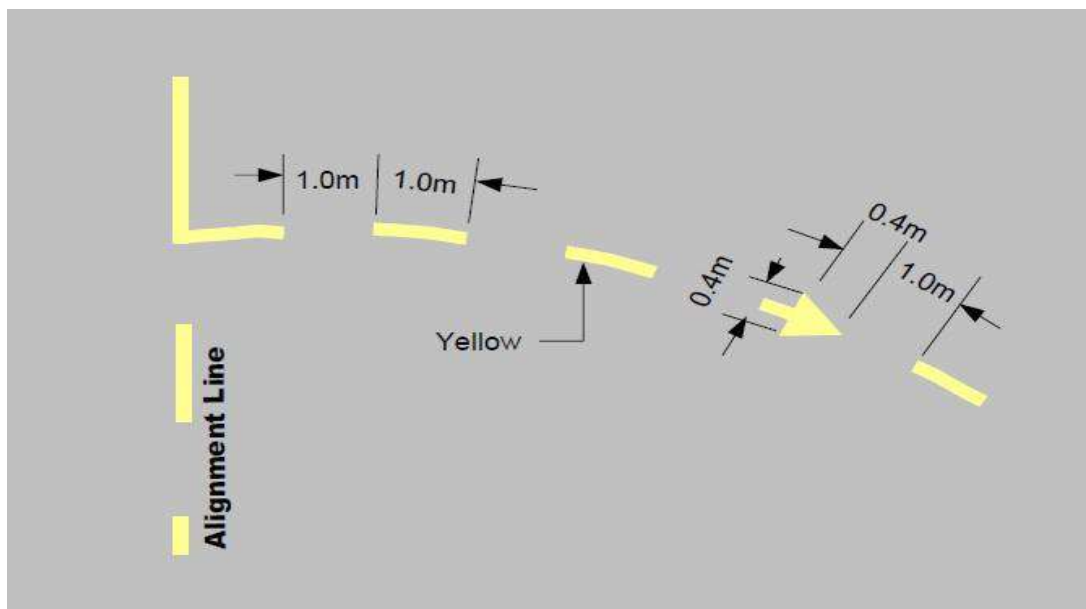


Figure 8.5-16: Lead-out line

8.5.24 Aircraft parking position designation

- 8.5.24.1 The parking position designation must be located adjacent to the parking position, either on the ground or on the aerobridge, and be visible to the pilot.
- 8.5.24.2 For fixed wing aircraft, the position designation, marked on the ground, must be placed 4 m forward of the nose wheel position and 5 m to the left, as viewed by the pilot. The designation must be yellow, and consist of characters 1 m high in a 2 m inside diameter circle with a 0.15 m line thickness, as shown in Figure 8.5-17.
- 8.5.24.3 At aerobridge positions, the aerobridge designation must be the same as the associated parking position designation. The size of the position designation must not be less than the legend and face size specified in Table 8.6-1.
- 8.5.24.4 An illustration showing a combination of all the aircraft parking position markings at an aircraft parking position is shown in Figure 8.5-18.

8.5.25 Designation characters for taxi and apron markings

Note: - 1. See MOS 8.5.34 and 8.5.35, for specifications on the application, location and characteristics of mandatory instruction markings and information markings.

Note: - 2 The form and proportions of the letters, numbers and symbols of mandatory instruction markings and information markings must be on a grid.

- 8.5.25.1 All letters and numbers used in designations for taxi and apron markings must conform in style and proportion to the following illustrations. Actual dimensions must be determined in proportion to the overall height standard for each specific designator.

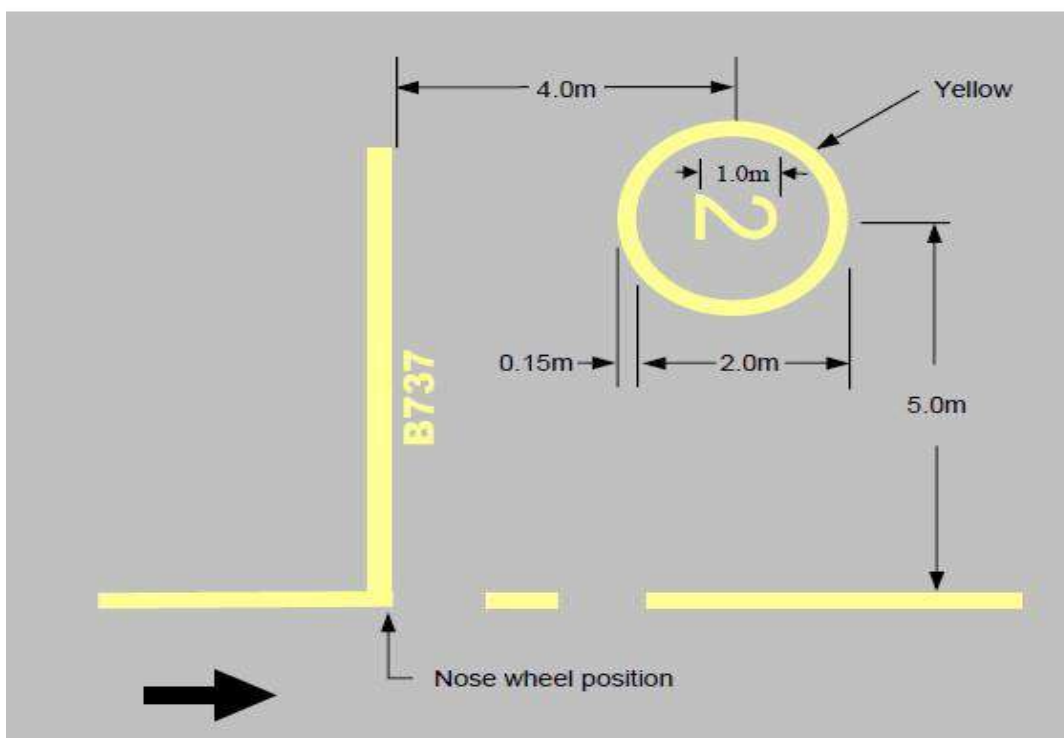


Figure 8.5-17: Aircraft parking position designation

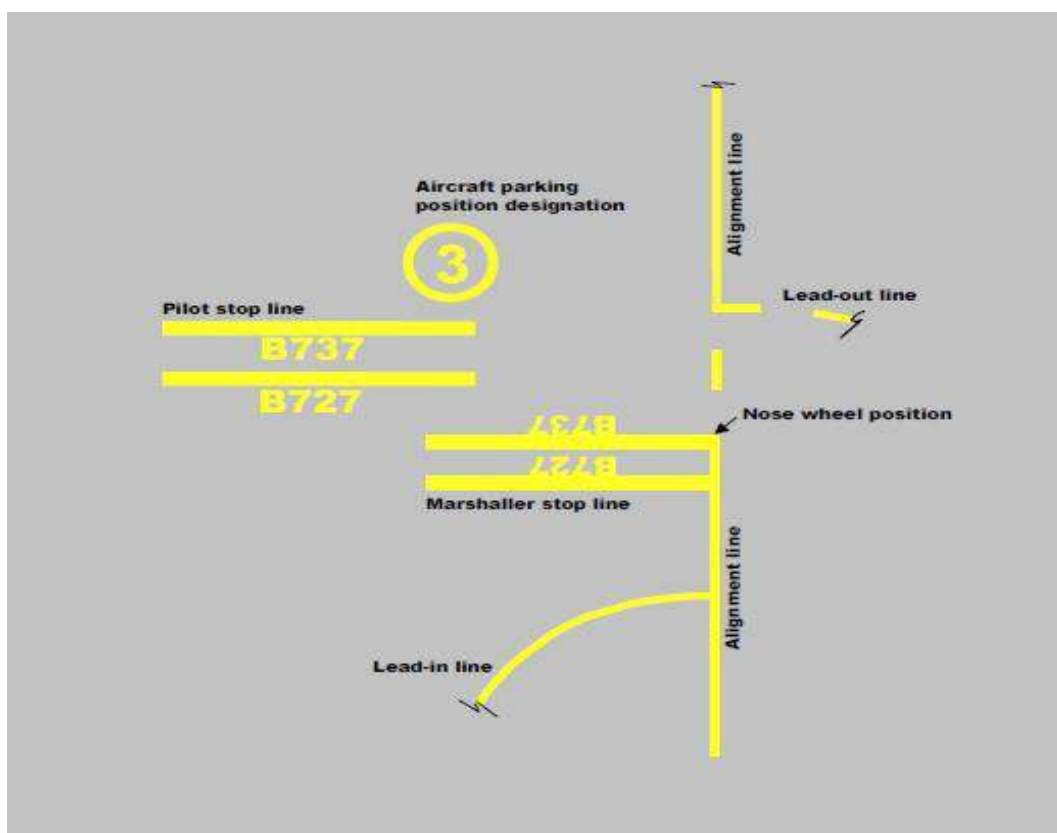


Figure 8.5-18: Aircraft parking position markings

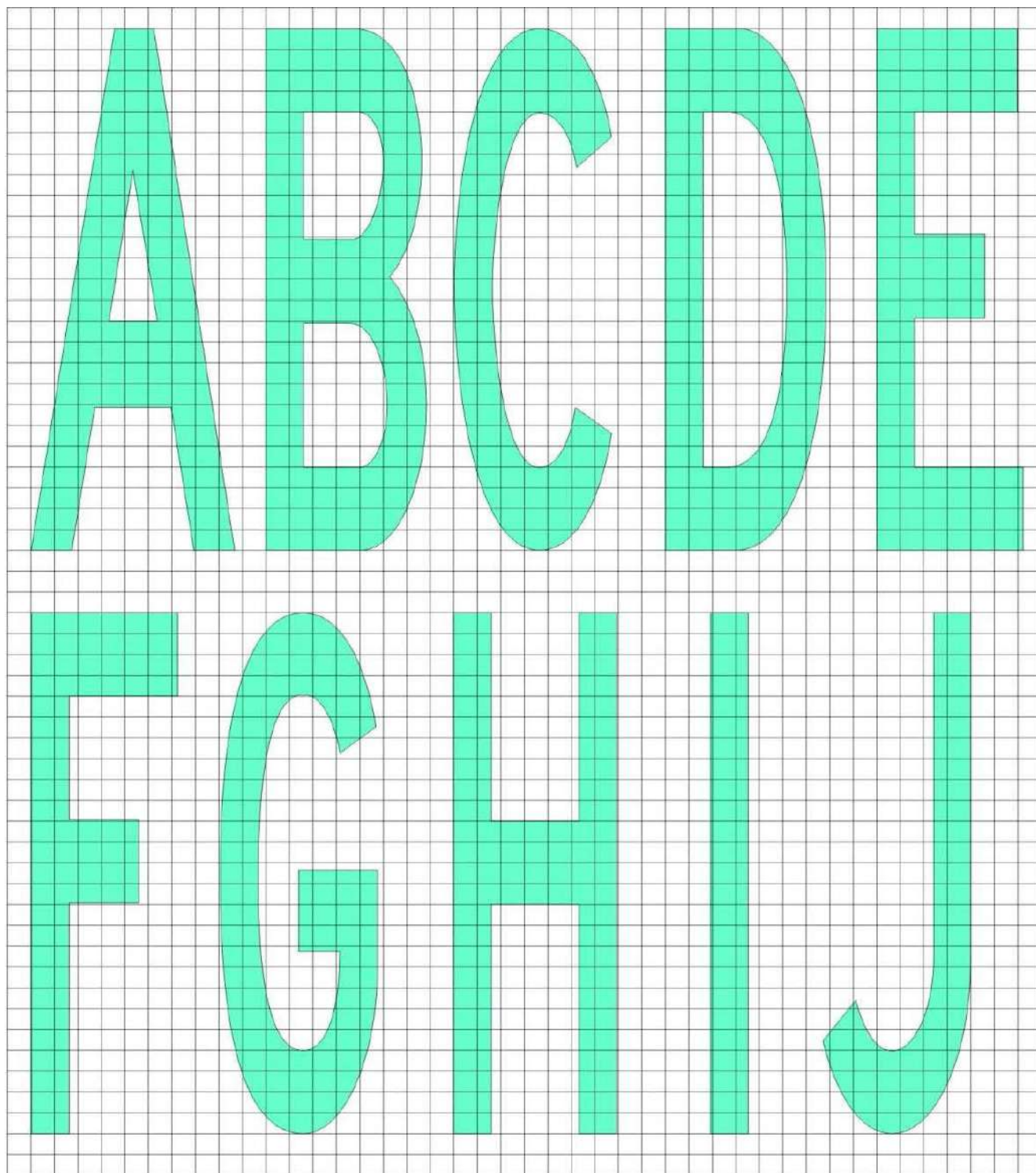


Figure 8.5-19: Letters and numbers used in designations for taxiway and apron markings

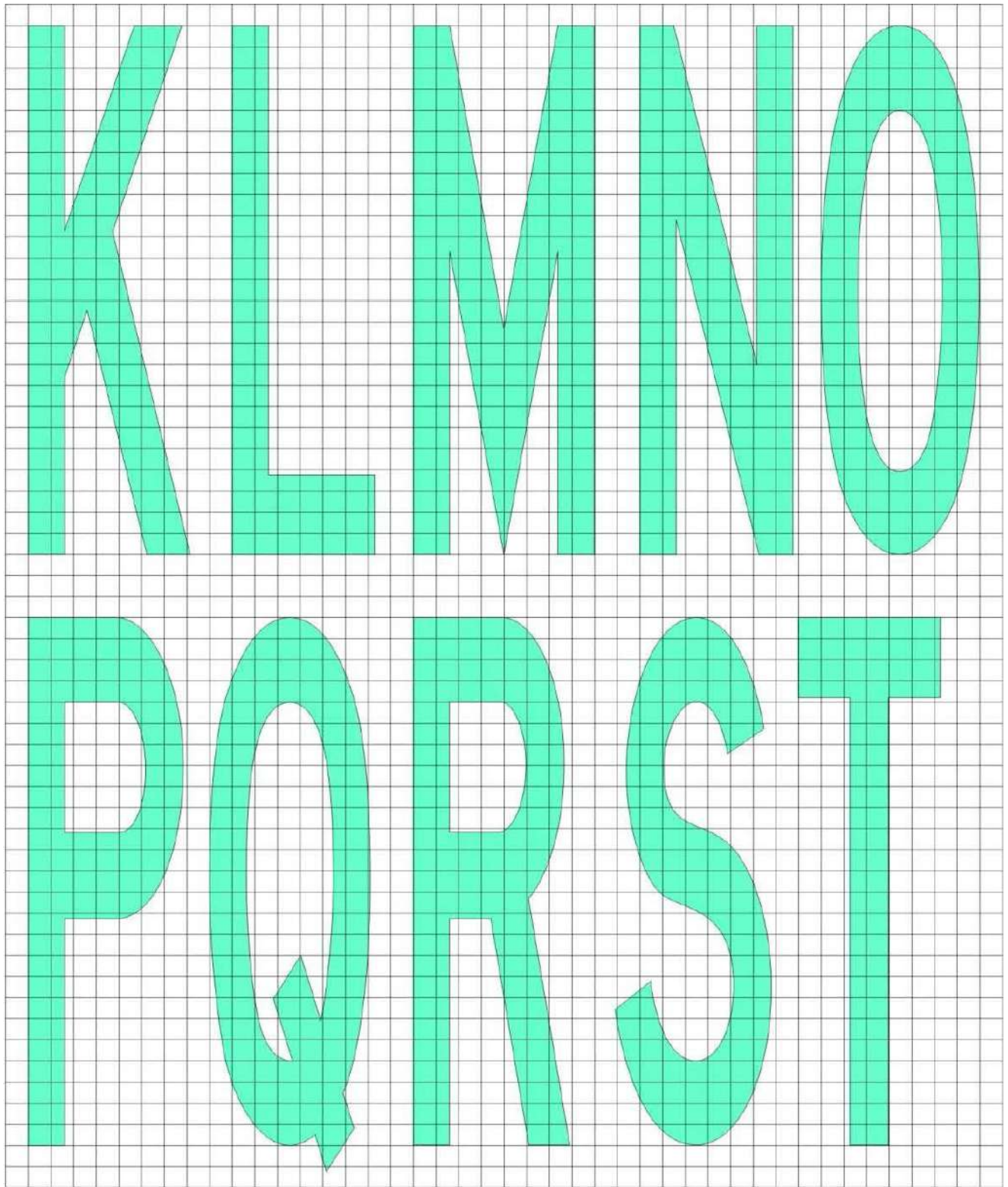


Figure 8.5-20: Letters and numbers used in designations for taxiway and apron markings

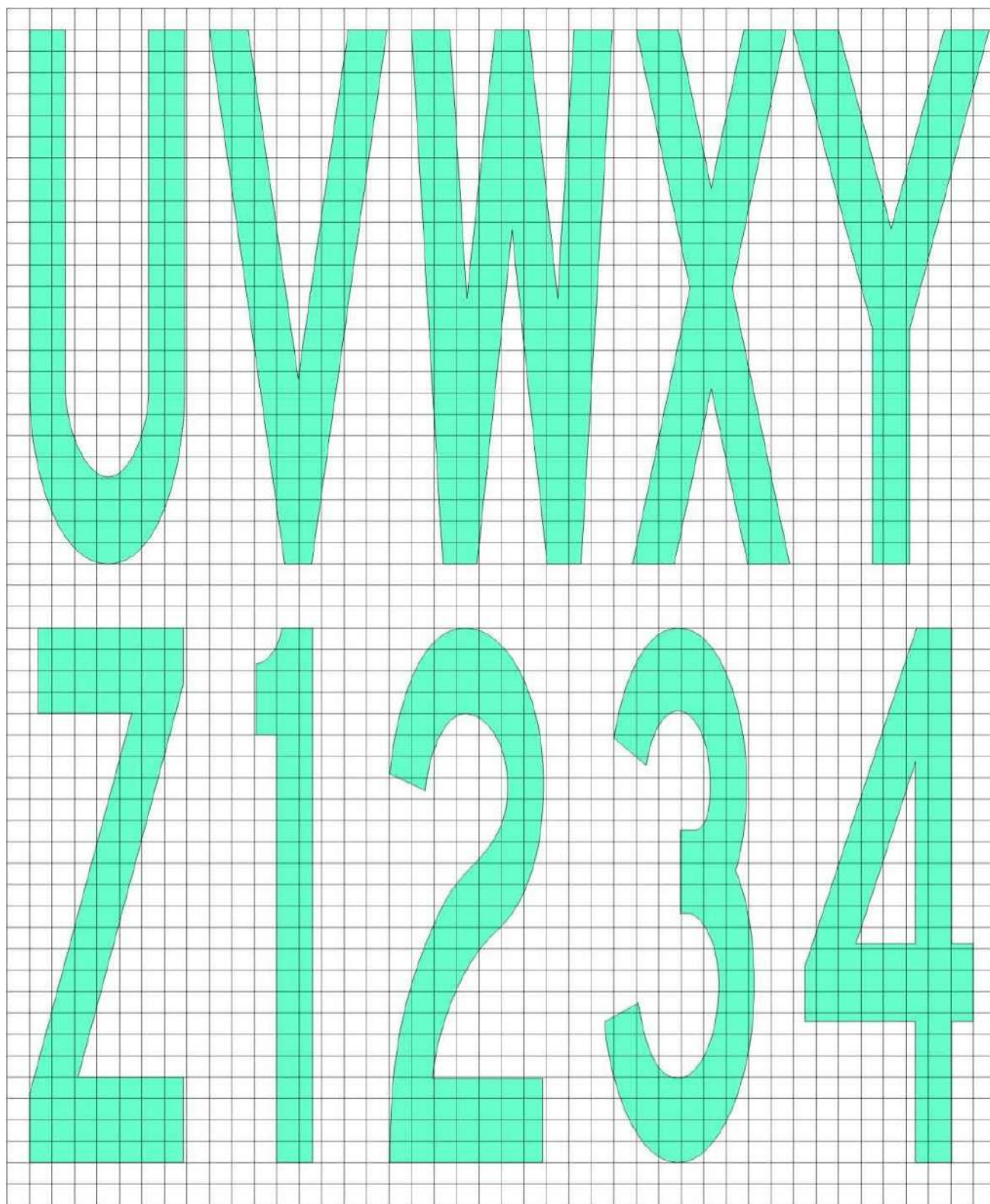


Figure 8.5-21: Letters and numbers used in designations for taxiway and apron markings

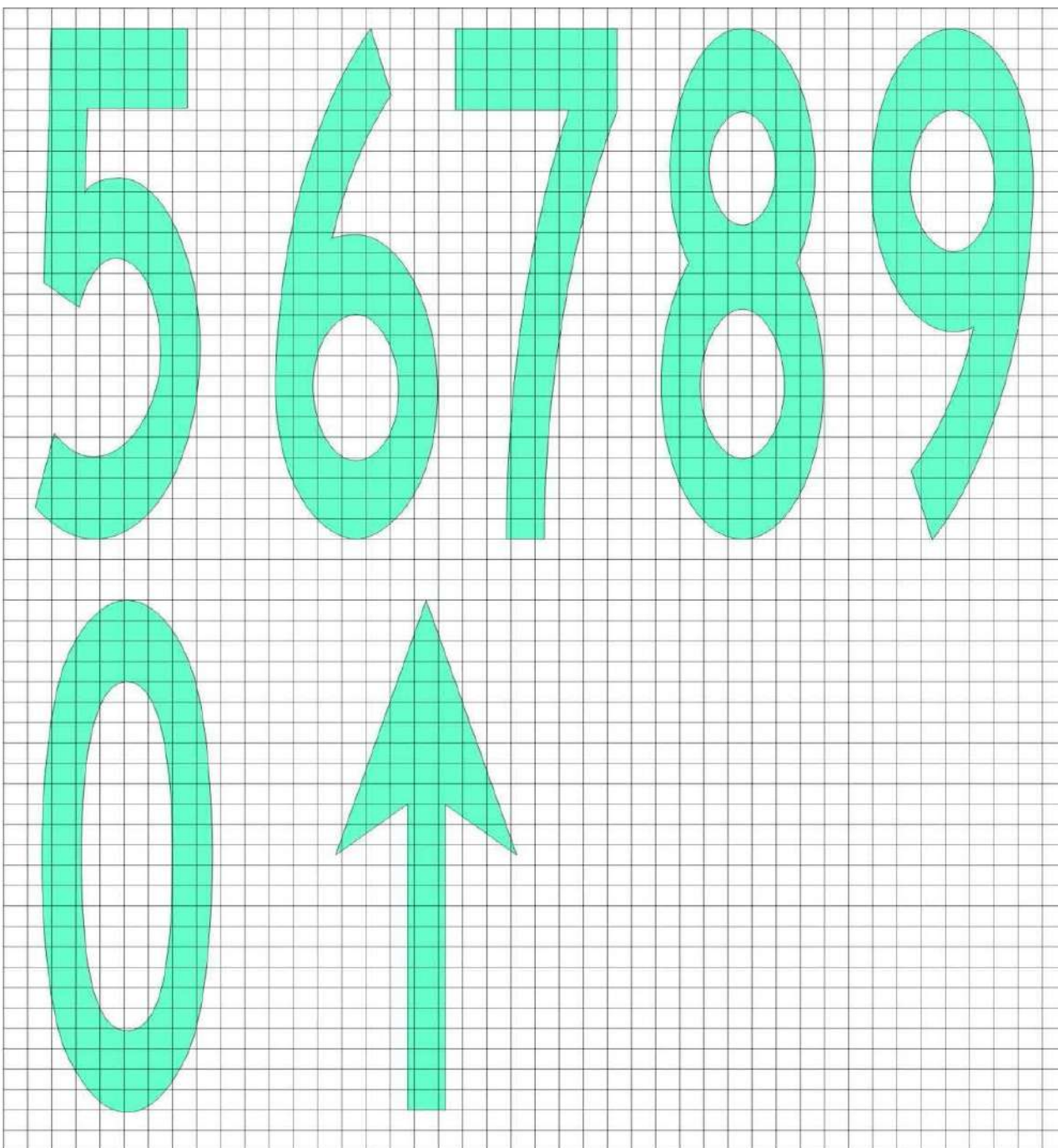


Figure 8.5-22: Letters and numbers used in designations for taxiway and apron markings

Note: - The mandatory instruction markings and information markings on pavements are formed as if shadowed (i.e., stretched) from the characters of an equivalent elevated sign by a factor of 2.5 as shown in the figure below. The shadowing, however, only affects the vertical dimension. Therefore, the spacing of characters for pavement marking is obtained by first determining the equivalent elevated sign character height and then proportioning from the spacing values given in Figure 8.6-7.

For example, in the case of the runway designator "10" which is to have a height of 4 000 mm (H_{ps}), the equivalent elevated sign character height is $4\ 000/2.5=1\ 600$ mm (H_{es}). Figure 8.6-7 (b) indicates numeral to numeral code 1 and from Table A4-1(c) Figure 8.6-7 (c). This code has a dimension of 96 mm, for a character height of 400 mm. The pavement marking spacing for "10" is then $(1\ 600/400)*96=384$ mm.

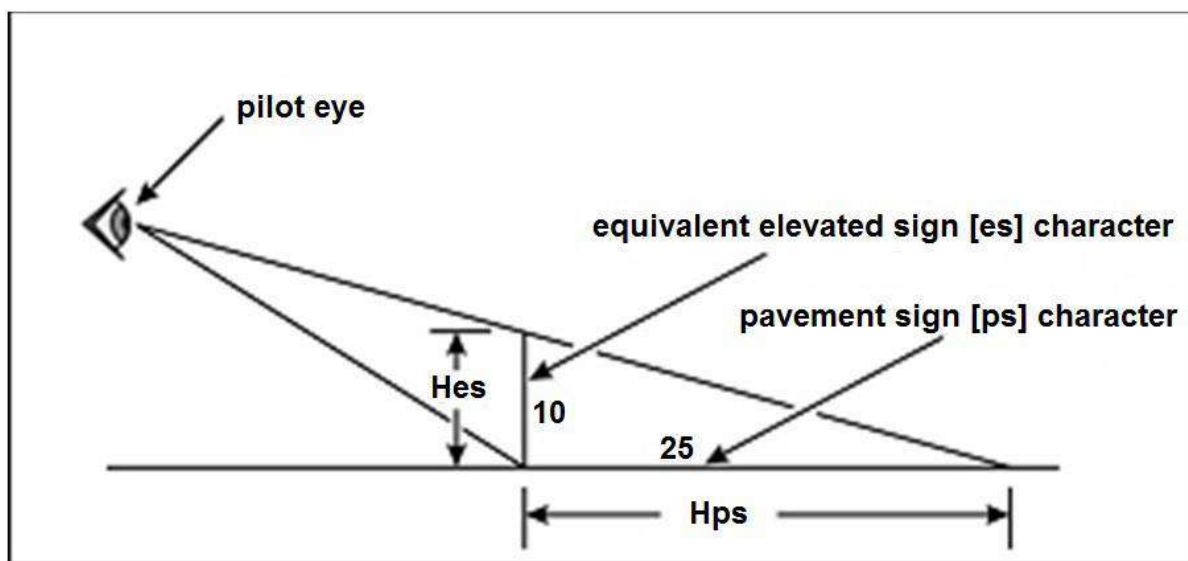


Figure 8.5-23: Mandatory Instruction and Information Markings

8.5.26 Tug operator guidance marking

8.5.26.1 Tug operator guidance marking must be provided on aprons where aircraft are being pushed back by tugs.

8.5.27 Aircraft push-back lines

8.5.27.1 The push-back line must be a broken line, painted white, comprising stripes 1 m long and 0.15 m wide, spaced at 1 m intervals. The line must be based on the required path of the nose wheel of the design aircraft. Where the line is used for tug operations with aircraft of reference code letter C, D and E, the final 10 m before the tow bar disconnect point must be straight.

8.5.28 Tug parking position lines

8.5.28.1 The tug parking position line marking must be provided at aerobridges and other power-in/push-out aircraft parking positions, to ensure parked tugs are clear of incoming aircraft. The marking must consist of a red line 0.10 m wide in the shape of a U, 3.5 m by 1.0 m commencing 3 m from the nose of the critical aircraft, as illustrated, below.

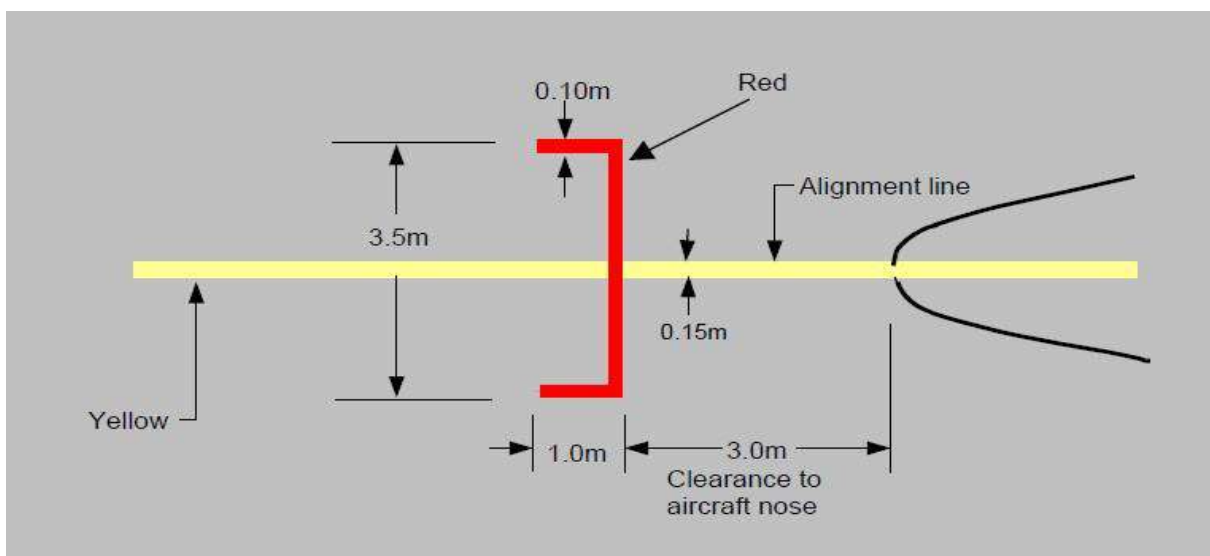


Figure 8.5-24: Tug parking position line

8.5.29 Tow bar disconnect markings

- 8.5.29.1 The tow bar disconnect point shown in Figure 8.5-25 must be located at the point of disconnection and must consist of a white line, 1.5 m long and 0.15 m wide, located on the left side of the taxi guideline or push-back line, as viewed from the tug, touching the guideline and at right angles to it.

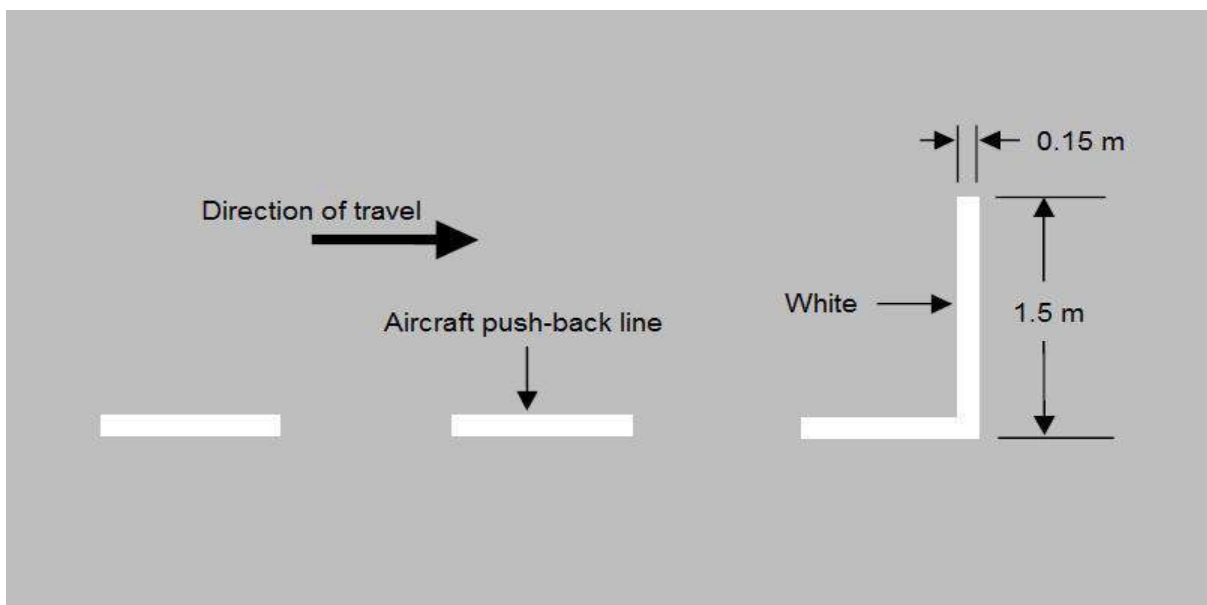


Figure 8.5-25: Tow bar disconnect marking

8.5.30 Push-back limit markings

- 8.5.30.1 Push-back limit markings must comprise of two parallel white lines at right angles and symmetrical about the push back line. The marking must be 1 m long, 0.15 m wide and lines are to be set 0.15 m apart, as shown below.

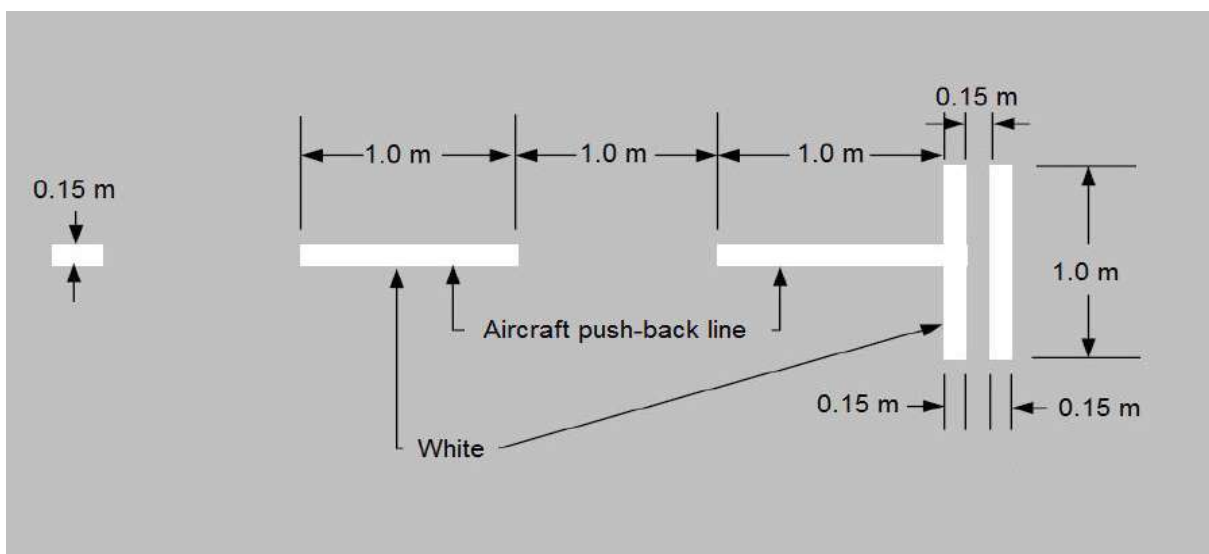


Figure 8.5-26: Push-back limit marking

8.5.31 Push-back alignment bars

- 8.5.31.1 Push-back alignment bars are provided to assist tug operators to align an aircraft correctly at the end of the push-back maneuver. The marking must be a broken white line, comprising stripes 1 m long and 0.15 m wide, spaced at 1 m intervals, for a length of 30 meters, aligned in the desired direction. The marking must commence 3 m past the tow disconnect marking, as shown below.

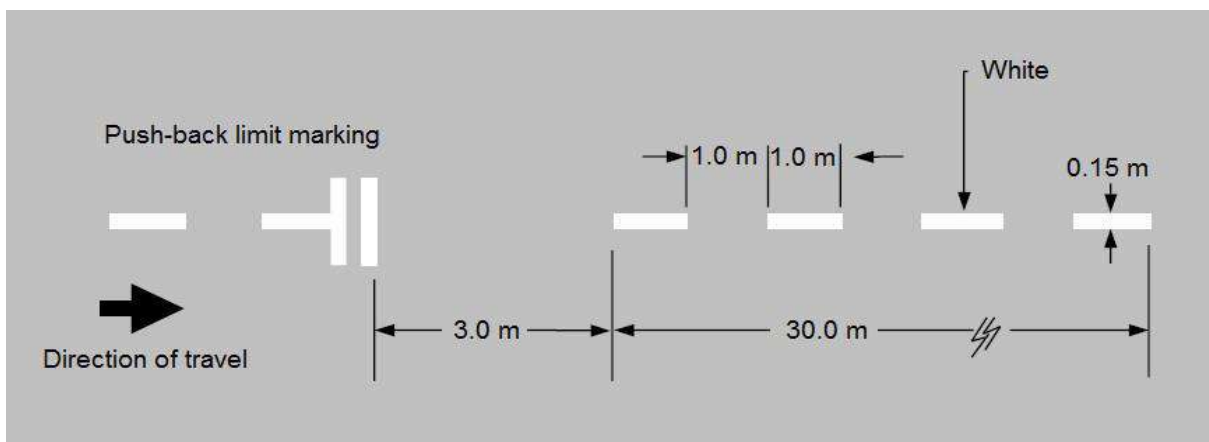


Figure 8.5-27: Push-back alignment line

8.5.32 Passenger path markings

- 8.5.32.1 Where provided, passenger path markings are provided to assist the orderly movement of passengers embarking or disembarking. Passenger path markings must be provided in accordance with the pattern and color of Department of Public Works and Highways (DPWH) pedestrian crossing marking standards. The width of the passenger pathway is to be commensurate with the expected pedestrian traffic.
- 8.5.32.2 The following diagram illustrates a typical layout for a pedestrian crossing.

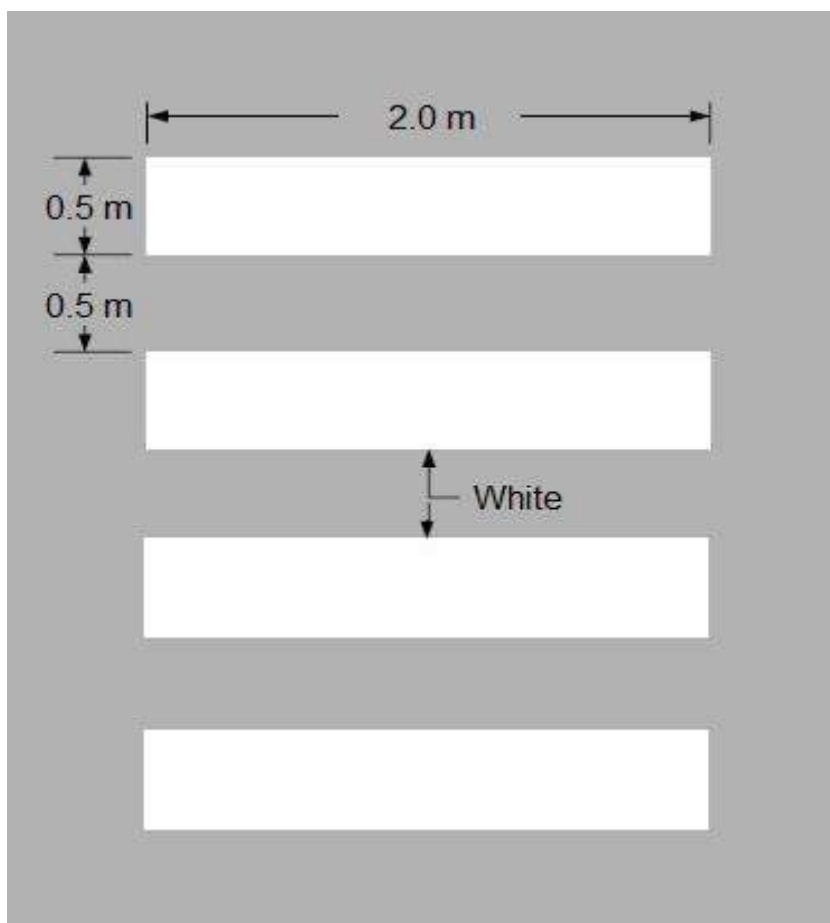


Figure 8.5-28: Pedestrian crossing

8.5.33 Road holding position marking

- 8.5.33.1 A road holding position marking shall be provided at all road entrances to a runway. It shall be located across the road at the holding position, and shall be in the form and color in accordance with local road traffic regulations. If no such regulations apply, it shall be in a form and color acceptable to CAAP.

8.5.34 Mandatory Instruction markings

Note: - Guidance on mandatory instruction marking is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- 8.5.34.1 Where it is impracticable to install a mandatory instruction sign in accordance with MOS 8.6.7.1 a mandatory instruction marking is to be provided on the surface of the pavement.
- 8.5.34.2 A mandatory instruction marking on taxiways where the code letter is A, B, C or D shall be located across the taxiway equally placed about the taxiway centerline and on the holding side of the runway holding position marking as shown in Figure 8.5-29 (A). The distance from the nearest edge of the marking and the runway holding position marking or centerline marking shall be not less than 1 m.

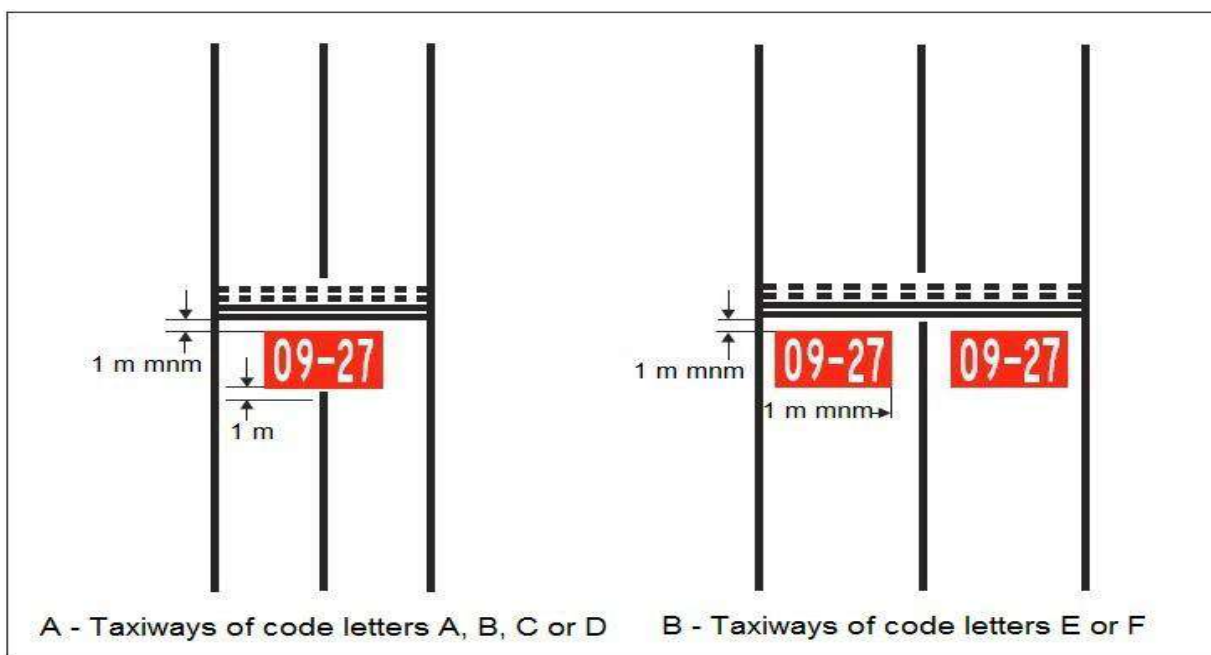


Figure 8.5-29: Mandatory instruction marking

- 8.5.34.3 A mandatory instruction marking on taxiways where the code letter is E or F shall be located on each side of the taxiway centerline and on the holding side of the runway holding position marking as shown in Figure 8.5-29(B). The distance from the nearest edge of the marking and the runway holding position marking or centerline marking shall be not less than 1 m.
- 8.5.34.4 A mandatory instruction marking shall consist of an inscription in white on a red background. Except for a NO ENTRY marking, the inscription shall provide information identical to that of the associated mandatory instruction sign. A NO ENTRY marking shall consist of an inscription in white reading NO ENTRY on a red background.
- 8.5.34.5 Where there is insufficient contrast between the marking and the pavement surface the mandatory instruction marking shall include an appropriate border, preferably white or black.
- 8.5.34.6 The character height for mandatory instruction should be 4 m for inscriptions where the code letter is C, D, E or F and 2 m otherwise. The inscriptions shall be in the form and proportions shown in Figure 8.5-19 to 8.5-22. The background of the marking shall extend at least 0.5 m laterally and vertically beyond the extremities of the inscription.
- 8.5.34.7 Where operationally required, such as on taxiways exceeding 60 m in width, or to assist in the prevention of a runway incursion, a mandatory instruction sign shall be supplemented by a mandatory instruction marking.
- 8.5.34.8 Except where operationally required, a mandatory instruction marking shall not be located on a runway.

8.5.35 Information markings

Note: - Guidance on information marking is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

- 8.5.35.1 Where an information sign would normally be installed but it is impractical to install, an information marking shall be displayed on the surface of the pavement.
- 8.5.35.2 Where operationally required an information sign shall be supplemented by an information marking.
- 8.5.35.3 An information (location/direction) marking shall be displayed prior to and following complex taxiway intersections and where operational experience has indicated the addition of a taxiway location marking could assist flight crew ground navigation.
- 8.5.35.4 An information (location) marking shall be displayed on the pavement surface at regular intervals along taxiways of great length.
- 8.5.35.5 The information marking shall be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.
- 8.5.35.6 An information marking shall consist of:
- (a) an inscription in yellow on a black background when it replaces or supplements a location sign; and
 - (b) an inscription in black on a yellow background when it replaces or supplements a direction or destination sign.
- 8.5.35.7 Where there is insufficient contrast between the marking background and the pavement surface, the marking shall include:
- (a) a black border where the inscriptions are in black; and
 - (b) a yellow border where the inscriptions are in yellow
- 8.5.35.8 The character height for information markings should be 4 m. The inscriptions shall be in the form and proportions shown in MOS Figure 8.5-19 to 8.5-22.

8.5.36 Typical apron markings

- 8.5.36.1 The following Figure 8.5-30 illustrates an apron with typical apron markings.

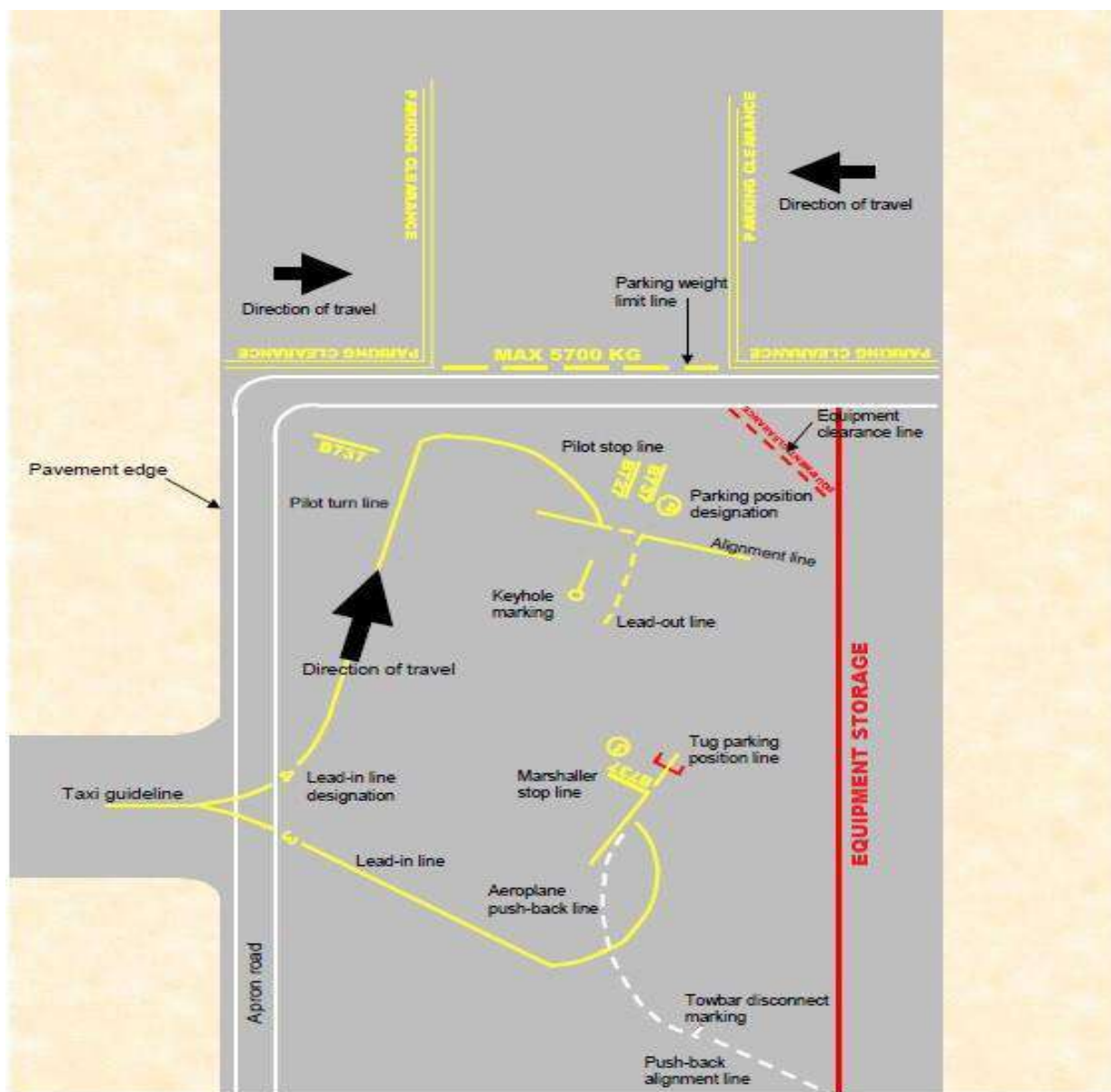


Figure 8.5-30: Typical apron markings

8.5.37 VOR aerodrome checkpoint marking

8.5.37.1 When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

Note: - See MOS 8.6.21 for VOR aerodrome checkpoint sign.

8.5.37.2 Site selection

Note: - Guidance on the selection of sites for VOR aerodrome checkpoints is given in CAR-ANS Part 6 Attachment E.

A VOR aerodrome checkpoint marking shall be centered on the spot at which an aircraft is to be parked to receive the correct VOR signal.

- 8.5.37.3 VOR aerodrome checkpoint marking shall consist of a circle 6 m in diameter and have a line width of 15 cm [see Figure 8.5-31 (A)].
- 8.5.37.4 When it is preferable for an aircraft to be aligned in a specific direction, a line shall be provided that passes through the center of the circle on the desired azimuth. The line shall extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line shall be 15 cm [see Figure 8.5-31(B)].
- 8.5.37.5 A VOR aerodrome checkpoint marking shall preferably be white in color but shall differ from the color used for the taxiway markings.

Note: - To provide contrast, markings may be bordered with black.

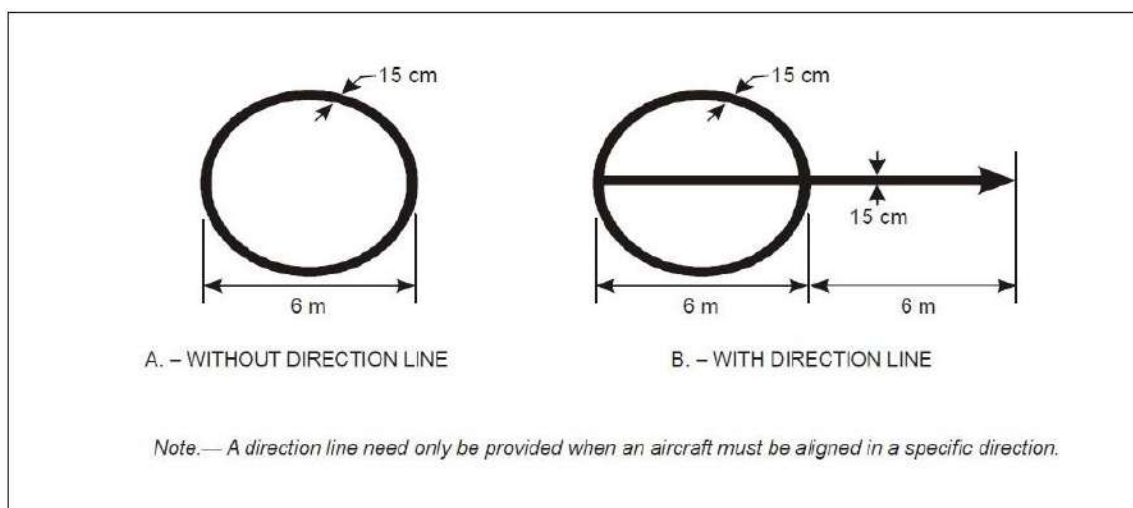


Figure 8.5-31: VOR aerodrome checkpoint marking

Section 8.6 Signs

8.6.1 Introduction

- 8.6.1.1 Signs that convey messages that must be obeyed by pilots are known as mandatory instruction signs. These signs must have white lettering on a red background. If required by CAAP for environmental or other factors to increase conspicuity of mandatory instruction signs, the outside edge of the inscription shall be supplemented by a black outline 10 mm in width for signs at runways code number 1 or 2, and 20 mm in widths for signs at other runway code numbers.
- 8.6.1.2 Signs that convey messages of information are known as information signs. These signs must have either black lettering on a yellow background, or yellow lettering on a black background.
- 8.6.1.3 A location sign shall consist of an inscription in yellow on a black background and where it is a stand-alone sign shall have a yellow border.
- 8.6.1.4 Mandatory signs must be provided at international aerodromes, and at other aerodromes that have air traffic control and for which CAAP determines such signs are required for safety reasons.

- 8.6.1.5 Aerodrome operators will consult with airlines and with Air Traffic Control, on the need for information signs. Notwithstanding this, information signs must be provided at aerodromes where taxiway intersection departures are permitted.

8.6.2 Naming of taxiway location signs

- 8.6.2.1 The following convention must be used in the naming of taxiway location signs:

- (a) a single letter shall be used, without numbers, to designate each main taxiway;
- (b) the same letter must be used throughout the length of taxiway, except where a turn of 90 degrees or more is made to join a runway, a different letter may be assigned to that portion of taxiway after the turn;
- (c) for each intersecting taxiway, a different single letter must be used;
- (d) When designating taxiways, the use of words such as inner and outer should be avoided wherever possible;
- (e) When designating taxiways, the use of the letters I, O or X shall not be used to avoid confusion with the numerals 1, 0 and closed marking wherever possible. Letter Q should only be used where unavoidable;
- (f) At aerodromes where the number of taxiways are or will be large, alphanumeric designators may be used for short intersecting taxiways. Successive intersecting taxiways must use the same letter, with sequential numbers. If sequential numbers are not practicable, due to geometry of the taxiway system, all pilot-used taxiway plans (aerodrome charts) must include advice as to the missing designators;
- (g) A taxiway shall be identified by a designator comprising a letter, letters or a combination of a letter or letters followed by a number;
- (h) the use of letters and numbers must be easily comprehensible. Should it ever be necessary to use double-digit alphanumeric designators, care must be taken to ensure the numbers used in the taxiway designation cannot in any way be confused with the runway designations. Abbreviations of geographic or relative location of taxiways, e.g. NP 1 (for north parallel taxiway No. 1), WC (for west crossing or west connecting taxiway) should not be used unless with prior approval of CAAP; and
- (i) The use of numbers alone on the maneuvering area shall be reserved for the designation of runways.

8.6.3 Dimensions, location and lettering

- 8.6.3.1 Signs must be located to provide adequate clearance to passing aircraft. The depth and width of the signboard is dependent on the location of the sign, the size of the characters and the length of message conveyed.

- 8.6.3.2 Where signs are provided only on one side of the taxiway, they must be located on the pilots' left side unless this is impracticable. Where signs are to be read from both directions, they must be oriented so as to be at right angles to the taxi guideline. Where signs are to be read in one direction only, they should be oriented so as to be at 75 degrees to the taxi guideline.

8.6.4 Sign size and location distances, incl. runway exit signs

8.6.4.1 Sign size and location distances must be in accordance with Table 8.6-1 and Table 8.6-2.

Sign Height (mm)					Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code Number	Type	Legend	Face (min)	Installed (max)		
1 or 2 ^a	I	200	300	700	5 - 11 m	3 - 10 m
1 or 2	M	300	450	900	5 - 11 m	3 - 10 m
3 or 4 ^a	I	300	450	900	11 - 21 m	8 - 15 m
3 or 4	M	400	600	1100	11 - 21 m	8 - 15 m
^a For runway exit signs, use the mandatory size.						
I - Information sign type, M - Mandatory instruction sign type.						

Table 8.6-1

Runway code number	Minimum character height		
	Mandatory instruction sign	Information sign	
		Runway exit and runway vacate signs	Other signs
1 or 2	300 mm	300 mm	200 mm
3 or 4	400 mm	400 mm	300 mm

Table 8.6-2

Note: - Where a taxiway location sign is installed in conjunction with a runway designation sign MOS 8.6.17, the character size shall be that specified for mandatory instruction signs.

8.6.4.2 The face height of signs, stroke width of letters and arrows shall be as follows:

Legend height	Face height (min)	Stroke width
200 mm	300 mm	32 mm
300 mm	450 mm	48 mm
400 mm	600 mm	64 mm

8.6.4.3 The form and proportion of the letters, numbers and symbols used on movement area guidance signs must be in accordance with Figure 8.6-1 to Figure 8.6-6 and Table 8.6-3. The grid spacing used in the following illustrations is 0.20 m.

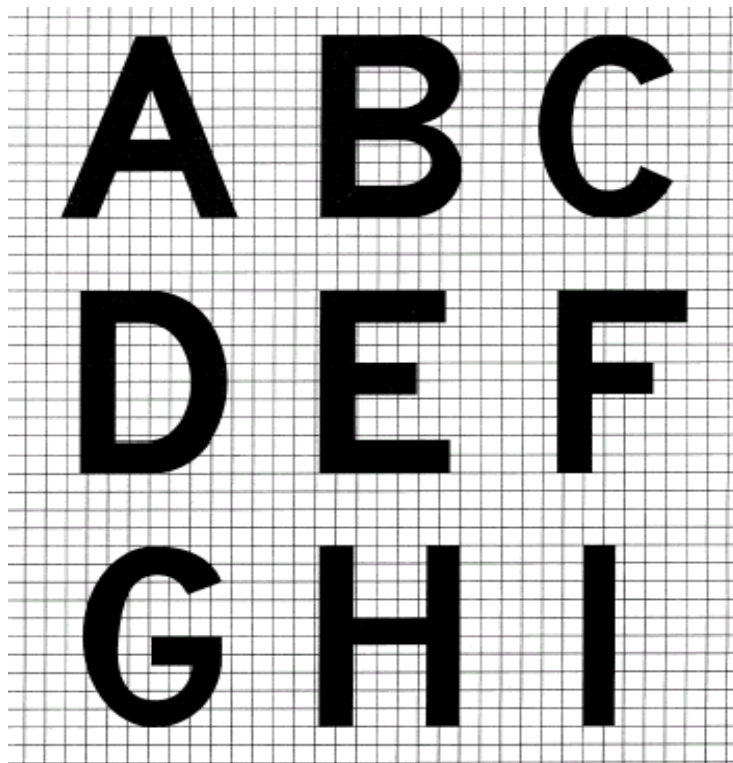


Figure 8.6-1: Form of characters

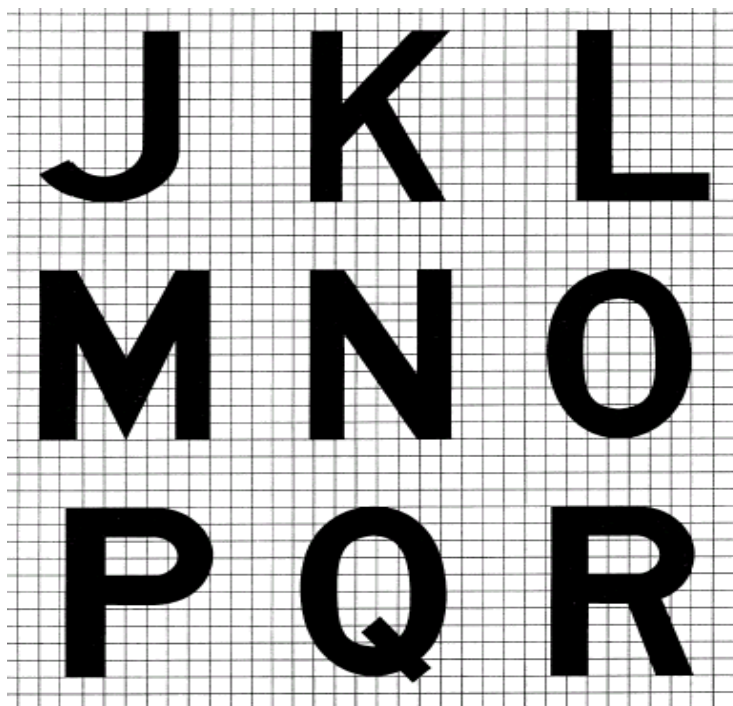


Figure 8.6-2: (cont.)

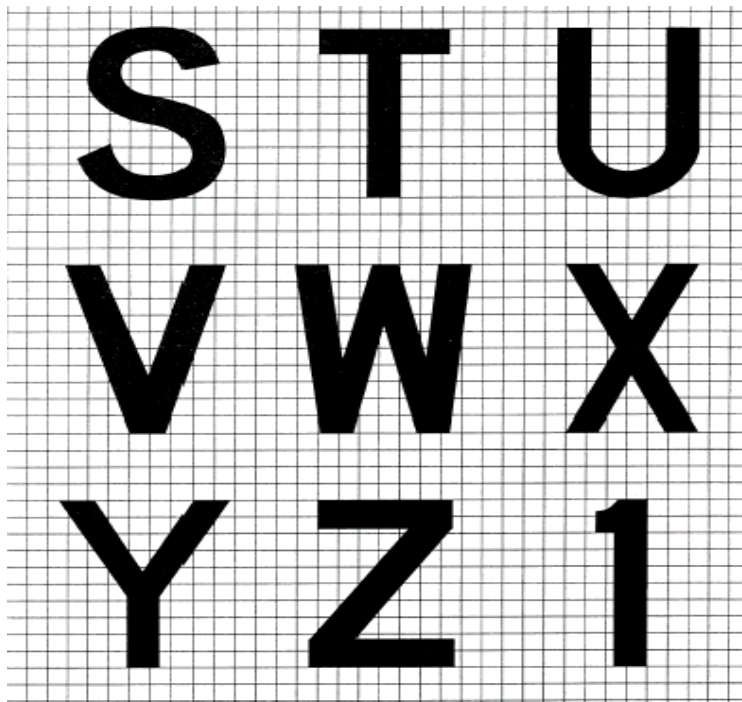


Figure 8.6-3: (cont.)

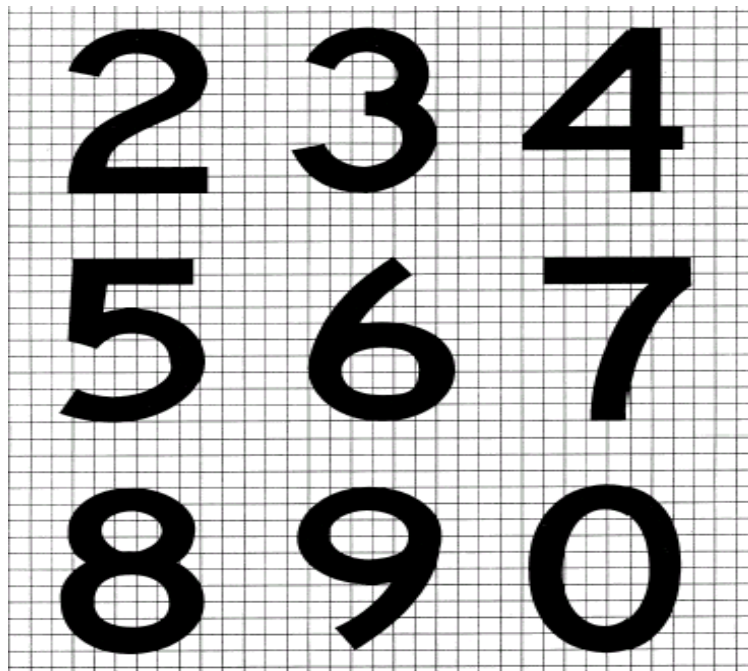


Figure 8.6-4: (cont.)

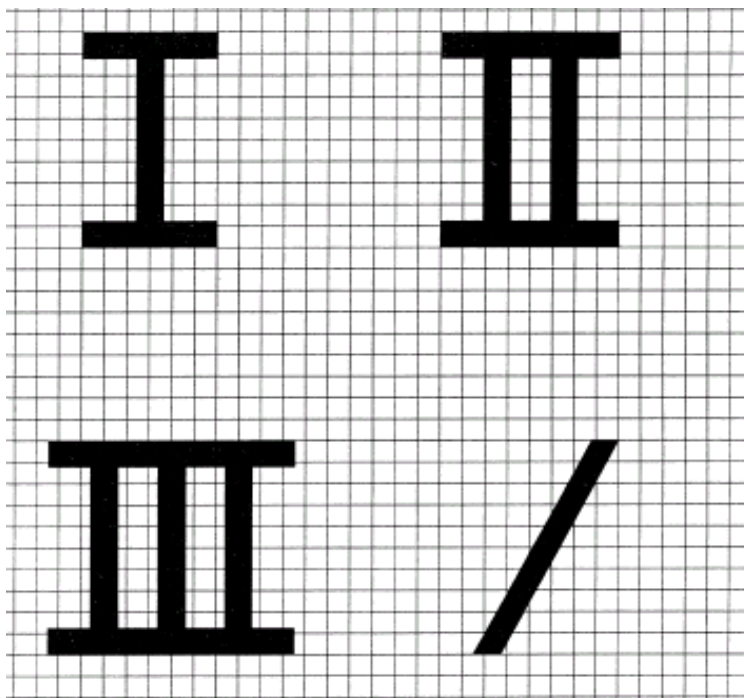
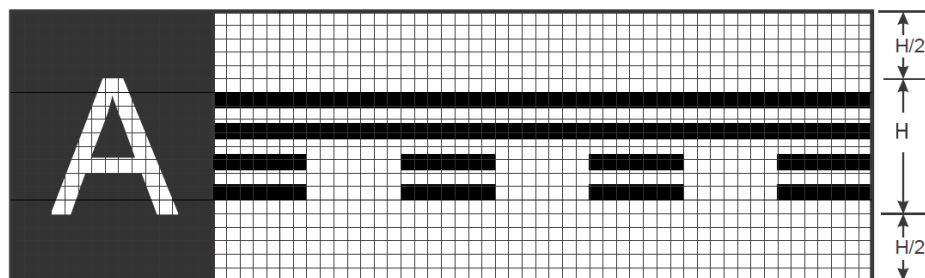
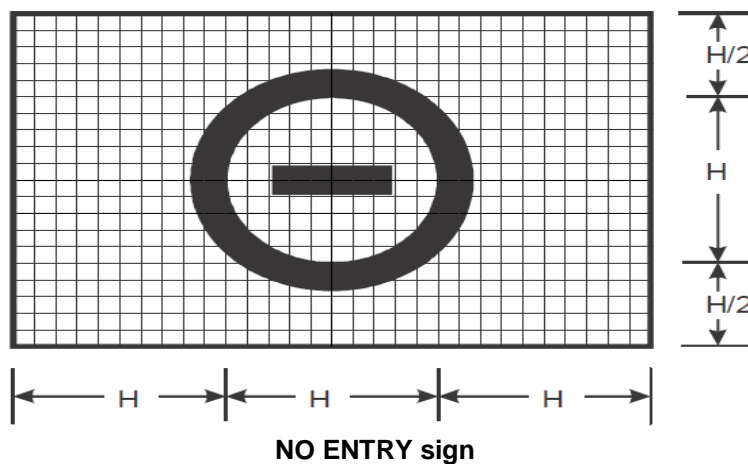


Figure 8.6-5: (cont.)



Runway vacated sign (with typical location sign)



NO ENTRY sign

Figure 8.6-6: Runway vacated and NO ENTRY signs

a) Letter to letter code number				
Preceding Letter	Following Letter			Code number
	B, D, E, F, H, I, K, L, M, N, P, R, U	C, G, O, Q, S, X, Z	A, J, T, V, W, Y	
A	2	2	4	
B	1	2	2	
C	2	2	3	
D	1	2	2	
E	2	3	3	
F	2	2	3	
G	1	2	2	
H	1	1	2	
I	1	1	2	
J	1	1	2	
K	2	2	3	
L	2	2	4	
M	1	1	2	
N	1	1	2	
O	1	2	2	
P	1	2	2	
Q	1	2	2	
R	1	2	2	
S	1	2	2	
T	2	2	4	
U	1	1	2	
V	2	2	4	
W	2	2	4	
X	2	2	3	
Y	2	2	4	
Z	2	2	3	

b) Numeral to numeral code number				
Preceding Numeral	Following Numeral			Code number
	1, 5	2, 3, 6, 8, 9, 0	4, 7	
1	1	1	2	
2	1	2	2	
3	1	2	2	
4	2	2	4	
5	1	2	2	
6	1	2	2	
7	2	2	4	
8	1	2	2	
9	1	2	2	
0	1	2	2	

c) Space between characters				
Code No.	Character height (mm)			Space (mm)
	200	300	400	
1	48	71	96	
2	38	57	76	
3	25	38	50	
4	13	19	26	

d) Width of letter				
Letter	Letter height (mm)			Width (mm)
	200	300	400	
A	170	255	340	
B	137	205	274	
C	137	205	274	
D	137	205	274	
E	124	186	248	
F	124	186	248	
G	137	205	274	
H	137	205	274	
I	32	48	64	
J	127	190	254	
K	140	210	280	
L	124	186	248	
M	157	236	314	
N	137	205	274	
O	143	214	286	
P	137	205	274	
Q	143	214	286	
R	137	205	274	
S	137	205	274	
T	124	186	248	
U	137	205	274	
V	152	229	304	
W	178	267	356	
X	137	205	274	
Y	171	257	342	
Z	137	205	274	

e) Width of numeral				
Numeral	Numeral height (mm)			Width (mm)
	200	300	400	
1	50	74	98	
2	137	205	274	
3	137	205	274	
4	149	224	298	
5	137	205	274	
6	137	205	274	
7	137	205	274	
8	137	205	274	
9	137	205	274	
0	143	214	286	

INSTRUCTIONS

- To determine the proper SPACE between letters or numerals, obtain the code number from table a) or b) and enter table c) for that code number to the desired letter or numeral height.
- The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single character such as 'A →', the space may be reduced to not less than one quarter of the height of the character in order to provide a good visual balance.
- Where the numeral follows a letter or vice versa use Code 1.
- Where a hyphen, dot, or diagonal stroke follows a character or vice versa use Code 1.
- For the intersection take-off sign, the height of the lower case "m" is 0.75 of the height of the preceding "0" (zero) and spaced from the preceding "0" at code 1 for the character height of the numerals.

Table 8.6-3: Letters and numeral widths and space between letter or numerals

8.6.4.4

The face width of signs shall be determined using MOS 8.6-7 except that, where a mandatory instruction sign is provided on one side of a taxiway only, the face width shall not be less than:

- 1.94 m where the code number is 3 or 4; and
- 1.46 m where the code number is 1 or 2.

Note: - Additional guidance on determining the face width of a sign is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

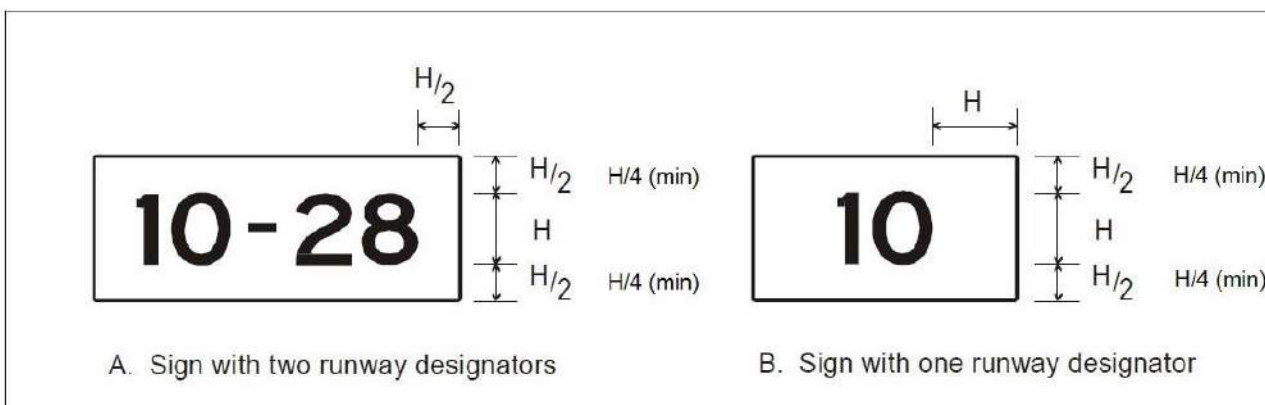


Figure 8.6-7 Sign dimensions

Explanatory Note to Figure 8.6-7: "H" stands for the inscription height

- 8.6.4.5 The forms of characters, i.e. letters, numbers, arrows and symbols, shall conform to those shown in Figure 8.6-1 to 8.6-6. The width of characters and the space between individual characters shall be determined as indicated in Table 8.6-3.
- 8.6.4.6 Borders
- The black vertical delineator between adjacent direction signs should have a width of approximately 0.7 of the stroke width.
 - The yellow border on a stand-alone location sign should be approximately 0.5 stroke width.
- 8.6.4.7 The colors of signs shall be in accordance with the appropriate specifications in MOS 9.2.
- 8.6.5 Structural requirements**
- 8.6.5.1 Signs must be lightweight and frangibly mounted. They must be constructed so as to withstand a wind velocity of up to 60 m/sec without sustaining damage. Mountings must be constructed so as to fail, for frangibility requirements, under a static load not exceeding 8 kPa distributed over the sign face.
- 8.6.5.2 Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. The installed height of the sign shall not exceed the dimension shown in the appropriate column of Table 8.6-1.
- 8.6.6 Illumination**
- 8.6.6.1 Signs shall be illuminated when they are intended for use:
- in runway visual range conditions of 800m or less;

- (b) at night in association with instrument runways; or
- (c) at night in association with non-instrument runways where the code letter is 3 or higher.

8.6.6.2 All signs shall be retroreflective and /or illuminated when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

8.6.6.3 Illumination must be provided to all mandatory instruction signs and information signs meant for use by code 4 aircraft. If the location of a sign is such that the retro-reflectiveness is ineffective, illumination must be provided. Both external and internal illumination is acceptable, but care must be taken to prevent dazzle.

8.6.6.4 The average sign luminance must be as follows:

- (a) where operations are conducted in runway visual range of less than 0 m, the average sign luminance must be at least:

Red	30 cd/m ²
Yellow	150 cd/m ²
White	300 cd/m ²

- (b) where operations are conducted at night, in runway visual range of 800 m or greater, average sign luminance must be at least:

Red	10 cd/m ²
Yellow	50 cd/m ²
White	100 cd/m ²

8.6.6.5 The luminance ratio between red and white elements of a mandatory sign must not be less than 1:5 and not greater than 1:10.

8.6.6.6 The average luminance of the sign is calculated by establishing grid points as shown in Figure 8.6-8 and using the luminance values measured at all grid points located within the rectangle representing the sign. This procedure is set out in Section 8.7.

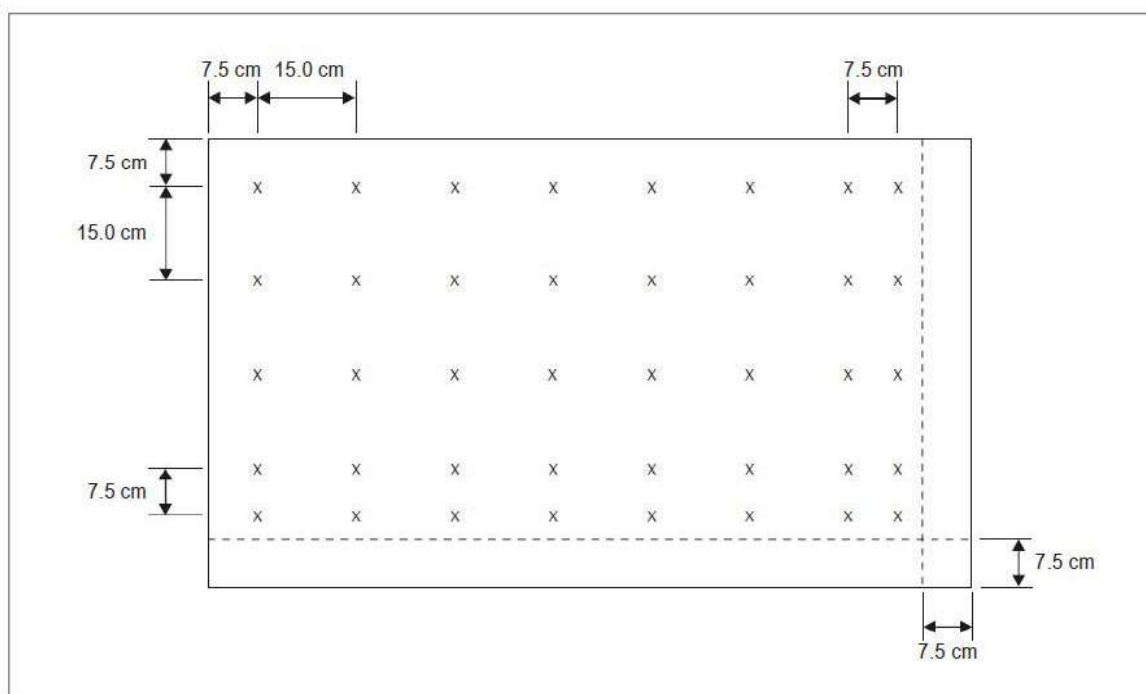


Figure 8.6-8: Grid points for calculating average luminance of a sign

Note: - 1. The average luminance of a sign is calculated by establishing grid points on a sign face showing typical inscriptions and a background of the appropriate color (red for mandatory instruction signs and yellow for direction and destination signs) as follows:

- a) *Starting at the top left corner of the sign face, establish a reference grid point at 7.5 cm from the left edge and the top of the sign face*
- b) *Create a grid of 15 cm spacing horizontally and vertically from the reference grid point. Grid points within 7.5 cm of the edge of the sign face shall be excluded.*
- c) *Where the last point in a row/column of grid points is located between 22.5 cm and 15 cm from the edge of the sign face (but not inclusive), an additional point shall be added 7.5 cm from this point.*
- d) *Where a grid point falls on the boundary of a character and the background, the grid point shall be slightly shifted to be completely outside the character.*

Note: - 2. Additional grid points may be required to ensure that each character includes at least five evenly spaced grid points.

Note: - 3. Where one unit includes two types of signs, a separate grid shall be established for each type.

8.6.6.7

The average value is the arithmetic average of the luminance values measured at all considered grid points.

Note: - Guidance on measuring the average luminance of a sign is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

8.6.6.8 In order to achieve uniformity of signal, luminance values must not exceed a ratio of 1.5:1 between adjacent grid points. Where the grid spacing is 7.5 cm, the ratio between luminance values of adjacent grid points must not exceed a ratio of 1.25:1. The ratio between the maximum and minimum luminance value over the whole sign face must not exceed 5:1.

8.6.6.9 Signs must have colors red, white, yellow, and black that comply with the relevant recommendations in MOS 9.2, for externally illuminated signs, retro-reflective signs and trans illuminated signs, as appropriate.

8.6.7 **Mandatory instruction signs**

Note: - See Figure 8.6-14 for pictorial representation of mandatory instruction signs and Figure 8.6-11 for examples of locating signs or sign positions at taxiway/runway intersections.

8.6.7.1 Mandatory instruction signs include runway designation signs, category I, II or III runway holding position signs, runway-holding position signs, NO ENTRY signs, vehicular STOP signs and runway/runway intersection signs. They are installed to identify locations beyond which taxiing aircraft or ground vehicles shall not proceed unless authorized by ATC.

8.6.7.2 See MOS 8.6.24 for specifications on road-holding position signs A pattern "A" runway-holding position marking shall be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.

8.6.7.3 A pattern "B" runway-holding position marking shall be supplemented with a category I, II or III holding position sign.

8.6.7.4 A pattern "A" runway-holding position marking at a runway-holding position established in accordance with MOS 6.8.2.3 shall be supplemented with a runway-holding position sign.

Note: - See MOS 8.4.3 for specifications on runway-holding position marking.

8.6.7.5 A runway designation sign at a taxiway/runway intersection shall be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

Note: - See MOS 8.6.14 for characteristics of location signs.

8.6.7.6 A NO ENTRY sign shall be provided when entry into an area is prohibited.

8.6.7.7 A runway designation sign at a taxiway/runway intersection or a runway/runway intersection shall be located on each side of the runway-holding position marking facing the direction of approach to the runway.

8.6.7.8 A category I, II or III holding position sign shall be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.

8.6.7.9 A NO ENTRY sign shall be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.

- 8.6.7.10 A runway-holding position sign shall be located on each side of the runway-holding position established in accordance with MOS 6.8.2.3, facing the approach to the obstacle limitation surface or ILS sensitive area, as appropriate.
- 8.6.7.11 A mandatory instruction sign shall consist of an inscription in white on a red background.
- 8.6.7.12 Where, owing to environmental or other factors, the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription should be supplemented by a black outline measuring 10 mm in width for runway code numbers 1 and 2, and 20 mm in width for runway code numbers 3 and 4.
- 8.6.7.13 The inscription on a runway designation sign shall consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.
- 8.6.7.14 The inscription on a category I, II, III or joint II/III holding position sign shall consist of the runway designator followed by CAT I, CAT II, CAT III or CAT II/III, as appropriate.
- 8.6.7.15 The inscription on a NO ENTRY sign shall be in accordance with MOS Figure 8.6-14.
- 8.6.7.16 The inscription on a runway-holding position sign at a runway-holding position established in accordance with MOS 8.6.2.3 shall consist of the taxiway designation and a number.
- 8.6.7.17 Where installed, the inscriptions/symbol shall be used as shown in Figure 8.6-14.

8.6.8 Runway designation signs

- 8.6.8.1 A runway designation sign, as illustrated in Figures 8.6-9 and 8.6-14, must be provided at a taxiway/runway intersection, where a pattern 'A' runway holding position marking is provided. Only the designation for one end of the runway must be shown where the taxiway intersection is located at or near that end of the runway. Designations for both ends of the runway, properly orientated with respect to the viewing position of the sign, must be shown where the taxiway is located elsewhere.
- 8.6.8.2 A taxiway location sign must be provided alongside the runway designation sign, in the outboard (farthest from the taxiway) position.
- 8.6.8.3 A runway designation sign must be provided on each side of a taxiway facing the direction of approach to the runway.
- 8.6.8.4 The inscription on a runway designation sign shall consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.

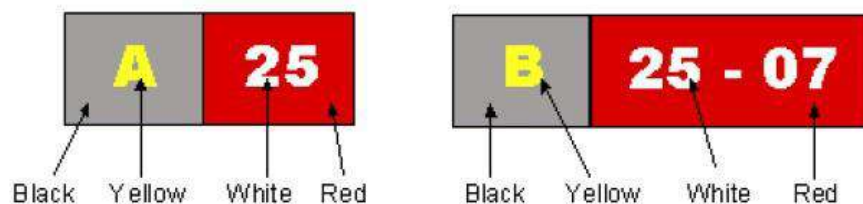


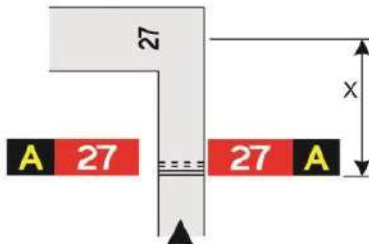
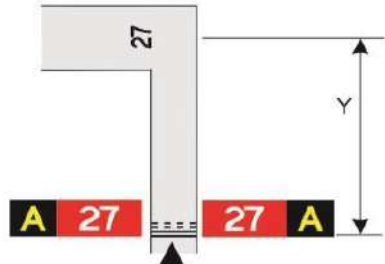
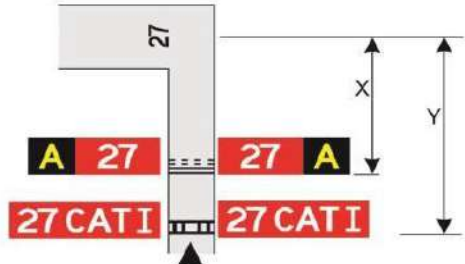
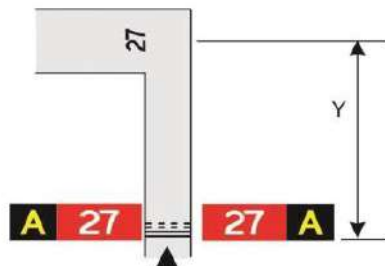
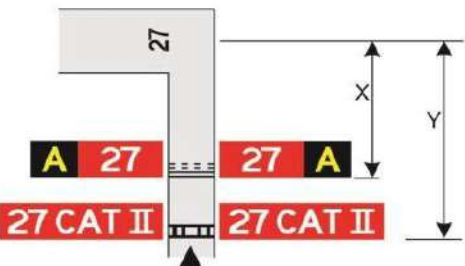
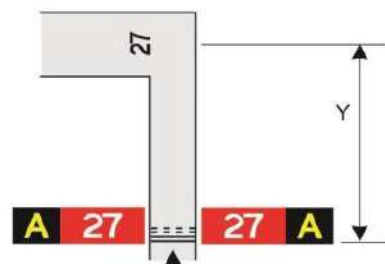
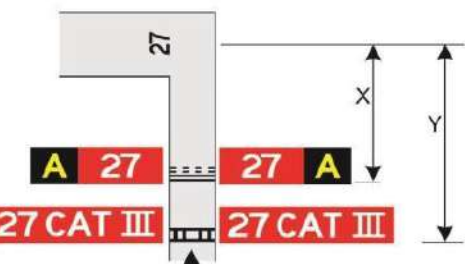
Figure 8.6-9: Runway designation signs with taxiway location sign

8.6.9 Category I, II or III Runway designation signs

- 8.6.9.1 Where a pattern 'B' taxi-holding position marking is provided, in addition to a pattern A holding position marking and sign, the sign shown below must be provided on each side of the taxiway.



Figure 8.6-10: Category I runway-holding position sign

NON-INSTRUMENT, NON-PRECISION, TAKE-OFF RUNWAYS		
		
PRECISION APPROACH RUNWAYS		
CATEGORY I		
CATEGORY II		
CATEGORY III		

Note. — Distance X is established in accordance with Table 6.5-1 Distance Y is established at the edge of the ILS/MLS critical/sensitive area.

Figure 8.6-11 : Category I, II, III runway-holding position sign

8.6.10 Runway holding position sign

8.6.10.1 Runway-holding position signs must be provided at a taxiway location, other than an intersection, where air traffic control has a requirement for aircraft to stop, such as entry to an ILS sensitive area. The sign is a taxiway designation sign, but with white lettering on a red background.

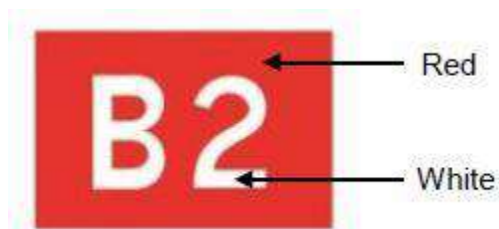


Figure 8.6-12: Mandatory runway-holding position sign

8.6.11 Aircraft NO ENTRY sign

- 8.6.11.1 A NO ENTRY sign, consisting of a white circle with a horizontal bar in the middle, on a red background, must be provided at the entrance of an area to which entry is prohibited. Where practicable, a NO ENTRY sign must be located on each side of the taxiway.

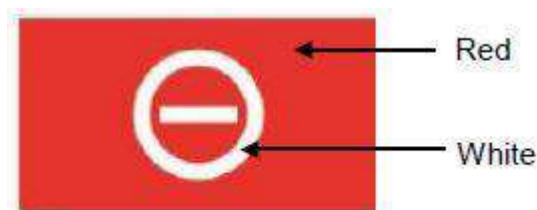


Figure 8.6-13: Aircraft NO ENTRY sign

8.6.12 Vehicle STOP signs

- 8.6.12.1 Where required, vehicular 'STOP' signs can be provided at road/taxiway intersections, road holding positions, or entrance to ILS sensitive areas. This sign should be the same as a local road traffic sign. In addition, the vehicular holding position should be marked in accordance with local traffic pavement marking. See also MOS Section 8.6.24 for provision and location of a road- holding position.

8.6.13 Runway/Runway intersection signs

- 8.6.13.1 These are runway designation signs, which must be provided on each side of a runway. The sign must show the designation of the intersecting runway, oriented with respect to the viewing position of the sign, and separated by a dash. For example, '15-33' indicates the runway threshold '15' is to the left, and '33' is to the right.
- 8.6.13.2 The overall height of the sign above the ground, and offset from the edge of the runway pavement, must be such as to provide at least 300 mm clearance between the top of the sign and any part of the most critical aircraft using the runway when the outer edge of the wheel of the aircraft is at the runway pavement edge.


Runway designation of a runway extremity (Example)	25	Indicates a runway-holding position at a runway extremity
Runway designation of both extremities of a runway (Example)	25-07	Indicates a runway-holding position located at taxiway/runway intersection other than runway extremity
Category I hold position (Example)	25 CAT I	Indicates a category I runway-holding position at the threshold of runway 25
Category II hold position (Example)	25 CAT II	Indicates a category II runway-holding position at the threshold of runway 25
Category III hold position (Example)	25 CAT III	Indicates a category III runway-holding position at the threshold of runway 25
Category II and III hold position (Example)	25 CAT II/III	Indicates a joint category II and III runway-holding position at the threshold of runway 25
Category I, II and III hold position (Example)	25 CAT I/II/III	Indicates a joint category I, II and III runway-holding position at the threshold of runway 25
NO ENTRY		Indicates that entry to an area is prohibited
Runway-holding position (Example)	B2	Indicates a runway-holding position (in accordance with 3.12.3)

Figure 8.6-14 Mandatory instruction signs

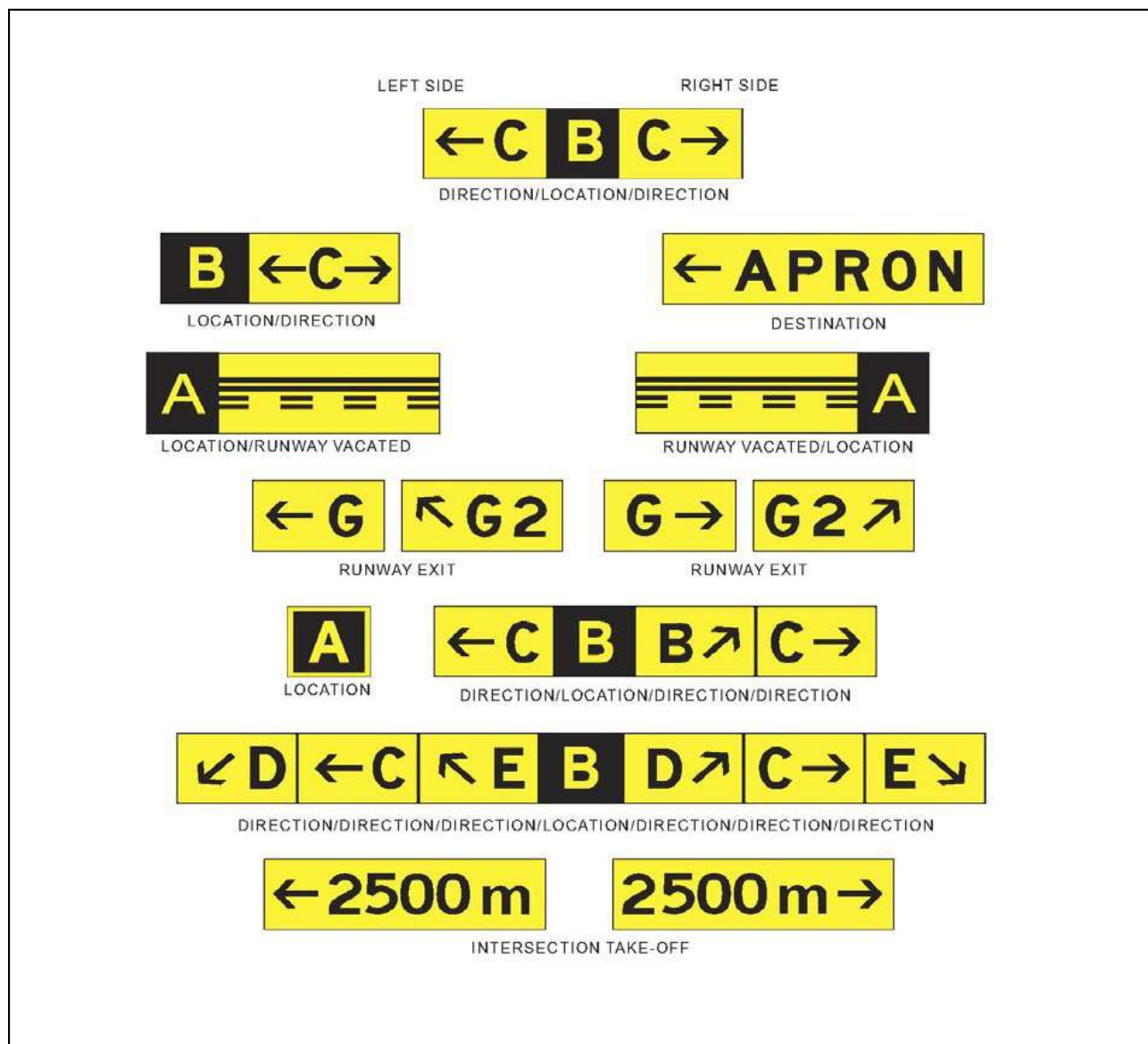


Figure 8.6-15 Information signs

8.6.14 Information Signs

Note: - Signs shall be either fixed message signs or variable message signs. Guidance on signs is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

8.6.14.1 Signs shall be provided to convey a mandatory instruction, information on a specific location or destination on a movement area or to provide other information to meet the requirements of MOS 10.19 (SMGCS).

Note: - See MOS 8.5.35 for specifications on information marking.

8.6.14.2 A variable message sign should be provided where:

- (a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or
- (b) there is a need for variable predetermined information to be displayed on the sign to meet the requirements of MOS 10.19 (SMGCS).

- 8.6.14.3 A variable message sign shall show a blank face when not in use.
- 8.6.14.4 In case of failure, a variable message sign shall not provide information that can lead to unsafe action from a pilot or a vehicle driver.
- 8.6.14.5 The time interval to change from one message to another on a variable message sign shall be as short as practicable and shall not exceed 5 seconds.
- 8.6.14.6 Information signs will include: taxiway location signs, direction signs, destination signs, runway exit signs, vacated signs, intersection take-off signs and distance to go signs.
- 8.6.14.7 Signs shall be rectangular, as shown in Figures 8.6-14 and 8.6-15 with the longer side horizontal.
- 8.6.14.8 The only signs on the movement area utilizing red shall be mandatory instruction signs.
- 8.6.14.9 The inscriptions on a sign shall be in accordance with the provisions of MOS 8.6.4.17.
- 8.6.14.10 An information sign shall be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.
- 8.6.14.11 Except as specified in MOS 8.6.19.3 and 8.6.16.4, information signs shall, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table 8.6-1.
- 8.6.14.12 An information sign other than a location sign shall not be collocated with a mandatory instruction sign.

8.6.15 Taxiway location signs

- 8.6.15.1 A taxiway location sign installed in conjunction with a direction sign or a runway designation sign shall be positioned outboard of the runway designation sign.
- 8.6.15.2 A location sign shall be provided in conjunction with a runway designation sign except at a runway/runway intersection.
- 8.6.15.3 A location sign shall be provided at an intermediate holding position. Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign shall consist of the taxiway designation and a number.
- 8.6.15.4 A location sign shall be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

- 8.6.15.5 Where necessary, a location sign shall be provided to identify taxiways exiting an apron or taxiways beyond an intersection.
- 8.6.15.6 Where a taxiway ends at an intersection such as a “T” and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid shall be used.
- 8.6.15.7 Where provided in conjunction with a runway vacated sign, the taxiway location sign shall be positioned outboard of the runway vacated sign.
- 8.6.15.8 The inscription on a location sign shall comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and shall not contain arrows.
- 8.6.15.9 A combined location and direction sign shall be provided when it is intended to indicate routing information prior to a taxiway intersection.
- 8.6.15.10 Where a location sign and direction signs are used in combination:
- (a) all direction signs related to left turns shall be placed on the left side of the location sign, and all direction signs related to right turns shall be placed on the right side of the location sign, except that where the junction consists of one intersecting taxiway, the location sign may alternatively be placed on the left-hand side;
 - (b) the direction signs shall be placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;
 - (c) an appropriate direction sign shall be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and
 - (d) adjacent direction signs shall be bordered by a yellow line as shown in Figures 8.6-15 and 8.6-16.



Figure 8.6-16: Taxiway location sign

8.6.16 Direction signs

- 8.6.16.1 A direction sign shall be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.
- 8.6.16.2 Each taxiway direction must be indicated by an arrow, as shown in Figure 8.6- 17 and Figure 8.6-15. The sign must have black letters with yellow background. A direction sign must be complemented by a location sign, except where the taxiway designation is adequately displayed by previous location signs along the taxiway.

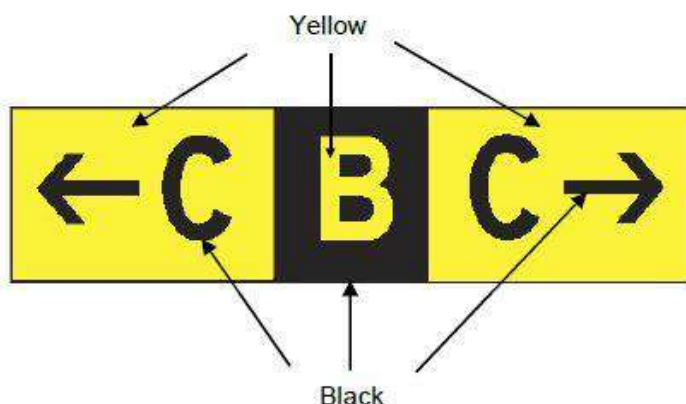


Figure 8.6-17: Direction/location/direction sign

- 8.6.16.3 At a taxiway intersection, information signs shall be located prior to the intersection and in line with intermediate holding position marking. Where there is no intermediate holding position marking, the signs shall be installed at least 60 m from the centerline of the intersecting taxiway where the code number is 3 or 4, and at least 40 m where the code number is 1 or 2.

Note: - A location sign installed beyond a taxiway intersection may be installed on either side of a taxiway.

- 8.6.16.4 A direction sign, barricade and/or other appropriate visual aid used to identify a “T” intersection should be located on the opposite side of the intersection facing the taxiway.

- 8.6.16.5 The inscription on a direction sign shall comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure 8.6-15.

8.6.17 Destination signs

- 8.6.17.1 Destination signs must have black letters on yellow background, as shown in Figure 8.6-18 and Figure 8.6-15. They advise pilots of facilities on, or near, the movement area. This sign must not be collocated with a location or direction sign.



Figure 8.6-18: Destination sign

- 8.6.17.2 Examples of common sign text used for destination signs are set out below:

Sign text	Meaning
RAMP or APRON	General parking, servicing and loading area
PARK or PARKING	Aircraft parking area
CIVIL	Civilian areas of joint-use aerodromes
MIL	Military area of a joint-use aerodrome.
CARGO	Freight or cargo handling area.
INTL	International areas
DOM	Domestic areas
RUNUP	Engine run-up areas
AC	Altimeter check point
VOR	VOR check point
FUEL	Fuel or service area
HGR	Hangar or hangar area

- 8.6.17.3 The inscription on a destination sign shall comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure 8.6-15.

8.6.18 Intersection take-off sign

- 8.6.18.1 The take-off run available sign indicates to pilots the length of take-off run available from a particular taxiway, where intersection departures are available. This sign is provided to pilots to confirm that they are at the correct take-off location:
- where the take-off point is close to the start of a runway, the sign is to show the designation of the take-off runway, and the take-off run available in meters, as shown in Figure 8.6-19.
 - where the take-off point is not close to the start of the runway, the sign is to show the take-off run available in meters, plus an arrow, appropriately located and orientated, indicating the direction in which that take-off run is available, as shown in Figure 8.6-15 and Figure 8.6-20.
 - where intersection departures are available in both directions from the position, two signs, one for each direction of take-off, are required.
 - the intersection take-off signs are to be located abeam the runway-holding position on the entry taxiway. Where one intersection take-off sign is provided, it is to be located on the left hand side of the entry taxiway. Where take-off is available in both directions, the two signs are to be located one on each side of the taxiway, corresponding to the direction of take-off. Intersection take-off signs must not obscure a pilot's view of any mandatory instruction signs.
 - the distance between the sign and the centerline of the runway shall be not less than 60 m where the code number is 3 or 4, and not less than 45 m where the code number is 1 or 2.



Figure 8.6-19: Take-off run distance available sign



Figure 8.6-20 Take-off run distance available sign

- 8.6.18.2 An intersection take-off sign shall be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.
- 8.6.18.3 The inscription on an intersection take-off sign shall consist of a numerical message indicating the remaining take-off run available in meters plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in MOS Figure 8.6-15.
- 8.6.19 Runway exit signs**
- 8.6.19.1 Runway exit signs, as shown in Figure 8.6-21, advise pilots of the designation and direction of a taxiway from which they can exit. Runway exit signs must be provided where there is an operational need to identify a runway exit.
- 8.6.19.2 The sign must consist of black lettering on a yellow background, with a black arrow outboard of the taxiway designator, or to the right of the designator for exits to the right, and to the left for exits to the left.
- 8.6.19.3 A runway exit sign shall be located on the same side of the runway as the exit is located (i.e. left or right) and positioned in accordance with Table 8.6-1.
- 8.6.19.4 A runway exit sign shall be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.
- 8.6.19.5 The inscription on a runway exit sign shall consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

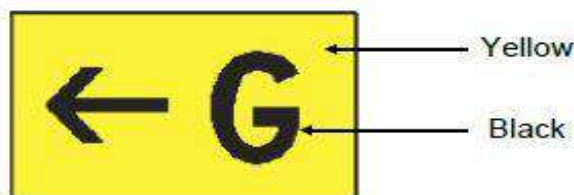


Figure 8.6-21: Runway exit sign

8.6.20 Runway Vacated Sign

- 8.6.20.1 A runway vacated sign shall be provided where the exit taxiway is not provided with taxiway centerline lights and there is a need to indicate to a pilot leaving a runway the perimeter of the ILS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farther from the runway centerline.

Note: - See Figure 9.12-1 for specifications on color coding taxiway centerline lights.

- 8.6.20.2 A runway vacated sign shall be located at least on one side of the taxiway. The distance between the sign and the centerline of a runway shall be not less than the greater of the following:
- (a) the distance between the centerline of the runway and the perimeter of the ILS critical/sensitive area; or
 - (b) the distance between the centerline of the runway and the lower edge of the inner transitional surface.
- 8.6.20.3 The inscription on a runway vacated sign shall depict the pattern A runway-holding position marking as shown in Figure 8.6-15.
- 8.6.21 VOR aerodrome checkpoint sign**
- 8.6.21.1 When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.
- Note: - See 8.5.37 for VOR aerodrome checkpoint marking.*
- 8.6.21.2 A VOR aerodrome checkpoint sign shall be located as near as possible to the checkpoint and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome checkpoint marking.
- 8.6.21.3 A VOR aerodrome checkpoint sign shall consist of an inscription in black on a yellow background.

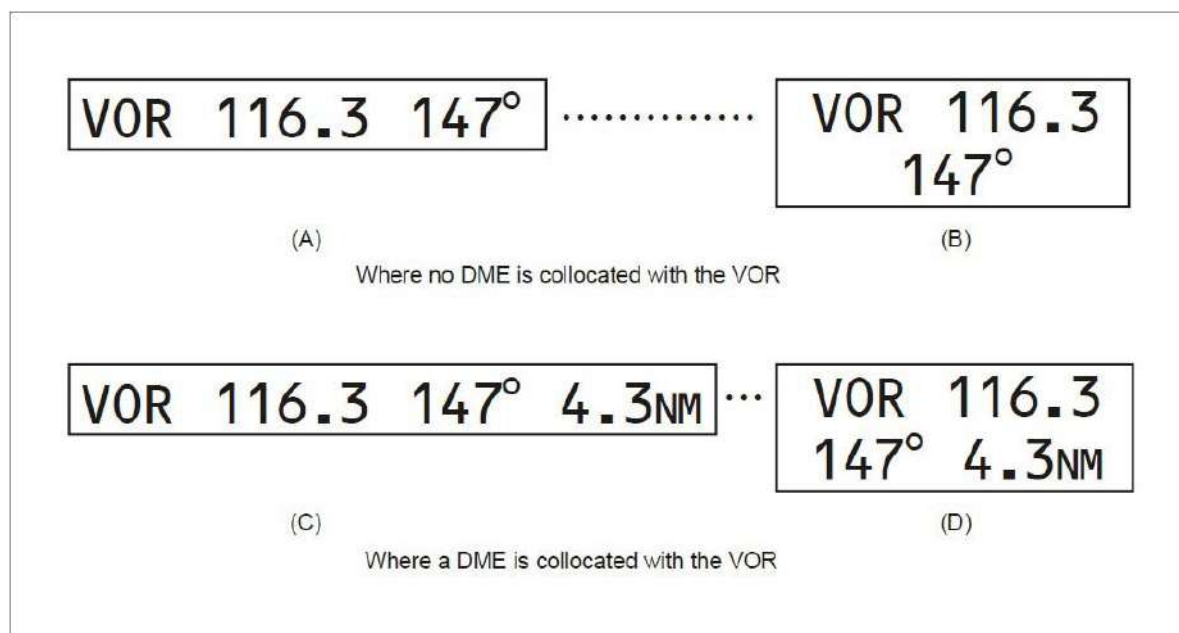


Figure 8.6-22. VOR aerodrome checkpoint sign

- 8.6.21.4 The inscriptions on a VOR checkpoint sign shall be in accordance with one of the alternatives shown in Figure 8.6-22 in which:
- VOR is an abbreviation identifying this as a VOR checkpoint;

116.3 is an example of the radio frequency of the VOR concerned;

147° is an example of the VOR bearing, to the nearest degree, which should be indicated at the VOR checkpoint; and

4.3 NM is an example of the distance in nautical miles to a DME collocated with the VOR concerned.

Note: - Tolerances for the bearing value shown on the sign are given in CAR-ANS Part 10, Attachment E. It will be noted that a checkpoint can only be used operationally when periodic checks show it to be consistently within ± 2 degrees of the stated bearing.

8.6.22 Aerodrome identification sign

8.6.22.1 An aerodrome identification sign shall be provided at an aerodrome where there is insufficient alternative means of visual identification.

8.6.22.2 The aerodrome identification sign shall be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.

8.6.22.3 The aerodrome identification sign shall consist of the name of the aerodrome.

8.6.22.4 The color selected for the sign shall give adequate conspicuity when viewed against its background.

8.6.22.5 The characters shall have a height of not less than 3 m.

8.6.23 Aircraft stand identification signs

8.6.23.1 An aircraft stand identification marking shall be supplemented with an aircraft stand identification sign where feasible.

8.6.23.2 An aircraft stand identification sign shall be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

8.6.23.3 An aircraft stand identification sign shall consist of an inscription in black on a yellow background.

8.6.23.4 Apron stand designators should not be the same as taxiway designators.

8.6.24 Road-holding position sign

8.6.24.1 A road-holding position sign shall be provided at all road entrances to a runway.

8.6.24.2 The road-holding position sign shall be located 1.5 m from one edge of the road (left or right as appropriate to the local traffic regulations) at the holding position.

8.6.24.3 A road-holding position sign shall consist of an inscription in white on a red background.

8.6.24.4 The inscription on a road-holding position sign shall be in the national language, be in conformity with the local traffic regulations and include the following:

- (a) a requirement to stop; and
- (b) where appropriate:
 - (i) a requirement to obtain ATC clearance; and
 - (ii) location designator.

Note: - Examples of road-holding position signs are contained in the Aerodrome Design Manual (Doc 9157), Part 4

- 8.6.24.5 A road-holding position sign intended for night use shall be retroreflective or illuminated.

Section 8.7 Wind Direction Indicators

8.7.1 Requirements

- 8.7.1.1 CAR-Aerodromes requires the aerodrome operator to install and maintain at least one wind direction indicator at the aerodrome. CAAP may issue directions requiring additional wind direction indicators to be provided.
- 8.7.1.2 If a straight-in landing off an instrument approach is permitted at any runway, CAR-Aerodromes, subject to paragraph 8.7.1.3, requires a wind direction indicator be provided at the threshold of that runway. Subject to 8.7.1.3, CAR- Aerodromes also requires that non-precision approach runways be provided with a wind direction indicator at the threshold of a runway, except that for runways 1200 meters or less in length, one centrally located wind indicator is acceptable if it is visible from the parking area and both approaches.
- 8.7.1.3 Paragraph 8.7.1.2 does not apply to a runway if surface wind information is passed to the pilots of aircraft approaching the runway through:
- (a) an automatic weather observing system that:
 - (i) is compatible with the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) weather observing system; and
 - (ii) provides surface wind information through an aerodrome weather information broadcast, or
 - (b) an approved observer having a communication link with pilots through which timely information about surface wind may be clearly passed to them; or
 - (b) any other approved means of providing surface wind information.
- 8.7.1.4 A wind direction indicator must be located so as to be visible from aircraft that are in flight or aircraft that are on the movement area.
- 8.7.1.5 A wind direction indicator must be located so as to be free from the effects of air disturbance caused by buildings or other structures.
- 8.7.1.6 A wind direction indicator provided at the threshold of a runway must be located:
- (a) except if it is not practicable to do so, on the left hand side of the runway as seen from a landing aircraft; and
 - (b) outside the runway strip; and

(c) clear of the transitional obstacle limitation surface.

8.7.1.7 If practicable to do so, a wind direction indicator provided at the threshold of a runway must be located 100 meters upwind of the threshold.

8.7.2 Wind direction indicator characteristics

8.7.2.1 A wind direction indicator must consist of a tapering fabric sleeve attached to a pole 6.5 m above the ground.

8.7.2.2 The sleeve must be 3.65 m long and taper uniformly from 900 millimeters in diameter to 250 millimeters in diameter.

8.7.2.3 The wide end must be mounted on a rigid frame to keep the end of the sleeve open and attached to the pole so as to allow it to move around freely.

8.7.2.4 The fabric of the primary wind direction indicator must be white and that of any additional wind direction indicator must be:

- (a) yellow, if it is not intended to be illuminated at night; or
- (b) if it is intended to be illuminated at night; either white, or another color that is clearly visible when illuminated.

Note: - Natural or synthetic fibers having weight range of at least 270 to 275 g/m² have been used effectively as wind indicator sleeve material.

8.7.2.5 The color or colors shall be so selected as to make the WDI clearly visible and understandable from a height of at least 300 m, having regard to background. Where practicable, a single color, preferably, white or orange, shall be used. Where a combination of two colors is required to give adequate conspicuity against changing backgrounds, they shall preferably be orange and white, red and white, or black or white, and shall be arranged in five alternate bands, the first and last bands being the darker color.

8.7.2.6 The primary wind direction indicator must be located in the center of a black colored circle 15 m in diameter, and bordered:

- (a) by a white perimeter 1.2 m wide; or
- (b) by a ring of 15 equally spaced white markers each with a base not less than 0.75 m in diameter.

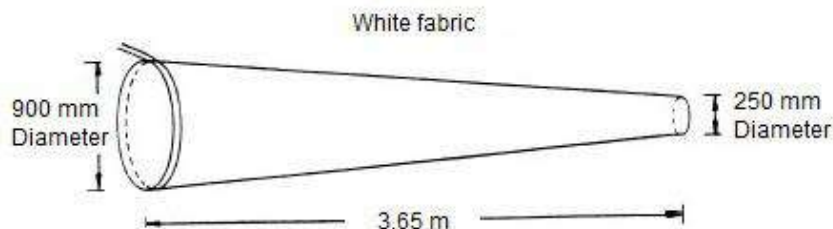


Figure 8.7-1: Wind Direction Indicator

8.7.2.7 For the illumination of wind direction indicators, see MOS Chapter 9.

8.7.3 Signaling Lamp

- 8.7.3.1 A signaling lamp shall be provided at a controlled aerodrome in the aerodrome control tower.
- 8.7.3.2 A signaling lamp shall be capable of producing red, green, and white signals, and of:
- (a) being aimed manually at any target as required;
 - (b) giving a signal in any one color followed by a signal in either of the two other colors; and
 - (c) transmitting a message in any one of the three colors by Morse Code up to a speed of at least four (4) words per minute.
- When selecting the green light, use shall be made of the restricted boundary of green as specified in MOS 9.2.1.2.
- 8.7.3.3 The beam spread shall be not less than 1° nor greater than 3° , with negligible light beyond 3° . When the signaling lamp is intended for use in the daytime, the intensity of the colored light shall be not less than 6,000 cd.

Section 8.8 Ground Signals

8.8.1 Signal Areas

- 8.8.1.1 A signal area must be:
- (a) 9 meters in diameter;
 - (b) black,
 - (c) bordered by:
 - (i) a white border 1 meter wide; or
 - (ii) 6 equally spaced white markers, each with a base not less than 0.75 m in diameter; and
 - (d) not more than 15 m from the wind direction indicator, or, if applicable,
 - (e) the primary wind direction indicator. The primary wind direction indicator is located closest to the apron of the aerodrome.

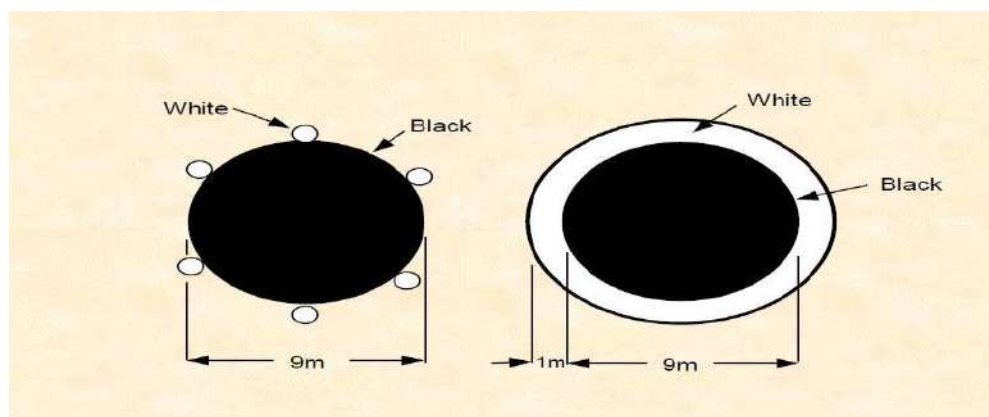


Figure 8.8-1: Signal Area

8.8.2 Ground Signals in Signal Area

- 8.8.2.1 A 'total unserviceability' signal must be displayed in a signal area when an aerodrome is closed to landing aircraft.
- 8.8.2.2 A 'total unserviceability' signal must consist of 2 white strips not less than 0.9 m wide and 6 m long, bisecting each other at right angles.
- 8.8.2.3 A 'restricted operations' signal must be displayed in the signal area at an aerodrome with more than one type of surface on its movement area, if aircraft are only to use:
- (a) the sealed runways, taxiways and aprons; or
 - (b) the gravel runways; where there are no sealed runways, taxiways and aprons.
- 8.8.2.4 For the purposes of Paragraph 8.8.2.3:
- (a) a sealed runway, taxiway or apron is one whose surface is wholly or mainly sealed; and
 - (b) a gravel runway, taxiway or apron is one whose surface is wholly or mainly gravel.
 - (c) the 'restricted operations' signal must consist of 2 white circles 1.5 m in diameter, connected by a white cross bar 1.5 m long and 0.4 m wide.
 - (d) a 'glider operations' signal, must consist of a white strip 5 m long and 0.4 m wide crossed at right angles by 2 strips 0.4 m wide and 2.5 m long, each being 1.05 m from the closest end of the horizontal strip, as shown below.

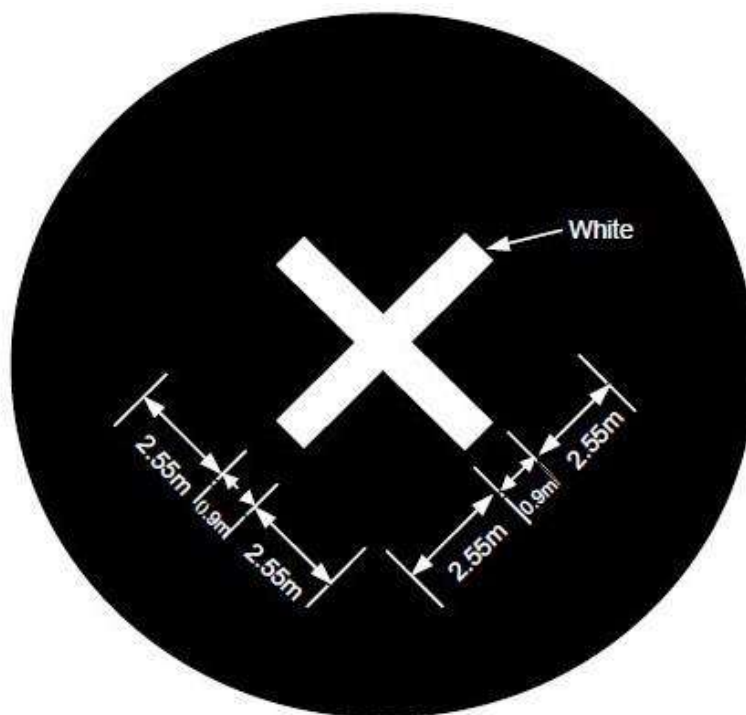


Figure 8.8-2: Total unserviceability signal

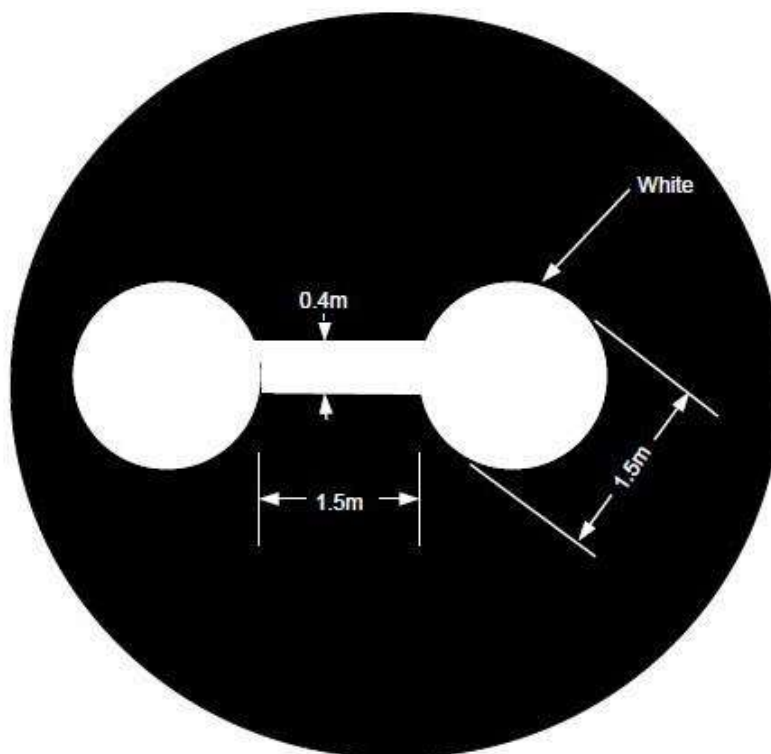


Figure 8.8-3: Restricted operations signal

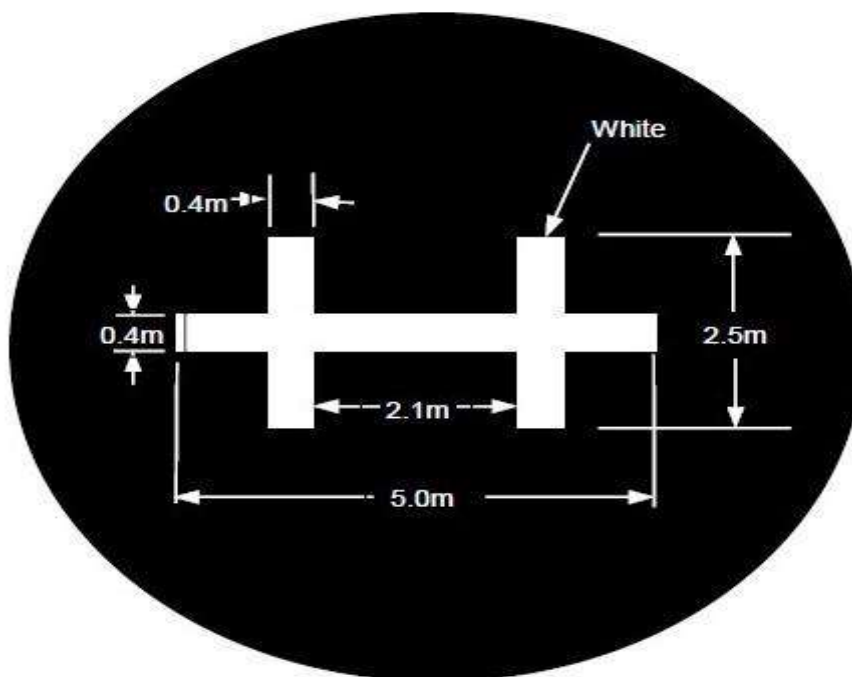


Figure 8.8-4: Glider operations signal

Section 8.9 Visual Aids denoting Restricted Use Areas

8.9.1 Closed runways and taxiways or parts thereof

- 8.9.1.1 This section identifies the markings used on unserviceable areas of runways, taxiways, aprons and holding bays and markers used to mark the boundary of unserviceable areas and limit of work areas.
- 8.9.1.2 A closed marking shall be displayed on a runway or taxiway or portion thereof which is permanently closed to the use of all aircraft.
- 8.9.1.3 A closed marking shall be displayed on a temporarily closed runway or taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.
- 8.9.1.4 On a runway, a closed marking shall be placed at each end of the runway, or portion thereof, declared closed, and additional markings shall be so placed that the maximum interval between markings does not exceed 300 m. On a taxiway a closed marking shall be placed at least at each end of the taxiway or portion thereof closed.
- 8.9.1.5 The closed marking shall be of the form and proportions as detailed in Figure 8.9-1(a), when displayed on a runway, and shall be of the form and proportions as detailed in Figure 8.9-1(b), when displayed on a taxiway. The marking shall be white when displayed on a runway and shall be yellow when displayed on a taxiway.

Note: - 1. When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

Note: - 2. Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

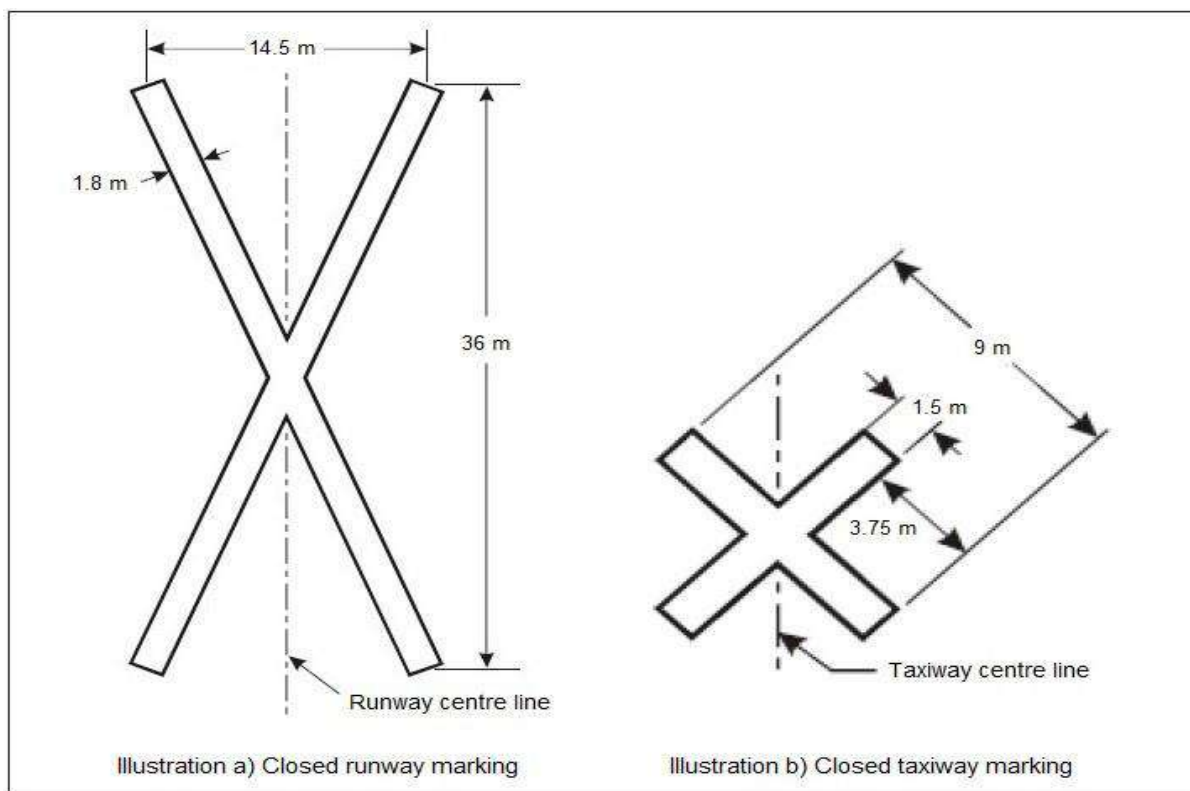


Figure 8.9-1: Closed runway and taxiway markings

- 8.9.1.6 When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings shall be obliterated.
- 8.9.1.7 Lighting on a closed runway or taxiway or portion thereof shall not be operated, except as required for maintenance purposes.
- 8.9.1.8 In addition to closed markings, when the runway or taxiway or portion thereof closed is intercepted by a usable runway or taxiway which is used at night, unserviceability lights shall be placed across the entrance to the closed area at intervals not exceeding 3 m.
- 8.9.1.9 Unserviceability marking is not required for time-limited works.

8.9.2 Non-load-bearing surfaces

- 8.9.2.1 Shoulders for taxiways, runway turn pads, holding bays and aprons and other non-load-bearing surfaces which cannot readily be distinguished from load-bearing surfaces and which, if used by aircraft, might result in damage to the aircraft shall

have the boundary between such areas and the load-bearing surface marked by a taxi side stripe marking.

Note: - The marking of runway sides is specified in MOS 8.3.6

8.9.2.2 A taxi side stripe marking shall be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

8.9.2.3 A taxi side stripe marking shall consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same color as the taxiway centerline marking.

Note: - Guidance on providing additional transverse stripes at an intersection or a small area on the apron is given in the Aerodrome Design Manual (Doc 9157), Part 4.

8.9.3 Pre-threshold area

8.9.3.1 When the surface before a threshold is paved and exceeds 60 m in length and is not suitable for normal use by aircraft, the entire length before the threshold shall be marked with a chevron marking.

8.9.3.2 A chevron marking shall point in the direction of the runway and be placed as shown in Figure 8.9-2. See also MOS Figure 8.2-1 for Runway pre-end markings.

8.9.3.3 A chevron marking shall be of conspicuous color and contrast with the color used for the runway markings; it should preferably be yellow. It should have an overall width of at least 0.9 m.

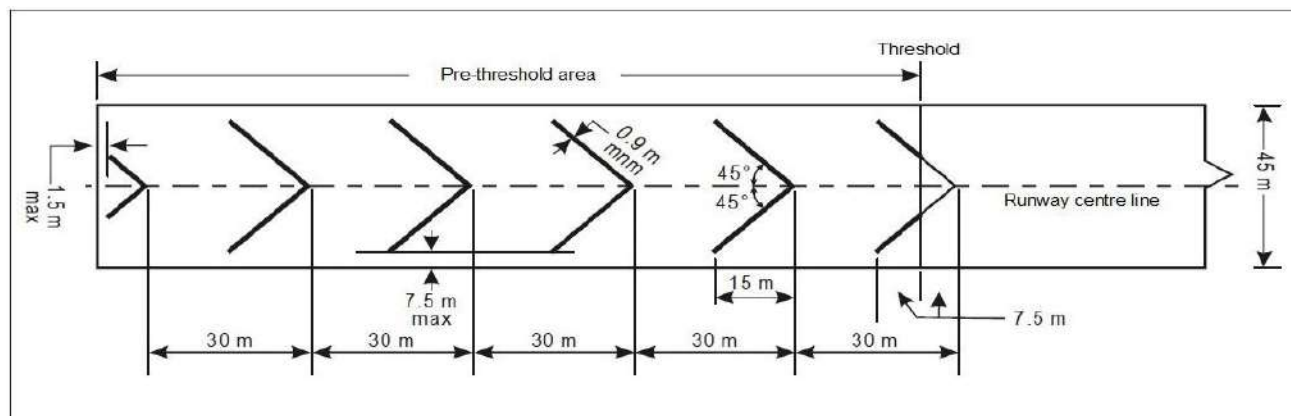


Figure 8.9-2: Pre-threshold marking

8.9.4 Unserviceable areas

8.9.4.1 Unserviceability markers shall be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely. On a movement area used at night, unserviceability lights shall be used.

Note: - 1. Unserviceability markers and lights are used for such purposes as warning pilots of a hole in a taxiway or apron pavement or outlining a portion of pavement, such as on an apron, that is under repair. They are not suitable for use when a portion of a runway becomes unserviceable, nor on a taxiway when a major portion of the width becomes unserviceable. In such instances, the runway or taxiway is normally closed.

Note: - 2. Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

- 8.9.4.2 Unserviceability markers and lights shall be placed at intervals sufficiently close so as to delineate the unserviceable area.

Note: - Guidance on the location of unserviceability lights is given in MOS Attachment A, Section 13.

- 8.9.4.3 An unserviceability marking may also be used to indicate any part of a taxiway or apron, which is not to be used by aircraft. The preferred method of marking an unserviceable part of taxiway or apron is by the placement of unserviceable markers at the entrance to that area or around the unserviceable area.

- 8.9.4.4 Characteristics of unserviceability markers

- (a) Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones or marker boards.

- 8.9.4.5 Characteristics of unserviceability lights

- (a) An unserviceability light shall consist of a red fixed light. The light shall have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case shall the intensity be less than 10 cd of red light.

- 8.9.4.6 Characteristics of unserviceability cones

- (a) An unserviceability cone shall be at least 0.5 m in height and red, orange or yellow or any one of these colors in combination with white.
- (b) Unserviceability markers are shown in Figure 8.2-1. They must consist of a white standard cone with a horizontal red stripe, 25 cm wide around its center, half way up the cone, so as to provide three bands of color, white-red-white.

- 8.9.4.7 Characteristics of unserviceability flags

- (a) An unserviceability flag shall be at least 0.5 m square and red, orange or yellow or any one of these colors in combination with white.

- 8.9.4.8 Characteristics of unserviceability marker boards

- (a) An unserviceability marker board shall be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.

8.9.5 Works Limit markers

- 8.9.5.1 Works limit markers, shown in Figure 8.2-1, where used, must be spaced at intervals marginally less than the smallest track of the plant or vehicles operating within the work area.
- 8.9.5.2 Other forms of work limit markers may be used for works on apron and other areas provided they are not a hazard to aircraft and other airside vehicles operating in the vicinity of the works area.

Section 8.10 Obstacle Markings

8.10.1 General

- 8.10.1.1 Fixed objects, temporary and permanent, which extend above the obstacle limitation surfaces but are permitted to remain or objects which are present on the movement area are regarded as obstacles, and must be marked. The aerodrome operator must submit details of such obstacles to CAAP, for hazard assessment and particular requirements for marking and lighting. The relevant information must be included in the Aerodrome Manual.
- 8.10.1.2 A structure must be marked when more than 150 m higher than the surrounding terrain. Surrounding terrain means the area within 400 m of the structure. Structures above 90 m may need to be marked, and inconspicuous structures 75 m above ground level should also be marked. Fixed objects on the aerodrome movement area, such as ILS buildings, must be marked as obstacles.
- 8.10.1.3 CAAP may permit obstacles to remain unmarked:
- (a) when obstacles are sufficiently conspicuous by their shape, size or color; or
 - (b) when obstacles are shielded by other obstacles already marked; or
 - (c) when obstacles are lighted by high intensity obstacle lights by day.

8.10.2 Objects to be marked and/or lighted

Note: - 1. The marking and/or lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle.

Note: - 2. An autonomous aircraft detection system may be installed on or near an obstacle (or group of obstacles such as wind farms), designed to operate the lighting only when the system detects an aircraft approaching the obstacle, in order to reduce light exposure to local residents. Guidance on the design and installation of an autonomous aircraft detection system is available in the Aerodrome Design Manual (Doc 9157), Part 4. The availability of such guidance is not intended to imply that such a system has to be provided.

8.10.2.1 Objects within the lateral boundaries of the obstacle limitation surfaces

- (a) Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and shall be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.

- (b) Elevated aeronautical ground lights within the movement area shall be marked so as to be conspicuous by day. Obstacle lights shall not be installed on elevated ground lights or signs in the movement area.
- (c) All obstacles within the distance specified in Table 6.4-5, Table 6.4-5(E) or Table 6.4-5(F), from the center line of a taxiway, an apron taxiway or aircraft stand taxilane shall be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, lighted.
- (d) A fixed obstacle that extends above a take-off climb surface within 3000 m of the inner edge of the take-off climb surface shall be marked and, if the runway is used at night, lighted, except that:
 - (i) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;
 - (ii) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;
 - (iii) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and
 - (iv) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.
- (e) A fixed object, other than an obstacle, adjacent to a take-off climb surface shall be marked and, if the runway is used at night, lighted if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:
 - (i) the object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or
 - (ii) the object is lighted by high-intensity obstacle lights by day.
- (f) A fixed obstacle that extends above an approach surface within 3000 m of the inner edge or above a transitional surface shall be marked and, if the runway is used at night, lighted, except that:
 - (i) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;
 - (ii) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;
 - (iii) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and
 - (iv) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.
- (g) A fixed obstacle that extends above a horizontal surface shall be marked and, if the aerodrome is used at night, lighted, except that:
 - (i) such marking and lighting may be omitted when:
 - the obstacle is shielded by another fixed obstacle; or

- for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or
 - an aeronautical study shows the obstacle not to be of operational significance;
- (ii) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;
 - (iii) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and
 - (iv) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.
- (h) A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

Note: - See MOS 9.8.2 for information on the obstacle protection surface.

- (i) Other objects inside the obstacle limitation surfaces shall be marked and/or lighted if an aeronautical study indicates that the object can constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).

Note: - In certain circumstances, objects that do not project above any of the surfaces enumerated in MOS 7.3 may constitute a hazard to aeroplanes as, for example, where there are one or more isolated objects in the vicinity of an aerodrome.

- (j) Overhead wires, cables, etc., crossing a river, waterway, valley or highway shall be marked and their supporting towers marked and lighted if an aeronautical study indicated that the wires or cables can constitute a hazard to aircraft.

8.10.2.2

Objects outside the lateral boundaries of the obstacle limitation surfaces

- (a) Obstacles in accordance with MOS 7.1.5.2 shall be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.
- (b) Other objects outside the obstacle limitation surfaces shall be marked and/or lighted if an aeronautical study indicates that the object can constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).
- (c) Overhead wires, cables, etc., crossing a river, waterway, valley or highway shall be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

8.10.2.3

Obstacles other than wires and cables, must be painted in a pattern of contrasting colors which also contrast with the background. Orange and white or red and white are normally used.

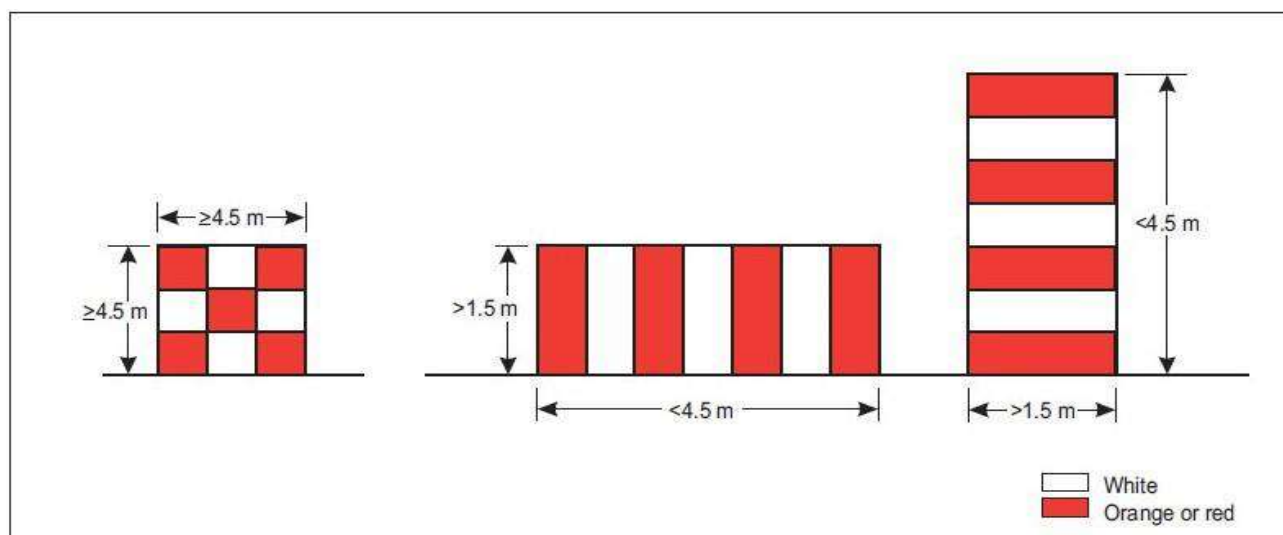


Figure 8.10-1: Basic marking patterns

Table 8.10-1 Marking band widths

Longest dimension			
Greater than	Not exceeding	Band width	
1.5 m	210 m	1/7	of longest dimension
210 m	270 m	1/9	of longest dimension
270 m	330 m	1/11	of longest dimension
330 m	390 m	1/13	of longest dimension
390 m	450 m	1/15	of longest dimension
450 m	510 m	1/17	of longest dimension
510 m	570 m	1/19	of longest dimension
570 m	630 m	1/21	of longest dimension

Note: - Table 8.10-1 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker color.

8.10.2.4 Obstacles with any dimension less than 1.5 m, except for masts, poles and towers described in Paragraph 8.10.2.5, must be painted in a solid contrasting color.

8.10.2.5 Masts, poles and towers must be marked in contrasting bands with the darker color at the top, as shown in Figure 8.10-2. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.

Note: - MOS Appendix 6 Table 6.1-1 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker color.

- 8.10.2.6 Fence posts which are determined to be obstacles must be painted in a single conspicuous color, normally white.

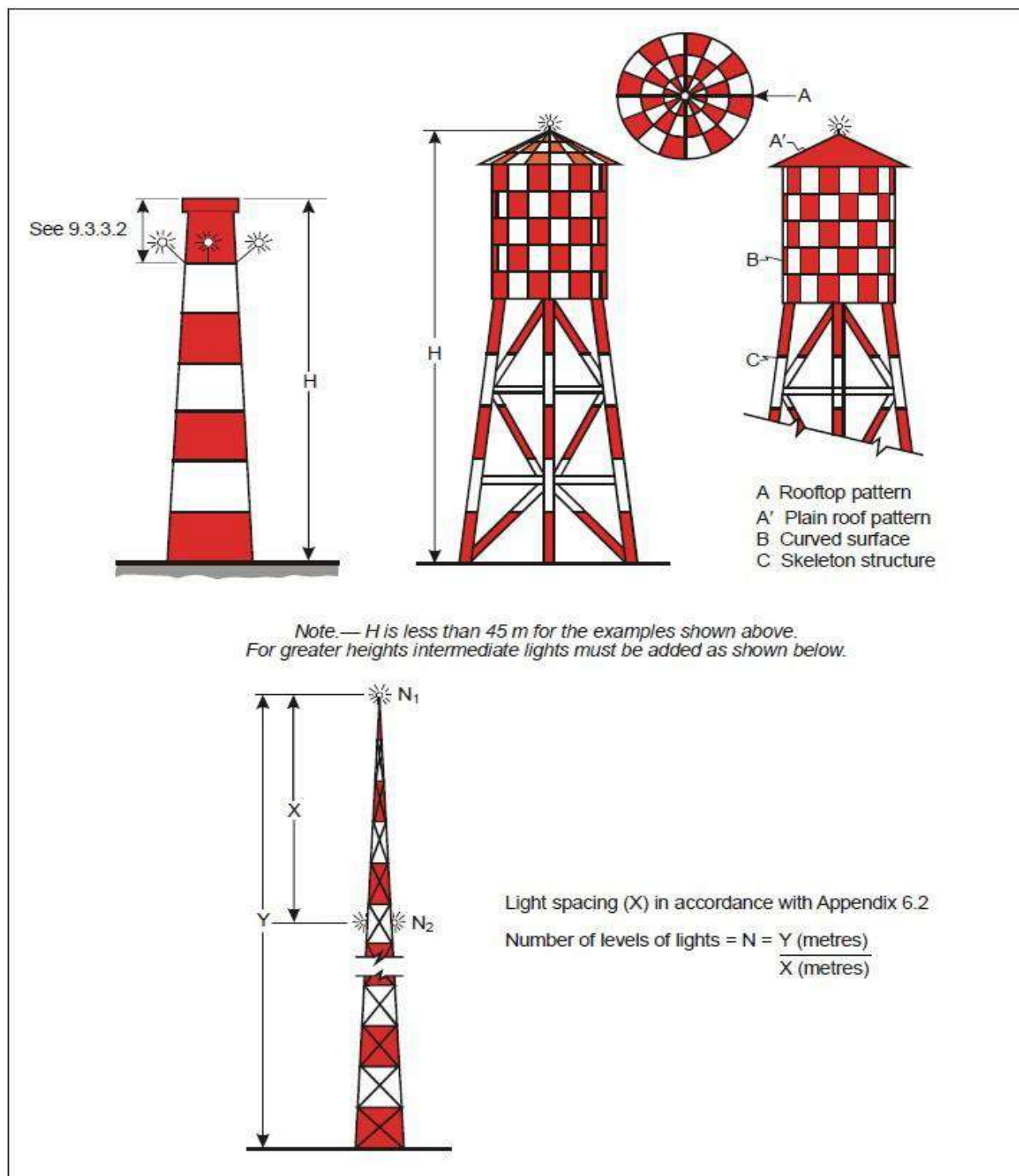


Figure 8.10-2: Marking and lighting of tall structures

8.10.3 Marking and/or lighting of objects

8.10.3.1 General

- (a) The presence of objects which must be lighted, as specified in MOS 8.10.2.7, shall be indicated by low-, medium- or high-intensity lights, or a combination of such lights.
- (b) The types of obstacle lights are the following:
 - (i) Low-intensity - Types A, B, C, D and E;
 - (ii) Medium-intensity - Types A, B and C; and
 - (iii) High-intensity - Type A and B.

Note: - For guidance on the specifications of the types of obstacle lights is given in MOS Appendix 6, Table 6-3.

- (c) The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

8.10.3.2 Marking of temporary and transient obstacles

- (a) Temporary and transient obstacles may be required by CAAP to be marked. Fixed temporary obstacles should be marked as described above for permanent obstacles. Where this is not practicable the use of unserviceability cone markers and/or flags is acceptable to delineate the shape and size of the obstacle so that it is clearly visible from any line of approach likely to be used by an aircraft.
- (b) Flags used for marking fixed temporary obstacles must be not less than 0.6 m square. They must be either orange or orange and white, split diagonally. Where orange merges with the background, another conspicuous color must be used.

8.10.3.3 Mobile objects

- (a) All mobile objects to be marked shall be colored or display flags.
- (b) When mobile objects are marked by color, a single conspicuous color, preferably red or yellowish green for emergency vehicles and yellow for service vehicles shall be used. Where so painted, it does not require additional marking.
- (c) Flags used to mark mobile objects shall be displayed around, on top of, or around the highest edge of the object. Flags shall not increase the hazard presented by the object they mark.
- (d) Flags used to mark mobile objects shall not be less than 0.9 m on each side and shall consist of a chequered pattern, each square having sides of not less than 0.3 m. The colors of the pattern shall contrast each with the other and

with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colors merge with the background.

- (e) Low intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

Note: - See PCARs Part 8 for lights to be displayed by aircraft.

- (f) Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security shall be flashing-blue and those displayed on other vehicles shall be flashing-yellow.
- (g) Low intensity obstacle lights, type D, shall be displayed on follow-me vehicles.
- (h) Low intensity obstacle lights on objects with limited mobility such as aerobridges shall be fixed-red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, type A, in MOS Appendix 6, Table 6.1-1, Table 6.1-2 and Table 6.1-3. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

8.10.3.4

Fixed objects

Note: - The fixed objects of wind turbines are addressed separately in MOS 8.10.3.5 (Wind Turbines) and the fixed objects of overhead wires, cables, etc. and supporting towers are addressed separately in MOS 8.10.3.6 (Overhead wires, cables and supporting towers).

- (a) All fixed objects to be marked shall, whenever practicable, be colored, but if this is not practicable, markers or flags shall be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or color need to be otherwise marked.
- (b) Objects with unbroken surfaces more than 4.5 m by 4.5 m size, must be painted in a chequered pattern of lighter and darker squares or rectangles, with sides no less than 1.5 m and no more than 3 m long, as shown in Figure 8.10-1 (a). The corners of the obstacle must be painted in the darker color. Orange and white or alternatively red and white shall be used, except where such colors merge with the background.
- (c) Objects more than 1.5 m size in one direction and less than 4.5 m in the other, or any lattice object greater than 1.5 m in size in both directions, must be marked with alternating contrasting bands of color, with the ends painted in the darker color, as shown in Figure 8.10-1 (b) & (c). The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.
- (d) An object shall be colored in a single conspicuous color if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red shall be used, except where such colors merge with the background

Note: - Against some backgrounds it may be found necessary to use a different color from orange or red to obtain sufficient contrast.

- (e) Flags used to mark fixed objects shall be displayed around, on top of, or around the highest edge of the object. When flags are used to mark

extensive objects or a group of closely spaced objects, they shall be displayed at least every 15 m. Flags shall not increase the hazard presented by the object they mark.

- (f) Flags used to mark fixed objects shall not be less than 0.6 m on each side and shall be orange in color or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colors merge with the background, other conspicuous colors shall be used.
- (g) Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.
- (h) A marker shall be of one color. When installed, white and red, or white and orange markers shall be displayed alternately. The color selected shall contrast with the background against which it will be seen.
- (i) Where, in the opinion of appropriate authority the use of high intensity obstacle lights, type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10,000 m radius) or cause significant environmental concerns, a dual obstacle lighting system shall be provided. This system shall be composed of high intensity obstacle lights, Type A or medium intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle light, Type B or C, for night-time use.

8.10.3.5

Wind turbines

- (a) A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.

Note: - 1. Additional lighting or markings may be provided where in the opinion of CAAP such lighting or markings are deemed necessary.

Note: - 2. Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.

Note: - 3. In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation should be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.

Markings

- (b) The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines shall be painted white, unless otherwise indicated by an aeronautical study.

Lighting

- (c) When lighting is deemed necessary, medium intensity obstacle lights shall be used. In the case of a wind farm, i.e. group of two or more wind turbines shall be regarded as an extensive object and the lights shall be installed:
- (i) to identify the perimeter of the wind farm;
 - (ii) respecting the maximum spacing, in accordance with MOS 9.3.3.4 between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;
 - (iii) so that, where flashing lights are used, they flash simultaneously; and
 - (iv) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located.
 - (v) at locations prescribed in a), b) and d), respecting the following criteria:
 - for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle shall be provided;
 - for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate shall be provided in case of failure of the operating light. The lights shall be installed to assure that the output of either light is not blocked by the other; and
 - in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, shall be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note: - The above MOS 8.10.3.5 (c)(v) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

- (d) The obstacle lights shall be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.
- (e) Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation shall be in accordance with MOS 8.10.3.5(c)(v) or as determined by an aeronautical study.

8.10.3.6

Overhead wires, cables, etc. and supporting towers

Marking

- (a) The wires, cables, etc. to be marked must be equipped with markers; the supporting tower must be colored.

Marking by colors

- (b) The supporting towers of overhead wires, cables, etc. that require marking shall be marked in accordance with MOS 8.10.3.4 (a) to (e), except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

Marking by markers

- (c) Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.
- (d) A marker displayed on an overhead wire, cable, etc. must be spherical and have a diameter of not less than 60 cm.
- (e) The spacing between two consecutive markers or between a marker and a supporting tower must be appropriate to the diameter of the marker, but in no case shall the spacing exceed:
 - (i) 30 m where the marker diameter is 60 cm progressively increasing with the diameter of the marker to
 - (ii) 35 m where the marker diameter is 80 cm and further progressively increasing to a maximum of
 - (iii) 40 m where the marker diameter is of at least 130 cm.

Where multiple wires, cables, etc. are involved, a marker shall be located not lower than the level of the highest wire at the point marked.

- (f) A marker shall be of one color. When installed, white and red, or white and orange markers shall be displayed alternately. The color selected shall be in contrast with the background against which it will be seen.
- (g) When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, shall be provided on their supporting towers.

Lighting

- (h) High intensity obstacle lights, Type B, shall be used to indicate the presence of the tower supporting overhead wires, cables, etc. where:
 - (i) an aeronautical study indicates such light to be essential for the recognition of the presence of wires, cables, etc.; or
 - (ii) it has not been found practicable to install marker on the wires, cables, etc.

- (i) Where high intensity obstacle lights, Type B, are used on an object other than a tower supporting overhead wires or cables, the spacing between the lights is not to exceed 105 m. Where the high intensity obstacle lights are used on a tower supporting wires or cables, they are to be located on three levels:
- (i) at the top of the tower;
 - (ii) at the lowest level of the catenary of the wires or cables; and
 - (iii) at approximately midway between the two levels.

Note: - In some cases this may require the bottom and middle lights to be located off the tower.

- (j) High intensity obstacle lights, Type B, located on a tower supporting overhead wires or cables are to flash sequentially; first the middle light, second the top light, and last the bottom light. Cycle frequency is to be 40-60 per minute and the intervals between flashes of lights are to approximate the following ratios:

Flash interval between:	Ratio of cycle time
middle and top light	1/13
top and bottom light	2/13
bottom and middle light	10/13

Table 8.10-2: Flash interval with corresponding Ratio of cycle time

Note: - High intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, operation and the location of high-intensity obstacle lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- (k) Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10,000 m radius) or cause significant environmental concerns, a dual obstacle lighting system should be provided. This system shall be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for night time use. Where medium-intensity lights are used they shall be installed at the same level as the high-intensity obstacle light Type B.
- (l) To minimize environmental impact, unless otherwise directed by CAAP, the installation setting angles for high intensity obstacle lights are to be:

Height of light unit above terrain (AGL)		Angle of the peak of the beam above the horizontal
Greater than	Not exceeding	
151 m		0°
122 m	151 m	1°
92 m	122 m	2°
	92 m	3°

Table 8.10-3: Installation setting angles for high intensity obstacle lights

8.10.4 Marking of Vehicles

- 8.10.4.1 A vehicle used regularly on the maneuvering area by day shall be painted a single conspicuous color, preferably yellow or orange. Where so painted, it does not require additional marking.
- 8.10.4.2 Vehicles not painted yellow or orange must be marked, either by using either:
- (a) a vehicle warning light in accordance with Paragraph 9.18.1; or
 - (b) flags.
- 8.10.4.3 Flags must be not less than 0.9 m square and consist of an orange and white chequered pattern, each square of which must have sides not less than 0.3 m. Where orange merges with the background, another color that contrasts with the background must be used.

Section 8.11 Helicopter Areas on Aerodromes**8.11.1 Introduction**

- 8.11.1.1 At aerodromes used by both helicopters and fixed wing aircraft, specific markings must be provided on facilities for the exclusive use of helicopters.

8.11.2 Helicopter Landing and Lift-off Area markings

- 8.11.2.1 Where a specific area, other than the runway, is provided for the landing and lift-off of helicopters, the area must be marked by a circle, painted white, with an inside radius of 6 m and a line width of 1 m. A white 'H' marking must be provided, located centrally within the circle, aligned with the orientation of the helicopter landing direction. The dimensions of the H marking must be 6 m high and 3 m wide, with a line width of 1 m.

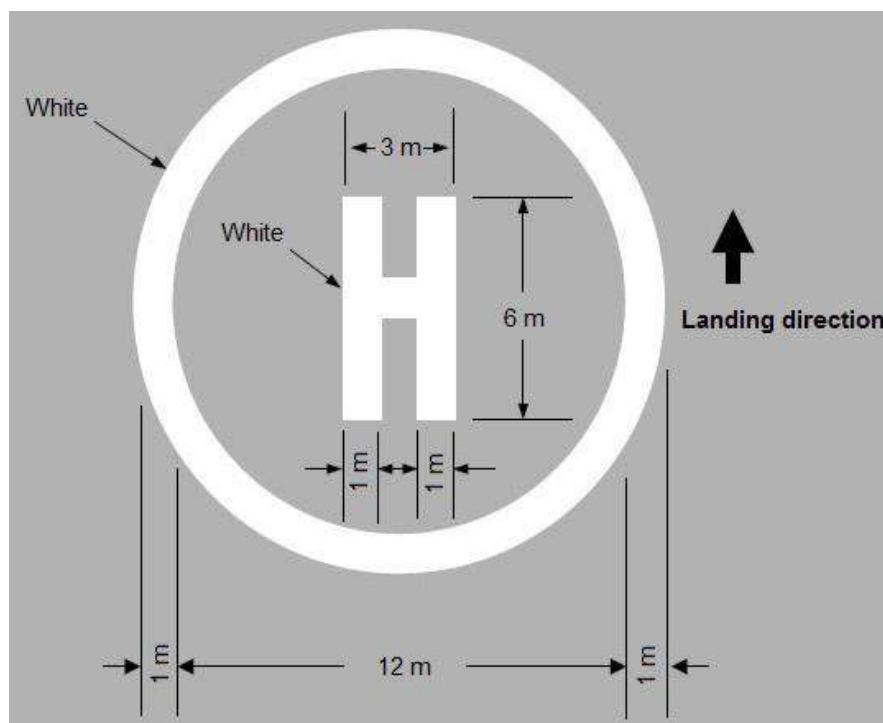


Figure 8.11-1: Helicopter landing and lift-off marking

8.11.3 Helicopter apron markings

8.11.3.1 Helicopter apron markings comprise taxi guidelines, lead-in lines and helicopter parking position markings. Markings for taxi guidelines and lead-in lines to dedicated helicopter parking positions must be the same as for fixed wing aircraft.

8.11.4 Helicopter parking position markings

8.11.4.1 Where a dedicated helicopter parking position is provided on a sealed, concrete or asphalt apron, it must be marked with the letter 'H', painted yellow, 4 m high, 2 m wide with line width 0.7 m. The marking must conform to the shape and proportions shown in Figure 8.11-2.

8.11.4.2 The letter H must be located centrally in the parking position and aligned with the desired orientation of the helicopter when parked. This marking also serves as the parking position designator.

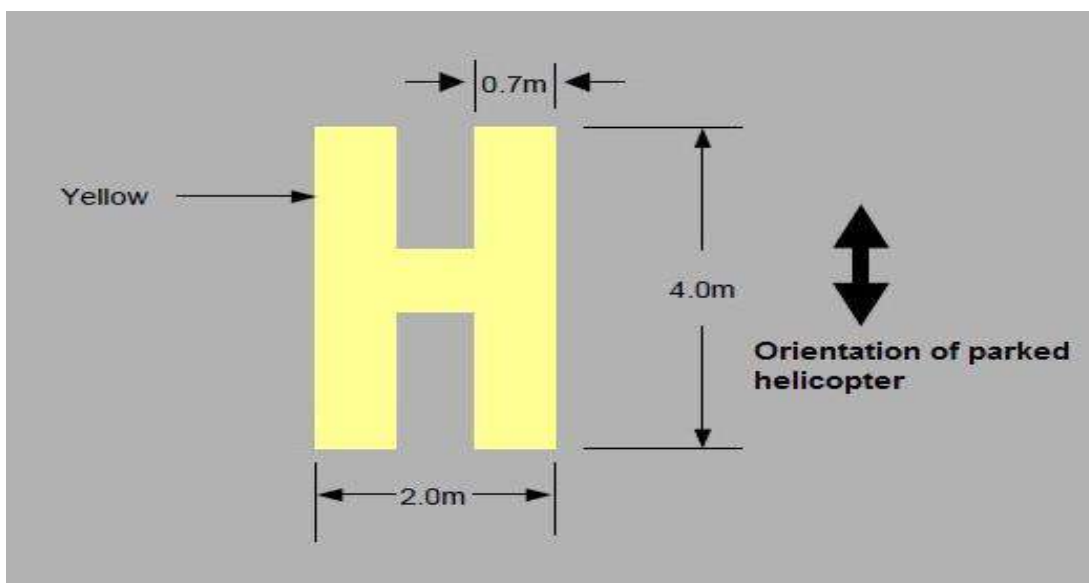


Figure 8.11-2: Helicopter parking position marking

8.11.5 Helicopter taxi guideline designation

- 8.11.5.1 Designation must be provided where a taxi guideline leads to a parking position reserved for helicopters only. Where an apron contains both fixed wing and dedicated helicopter parking positions, taxi guidelines leading to dedicated helicopter parking positions must be marked with a 2 m high, yellow designator 'H', at their divergence from the aircraft taxi guideline, as shown in Figure 8.11-3.
- 8.11.5.2 These designations must be located and oriented in such a way that they can be seen by the critical aircraft 15 m away on the taxi guideline.

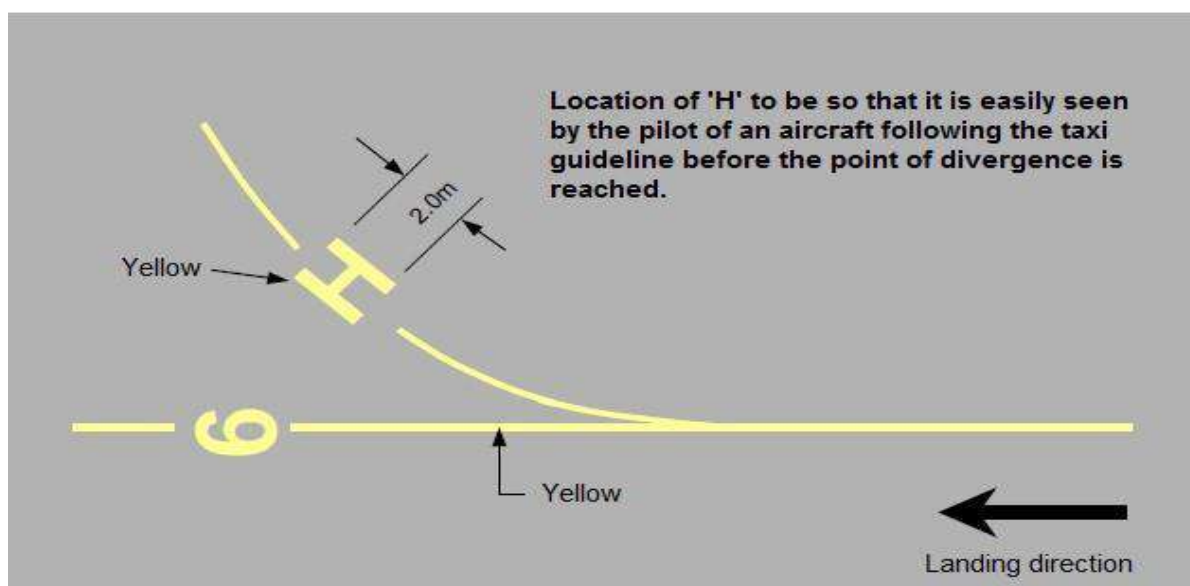


Figure 8.11-3: Helicopter taxi guideline designator

8.11.6 Helicopter parking position numbers

- 8.11.6.1 Parking position numbers must be provided when there is more than one helicopter parking position on an apron. All parking positions must be numbered above, and below the helicopter parking position marking. Numbers must be 2 m high, painted yellow, as illustrated in Figure 8.11-4.

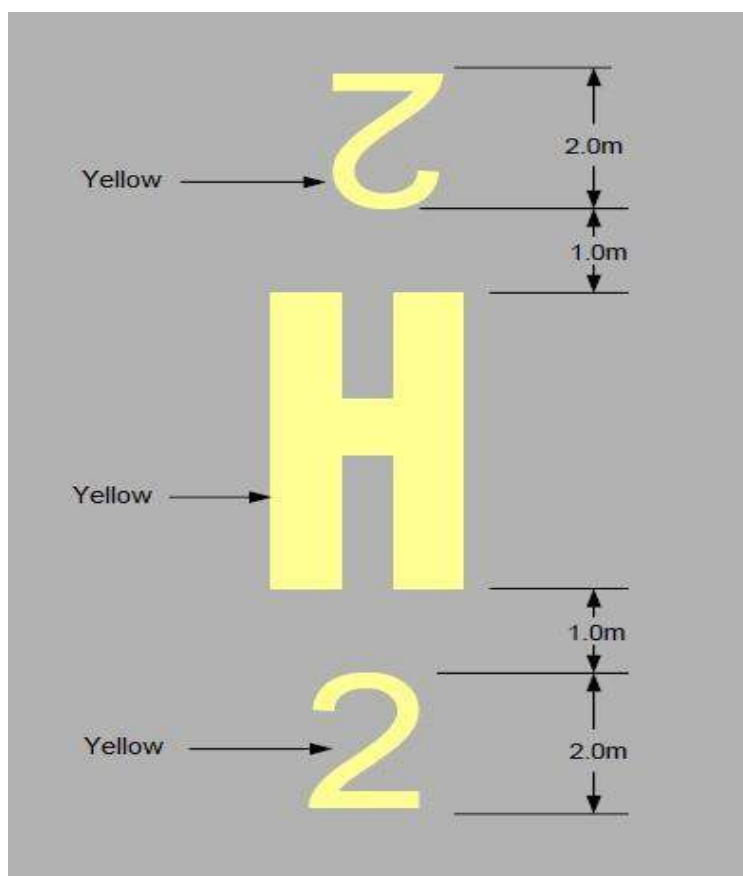


Figure 8.11-4: Helicopter parking position number

8.11.7 Helicopter apron edge markings

- 8.11.7.1 Apron edge markings must be provided when it is necessary to clearly define areas allocated specifically for helicopter parking.
- 8.11.7.2 On sealed, concrete or asphalt aprons, the edge marking must consist of two continuous lines 0.15 m wide, 0.15 m apart, painted light blue. Additionally, the words 'HELICOPTER ONLY' must be painted in yellow, along the edge marking, outside the helicopter apron, and legible to pilots of approaching aircraft. The letters must be 0.5 m high, located 0.15 m from the helicopter apron edge marking. These words must be spaced at intervals not exceeding 50 m, along the helicopter apron edge marking, as shown below.

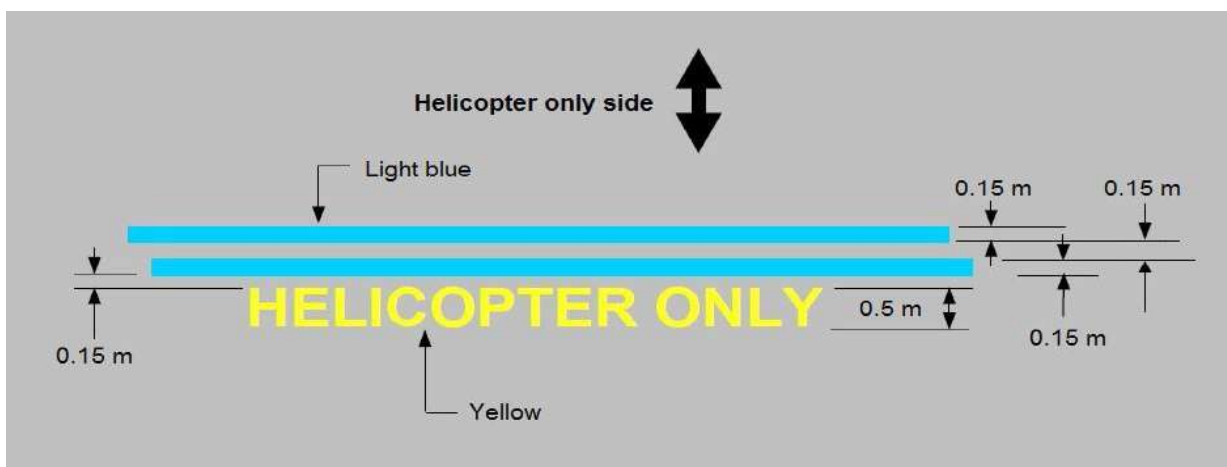


Figure 8.11-5: Helicopter apron edge markings

- 8.11.7.3 On gravel or natural surfaces, the apron must be marked using light blue cones; spaced at a minimum of 30 m, and a maximum of 60 m, apart.

Section 8.12 Marking of Glider Runway Strips on an aerodrome

- 8.12.1.1 When gliding operations are being conducted at an aerodrome, a signal consisting of a double white cross must be displayed in the signal circle. Details of the signal are illustrated in Figure 8.12-4, below.
- 8.12.1.2 Where the glider runway strip is located wholly or partly within an existing runway strip for powered aircraft, the width of the glider runway strip must be fixed on the one side by the edge of the runway for powered aircraft, and on the other by the existing runway strip markers adjusted as necessary, as shown below in Figure 8.12-1 and Figure 8.12-2.
- 8.12.1.3 Where a glider runway strip is located outside an existing runway strip for powered aircraft, the glider runway strip must be marked with boundary markers of a conspicuous color other than white, as shown in Figure 8.12-3.
- 8.12.1.4 Where an end of a glider runway strip is not alongside the end of an existing runway strip for powered aircraft, an additional white double cross on a black background must be displayed 20 m in front of the glider strip end markers, as shown in Figures 8.12-2 and 8.12-3.

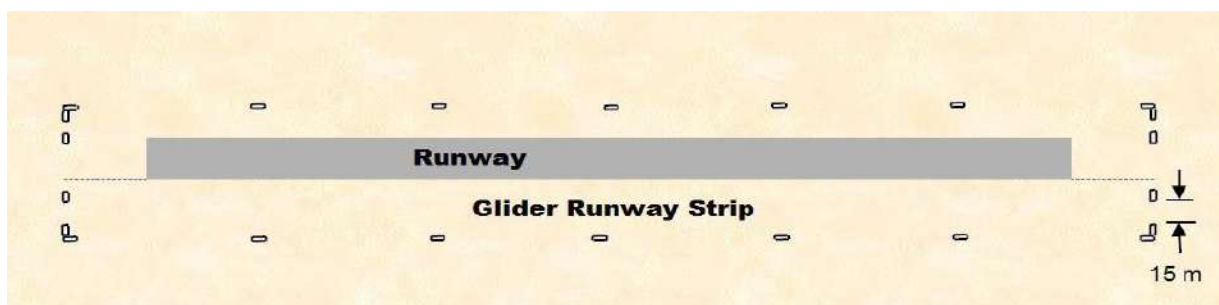


Figure 8.12-1: Glider runway strip taking up the full length of powered aircraft runway strip (no signal required)

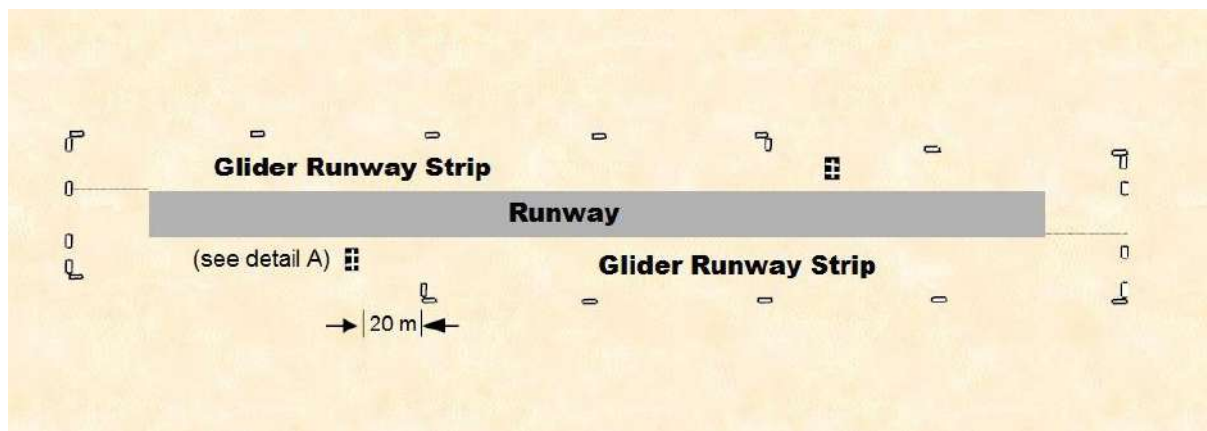


Figure 8.12-2: Glider runway strip taking part of the powered aircraft runway strip

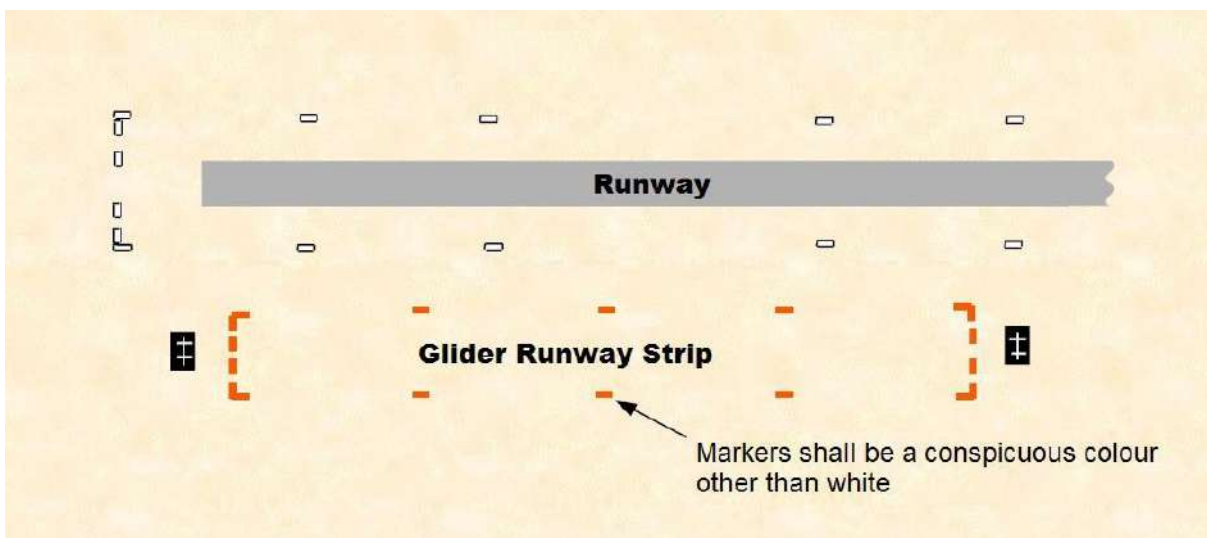


Figure 8.12-3: Glider runway strip outside an existing powered aircraft runway strip

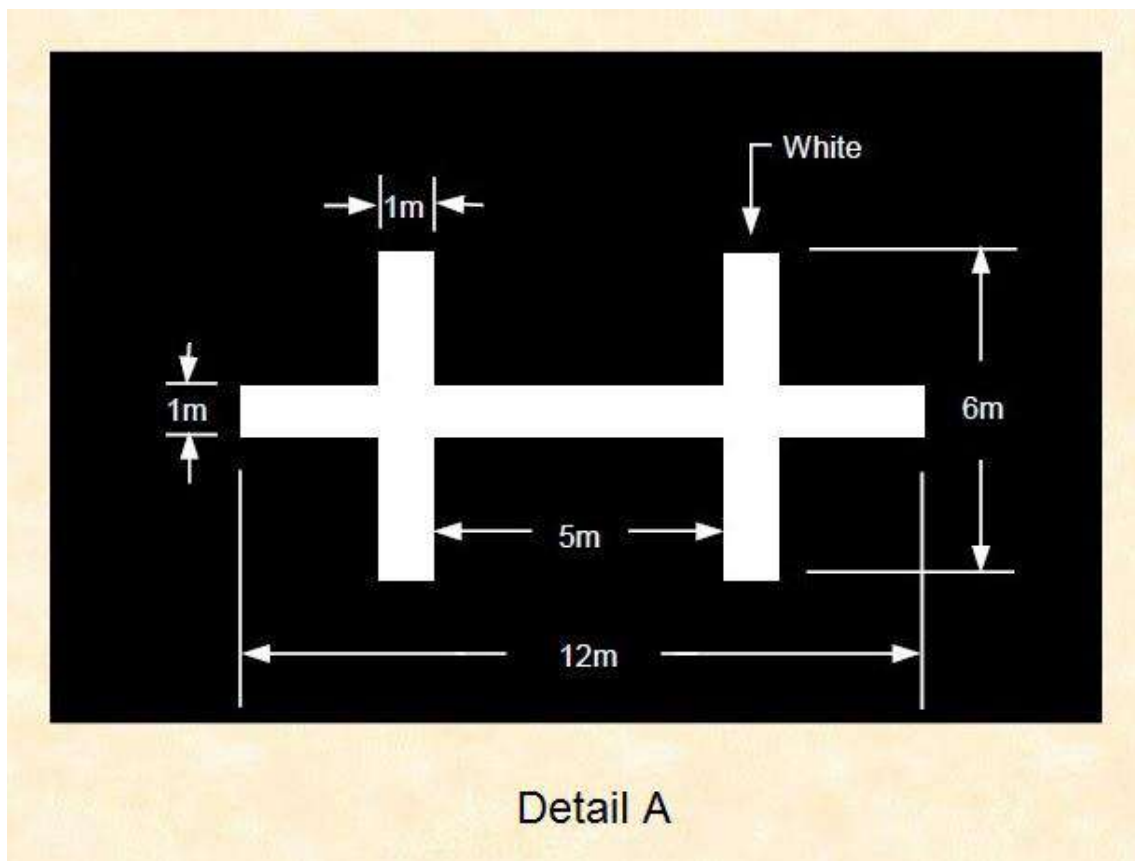


Figure 8.12-4: Detail of glider operations signal

CHAPTER 9. Aerodrome visual aids – aerodrome lighting

Section 9.1 General

Note: - This chapter contains standards on aspects of aerodrome design and operations that are not covered elsewhere in this manual.

9.1.1 Application and definitions

9.1.1.1 Existing installed lighting systems must be operated and maintained in accordance with existing procedures. The standards in this chapter may not apply to an existing lighting facility until:

- (a) the light fittings of a lighting system are being replaced with fittings of a different type. In this case a lighting system means lights on a section of taxiway (not all taxiways), lights on a threshold (not all thresholds) etc.
- (b) on a clearway if it would endanger an aircraft in the air.
- (c) there is a change in the category (see 9.1.1.2) aerodrome layout or the aerodrome traffic density increases; or
- (d) in exceptional circumstances, CAAP determines that in the interest of safety, a lighting facility has to meet the standards of this chapter.

9.1.1.2 For aerodrome lighting purposes, words used in this chapter have the following meaning:

- (a) **Aerodrome layout.** This means the number of runways, taxiways and aprons at an aerodrome provided with lighting, and is divided into the following categories:
 - (i) **Basic** – an aerodrome with one runway, with one taxiway to one apron area;
 - (ii) **Simple** – an aerodrome with one runway, having more than one taxiway to one or more apron areas;
 - (iii) **Complex** – an aerodrome with more than one runway, having many taxiways to one or more apron areas.
- (b) **Aerodrome traffic density.** This means the number of aircraft movements in the mean busy hour, and is divided into the following categories:
 - (i) **Light** – not greater than 15 movements per runway or typically less than 20 total aerodrome movements;
 - (ii) **Medium** – 16 to 25 movements per runway or typically between 20 to 35 total aerodrome movements;
 - (iii) **Heavy** – 26 or more movements per runway or typically more than 35 aerodrome movements.

Note: - 1. The number of movements in the mean busy hour is the arithmetic mean over the year of the number of movements in the daily busiest hour.

Note: - 2. Either a take-off or a landing constitutes a movement.

- (c) **Upgrade of a facility.** A facility is deemed to be upgraded if anything is

changed to allow it to:

- (i) accommodate aeroplanes from a higher reference code, such as from code 2 to code 3 runway or code 3 to code 4;
- (ii) be used by aeroplanes flying under different approach conditions, such as:
 - from non-instrument to non-precision instrument;
 - from non-precision instrument to precision instrument
 - from precision category I to category II or III.
- (d) **Practicable.** This term is used to allow CAAP acceptance of variation to a standard due to insurmountable difficulties in the way of full compliance. If an aerodrome operator believes that compliance with a standard is impracticable, the onus rests with that operator to demonstrate the impracticability to the satisfaction of the CAAP.

9.1.2 Standardization of aerodrome lighting

- 9.1.2.1 It is important, for pilot recognition and interpretation of aerodrome lighting systems, that standard configurations and colors be used. The pilot always views the aerodrome lighting systems in perspective, never in plan, and has to interpret the guidance provided, while traveling at high speed, sometimes with only a limited segment of the lighting visible. As time will be limited to see and react to visual aids, particularly in the lower visibilities, simplicity of pattern, in addition to standardization, is extremely important.
- 9.1.2.2 Pilot visual workload and interpretation is best moderated by standardization, balance and integrity of elements. A ragged system with many missing lights can break the pattern from the pilot's eye position, restricted as that position is by cockpit cut-off angles and possibly by patchy fog or other conditions.
- 9.1.2.3 For some aerodrome lighting systems, historic usage in various countries has resulted in more than one system being recognized by ICAO. In these circumstances, CAAP may have endorsed some, but not all, ICAO systems for use in Republic of the Philippines.
- 9.1.2.4 Those systems not included in this MOS are not endorsed by CAAP for use in the Republic of the Philippines. Pilot training gives pilots familiarity with standard systems, so it is important that aerodrome owners do not introduce non-endorsed or non-standard aerodrome lighting systems.
- 9.1.2.5 If the aerodrome owner has any doubts about a new system for their aerodrome, they shall check with CAAP before proceeding.

9.1.3 Reserved

9.1.4 Minimum lighting system requirements

- 9.1.4.1 At an aerodrome available for night operations, at least the following facilities must be provided with appropriate lighting:
- (a) runways, taxiways and aprons intended for night use;

- (b) at least one wind direction indicator;
- (c) if an obstacle within the applicable OLS area of the aerodrome is determined by CAAP as requiring obstacle lighting, the obstacle lighting.

Note: - In the case of taxiways used only by aeroplanes of code A or B, taxiway reflective markers may be used in lieu of some taxiway lighting.

9.1.4.2 Where any approach end of a runway is intended to serve jet-propelled aeroplanes engaged in air transport operations, that approach end must be provided with an approved visual approach slope indicator system, in accordance with MOS 9.8.1.1 (a). Additionally CAAP may direct a runway to be provided with a visual approach slope indicator system if the circumstances surrounding the aerodrome require such an aid for aircraft safety purposes.

9.1.4.3 To avoid confusion at an aerodrome with more than one visual approach slope indicator system, the same type of approach slope indicator system must be used, in accordance with MOS 9.8.1.8.

9.1.4.4 A simple approach lighting system as specified in MOS 9.6.1.1 – 9.6.1.8 shall be installed wherever practicable:

- (a) for a non-instrument runway where the code number is 3 or 4 and the runway is intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids; and
- (b) for a non-precision approach runway; except where such runways are only used in conditions of good visibility or sufficient guidance is provided by other visual aids.

Note: - 1. A simple approach lighting system can also provide visual guidance by day.

Note: - 2. It is advisable to give consideration to the installation of a precision approach category I lighting system or to the addition of a runway lead-in lighting system.

9.1.4.5 A precision approach category I lighting system as specified in MOS 9.6.2 shall be provided wherever practicable to serve a precision approach runway category I.

9.1.4.6 A precision approach category II or III lighting system as specified in MOS 9.6.3 shall be provided to serve a precision approach runway category II or III.

9.1.4.7 Movement area guidance signs intended for use at night must be illuminated in accordance with the standards set out in Chapter 8.

9.1.4.8 In certain circumstances additional lighting systems (e.g. aerodrome beacons, visual docking guidance systems and runway threshold identification lights) may be required at some aerodromes. Where provided, they shall be in compliance with the standards set out in this chapter.

9.1.5 Primary source of electricity supply

9.1.5.1 Adequate primary power supply shall be available at aerodromes for the safe functioning of air navigation facilities.

- 9.1.5.2 The design and provision of electrical power systems for aerodrome visual and radio navigation aids shall be such that an equipment failure will not leave the pilot with inadequate visual and non-visual guidance or misleading information.

Note: - The design and installation of the electrical systems need to take into consideration factors that can lead to malfunction, such as electromagnetic disturbances, line losses, power quality, etc. Additional guidance is given in the Aerodrome Design Manual (Doc 9157), Part 5.

- 9.1.5.3 Unless it is impracticable to do so, except for Paragraph 9.1.5.5 below, an aerodrome lighting system must be an electrically connected installation, with the primary source of electric power supplied by the local electricity supply authority.

- 9.1.5.4 Where the power supply of an aerodrome lighting system has to be derived from a source other than the normal reticulated electricity supply, a note to that effect shall be included in AIP.

- 9.1.5.5 If, at an aerodrome intended for use by aircraft with less than 10 passenger seats engaged in air transport operations, power supply cannot be supplied by normal reticulated electricity, the supply may be derived from stand-alone generators or solar charged batteries.

9.1.6 Electrical circuitry

- 9.1.6.1 Where they are electrically connected, aerodrome ground lighting, which includes runway, taxiway, approach, visual approach slope indicator and MAGS lighting circuits must be by means of the series current system.

Note: - Inter-leaf circuitry is recommended for aerodromes intended for precision approach operations. Guidance on this may be found in ICAO Aerodrome Design Manual Part 5.

- 9.1.6.2 Feeder cables and series isolating transformers must be installed below ground, being:

- (a) directly buried; or
- (b) in pits, ducts or similar receptacles.

Note: - Guidance on underground electrical systems, refer to Chapter 4 of ICAO Doc 9157 Part 5.

- 9.1.6.3 Other electrical equipment and wiring, except for a light or light fitting, must not be installed above ground level in the maneuvering area.

9.1.7 Secondary power supply

- 9.1.7.1 Secondary power supply means electricity power supply that is connected to the load automatically on the failure of the primary power source.

This may be derived by either of the following:

- (a) independent public power, which is a source of power supplying the aerodrome service from a substation other than the normal substation

through a transmission line following a route different from the normal the normal and independent public power supplies is extremely remote; or

- (b) stand by power unit(s), which are generators, batteries etc. from which electric power can be obtained.

Note: - Guidance on electrical systems is included in the Aerodrome Design Manual (Doc 9157), Part 5.

9.1.7.2 Secondary power must be provided to at least one runway at an aerodrome intended for category I precision approach operations, which would allow the operation of the following lighting systems:

- (a) approach lighting;
- (b) visual approach slope indicator;
- (c) runway edge lights;
- (d) runway threshold lights
- (e) runway end lights;
- (f) essential taxiway and runway guard lights;
- (g) apron lighting; and
- (h) obstacle lighting, if any, lighting of which has been determined by CAAP as essential for the safety of aircraft operations.

Note: - Not applicable in general to off-aerodrome obstacle lighting, the lighting availability status of which is subject to aerodrome operator monitoring.

9.1.7.3 In addition to Paragraph 9.1.7.2 above, for an aerodrome intended for Cat II and III precision approach operations, the secondary power must be adequate for the lighting of the following:

- (a) runway centerline lights;
- (b) touchdown zone lights; and
- (c) all stop bars.

9.1.8 Switch-over time limits

9.1.8.1 The time interval between failure of the primary source of power and the complete restoration of the services required MOS 9.1.8.7 shall be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 9.1-1 for maximum switch-over times shall apply.

Note: - A definition of switch-over time is given in MOS 1.4.

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators ^a	See
	Runway edge ^b	9.1.8.1 and
	Runway threshold ^b	9.1.8.6
	Runway end ^b	
	Obstacle ^a	
Non-precision approach	Approach lighting system	15 seconds
	Visual approach slope indicators ^{a, d}	15 seconds
	Runway edge ^d	15 seconds
	Runway threshold ^d	15 seconds
	Runway end	15 seconds
	Obstacle ^a	15 seconds
Precision approach category I	Approach lighting system	15 seconds
	Runway edge ^d	15 seconds
	Visual approach slope indicators ^{a, d}	15 seconds
	Runway threshold ^d	15 seconds
	Runway end	15 seconds
	Essential taxiway ^a	15 seconds
	Apron lightings	15 seconds
Precision approach category II/III	Obstacle ^a	15 seconds
	Inner 300 m of the approach lighting system	1 second
	Other parts of the approach lighting system	15 seconds
	Obstacle ^a	15 seconds
	Runway edge	15 seconds
	Runway threshold	1 second
	Runway end	1 second
	Runway center line	1 second
	Runway touchdown zone	1 second
	All stop bars	1 second
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Essential taxiway	15 seconds
	Runway edge	15 seconds
	Runway end	1 second
	Runway center line	1 second
	All stop bars	1 second
	Essential taxiway ^a	15 seconds
	Obstacle ^a	15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.

b. See MOS 9.1.17, regarding the use of emergency lighting.

c. One second where no runway centerline lights are provided.

d. One second where approaches are over hazardous or precipitous terrain.

Table 9.1-1. Secondary power supply requirements

- 9.1.8.2 The provision of a definition of switch-over time shall not require the replacement of an existing secondary power supply before 1 January 2010. However, for a secondary power supply installed after 4 November 1999, the electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are capable of meeting the requirements of Table 9.1-1 for maximum switch-over times as defined in Chapter 1.
- 9.1.8.3 For a precision approach runway, a secondary power supply capable of meeting the requirements of Table 9.1-1 for the appropriate category of precision approach runway shall be provided. Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.
- 9.1.8.4 For a runway meant for take-off in runway visual range conditions less than a value of 800 m, a secondary power supply capable of meeting the relevant requirements of Table 9.1-1 shall be provided.
- 9.1.8.5 At an aerodrome where the primary runway is a non-precision approach runway, a secondary power supply capable of meeting the requirements of Table 9.1-1 shall be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.
- 9.1.8.6 At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of MOS 9.1.8.1 shall be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system in accordance with the specification of MOS 9.1.17 is provided and capable of being deployed in 15 minutes.
- 9.1.8.7 The following aerodrome facilities shall be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:
- (a) the signaling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;
- Note: - The requirement for minimum lighting may be met by other than electrical means.*
- (b) all obstacle lights which, in the opinion of the appropriate authority, are essential to ensure the safe operation of aircraft;
 - (c) approach, runway and taxiway lighting as specified in MOS 9.1.8.3 to 9.1.8.6;
 - (d) meteorological equipment;
 - (e) essential security lighting, if provided in accordance with MOS 10.2.8;
 - (f) essential equipment and facilities for the aerodrome responding emergency agencies;
 - (g) floodlighting on a designated isolated aircraft parking position if provided in accordance with MOS 9.15.2.1; and
 - (h) illumination of apron areas over which passengers may walk.

Note: - Specifications for secondary power supply for radio navigation aids and ground elements of communications systems are given in Annex 10, Volume I, Chapter 2.

9.1.8.8 Requirements for a secondary power supply shall be met by either of the following:

- (a) independent public power, which is a source of power supplying the aerodrome service from a substation other than the normal substation through a transmission line following a route different from the normal power supply route and such that the possibility of a simultaneous failure of the normal and independent public power supplies is extremely remote; or
- (b) standby power unit(s), which are engine generators, batteries, etc., from which electric power can be obtained.

Note: - Guidance on electrical systems is included in the Aerodrome Design Manual (Doc 9157), Part 5.

9.1.8.9 System design

- (a) For a runway meant for use in runway visual range conditions less than a value of 550 m, the electrical systems for the power supply, lighting and control of the lighting systems included in Table 9.1-1 shall be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information.

Note: - Guidance on means of providing this protection is given in the Aerodrome Design Manual (Doc 9157), Part 5

- (b) Where the secondary power supply of an aerodrome is provided by the use of duplicate feeders, such supplies shall be physically and electrically separate so as to ensure the required level of availability and independence.
- (c) Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems shall be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.

9.1.8.10 Monitoring

Note: - Guidance on this subject is given in the Aerodrome Design Manual (Doc 9157), Part 5.

- (a) A system of monitoring shall be employed to indicate the operational status of the lighting systems.
- (b) Where lighting systems are used for aircraft control purposes, such systems shall be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information shall be automatically relayed to the air traffic services unit.
- (c) Where a change in the operational status of lights has occurred, an indication shall be provided within two seconds for a stop bar at a runway- holding position and within five seconds for all other types of visual aids.

- (d) For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 9.1-1 shall be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in MOS 9.1.15.3 to 9.1.15.8, as appropriate. This information shall be automatically relayed to the maintenance crew.
- (e) For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 9.1-1 shall be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified by the appropriate authority below which operations shall not continue. This information shall be automatically relayed to the air traffic services unit and displayed in a prominent position.

Note: - Guidance on air traffic control interface and visual aids monitoring is included in the Aerodrome Design Manual (Doc 9157), Part 5

9.1.9 Standby power supply

Note:- Operational credit is given to a runway lighting system notified in AIP as provided with standby power or portable lighting. This is because when a flight is planned to land at night at an aerodrome with electric runway lighting, provision must be made for flight to an alternate aerodrome unless the destination aerodrome has standby power, or portable runway lights are available and arrangements have been made for a responsible person to be in attendance.

9.1.9.1 For lighting to be notified in AIP as provided with standby power, the standby power supply must be either secondary power or standby generators which are manually activated.

9.1.9.2 Where the activation of the standby power is not automatic, procedures must be established to facilitate the introduction of standby power as soon as possible when the need arises.

Note: - 1. For non-automatic activation the actual time required for activation of standby power should be notated in AIP.

Note: - 2. The procedures shall allow standby power to be provided within 15 minutes of demand.

9.1.10 Portable lighting

9.1.10.1 Portable lights may comprise liquid fuel-burning flares or lamps, or battery powered electric lights.

9.1.10.2 When an aerodrome is notified in AIP as provided with portable lighting, the portable lights must be kept in a state of readiness and serviceable condition with clean glasses, and appropriate persons must be trained such that the lights can be deployed and put into operation without delay, when the need arises.

Note: - Due to the time required to deploy portable lights, the AIP entry shall include a notation that prior notice is required.

9.1.10.3 The portable lights must be placed at the same spacing as installed lights.

Note: - To allow speedy deployment, the locations of the portable lights shall be clearly marked, and the surface appropriately treated and maintained.

- 9.1.10.4 When required, they must be lit or switched on at least 30 minutes before the estimated time of arrival.

Note: - The portable lights shall be so deployed such that an aircraft can land into the wind.

- 9.1.10.5 For aircraft departing, the portable lights must be lit or switched on at least 10 minutes before the time of departure and to be retained for at least 30 minutes after take-off, or if air-ground communications do not exist, for at least one hour after take-off, in case the aeroplane needs to return to the aerodrome.

9.1.11 Light fixtures and supporting structures

- 9.1.11.1 All aerodrome light fixtures and supporting structures must be of minimum weight while being fit for the function, and frangible.

Note: - See MOS Chapter 11 for information regarding siting of equipment and installations on operational areas, and the Aerodrome Design Manual (Doc 9157), Part 6, for guidance on frangibility of light fixtures and supporting structures.

- 9.1.11.2 Elevated approach lights and their supporting structures must be frangible, except that, in that portion of the approach lighting system beyond 300 m from the runway threshold:

- (a) where the height of a supporting structure exceeds 12 m, the frangibility requirement need apply to the top 12 m only; and
- (b) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects need be frangible.

- 9.1.11.3 Where an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it is to be suitably marked.

9.1.12 Elevated and inset lights

- 9.1.12.1 Elevated runway, stopway and taxiway lights must be frangible and sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. In general, they shall not be more than 360 mm above the ground.

- 9.1.12.2 Elevated lights, in general, are preferable to inset lights, because they provide a larger aperture from which light signals can be seen. Elevated lights must be used in all cases except:

- (a) where the use of inset lights is specified in this Chapter, or
- (b) where it is not practicable to use elevated lights.

Note: - Elevated lights are not practicable on pavements where aircraft or vehicles travel or in areas subject to significant jet blast.

- 9.1.12.3 Inset lights, also known as in-pavement lights, must not:

- (a) be constructed with sharp edges;

- (b) project more than 25 mm above the surrounding surface at locations where the lights will not normally come into contact with aircraft wheels, such as threshold lights, runway end lights and runway edge lights;
- (c) project more than 13 mm above the surrounding surface at locations which will normally come into contact with aircraft wheels, such as runway centerline lights, touch down zone lights and taxiway centerline lights.

9.1.12.4 Light fixtures inset in the surface of runways, stopways, taxiways and aprons shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.

9.1.12.5 The maximum surface temperature attained by an inset light must not exceed 160°C over a period of 10 minutes, if operating at maximum intensity while covered by an aircraft wheel.

Note: - Guidance on measuring the temperature of inset lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

9.1.12.6 The standard color of the casings of elevated light units is yellow.

9.1.13 Color of light shown

9.1.13.1 The color of the light shown must be in accordance with the applicable standard specified in MOS Section 9.2.

9.1.13.2 To ensure uniformity of visual appearance, light fittings using different filter technology must not be mixed (e.g. dichroic filters, other absorption filters, light emitting diode (LED), etc.) in such a way as to create inconsistency in either light color or intensity when viewed by pilots from a moving aircraft on a runway or taxiway.

9.1.14 Light intensity and control

Note: - In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end. (See MOS Attachment A, Section 7, and the Aerodrome Design Manual, Doc 9157, Part 4).

9.1.14.1 At an aerodrome with an air traffic service (ATS), the following lighting systems, if provided, must be equipped with an intensity control so that the ATS can select light output to suit ambient conditions and avoid dazzling pilots:

- (a) approach lighting system;
- (b) approach slope guidance system;
- (c) runway edge, threshold and end lights;
- (d) runway centerline lights;
- (e) runway touchdown zone lights;
- (f) taxiway centerline lights.

- 9.1.14.2 Intensity must be capable of being varied in 5 or 6 stages, for the following systems:
- (a) approach lighting systems;
 - (b) visual approach slope indicator systems;
 - (c) high intensity runway edge, threshold and end lights;
 - (d) runway centerline lights;
 - (e) runway touchdown zone lights.
- 9.1.14.3 Intensity must be capable of being varied in at least 3 stages for medium intensity runway edge, threshold and end lights.
- 9.1.14.4 If a runway is equipped with both high and medium intensity runway edge lighting, the 3 lowest intensity stages shall be provided by the medium intensity system.
- 9.1.14.5 Where a high-intensity lighting system is provided, a suitable intensity control shall be incorporated to allow for adjustment of the light intensity to meet the prevailing conditions. Separate intensity controls or other suitable methods shall be provided to ensure that the following systems, when installed, can be operated at compatible intensities:
- (a) approach lighting system;
 - (b) runway edge lights;
 - (c) runway threshold lights;
 - (d) runway end lights;
 - (e) runway centerline lights;
 - (f) runway touchdown zone lights; and
 - (g) taxiway centerline lights.
- 9.1.14.6 For taxiway lights:
- (a) Taxiway centerline lights with a main beam average intensity of the order of 50 cd or less, 3 stages of intensity control will normally be sufficient.
 - (b) Taxiway centerline lights with main beam average intensity of the order of 100 cd or greater will normally require more than 3 stages of intensity control, or alternatively to have the maximum light output permanently reduced by fixing the maximum intensity stage at less than 100% of the rated output of the light. One hundred percent output of these lights has been found to be too bright for normal conditions.
 - (c) Taxiway edge lights do not normally require separate intensity control. It is common for taxiway edge lights to be installed on the same electrical circuit as the low or medium intensity runway edge lights, and to be controlled by the runway light control.
- 9.1.14.7 Intensity must be reduced from each successive stage to an order of 25- 33%. This is based on the fact that a change of that magnitude is required for the human eye to detect that a change has occurred. For 6 stages of intensities, they should be of the order of: 100%, 30%, 10%, 3%, 1% and 0.3%.

- 9.1.14.8 At an aerodrome where the lighting is provided with intensity settings but the ATS does not provide 24 hour coverage and the operator leaves the lights turned on all night, the recommended stage of intensity which provides adequate illumination but will not dazzle pilots is stage 2.

Note: - Guidance on selecting series currents for various intensity stages for some airport lighting systems is given in the Table 9.1-2 below. The guidance is only applicable to systems installed to the industry standard of 6.6 amps series current giving 100% intensity, except where noted otherwise in the Table.

- 9.1.14.9 Where lighting systems are operated by ATS such systems shall be monitored automatically so as to provide an immediate indication of:

- (a) those lighting systems that are on;
- (b) the intensity of each lighting system;
- (c) any fault in a lighting system; and
- (d) such information is to be automatically relayed to the operator position.

- 9.1.14.10 At an aerodrome with Low Intensity Runway Edge Lighting Systems, in accordance with Paragraph 9.10.1.1(a), the light fittings used must be in compliance with Paragraph 9.10.6. However, it is permissible with these systems, at commissioning, to adjust and then set the system current to a value other than the rated current value. This is to enable the actual light output of the light units to be set to a suitable light level to match the specific conditions of the particular aerodrome, to harmonize with the intensity of visual approach slope indicators if present, and minimize the likelihood of dazzling pilots. Where the system current is set to a value other than the rated current, the actual value of current set must be recorded in the Aerodrome Manual.

- 9.1.14.11 The intensity of runway lighting shall be adequate for the minimum conditions of visibility and ambient light in which use of the runway is intended, and compatible with that of the nearest section of the approach lighting system when provided.

Note: - While the lights of an approach lighting system may be of higher intensity than the runway lighting, it is good practice to avoid abrupt changes in intensity as these could give a pilot a false impression that the visibility is changing during approach.

Lighting System	Nominal minimum intensity at rated output	Stage					
		6	5	4	3	2	1
Runway Edge Lights, Low Intensity	100 cd						100% 6.6 A
Runway Edge Lights, Medium Intensity	300 cd typical				100% 6.6 A	30% 5.4 A	10% 4.5 A
Runway Edge Lights, High Intensity	10,000 cd	100% 6.6 A	30% 5.4 A	10% 4.5 A			
Approach Lights * 12.5A/6.6A series isolating transformer * 6.6A/6.6A series isolating transformer	20,000 cd	100%	25%	6.5%	2%	0.5%	0.12%
		12.5 A	9.5 A	7.5 A	6.2 A	5.0 A	4.0 A
		6.6 A	5.3 A	4.3 A	3.6 A	3.2 A	3.0 A
Runway Centerline lights	5,000 cd	100% 6.6 A	25% 5.2 A	8% 4.4 A	2.5% 3.8 A	0.8% 3.3 A	0.25% 3.0 A
Runway Touchdown Zone lights	5,000 cd	100% 6.6 A	25% 5.2 A	8% 4.4 A	2.5% 3.8 A	0.8% 3.3 A	0.25% 3.0 A
Taxiway Centerline lights	50 cd				100% 6.6 A	40% 5.5 A	16% 4.8 A
PAPI	15,000 cd red light	100% 6.6 A	30% 5.5 A	10% 4.8 A	3% 3.85 A	1% 3.4 A	0.3% 3.0 A
T-VASIS	See Section 9.9 Paragraph 9.9.3.11.						

Table 9.1-1: Guidance on selecting series line currents for various intensity stages

Note: - 1. All values are for a standard system of 6.6A series current for full rated light output, (except Approach Lights using 12.5 A/6.6 A series isolating transformers), and would not be relevant for lighting systems installed to other electrical parameters.

Note: - 2. The current values are true root mean square (RMS) amperes.

Note: - 3. The intensity percentages are approximate only. At the higher Stages (5 and 6) it is more important to maintain the intensity ratio to runway edge lights as given in paragraphs 9.8.1.2 and 9.11.1.4. At the lower intensity stages, as used during good visibility conditions, maintaining those intensity ratios tends to result in glare for pilots, and so lower ratios are suggested.

9.1.15**Maintenance performance of aerodrome lighting (Visual aids)**

Note: - 1. These specifications are intended to define the maintenance performance level objectives. They are not intended to define whether the lighting system is operationally out of service.

Note: - 2. Enhanced vision systems (EVS) technology relies on the infra-red heat signature provided by incandescent lighting. Annex 15 protocols provide an appropriate means of notifying aerodrome users of EVS when lighting systems are converted to LED.

- 9.1.15.1 A light shall be deemed to be unserviceable when the main beam average intensity is less than 50% of value specified in the appropriate figure in MOS Section 9.7. For light units where the designed main beam average intensity is above the value shown in MOS Section 9.7 the 50% value shall be related to the design value.
- 9.1.15.2 A system of preventive maintenance of visual aids shall be employed to ensure lighting and marking system reliability.
- Note: - Guidance on preventive maintenance of visual aids is given in the Airport Services Manual (Doc 9137), Part 9.*
- 9.1.15.3 The system of preventive maintenance employed for a precision approach runway category II or III shall include at least the following checks:
- (a) visual inspection and in-field measurement of the intensity, beam spread and orientation of lights included in the approach and runway lighting systems;
 - (b) control and measurement of the electrical characteristics of each circuitry included in the approach and runway lighting systems; and
 - (c) control of the correct functioning of light intensity settings used by air traffic control.
- 9.1.15.4 In-field measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specification of MOS Figures 9.7-1 to 9.7-2; 9.10-3 to 9.10-10 & 9.10-12; MOS Figures 9.13-1 to 9.13-13, MOS Figures 9.8-4 and 9.8-9A & 9.8-9B (Aeronautical Ground Light Characteristics).
- 9.1.15.5 Measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken using a mobile measuring unit of sufficient accuracy to analyze the characteristics of the individual lights.
- 9.1.15.6 The frequency of measurement of lights for a precision approach runway category II or III shall be based on traffic density, the local pollution level, the reliability of the installed lighting equipment and the continuous assessment of the results of the in-field measurements but, in any event, shall not be less than twice a year for in-pavement lights and not less than once a year for other lights.
- 9.1.15.7 The system of preventative maintenance employed for a precision approach runway category II or III shall have as its objective that, during any period of category II or III operations, all approach and runway lights are serviceable and that in any event at least:
- (a) 95% of the lights are serviceable in each of the following particular significant elements:

- (i) precision approach category II and III lighting system, the inner 450 m;
- (ii) the runway centerline lights;
- (iii) the runway threshold lights;
- (iv) the runway edge lights;
- (b) 90% of the lights are serviceable in the touchdown zone lights;
- (c) 85% of the lights are serviceable in the approach lighting system beyond 450m;
- (d) 75% of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance the allowable percentages of unserviceable lights shall not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally an unserviceable light shall not be permitted adjacent to another unserviceable light except in a barrette or crossbar where two adjacent unserviceable lights may be permitted.

Note: - With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

- laterally: in the same barrette or crossbar; or
- longitudinally: in the same row of edge lights or barrettes.

9.1.15.8 The system of preventative maintenance employed for a stop bar provided at a runway holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of 350, shall have the following objectives:

- (a) no more than two lights will remain unserviceable; and
- (b) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.

9.1.15.9 The system of preventative maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of 350m shall have as its objective that no two adjacent taxiway centerline lights shall be unserviceable.

9.1.15.10 The system of preventative maintenance employed for a precision approach runway category I shall have as its objective that during any period of category I operations all approach and runway lights are serviceable, and that in any event at least 85% of the lights are serviceable in each of the following:

- (a) precision approach category I lighting system;
- (b) the runway threshold lights;
- (c) the runway edge lights; and
- (d) the runway end lights.

In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.

Note: - In barrettes and crossbars, guidance is not lost by having two adjacent unserviceable lights.

9.1.15.11 The system of preventative maintenance employed for a runway meant for take-off in runway visual range conditions of less than a value of 550m shall have as its objective that during any period of operations all runway lights are serviceable and that in any event:

- (a) precision approach category I lighting system;
- (b) the runway threshold lights;

In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light.

9.1.15.12 The system of preventative maintenance employed for a runway meant for take-off in runway visual range conditions value of 550m or greater shall have as its objective that during any period of operations all runway lights are serviceable and that in any event at least 85% of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light.

9.1.15.13 During low visibility procedures, appropriate authority restricts construction or maintenance activities in the proximity of aerodrome electrical systems.

9.1.16 Commissioning of lighting systems

9.1.16.1 Commissioning means a formal process by which the performance of the lighting system is confirmed. It may incorporate a series of procedures designed to determine the suitable performance and accuracy of information provided by any visual aid in conformity with specifications and CAAP standards. The commissioning process shall be confirmed by a qualified person. Qualified person in this case means:

- (a) **For ground check of compliance with electrical specifications and CAAP standards:** engineer or airfield power technician with qualifications, training and experience satisfactory to CAAP.

Note: - Evidence supplied by authoritative source that the light units are in compliance with the standards is acceptable.

- (b) **For flight checking of compliance with operational specifications:** a person or organization approved by CAAP i.e. Flight Inspection and Calibration Group (FICG) as having the competency to conduct commissioning flight checks.

9.1.16.2 All aerodrome lighting systems must be commissioned before they are notified as available for normal operations.

9.1.16.3 The ground check of a visual approach slope indicator system must include verification of vertical and horizontal angles of light signal changes by a person having civil engineering or surveying qualification and experience.

9.1.16.4 The commissioning of the following lighting systems, in addition to the ground check, must include flight checks of:

- (a) approach lighting system;

- (b) runway lighting system for instrument runways;
- (c) visual approach slope indicator system (e.g. VASI / PAPI)
 - (i) used by jet propelled aeroplanes engaged in air transport operations; or
 - (ii) installed on CAAP direction, in accordance with 9.8.1.1(b);

9.1.16.5 For a visual approach slope indicator system specified in MOS 9.1.15.4, that is provided for temporary use only, for example due to a temporary displaced threshold, or during works in progress, the requirement for a flight check may be waived by CAAP.

9.1.16.6 For those systems specified in MOS 9.1.15.4, the aerodrome operator shall submit duly certified ground check and flight check reports to CAAP. If satisfied with the reports, CAAP will approve the issue of a permanent NOTAM. Information for a visual approach slope indicator system to be included in the permanent NOTAM is included in MOS 5.6.

9.1.16.7 For those systems not specified in Paragraph 9.1.15.4, the aerodrome operator must use the duly certified ground check as sufficient evidence of compliance with standards to initiate a permanent NOTAM.

9.1.16.8 At any time after commissioning, CAAP may direct the ground checking and/or the flight checking of a lighting system specified in Paragraph 9.1.15.4, following substantial changes to the system or on receipt of adverse reports on the performance of the system from pilots or aircraft operators. Examples of substantial changes to the system include:

- (a) removal and replacement of 50% or more of the light fittings, at the same time, of an approach or runway lighting system;
- (b) removal and replacement of one or more light units of a PAPI system; and
- (c) removal and replacement of two or more light units, at the same time, of an AT-VASIS system.

Note: - Before a runway is opened for night use, the status of obstacles need to be assessed for obstacle lighting purposes, particularly if the obstacles are within 3 km of the aerodrome.

9.1.17 Emergency lighting

9.1.17.1 At an aerodrome provided with runway lighting and without a secondary power supply, sufficient emergency lights shall be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.

Note: - Emergency lighting may also be useful to mark obstacles or delineate taxiways and apron areas

9.1.17.2 When installed on a runway the emergency lights shall, as a minimum, conform to the configuration required for a non-instrument runway.

9.1.17.3 The color of the emergency lights shall conform to the color requirements for runway lighting, except that, where the provision of colored lights at the threshold and the runway end is not practicable, all lights may be variable white or as close

to variable white as practicable.

Section 9.2 Colors for Aeronautical Ground Lights

9.2.1 General

Introductory Note: - The following specifications define the chromaticity limits of colors to be used for aeronautical ground lights, markings, signs and panels. The specifications are in accord with the 1983 specifications of the International Commission on Illumination (CIE), except for the color orange in Figure 9.2-1.

It is not possible to establish specifications for colors such that there is no possibility of confusion. For reasonably certain recognition, it is important that the eye illumination be well above the threshold of perception, that the color not be greatly modified by selective atmospheric attenuations and that the observer's color vision be adequate. There is also a risk of confusion of color at an extremely high level of eye illumination such as may be obtained from a high- intensity source at very close range. Experience indicates that satisfactory recognition can be achieved if due attention is given to these factors.

*The chromaticities are expressed in terms of the standard observer and coordinate system adopted by the International Commission on Illumination (CIE) at its Eighth Session at Cambridge, England, in 1931.**

The chromaticities for solid state lighting (e.g. LED) are based upon the boundaries given in the standard S 004/E-2001 of the International Commission on Illumination (CIE), except for the blue boundary of white.

9.2.2 Chromaticities for lights having filament-type light sources

9.2.2.1 The chromaticities of aeronautical ground lights with filament-type light sources shall be within the following boundaries:

(a) Red

Purple boundary	$y = 0.980 - x$
Yellow boundary	$y = 0.335$, except for visual approach slope indicator systems;
Yellow boundary	$y = 0.320$, for visual approach slope indicator systems.

Note.— See 9.8.4.6 (c)

(b) Yellow

Red boundary	$y = 0.382$
White boundary	$y = 0.790 - 0.667x$
Green boundary	$y = x - 0.120$

(c) Green

Yellow boundary	$y = 0.360 - 0.080y$
White boundary	$x = 0.650y$
Blue boundary	$y = 0.390 - 0.171x$

- (d) Blue
 Green boundary $y = 0.805x + 0.065$
 White boundary $x = 0.400 - x$
 Purple boundary $x = 0.600y + 0.133$
- (e) White
 Yellow boundary $x = 0.500$
 Blue boundary $x = 0.285$
 Green boundary $y = 0.440$ and $y = 0.150 + 0.640x$
 Purple boundary $y = 0.050 + 0.750x$ and $y = 0.382$
- (f) Variable White
 Yellow boundary $x = 0.255 + 0.750y$ and $y = 0.790 - 0.667x$
 Blue boundary $x = 0.285$
 Green boundary $y = 0.440$ and $y = 0.150 + 0.640x$
 Purple boundary $y = 0.050 + 0.750x$ and $y = 0.382$

Note: - Guidance on chromaticity changes resulting from the effect of temperature on filtering elements is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- 9.2.2.2 Where dimming is not required, or where observers with defective color vision must be able to determine the color of the light, green signals shall be within the following boundaries:

Yellow boundary $y = 0.726 - 0.726x$
 White boundary $x = 0.650y$
 Blue boundary $y = 0.390 - 0.171x$

Note: - Where the color signal is to be seen from long range, it has been the practice to use colors within the boundaries of MOS 5.1.2.2.

- 9.2.2.3 Where increased certainty of recognition from white, is more important than maximum visual range, green signals shall be within the following boundaries:

Yellow boundary $y = 0.726 - 0.726x$
 White boundary $x = 0.625y - 0.041$
 Blue boundary $y = 0.390 - 0.171x$

9.2.3 Discrimination between colored lights having filament-type sources

- 9.2.3.1 If there is a requirement to discriminate yellow and white from each other, they must be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

- 9.2.3.2 If there is a requirement to discriminate yellow from green or white, as for example, with exit taxiway centerline lights, the 'y' co-ordinate of the yellow light must not exceed a value of 0.40.

Note: - The limits of white have been based on the assumption that they will be used in situations in which the characteristics (color, temperature) of the light source will be substantially constant.

9.2.3.3 The color variable white is intended to be used only for lights that are to be varied in intensity, e.g. to avoid dazzling. If these lights are to be discriminated from yellow lights, the lights must be designed and operated so that:

- (a) the 'x' co-ordinate of the yellow is at least 0.050 greater than the 'x' co-ordinate of the white; and
- (b) the disposition of the lights is such that the yellow lights are displayed simultaneously and in close proximity to the white lights.

9.2.4 Chromaticities for lights having a solid state light source

9.2.4.1 The chromaticities of aeronautical ground lights with solid state light sources, e.g. LEDs, shall be within the following boundaries:

CIE Equations (see Figure 9.2-1b):

- (a) Red

Purple boundary	$y =$	$0.980 - x$	
Yellow boundary	$y =$	0.335 , except for	visual approach slope indicator systems;
Yellow boundary	$y =$	0.320 , for	visual approach slope indicator systems.

Note: - See 9.8.4.6 (c)

- (b) Yellow

Red boundary	$y =$	0.387
White boundary	$y =$	$0.980 - x$
Green boundary	$y =$	$0.727x + 0.054$
- (c) Green (also refer to MOS 9.8.4.7 and 9.8.4.8)

Yellow boundary	$x =$	0.310
White boundary	$x =$	$0.625y - 0.041$
Blue boundary	$y =$	0.400
- (d) Blue

Green boundary	$y =$	$0.1141x - 0.0377$
White boundary	$x =$	$0.400 - y$
Purple boundary	$x =$	$0.134 + 0.590y$
- (e) White

Yellow boundary	$x =$	0.440
Blue boundary	$x =$	0.320
Green boundary	$y =$	$0.150 + 0.643x$
Purple boundary	$y =$	$0.050 + 0.757x$
- (f) Variable White

The boundaries of variable white for solid state light sources are those of (e) White above

9.2.4.2 Where observers with defective color vision must be able to determine the color of

the light, green signals shall be within the following boundaries:

Yellow boundary $y = 0.726 - 0.726x$

White boundary $x = 0.625y - 0.041$

Blue boundary $y = 0.400$

- 9.2.4.3 In order to avoid a large variation of shades of green, if colors within the boundaries below are selected, colors within the boundaries of MOS 9.2.4.2 shall not be used.

Yellow boundary $x = 0.310$

White boundary $x = 0.625y - 0.041$

Blue boundary $y = 0.726 - 0.726x$

9.2.5 Color measurement for filament-type and solid state-type light sources

- 9.2.5.1 The color of aeronautical ground lights shall be verified as being within the boundaries specified in Figure 9.2-1a or 9.2-1b, as appropriate, by measurement at five points within the area limited by the innermost isocandela curve (isocandela diagrams in Chapter 9, collective notes to figures), with operation at rated current or voltage. In the case of elliptical or circular isocandela curves, the color measurements shall be taken at the center and at the horizontal and vertical limits. In the case of rectangular isocandela curves, the color measurements shall be taken at the center and the limits of the diagonals (corners). In addition, the color of the light shall be checked at the outermost isocandela curve to ensure that there is no color shift that might cause signal confusion to the pilot.

Note: - 1. For the outermost isocandela curve, a measurement of color coordinates should be made and recorded for review and judgement of acceptability by the State.

Note: - 2. Certain light units may have application so that they may be viewed and used by pilots from directions beyond that of the outermost isocandela curve (e.g. stop bar lights at significantly wide runway-holding positions). In such instances, the State should assess the actual application and if necessary require a check of color shift at angular ranges beyond the outermost curve.

- 9.2.5.2 In the case of visual approach slope indicator systems and other light units having a color transition sector, the color shall be measured at points in accordance with MOS 9.2.5.1, except that the color areas shall be treated separately and no point shall be within 0.5 degrees of the transition sector.

9.2.6 Colors for markings, signs and panels

Note: - 1. The specifications of surface colors given below apply only to freshly colored surfaces. Colors used for markings, signs and panels usually change with time and therefore require renewal.

Note: - 2. Guidance on surface colors is contained in the CIE document entitled Recommendations for Surface Colors for Visual Signaling — Publication No. 39- 2 (TC-106) 1983.=

Note: – 3. The specifications recommended in MOS 9.2.6.4 for transilluminated panels are interim in nature and are based on the CIE specifications for transilluminated signs. It is intended that these specifications will be reviewed and updated as and when CIE develops specifications for transilluminated panels.

9.2.6.1 The chromaticities and luminance factors of ordinary colors, colors of retroreflective materials and colors of transilluminated (internally illuminated) signs and panels shall be determined under the following standard conditions:

- (a) angle of illumination: 45°;
- (b) direction of view: perpendicular to surface; and
- (c) illuminant: CIE standard illuminant D₆₅.

9.2.6.2 The chromaticity and luminance factors of ordinary colors for markings and externally illuminated signs and panels shall be within the following boundaries when determined under standard conditions.

CIE Equations (see MOS Figure 9.2-2):

- (a) Red

Purple boundary	$y =$	$0.345 - 0.051x$
White boundary	$y =$	$0.910 - x$
Orange boundary	$y =$	$0.314 + 0.047x$
Luminance factor	$\beta =$	0.07 (nm)
- (b) Orange

Red boundary	$y =$	$0.285 + 0.100x$
White boundary	$y =$	$0.940 - x$
Yellow boundary	$y =$	$0.250 + 0.220x$
Luminance factor	$\beta =$	0.20 (nm)
- (c) Yellow

Orange boundary	$y =$	$0.108 + 0.707x$
White boundary	$y =$	$0.910 - x$
Green boundary	$y =$	$1.35x - 0.093$
Luminance factor	$\beta =$	0.45 (nm)
- (d) White

Purple boundary	$y =$	$0.010 + x$
Blue boundary	$y =$	$0.610 - x$
Green boundary	$y =$	$0.030 + x$
Yellow boundary	$y =$	$0.710 - x$
Luminance factor	$\beta =$	0.75 (nm)
- (e) Black

Purple boundary	$y =$	$x - 0.030$
Blue boundary	$y =$	$0.570 - x$
Green boundary	$y =$	$0.050 + x$
Yellow boundary	$y =$	$0.740 - x$
Luminance factor	$\beta =$	0.03 (max)
- (f) Yellowish green

Green boundary	$y =$	$1.317x + 0.4$
White boundary	$y =$	$0.910 - x$
Yellow boundary	$y =$	$0.867x + 0.4$
(g) Green		
Yellow boundary	$x =$	0.313
White boundary	$y =$	$0.243 + 0.670x$
Blue boundary	$y =$	$0.493 - 0.524x$
Luminance factor	$\beta =$	0.10 (nm)

Note: - The small separation between surface red and surface orange is not sufficient to ensure the distinction of these colors when seen separately.

9.2.6.3

The chromaticity and luminance factors of colors of retroreflective materials for markings, signs and panels shall be within the following boundaries when determined under standard conditions.

CIE Equations (see MOS Figure 9.2-3):

(a) Red		
Purple boundary	$y =$	$0.345 - 0.051x$
White boundary	$y =$	$0.910 - x$
Orange boundary	$y =$	$0.314 + 0.047x$
Luminance factor	$\beta =$	0.03 (nm)
(b) Orange		
Red boundary	$y =$	$0.265 + 0.205x$
White boundary	$y =$	$0.910 - x$
Yellow boundary	$y =$	$0.207 + 0.390x$
Luminance factor	$\beta =$	0.14 (nm)
(c) Yellow		
Orange boundary	$y =$	$0.160 + 0.540x$
White boundary	$y =$	$0.910 - x$
Green boundary	$y =$	$1.35x - 0.093$
Luminance factor	$\beta =$	0.16 (nm)
(d) White		
Purple boundary	$y =$	x
Blue boundary	$y =$	$0.610 - x$
Green boundary	$y =$	$0.040 + x$
Yellow boundary	$y =$	$0.710 - x$
Luminance factor	$\beta =$	0.27 (nm)
(e) Blue		
Green boundary	$y =$	$0.118 + 0.675x$
White boundary	$y =$	$0.370 - x$
Purple boundary	$y =$	$1.65x - 0.187$
Luminance factor	$\beta =$	0.01 (nm)
(f) Green		
Yellow boundary	$y =$	$0.711 - 1.22x$

White boundary	$y =$	$0.243 + 0.670x$
Blue boundary	$y =$	$0.405 - 0.243x$
Luminance factor	$\beta =$	0.03 (mnm)

9.2.6.4

The chromaticity and luminance factors of colors for luminescent or transilluminated (internally illuminated) signs and panels shall be within the following boundaries when determined under standard conditions.

CIE Equations (see MOS Figure 9.2-4):

- (a) Red
- | | | |
|---|-----------|-----------------------|
| Purple boundary | $y =$ | $0.345 - 0.051x$ |
| White boundary | $y =$ | $0.910 - x$ |
| Orange boundary | $y =$ | $0.314 + 0.047x$ |
| Luminance factor
(day condition) | $\beta =$ | 0.07 (mnm) |
| Relative luminance
to white (night
condition) | | 5% (min)
20% (max) |
- (b) Yellow
- | | | |
|---|-----------|------------------------|
| Orange boundary | $y =$ | $0.108 + 0.707x$ |
| White boundary | $y =$ | $0.910 - x$ |
| Green boundary | $y =$ | $1.35x - 0.093$ |
| Luminance factor
(day condition) | $\beta =$ | 0.45 (mnm) |
| Relative luminance
to white (night
condition) | | 30% (mnm)
80% (max) |
- (c) White
- | | | |
|---|-----------|----------------------|
| Purple boundary | $y =$ | $0.010 + x$ |
| Blue boundary | $y =$ | $0.610 - x$ |
| Green boundary | $y =$ | $0.030 + x$ |
| Yellow boundary | $y =$ | $0.710 - x$ |
| Luminance factor
(day condition) | $\beta =$ | 0.75 (mnm) |
| Relative luminance
to white (night
condition) | | 100% |
- (d) Black
- | | | |
|-------------------------------------|-----------|----------------------|
| Purple boundary | $y =$ | $x - 0.030$ |
| Blue boundary | $y =$ | $0.570 - x$ |
| Green boundary | $y =$ | $0.050 + x$ |
| Yellow boundary | $y =$ | $0.740 - x$ |
| Luminance factor
(day condition) | $\beta =$ | 0.03 (max) |
| Relative luminance | | 0% (mnm) |

- to white (night condition) 2% (max)
- (e) Green
- Yellow boundary $x = 0.313$
- White boundary $y = 0.243 + 0.670x$
- Blue boundary $y = 0.493 - 0.524x$
- Luminance factor (day condition) $\beta = 0.10$ minimum (day conditions)
- Relative luminance to white (night condition) 5% (minimum)
- 30% (maximum)

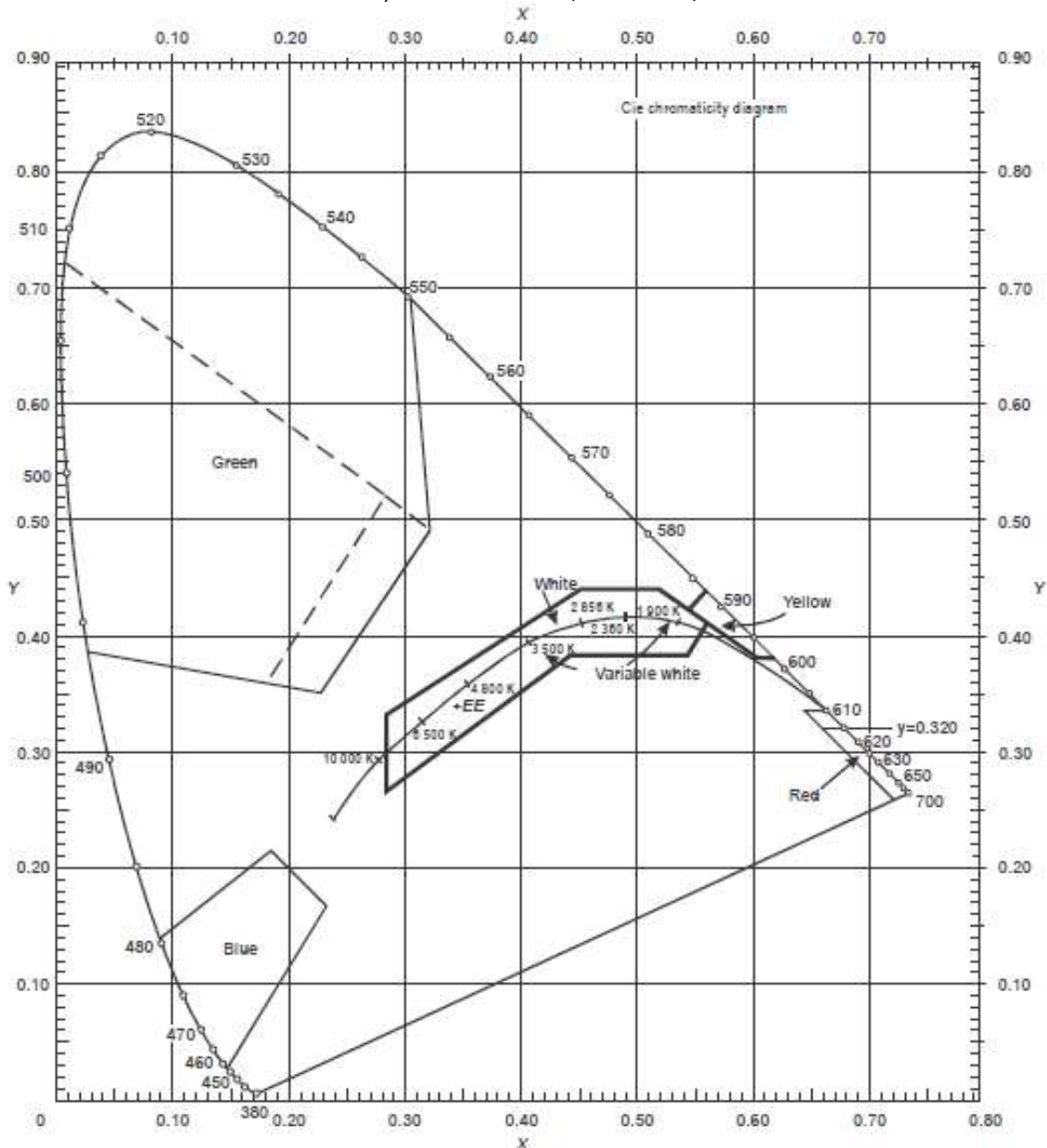


Figure 9.2-1a: Colors for aeronautical ground lights (filament-type lamps)

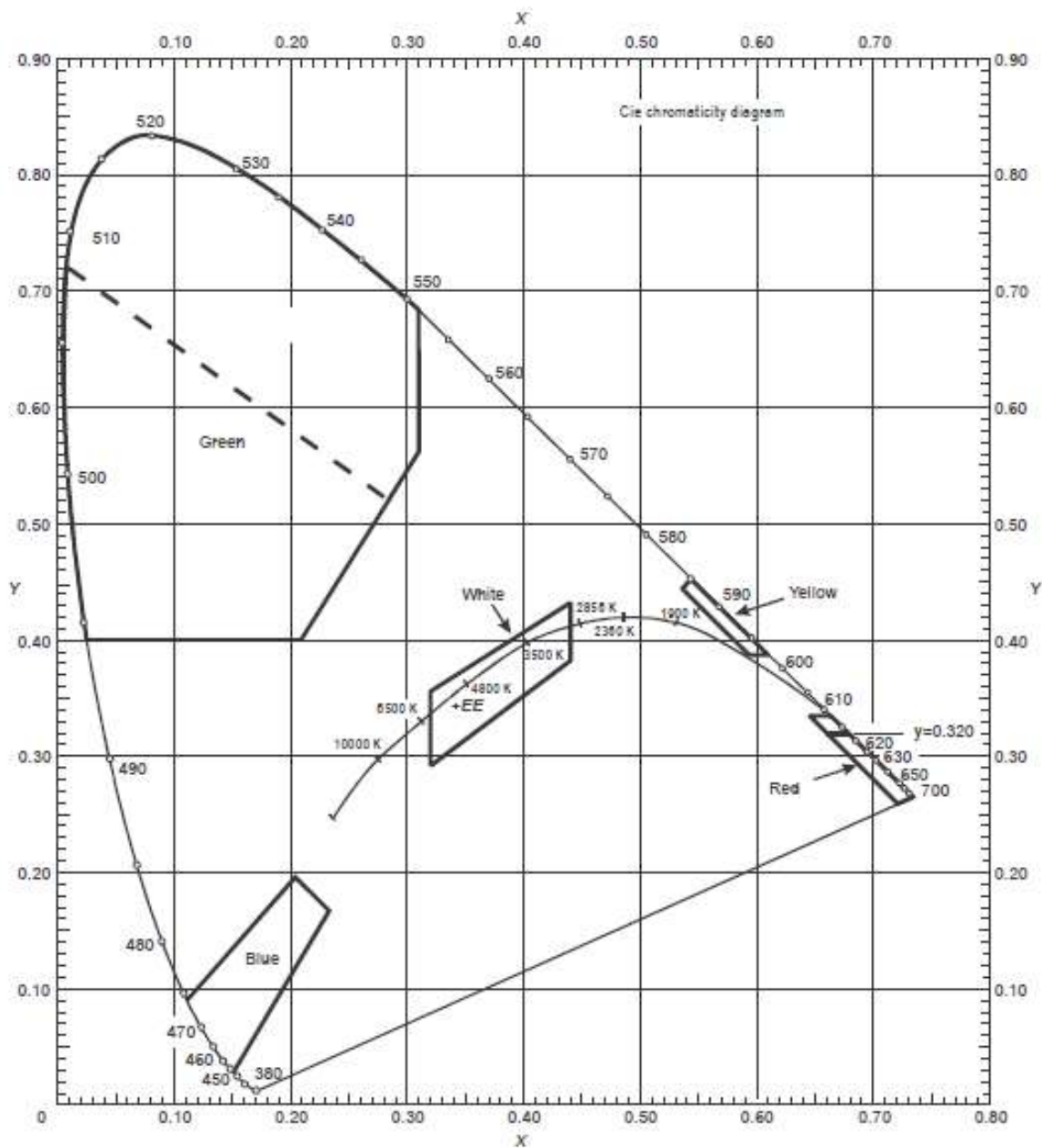


Figure 9.2-1b: Colors for aeronautical ground lights (solid state lighting)

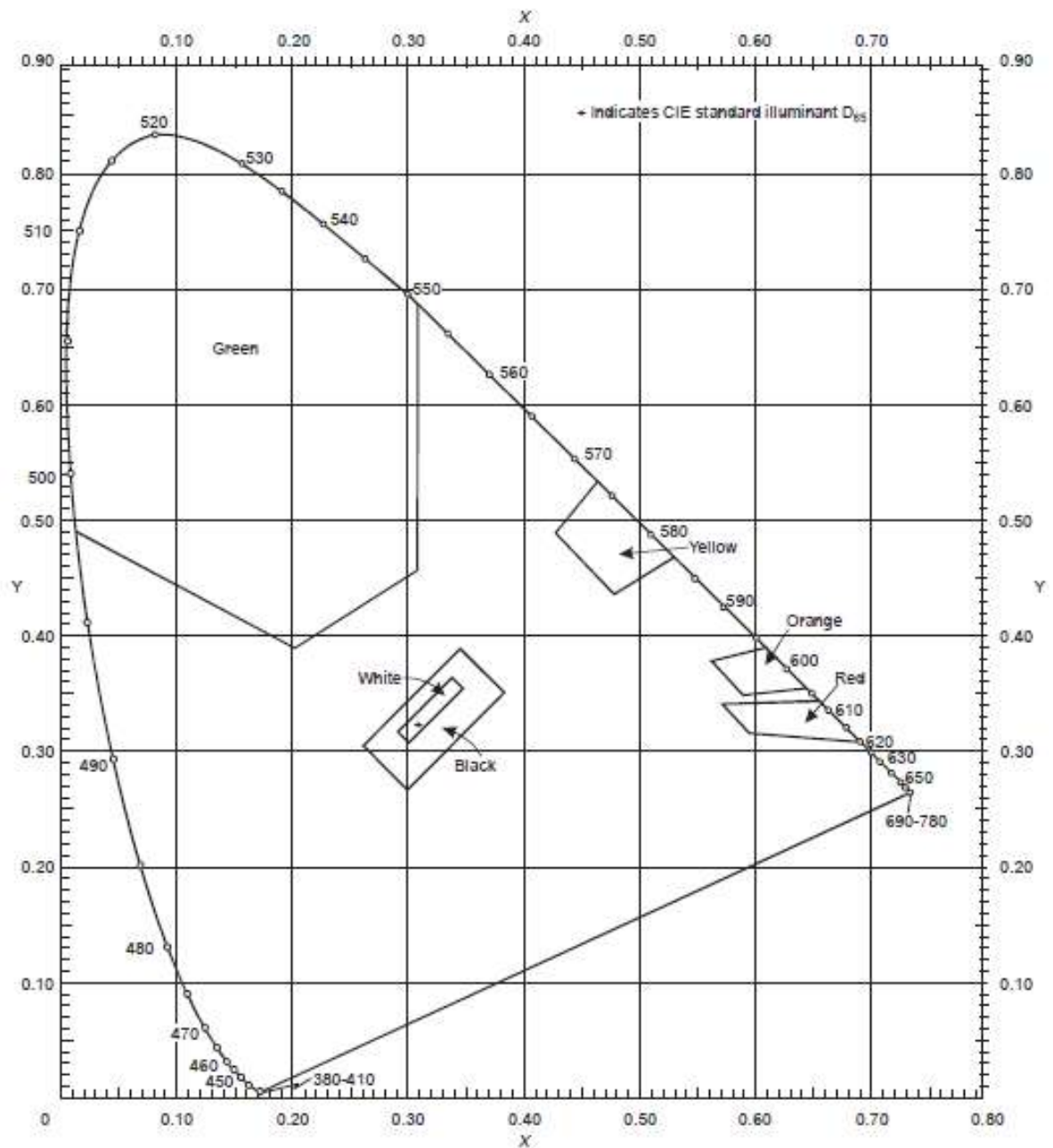


Figure 9.2-2. Ordinary colors for markings and externally illuminated signs and panels

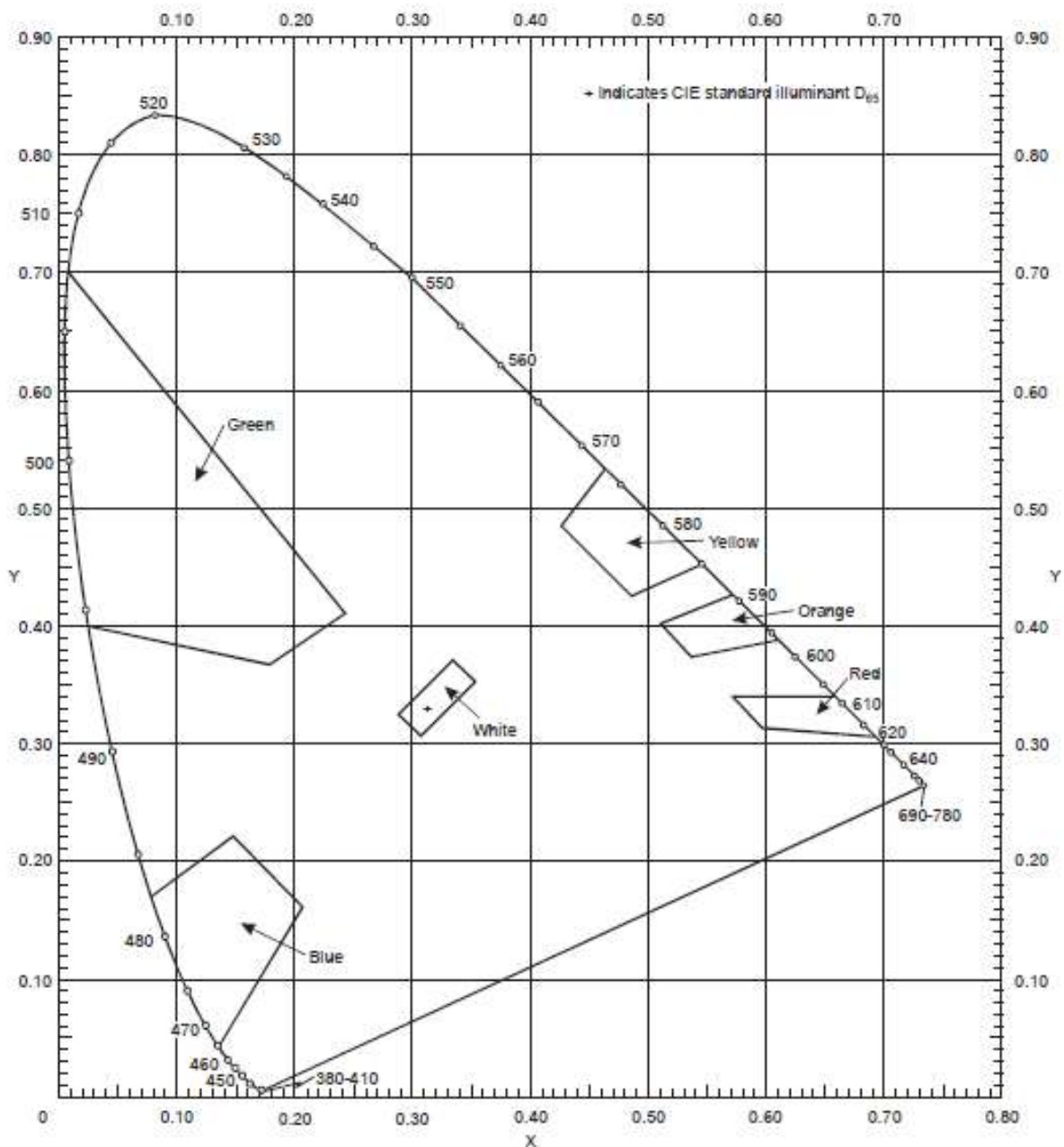


Figure 9.2-3. Colors of retroreflective materials for markings, signs and panels

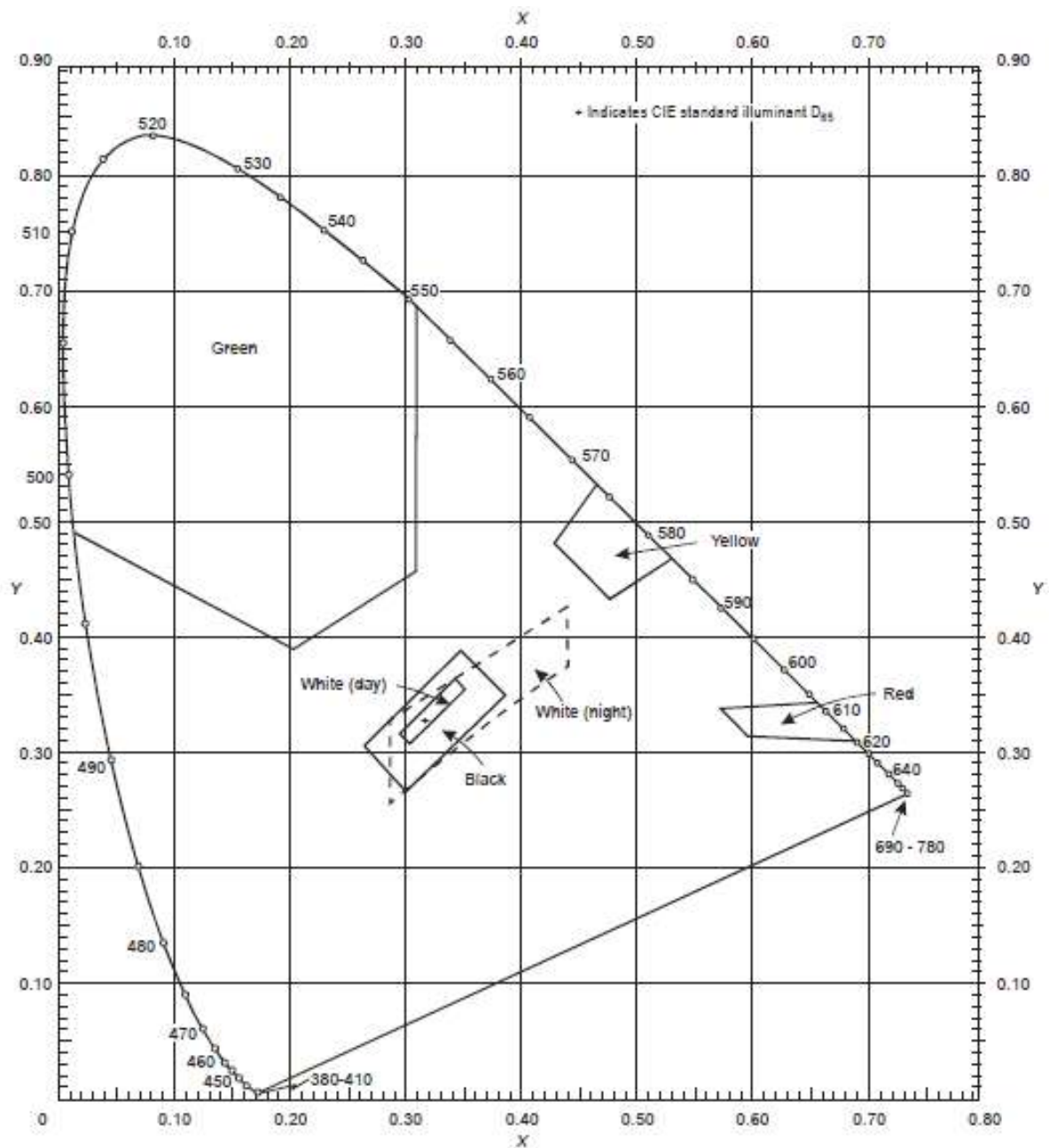


Figure 9.2-4. Colors of luminescent or transilluminated (internally illuminated) signs and panels

Section 9.3 Obstacle lighting**9.3.1 General**

9.3.1.1 The lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle.

9.3.1.2 If CAAP determines that an object or a proposed object that intrudes into navigable airspace requires, or will be required to be provided with, obstacle lighting, the responsibility for the provision and maintenance of obstacle lighting on a building or structure rests with the owner of the building or structure. Within the limits of the obstacle limitation surfaces of an aerodrome, responsibility for the provision and maintenance of obstacle lighting on natural terrain or vegetation, where determined necessary for aircraft operations at the aerodrome, rests with the aerodrome operator.

9.3.1.3 In general, an object in the following situations would require to be provided with obstacle lighting unless CAAP, after an aeronautical study, assesses it as being shielded by another lit object or that it is of no operational significance:

- (a) for a runway intended to be used at night:
 - (i) if the object extends above the take-off climb surface within 3000 m of the inner edge of the take-off climb surface;
 - (ii) if the object extends above the approach or transitional surface within 3000 m of the inner edge of the approach surface;
 - (iii) if the object extends above the applicable inner, conical or outer horizontal surfaces;
 - (iv) if the object extends above the obstacle protection surface of the T-VASIS or PAPI installed at the aerodrome;
 - (v) a vehicle or other mobile objects, excluding aircraft, on the movement area, except aircraft service equipment and vehicles used only on aprons;
 - (vi) obstacles in the vicinity of taxiways, apron taxiways or taxilanes, except that obstacle lights are not to be installed on elevated ground lights or signs in the movement area; and
- (b) outside the obstacle limitation surfaces of an aerodrome, if the object is or will be more than 110 m above ground level.

9.3.1.4 Owners of tall buildings or structures below the obstacle limitation surfaces, or less than 110 m above ground level, may, of their own volition, provide obstacle lighting to indicate the presence of such buildings or structures at night. To ensure consistency and avoid any confusion to pilots, the obstacle lighting provided needs to conform to the standards specified in this chapter.

9.3.1.5 In circumstances where the provision of obstacle marking is impracticable, obstacle lighting must be used during the day in lieu of obstacle marking.

9.3.2 Types of obstacle lighting and usage

9.3.2.1 Three types of lights used for lighting obstacles are detailed in MOS 8.10.3.1.

9.3.2.2 Lighting of objects with a height less than 45m above ground level

- (a) Low intensity obstacle lights Type A or B are steady red lights and are to be used on non-extensive objects whose height above the surrounding ground is less than 45 m.

Note: - A group of trees or buildings is regarded as an extensive object.

- (b) Where the use of low-intensity obstacle lights, Type A or B, will be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights shall be used.
- (c) Low-intensity obstacle lights, Type B, shall be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with MOS 9.3.2.2(d).
- (d) Medium-intensity obstacle lights, Type A, B or C, shall be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, shall be used alone, whereas medium intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

Note: - A group of buildings is regarded as an extensive object.

9.3.2.3 Lighting of objects with a height 45 m to a height less than 150 m above ground level:

- (a) Medium-intensity obstacle lights, Type A, B or C, shall be used. Medium intensity obstacle lights, Types A and C, shall be used alone, whereas medium intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.
- (b) Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.
- (c) Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.
- (d) When the top of the obstacle is more than 45 m above the level of the surrounding ground or the elevation of the tops of nearby buildings (when the obstacle is surrounded by buildings), the top light, Type C are to be medium intensity lights. Additional low intensity lights are to be provided at lower levels to indicate the full height of the structure. These additional lights are to be spaced as equally as possible, between the top lights and ground level or the level of tops of nearby buildings, as appropriate. The spacing between the

lights is not to exceed 52 m.

- (e) Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 9.3.3.1 except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.
- (f) There are three types of medium intensity obstacle lights:
 - (i) TYPE A, Flashing white light. Likely to be unsuitable for use in environmentally sensitive locations, and near built-up areas. It must be used in lieu of obstacle markings during the day to indicate temporary obstacles in the vicinity of an aerodrome, for example construction cranes, etc. and are not to be used in other applications without specific CAAP agreement.
 - (ii) TYPE B, Flashing red light, also known as a hazard beacon, is suitable for all applications, and is extensively used to mark terrain obstacles such as high ground.
 - (iii) TYPE C, Steady red light, which must be used where there is opposition to the use of a flashing red light, for example in environmentally sensitive locations.

9.3.2.4

Lighting of objects with a height 150 m or more above ground level:

- (a) High-intensity obstacle lights, Type A, shall be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150 m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.
- (b) Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in MOS 9.3.3.1 except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.
- (c) Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10,000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, shall be used alone, whereas medium-intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.
- (d) Where an object is indicated by medium-intensity obstacle lights, Type A, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.
- (e) Where an object is indicated by medium-intensity obstacle lights, Type B, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of

nearby buildings, as appropriate, with the spacing not exceeding 52 m.

- (f) Where an object is indicated by medium-intensity obstacle lights, Type C additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

9.3.3 Location of obstacle lights

- 9.3.3.1 In the case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights are to be located as close as practicable to the top of the object. The top lights are to be arranged so as to at least indicate the points or edges of the object highest above the obstacle limitation surface.
- 9.3.3.2 Recommendations on how a combination of low-, medium-, and/or high- intensity lights on obstacles shall be displayed are given in *MOS Appendix 6, Table 6-2 & Table 6-3*. In the case of a chimney or other structure of like function, the top lights are to be placed sufficiently below the top (nominally 1.5 m to 3 m) as shown in Fig. 8.10-2, so as to minimize contamination by smoke, etc.
- 9.3.3.3 In the case of a tower or antenna structure to be provided with high intensity obstacle lights by day, and the structure has an appurtenance such as a rod or antenna extending greater than 12 m above the structure, and it is not practicable to locate the high intensity obstacle light on top of the appurtenance, the high intensity obstacle light is to be located at the highest practicable point and, if practicable, have a medium intensity obstacle light Type A (flashing white) mounted on the top.
- 9.3.3.4 In case of an extensive object or a group of closely spaced objects to be lighted that are:
 - (a) penetrating a horizontal OLS or located outside an OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and
 - (b) penetrating a sloping OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area shall be marked.
- 9.3.3.5 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and
 - (a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m.
 - (b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.
- 9.3.3.6 When the obstacle limitation surface concerned is sloping and the highest point above the obstacle limitation surface is not the highest point of the object, additional obstacle lights are to be placed on the highest part of the object.

- 9.3.3.7 When the top of the obstacle is more than 45 m above the level of the surrounding ground or the elevation of the tops of nearby buildings (when the obstacle is surrounded by buildings), the top lights are to be medium intensity lights. Additional low intensity lights are to be provided at lower levels to indicate the full height of the structure. These additional lights are to be spaced as equally as possible, between the top lights and ground level or the level of tops of nearby buildings, as appropriate. The spacing between the lights is not to exceed 45 m.
- 9.3.3.8 High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.
- 9.3.3.9 Illustrations of typical lighting of obstacles are shown below:

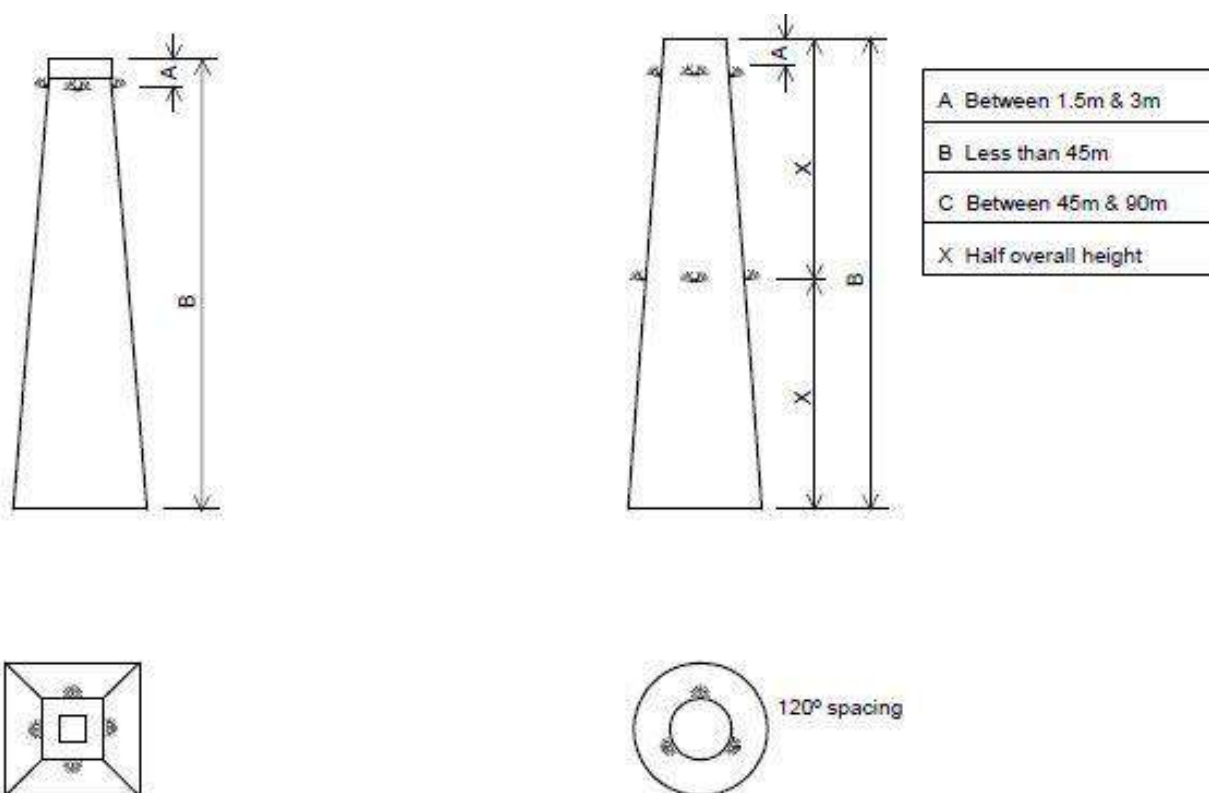


Figure 9.3-1: Typical lighting of tall obstructions

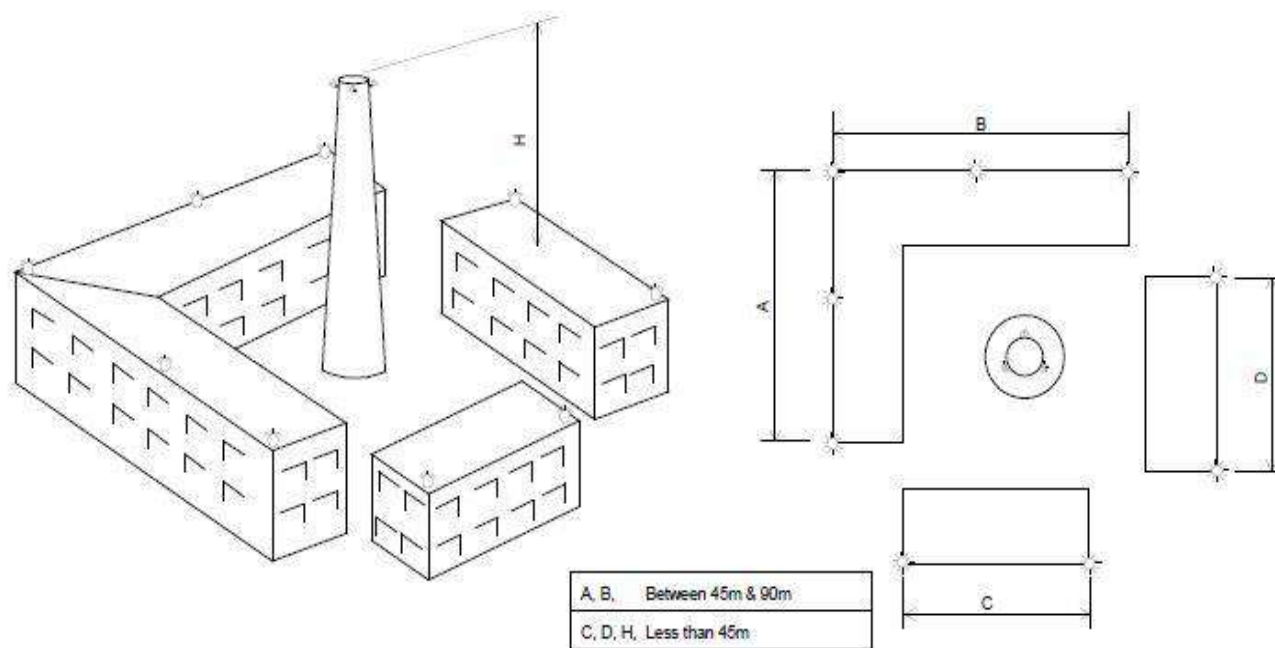


Figure 9.3-2: Typical lighting of a group of obstructions

A	90m or less
B	Between 25m and 45m
C	25m or less

Note: If A is more than 90m or B more than 45m intermediate lights shall be provided.

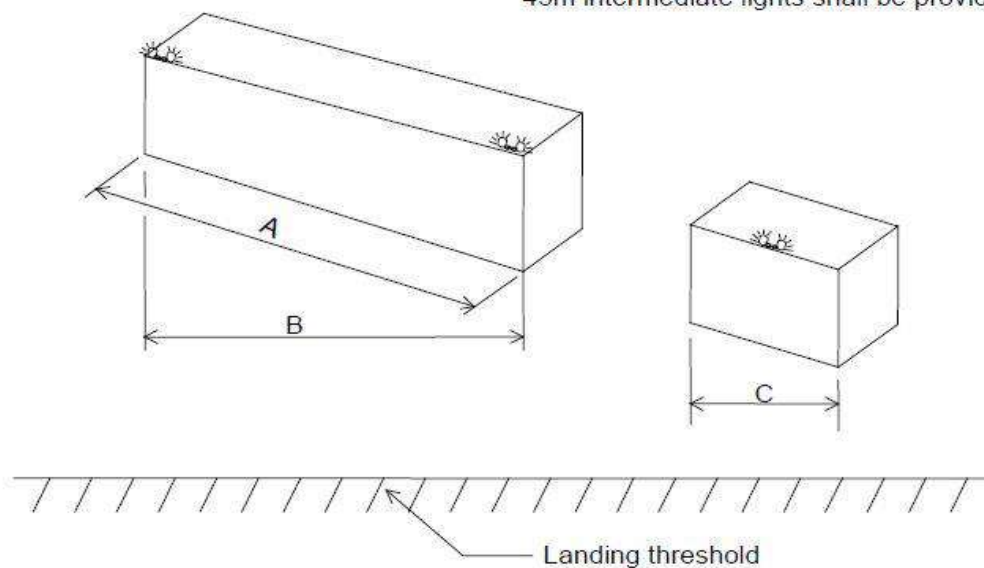
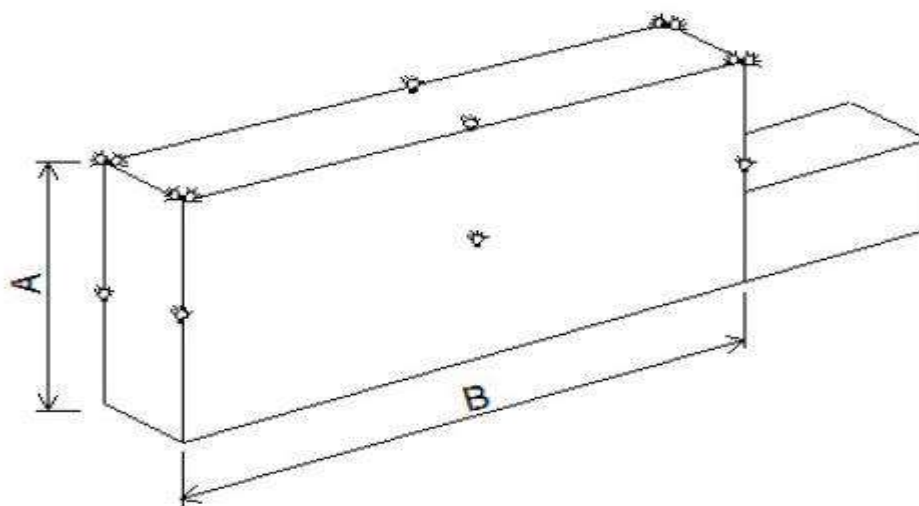


Figure 9.3-3: Typical lighting of horizontally extended obstructions



A, B	Between 45m and 90m
X	Equal spaces (maximum 45m)

Figure 9.3-4: Typical lighting of large obstructions

9.3.4 Natural Obstacles

9.3.4.1 Natural obstacles such as terrain and vegetation are normally extensive and the need for obstacle lighting will be assessed by CAAP on an individual case basis. Where required, obstacle lights are to be provided as follows:

- (a) if the obstacle is located within the approach area, the portion of the obstacle which is within the approach area is to be treated in the same manner as man-made obstacles for the provision of obstacle lights;
- (b) if the obstacle is located outside the approach area, it is to be marked by sufficient number of lights on the highest and most prominent features, so placed that the obstacle can be readily identified.

9.3.5 Temporary obstacles

9.3.5.1 At night and in poor visibility conditions, temporary obstacles in the approach area or on the movement area are to be marked with permanent or temporary red obstacle lights. The lights are to be so arranged that they clearly mark the height, limits and extent of the obstacle

9.3.6 Characteristics of low intensity obstacle lights

9.3.6.1 Low intensity obstacle lights, for general applications, are to have the following characteristics:

- (a) fixed lights showing red;
- (b) a horizontal beam spread that results in 360° coverage around obstacle;
- (c) a peak intensity of 100 cd minimum;
- (d) a vertical beam spread (to 50% of peak intensity) of 10°;

- (e) a vertical distribution with 100 cd minimum at +6° and +10° above the horizontal; and
- (f) not less than 10 cd at all elevation angles between -3° and +90° above the horizontal.

9.3.6.2 Low intensity obstacle lights, used to indicate taxiway obstacles or unserviceable areas of the movement area, are to have a peak intensity of 10 cd minimum.

9.3.7 Characteristics of medium intensity obstacle lights

9.3.7.1 Medium intensity obstacle lights are to be flashing or steady red lights or flashing white lights, visible in all directions in azimuth.

9.3.7.2 The frequency of flashes is to be between 20 and 60 flashes per minute.

9.3.7.3 The peak effective intensity is to be $2,000 \pm 25\%$ cd with a vertical distribution as follows:

- (a) vertical beam spread is to be 3° minimum (beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity);
- (b) at -1° elevation, the intensity is to be 50% minimum and 75% maximum of lower tolerance value of the peak intensity; and
- (c) at 0° elevation, the intensity is to be 100% minimum of the lower tolerance value of the peak intensity.

9.3.7.4 Where the flashing white light is used in lieu of obstacle marking during the day to indicate temporary obstacles in the vicinity of an aerodrome, in accordance with Paragraph 9.4.2.4(a), the peak effective intensity is to be increased to $20,000 \pm 25\%$ cd when the background luminance is 50 cd/m² or greater.

9.3.8 Characteristics of high intensity obstacle lights

9.3.8.1 High intensity obstacle lights are flashing white lights

9.3.8.2 The effective intensity of a high intensity obstacle light located on an object other than a tower supporting overhead wires or cables is to vary depending on background luminance as follows:

- (a) $200,000 \pm 25\%$ cd effective intensity at a background luminance of above 500 cd/m² (day);
- (b) $20,000 \pm 25\%$ cd effective intensity at a background luminance of between 50-500 cd/m² (dusk or dawn);
- (c) $2,000 \pm 25\%$ cd effective intensity at a background luminance of below 50 cd/m² (night).

9.3.8.3 The effective intensity of a high intensity obstacle light located on a tower supporting overhead wires or cables is to vary depending on background luminance as follows:

- (a) $100,000 \pm 25\%$ cd effective intensity at a background luminance of above 500 cd/m² (day);

- (b) 20,000 \pm 25% cd effective intensity at a background luminance of between 50-500 cd/m² (dusk or dawn);
- (c) 2,000 \pm 25% cd effective intensity at a background luminance of below 50 cd/m² (night).

9.3.8.4 High intensity obstacle lights Type A, Medium-intensity obstacle lights, Types A and B, located on an object other than a tower supporting overhead wires or cables are to flash simultaneously at a rate between 40-60 flashes per minute.

9.3.9 Floodlighting of Obstacles

9.3.9.1 Where the installation of normal obstacle lights is deemed impracticable or undesirable for aesthetic or other reasons, floodlighting of obstacles may be an acceptable alternative. However, floodlighting is not to be used unless with the concurrence of CAAP.

9.3.9.2 In general, floodlighting is not suitable if:

- (a) the structure is skeletal as a substantially solid surface or cladding with satisfactory reflectance properties are required; or
- (b) there is high background lighting level.

9.3.9.3 The floodlighting color is to be white. Illumination of the obstacle is to cover all directions of azimuth over the full height portion of the obstacle which needs to be illuminated and is to be uniform around the circumferences of the obstacle.

9.3.9.4 The minimum level of luminance is to be 5 cd/m² at all points.

Note: - Based on a reflectance factor of 50% for white paint, this would require illuminance of at least 10 lux. For concrete with typical reflectance factor of 40%, the required illuminance would be at least 12.5 lux. Materials with reflectance factors less than 30% are unlikely to be suitable for floodlighting.

9.3.9.5 The light fittings are to be spaced evenly around the structure, at not more than 120° with at least two fittings at each location. At each location the fittings are to be on separate circuits and separately fused.

9.3.10 On-going availability of obstacle lights

9.3.10.1 It is important that obstacle lights provided are in working condition when they are required to be on. The owners of obstacle lights needs to establish a pro- active maintenance program to minimize light outage.

9.3.10.2 For obstacle lights located within the obstacle limitation surface area of the aerodrome, the aerodrome operator is to establish a monitoring program, which is to include:

- (a) visual observation of the obstacles lights at least once every 24 hours (see note below); and
- (b) where a medium or high intensity obstacle light is located such that it is not readily observable visually:

- (i) establish a procedure whereby such a light would be visually monitored within every 24 hour period; or
- (ii) install an automatic visual or audio alarm indicator at an aerodrome location generally occupied by aerodrome personnel.

Note: - At smaller aerodromes with a low level of night aircraft operations, this period may be extended with the agreement of CAAP.

- 9.3.10.3 For obstacles located within the obstacle limitation surface area of the aerodrome, in the event of an obstacle light outage, the aerodrome operator is to:
- (a) notify CAAP immediately if the obstacle light has been determined by CAAP as being a requirement for aircraft operations;
 - (b) in any case, initiate NOTAM action to advise pilots of such light outage;
 - (c) liaise with the owner of the obstacle light to effect a speedy repair.
- 9.3.10.4 For obstacles located outside the obstacle limitation surface area of an aerodrome, the owners of the lights need to establish a program to monitor the lights and report light failures. The reporting point for obstacle light failure is normally CAAP or ATC when an obstacle light is unserviceable, the matter needs to be reported immediately to CAAP or ATC so that a NOTAM warning pilots of the light outage can be initiated.

Section 9.4 Aerodrome Beacons

9.4.1 General

- 9.4.1.1 An aerodrome beacon is to be provided if it is determined by CAAP that such a facility is operationally necessary.
- 9.4.1.2 The following factors will be used in determining operational necessity:
- (a) whether the aerodrome is intended to be used at night by aircraft navigating predominantly by visual means;
 - (b) the type and quantity of air traffic;
 - (c) the presence of other visual or radio aids;
 - (d) whether the location is subject to frequent periods of reduced visibility;
 - (e) whether it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.
- 9.4.1.3 Where provided, the aerodrome beacon is to be located on or adjacent to the aerodrome in an area of low ambient background lighting. In addition, the aerodrome beacon is to be sited so that it is neither shielded by obstacles nor dazzling to a pilot making an approach to land.
- 9.4.1.4 At international aerodromes or aerodromes in built-up areas, the aerodrome beacon is to show two flashes, one white and the other colored, so that they produce alternate white and color flashes. For land aerodromes, the color is to be green, for water aerodromes, the color is to be yellow.

9.4.1.5 At other locations, white flashes only is satisfactory.

9.4.1.6 The frequency of total flashes must be from 20 to 30 per minute.

Note: - Older beacons with a frequency of flashes in the range of 12 to 20 per minute are acceptable, until the next replacement or upgrade of the beacon.

9.4.1.7 The light from the beacon is to be visible from all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used, and the effective intensity of the flash shall be not less than 2 000 cd.

Note: - At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

9.4.1.8 The light intensity distribution of the aerodrome beacon must be in accordance with Table 9.5-1:

Elevation angle (in degrees)	Minimum effective intensity of white flashes (in candelas)
1 to 2	25 000
2 to 8	50 000
8 to 10	25 000
10 to 15	5 000
15 to 20	1 000

Table 9.5-1: Aerodrome beacon light intensity distribution

9.4.1.9 The effective intensity of color flashes is to be not less than 0.15 times the intensity of the white flashes at the corresponding angle of elevation.

9.4.1.10 Where provided, information on the color coding, flash rate and location (if not in the immediate vicinity of the aerodrome) of the aerodrome beacon is to be published in the aerodrome AIP entry.

9.5 Illuminated Wind Direction Indicator

9.5.1 General

9.5.1.1 At an aerodrome intended for night use, at least one wind direction indicator (WDI) is to be lit.

9.5.1.2 If a WDI is provided in the vicinity of a runway threshold to provide surface wind information for pilots engaged in instrument straight-in approach and landing operations, and such operations are to be conducted at night, then the wind direction indicator is to be lit.

- 9.5.1.3 The illumination of a wind direction indicator is to be achieved by providing floodlighting from above by means of:
- (a) (4) 200W 240V tungsten filament general purpose lamps in either vertical elliptical industry reflectors, or round deep bowl reflectors, between 1.8 m and 2.2 m above the mid-height of the sleeve mounting, and between 1.7 m and 1.9 m radial distance from the axis of rotation of the wind sleeve; or
 - (b) eight (8) 120W 240V PAR 38 flood lamps in reflector less fittings, between 1.8 m and 2.2 m above the mid height of the wind sleeve mounting, and between 1.7 m and 1.9 m radial distance from the axis of the rotation of the wind sleeve; or
 - (c) some other method of floodlighting which produces lighting equivalent to what would be provided under sub Paragraph 9.6.1.3(a) or 9.6.1.3(b), with accurate color rendering and no perceptible warm-up or re-strike delay.
- 9.5.1.4 The floodlighting is to be aimed and shielded so as to:
- (a) not cause any glare or distraction to pilots; and
 - (b) uniformly illuminate the maximum swept area of the wind sleeve.
- Note: - A uniformity ratio in the horizontal plane through the mid height of the wind cone of not more than 4:1 (average to minimum) will be satisfactory.*
- 9.5.1.5 If only one wind direction indicator is lit at an aerodrome and there are two or more lit runways, control of the lighting of the wind direction indicator is to be incorporated in the runway lighting control for each runway, so that energizing any runway lighting system will automatically energize the lighting of the wind direction indicator.
- 9.5.1.6 Where more than one wind direction indicator can be lit, control of the lighting of each wind direction indicator is to be incorporated in the runway lighting control for the operationally related runway.
- 9.5.1.7 If the electricity supply to a wind direction indicator is provided from a runway lighting circuit for which intensity control is provided, a uniform intensity is required for the wind direction indicator irrespective of the intensity setting of the runway lighting.

Section 9.6 Approach lighting systems

9.6.1 Simple approach lighting system

- 9.6.1.1 A simple approach lighting system shall consist of a row of lights on the extended centerline of the runway extending, whenever possible, over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 18 m or 30 m in length at a distance of 300 m from the threshold.
- 9.6.1.2 The lights forming the crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centerline lights. The lights of the crossbar shall be spaced so as to produce a linear effect, except that, when a crossbar of 30 m is used, gaps may be left on each side of the centerline. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note: - 1. Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centerline may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

Note: - 2. See MOS Attachment A, Section 16, for guidance on installation tolerances.

9.6.1.3 The lights forming the centerline shall be placed at longitudinal intervals of 60 m, except that, when it is desired to improve the guidance, an interval of 30 m may be used. The innermost light shall be located either 60 m or 30 m from the threshold, depending on the longitudinal interval selected for the centerline lights.

9.6.1.4 If it is not physically possible to provide a centerline extending for a distance of 420 m from the threshold, it shall be extended to 300 m so as to include the crossbar. If this is not possible, the centerline lights shall be extended as far as practicable, and each centerline light shall then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.

9.6.1.5 The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

- (a) no object other than an ILS antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centerline of the system; and
- (b) no light other than a light located within the central part of a crossbar or a centerline barrette (not their extremities) shall be screened from an approaching aircraft.

Any ILS antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

9.6.1.6 The lights of a simple approach lighting system shall be fixed lights and the color of the lights shall be such as to ensure that the system is readily distinguishable from other aeronautical ground lights, and from extraneous lighting if present. Each centerline light shall consist of either:

- (a) a single source; or
- (b) a barrette at least 3 m in length.

Note: - 1. When the barrette as in b) is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

Note: - 2. It may be advisable to use barrettes 4 m in length if it is anticipated that the simple approach lighting system will be developed into a precision approach lighting system.

Note: - 3. At locations where identification of the simple approach lighting system is difficult at night due to surrounding lights, sequence flashing lights installed in the outer portion of the system may resolve this problem.

9.6.1.7 Where provided for a non-instrument runway, the lights shall show at all angles in

azimuth necessary to a pilot on base leg and final approach. The intensity of the lights shall be adequate for all conditions of visibility and ambient light for which the system has been provided.

9.6.1.8 Where provided for a non-precision approach runway, the lights shall show at all angles in azimuth necessary to the pilot of an aircraft which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid. The lights shall be designed to provide guidance during both day and night in the most adverse conditions of visibility and ambient light for which it is intended that the system shall remain usable.

9.6.1.9 A simple approach lighting system is intended for a non-instrument or a non-precision approach runway. MOS Attachment A, Section 16 Figure A-4, provides a figure on a simple approach lighting system. Before a simple approach lighting system is installed, advice from CAAP shall be sought.

Note: - Standard runway edge and threshold lights, supplemented by a visual approach slope indicator system have been found adequate for non-instrument and non-precision approach runways.

9.6.1.10 Non-instrument runway. Where physically practicable, a simple approach lighting system as specified in MOS 9.6.1.1 to MOS 9.6.1.8 shall be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids.

Note: - A simple approach lighting system can also provide visual guidance by day.

9.6.1.11 Non-precision approach runway. Where physically practicable, a simple approach lighting system as specified in MOS 9.6.1.1 to MOS 9.6.1.8 shall be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

Note: - It is advisable to give consideration to the installation of a precision approach category I lighting system or to the addition of a runway lead-in lighting system.

9.6.2 Precision approach Category I lighting system

9.6.2.1 Where physically practicable, a precision approach Category I lighting system is to be provided to serve a Category I precision approach runway.

9.6.2.2 A precision approach Category I lighting system is to consist of a row of lights on the extended centerline of the runway extending, wherever possible, over a distance of 900 m prior to the threshold, with a row of lights forming a crossbar 30 m in length and at a distance of 300 m from the threshold.

Note: - 1. The installation of an approach lighting system of less than 900 m in length may result in operational limitations on the use of the runway.

Note: - 2. Existing lights spaced in accordance with imperial system measurements are deemed to comply with comparable metric system measurements.

Note: - 3. See MOS Attachment A, Section 16, Figure A-5 (B) for the illustration of Barrette Centerline and MOS Figure 9.6-1(B).

- 9.6.2.3 The lights forming the centerline are to be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.
- 9.6.2.4 Barrettes shall be at least 4 meters in length, and when composed of lights approximating point sources the lights shall be uniformly spaced at intervals not exceeding 1.5 meters.
- 9.6.2.5 The lights forming the crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centerline lights. The lights of the crossbar shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centerline. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note: - See MOS 9.6.1.2 Notes 1 & 2.

- 9.6.2.6 The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:
- (a) no object other than an ILS antenna is to protrude through the plane of the approach lights within a distance of 60 m from the centerline of the system; and
 - (b) no light, unless it is a light located within the central part of a crossbar or a centerline barrette (not their extremities), shall be screened from an approaching aircraft.

Any ILS antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

- 9.6.2.7 The centerline lights in a precision approach category I approach lighting system may be composed of barrettes in lieu of the point source lights described above.
- 9.6.2.8 If the centerline consists of barrettes as described in MOS 9.6.2.12 (b) and 9.6.2.13 (b), each barrette shall be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.
- 9.6.2.9 Each flashing light as described in 9.6.2.8 shall flash twice a second in sequence beginning with the outermost light and progressing to the innermost light. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights in the approach lighting system.
- 9.6.2.10 If the centerline lights in a category I approach light system consist of single light sources as described in MOS 9.6.2.12 (a) and 9.6.2.13 (a), additional crossbars to the one at 300 m from the threshold are to be provided, and are to be placed at 150 m, 450 m, 600 m and 750 m from the threshold. The lights forming each crossbar are to be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centerline lights. The lights of the crossbar are to be spaced so as to produce a linear effect, except that gaps, not exceeding 6 m, may be left on each side of the centerline. The lights within each bar on either side of the centerline are to be uniformly spaced at intervals of not more than 2.7 m.

Note: - See MOS Attachment A, Section 16, Figure A-5 (A) for the illustration of Distance Coded Centerline and Figure 9.6-1 (A).

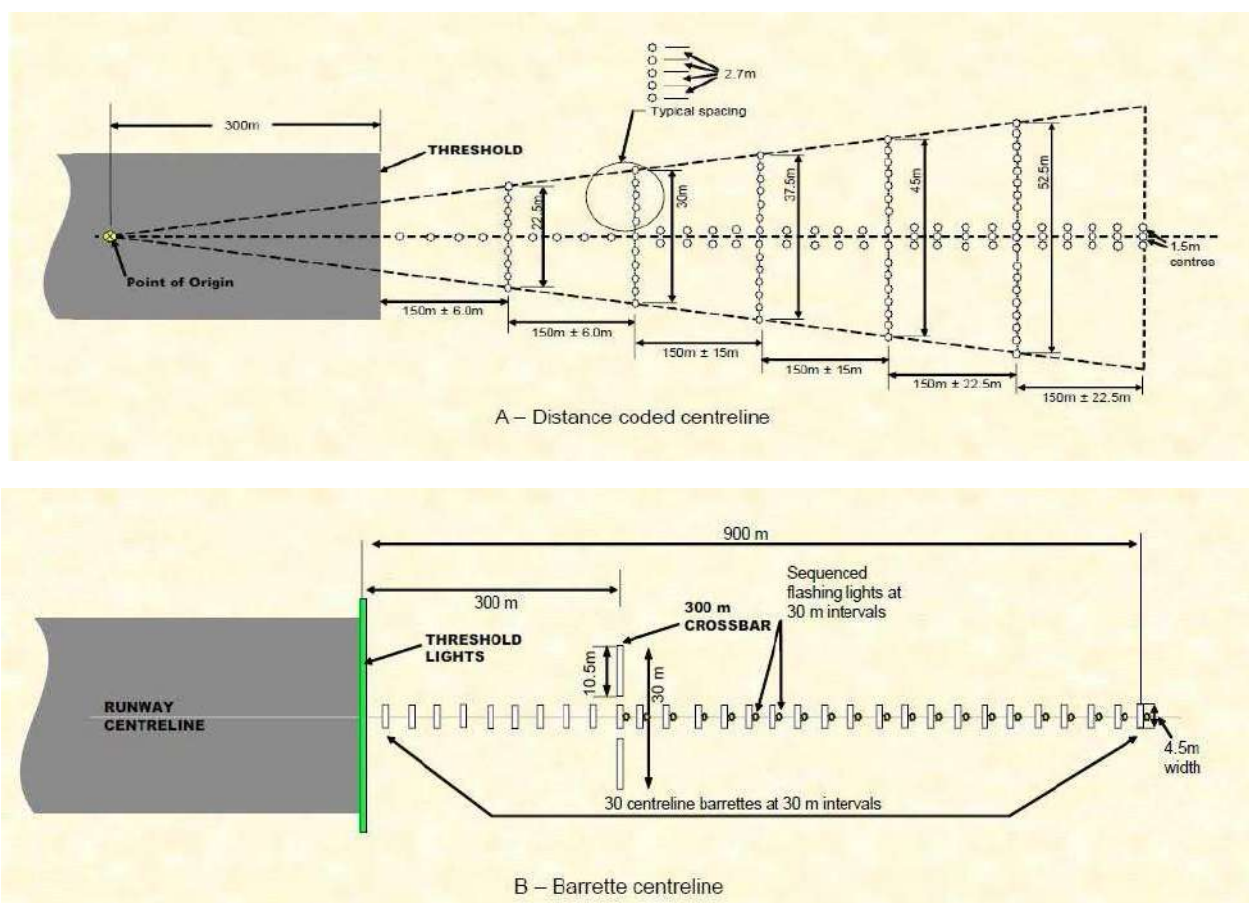


Figure 9.6-1: Illustration of a Category I approach lighting system

- 9.6.2.11 If additional crossbars of lights described in 9.6.2.10 are used, the outer ends of the crossbars shall lie on two straight lines that are parallel to the line of the centerline lights or converge to meet the runway centerline 300 m from the threshold.
- 9.6.2.12 The centerline and crossbar lights of a precision approach Category I lighting system are to be fixed lights showing variable white. Each centerline light position shall consist of either:
- a single light source in the innermost 300 m of the centerline, two light sources in the central 300 m of the centerline and three light sources in the outer 300 m of the centerline to provide distance information; or
 - a barrette.
- 9.6.2.13 Where the serviceability level of the approach lights specified as a maintenance objective in MOS 9.1.15.6 can be demonstrated, each centerline light position may consist of either:
- a single light source; or
 - a barrette.

- 9.6.2.14 The lights are to be in accordance with the specifications of MOS 9.7, Figure 9.7-1.

Note: - The flight path envelopes used in the design of these lights are given in MOS Attachment A, Figure A-3.

9.6.3 Precision Approach Category II and III Lighting System

- 9.6.3.1 A precision approach Category II and III lighting system is to be provided to serve a Category II or III precision approach runway.

- 9.6.3.2 From paragraphs 9.6.3.4 and 9.6.3.6 below, it is implicit that where Category II and III approach lights are provided, touchdown zone lights must also be provided.

- 9.6.3.3 A precision approach Category II and III lighting system is to consist of a row of lights on the extended centerline of the runway extending, wherever possible, over a distance of 900 m from the runway threshold. In addition, the system is to have two side rows of lights, extending 270 m from the threshold, and 2 crossbars, at 150 m and one at 300 m from the threshold, all as shown in MOS Figure 9.6-3.

Note: - The length of 900 m is based on providing guidance for operations under Cat I, II and III conditions. Reduced lengths may support Cat II and III operations but may impose limitations on Cat I operations. See MOS Attachment A Section 16.

- 9.6.3.4 Where the serviceability level for approach lights as specified at MOS 9.1.15.3 can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in MOS Figure 9.6-4.

- 9.6.3.5 The lights forming the centerline lights are to be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.

- 9.6.3.6 The lights forming the side rows are to be placed on each side of the centerline. The rows are to be spaced at 30 m intervals, with the first row located 30 m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side row is to be not less than 18 m nor more than 22.5 m, and preferably 18 m, but in any event is to be equal to that of the touchdown zone light barrettes.

- 9.6.3.7 The crossbar provided at 150 m from the threshold is to fill in the gaps between the centerline and side row lights.

- 9.6.3.8 The crossbar provided at 300 m from the threshold is to extend on both sides of the centerline lights to a distance of 15 m from the centerline.

- 9.6.3.9 If the centerline lights beyond 300 m from the threshold consists of lights as described in MOS 9.6.3.12 (b) or MOS 9.6.3.13 (b) are not barrettes, additional crossbars of lights shall be provided at 450 m, 600 m and 750 m from the threshold. When these additional crossbars are installed, the outer ends shall lie on two straight lines that are either parallel to the centerline or converge to meet the runway centerline 300 m from the threshold.

- 9.6.3.10 The system is to lie as nearly as practicable in the horizontal plane passing

through the threshold, provided that:

- (a) no object other than an ILS antenna is to protrude through the plane of the approach lights within a distance of 60 m from the centerline of the system; and
- (b) no light other than a light located within the central part of a crossbar, or a centerline light position, may be screened from an approaching aircraft.

Any ILS antenna protruding through the plane of the lights is to be treated as an obstacle and marked and lighted accordingly.

- 9.6.3.11 The centerline of a precision approach category II or III lighting system for the first 300 m from the threshold shall consist of barrettes showing variable white, except that if the threshold is displaced 300 m or more, the centerline may consist of single light sources showing variable white. When the serviceability level of the approach lights specified as maintenance objectives in MOS 9.1.15.3 can be demonstrated, the centerline of a precision approach category II and III lighting system for the first 300 m from the threshold may consist of either:
- (a) barrettes, if the centerline beyond 300 m consists of barrettes as described in 9.6.3.13 (a); or
 - (b) alternate single light sources and barrettes, where the centerline beyond 300m from the threshold consists of single light sources as described in 9.6.3.13 (b) with the innermost single light source located 30 m and the innermost barrette located 60 m from the threshold; or
 - (c) Single light sources where the threshold is displaced 300 m or more; and all of which shall show variable white.
- 9.6.3.12 Beyond 300 m from the threshold, each centerline light position shall consist of either:
- (a) a barrette as used on the inner 300 m: or
 - (b) two light sources in the central 300 m of the centerline and three light sources in the outer 300 m of the centerline; and
- all of which shall show variable white
- 9.6.3.13 When the serviceability level of the approach lights specified as maintenance objectives in 9.1.15.3 can be demonstrated, beyond 300 m from the threshold each centerline light position may consist of either:
- (a) a barrette; or
 - (b) a single light source: and
- all of which shall show variable white
- 9.6.3.14 Barrettes shall be at least 4 meters in length, and when composed of lights approximating point sources the lights shall be uniformly spaced at intervals not exceeding 1.5 meters.
- 9.6.3.15 If the centerline beyond 300 m from the threshold consists of barrettes as described in 9.6.3.12 (a) or 9.6.3.13 (a), each barrette beyond 300 m shall be supplemented

by a flashing light, except where such lighting is considered unnecessary by CAAP taking into account the characteristics of the system and the nature of the meteorological conditions.

- 9.6.3.16 Each flashing light as described in 9.6.3.13 shall flash twice a second in sequence beginning with the outermost light and progressing to the innermost light. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights in the approach lighting system.
- 9.6.3.17 The side row barrettes are to be fixed lights showing red. The length of a side row barrette and spacing between its lights are to be equal to those of the touchdown zone light barrettes. (See MOS 9.9.20.4).
- 9.6.3.18 The centerline and crossbar lights of a precision approach Category II and III lighting system are to be fixed lights showing variable white. The lights forming the crossbars are to be uniformly spaced at intervals of not more than 2.7 m.
- 9.6.3.19 The intensity of the red light is to be compatible with the intensity of the white light.
- 9.6.3.20 The lights are to be in accordance with the specifications of Section 9.7, Figure 9.7-1 and Figure 9.7-2.

Note: - The flight path envelopes used in the design of these lights are given in MOS Attachment A, Figure A-3.



300 m approach and runway lighting for precision approach runways, categories II and III

Typical full length configurations for precision approach runways, categories II and III

Figure 9.6-2: Illustration of category II and III approach lighting system

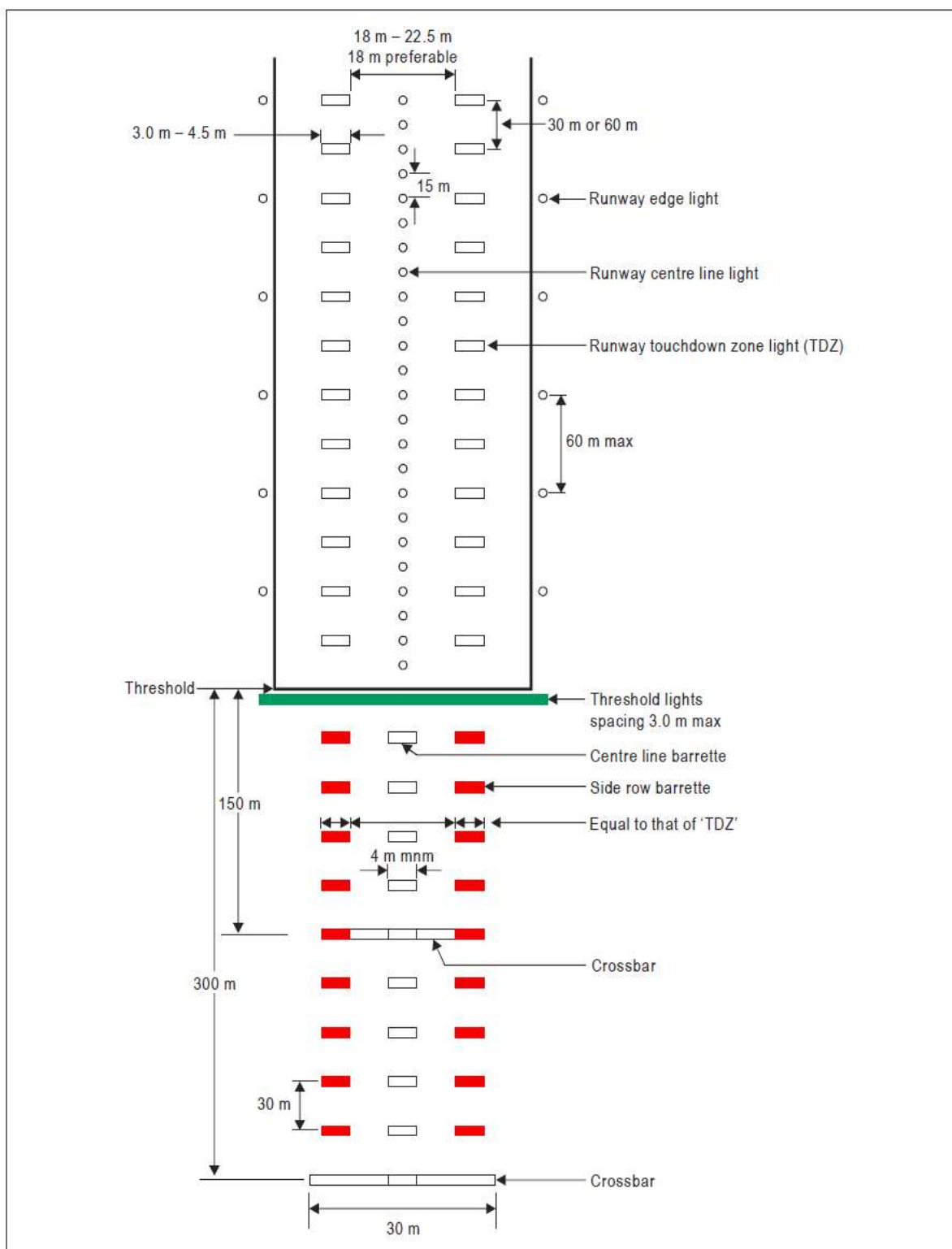


Figure 9.6-3. Inner 300 m approach and runway lighting for precision approach runways, categories II and III

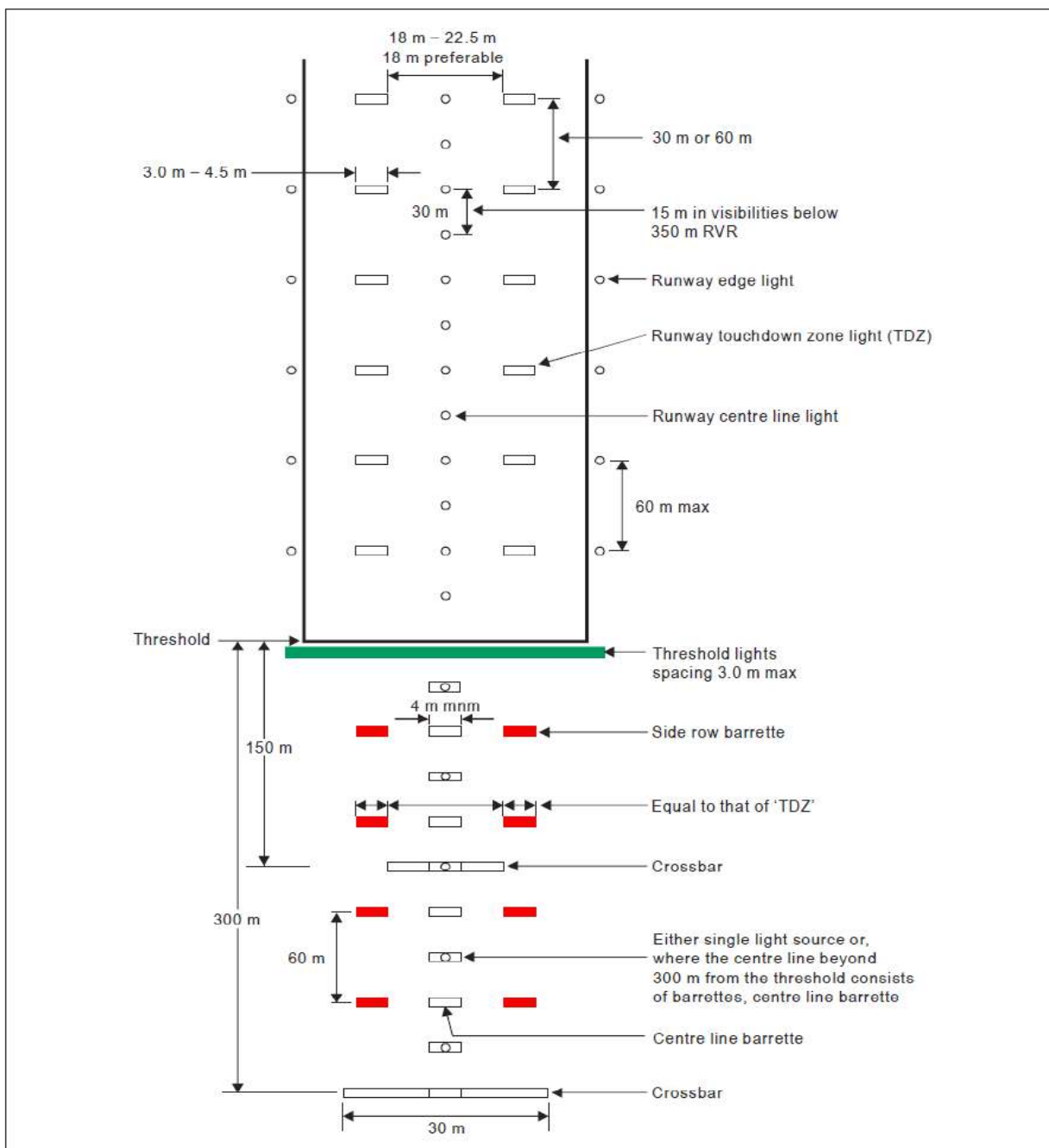


Figure 9.6-4. Inner 300 m approach and runway lighting for precision approach runways, categories II and III, where the serviceability levels of the lights specified as maintenance objectives in Chapter 10 can be demonstrated

Section 9.7 Isocandela Diagrams of Approach Lighting

9.7.1 Collective Notes

9.7.1.1 Except for Paragraph 9.10.1.4, the collective notes for Section 9.10 apply to this Section.

9.7.1.2

Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average intensity of the main beam of a new runway edge light is to be as follows:

- (a) Figure 9.7-1 Approach centerline and crossbars — 1.5 to 2.0 (white light)
- (b) Figure 9.7-2 Approach side row — 0.5 to 1.0 (red light)

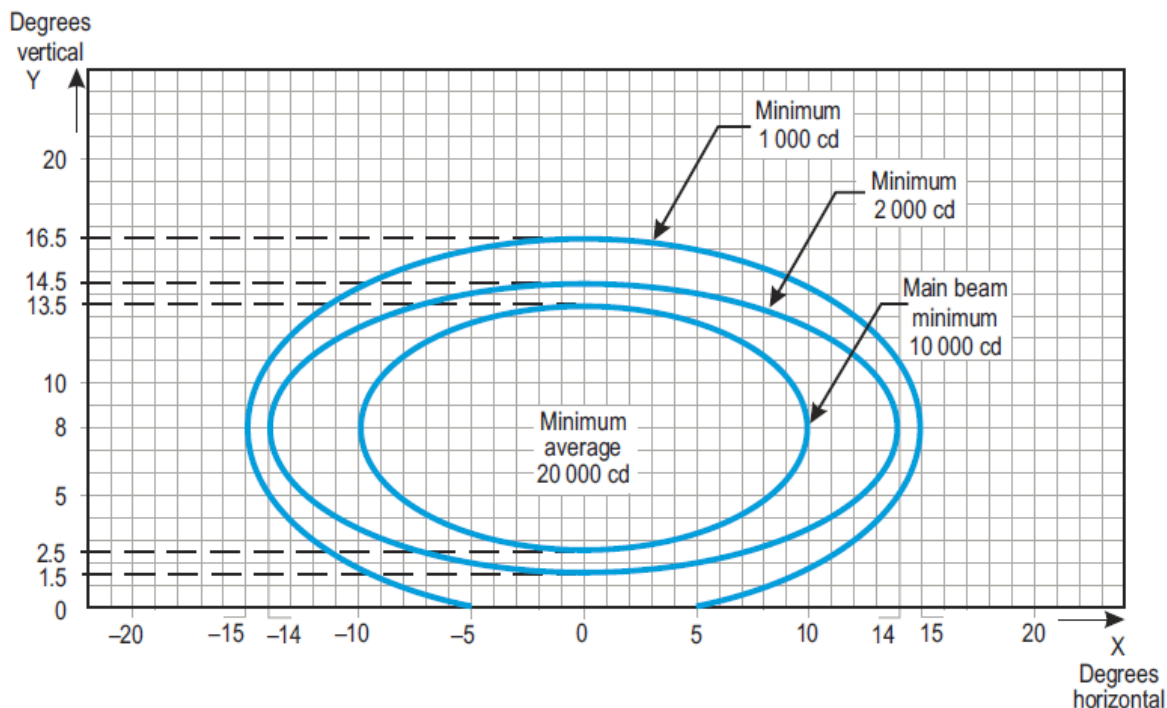


Figure 9.7-1: Isocandela diagram for approach centerline light and cross bars (white light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	10	14	15
b	5.5	6.5	8.5

2. Vertical setting angles of the lights must be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 315 m	0° — 11°
316 m to 475 m	0.5° — 11.5°
476 m to 640 m	1.5° — 12.5°
641 m and beyond	2.5° — 13.5° (as illustrated above)

3. Lights in crossbars beyond 22.5 m from the centerline must be toed-in 2 degrees. All other lights must be aligned parallel to the centerline of the runway.
4. See collective notes at MOS 9.10.1.

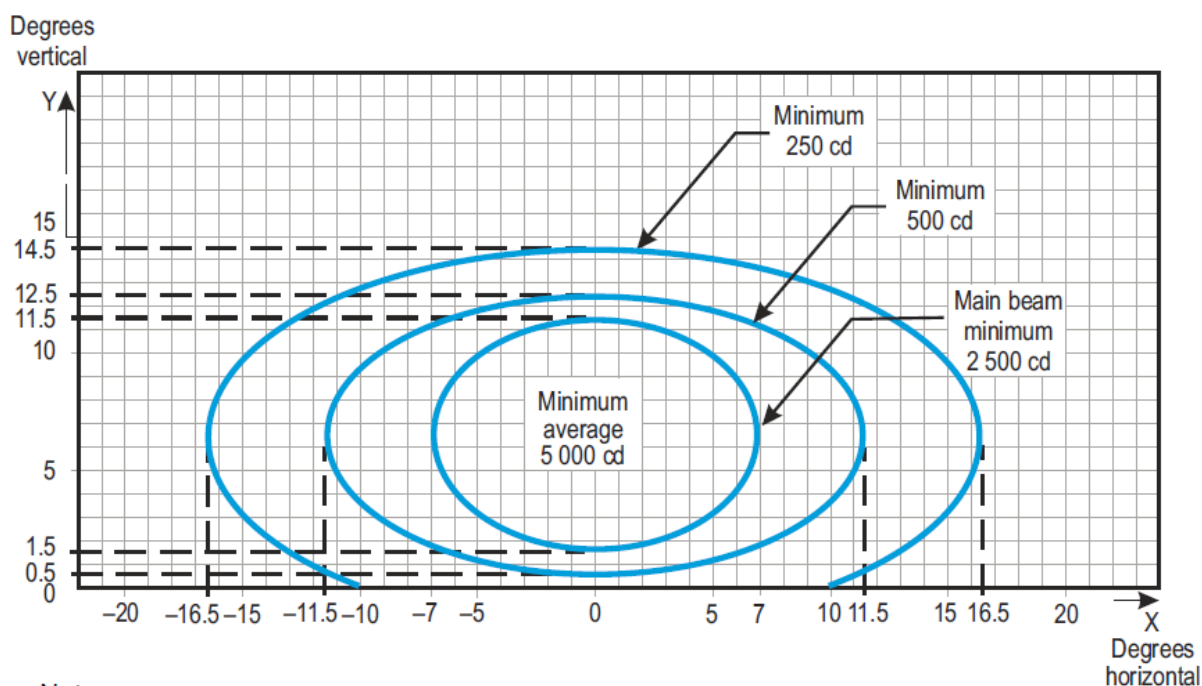


Figure 9.7-2: Isocandela Diagram for approach side row light (red light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	10	14	15
b	5.5	6.5	8.5

2. Toe-in 2 degrees

3. Vertical setting angles of the lights must be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 115 m	0.5° — 10.5°
116 m to 215 m	1.0° — 11°
216 m and beyond	1.5° — 11.5° (as illustrated above)

4. See collective notes at MOS 9.10.1.

Section 9.8 Visual Approach Slope Indicator Systems

9.8.1 General

9.8.1.1 A visual approach slope indicator system shall be provided to serve the approach to a runway, whether or not the runway is served by electronic approach slope guidance, where one of the following applies:

- The runway is used by jet-propelled aeroplanes engaged in air transport operations.
- CAAP directs that visual approach slope guidance be provided, because it has determined that such a visual aid is required for the safe operation of aircraft.

- 9.8.1.2 In making a determination that visual approach slope guidance is required, CAAP will take into account the following:
- (a) The runway is frequently used by other jet-propelled aeroplanes, or other aeroplanes with similar approach guidance requirements.
 - (b) The pilot of any type of aeroplane may have difficulty in judging the approach due to:
 - (i) inadequate visual guidance such as is experienced during an approach over water or featureless terrain by day or in the absence of sufficient extraneous lights in the approach area by night;
 - (ii) misleading approach information such as that produced by deceptive surrounding terrain, runway slope, or unusual combinations of runway width, length and light spacing;
 - (iii) a displaced threshold.
 - (c) The presence of objects in the approach area may involve serious hazard if an aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects.
 - (d) Physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway.
 - (e) Terrain or prevalent meteorological conditions are such that the aeroplane may be subjected to unusual turbulence during approach.
- 9.8.1.3 The presence of other visual or non-visual aids is a very important factor. Runways equipped with ILS will generally receive the lowest priority for a visual approach slope indicator system installation. It must be remembered, though, that visual approach slope indicator systems are visual approach aids in their own right and can supplement electronic aids. When serious hazards exist and/or a substantial number of aeroplanes not equipped for ILS use, a runway, priority might be given to installing a visual approach slope indicator on this runway.
- 9.8.1.4 CAAP may direct that a visual approach slope indicator system be provided for temporary use only, for example due to a temporary displaced threshold, or during works in progress.
- 9.8.1.5 The standard visual approach slope indicator systems shall consist of the following:
- (a) T-VASIS and AT-VASIS conforming to the specifications contained in MOS 9.8.3.2 to 9.8.3.6 inclusive; and
 - (b) PAPI and APAPI systems conforming to the specifications contained in MOS 9.8.3.7 to 9.8.4.9 inclusive as shown in MOS Figure 9.8-5.
- 9.8.1.6 PAPI, T-VASIS or AT-VASIS shall be provided where the code number is 3 or 4 when one or more of the conditions specified in MOS 9.8.1.2 exist.
- 9.8.1.7 As of 1 January 2020, the use of T-VASIS and AT-VASIS as standard visual approach slope indicator systems shall be discontinued.
- 9.8.1.8 PAPI or APAPI shall be provided where the code number is 1 or 2 when one or more of the conditions specified in MOS 9.8.1.2 exist.

- 9.8.1.9 Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in MOS 9.8.1.2 exist, a PAPI shall be provided except that where the code number is 1 or 2, an APAPI must be provided.
- 9.8.1.10 The standard installations must be:
- (a) At international aerodromes, T-VASIS, or double sided PAPI. Where this is impracticable, an AT-VASIS or PAPI is acceptable.
 - (b) At aerodromes other than international aerodromes, AT-VASIS or PAPI, except where (c) below applies.
 - (c) At aerodromes where CAAP has determined that additional roll guidance is required, and/or high system integrity is necessary, T-VASIS or double sided PAPI.
 - (d) AT-VASIS and PAPI must be installed on the left side of the runway, unless this is impracticable.
- 9.8.1.11 Where a T-VASIS is to be replaced by a PAPI, a double-sided PAPI must be provided.
- 9.8.1.12 Where more than one visual approach slope indicator system is provided at an aerodrome, to avoid confusion, the same type of approach slope indicator system must be used at each end of a runway. If there is more than one runway, the same type of approach slope indicator system must be used on all runways of similar reference code number.
- 9.8.1.13 Where a visual approach slope indicator system is provided for temporary use only, in accordance with 9.8.1.4, then 9.8.1.7 need not apply.
- 9.8.1.14 The choice of T-VASIS or PAPI is a matter between the aerodrome operator and airline operators using the runway.
- 9.8.1.15 A visual approach slope indicator system must not be brought into service until it is appropriately commissioned and approved by CAAP.

9.8.2 Obstacle protection surface

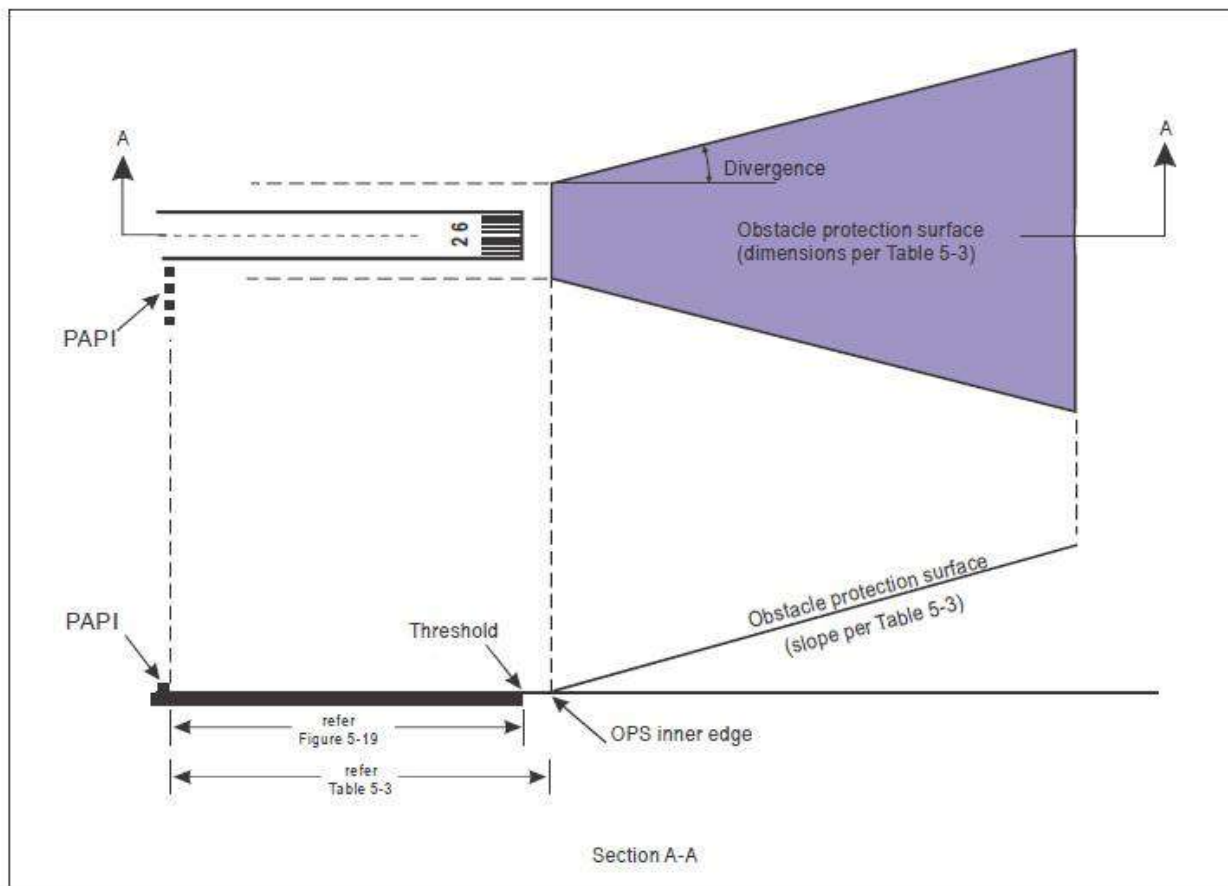


Figure 9.8-1: Obstacle Protection Surface for Visual Approach Slope Indicator Systems

Note: - The following specifications apply to T-VASIS, AT-VASIS, PAPI and APAPI.

- 9.8.2.1 An obstacle protection surface shall be established when it is intended to provide a visual approach slope indicator system.
- 9.8.2.2 The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope, shall correspond to those specified in the relevant column of Table 9.8-1 and in Figure 9.8-1.
- 9.8.2.3 New objects or extensions of existing objects shall not be permitted above an obstacle protection surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.
Note: - Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.
- 9.8.2.4 Existing objects above an obstacle protection surface shall be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of aeroplanes.

9.8.2.5 Where an aeronautical study indicates that an existing object extending above an obstacle protection surface (OPS) can adversely affect the safety of operations of aeroplanes, one or more of the following measures shall be taken:

- (a) remove the object;
- (b) suitably raise the approach slope of the system;
- (c) reduce the azimuth spread of the system so that the object is outside the confines of the beam;
- (e) displace the axis of the system and its associated obstacle protection surface by no more than 5°;
- (f) suitably displace the system upwind of the threshold such that the object no longer penetrates the OPS.

Note: - 1. Guidance on this issue is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

Note: - 2. The displacement of the system upwind of the threshold reduces the operational landing distance.

Surface Dimension	Runway type/code number							
	Non-instrument Code number				Instrument Code number			
	1	2	3	4	1	2	3	4
Length of inner edge	60 m	80 m ^a	150 m	150 m	150 m	150 m	300 m	300 m
Distance from the visual approach slope indicator system ^e	D ₁ +30 m	D ₁ +60 m	D ₁ +60 m	D ₁ +60 m	D ₁ +60 m	D ₁ +60 m	D ₁ +60 m	D ₁ +60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%
Total length	7 500 m	7 500 m _b	15 000 m	15 000 m	7 500 m	7 500 m _b	15 000 m	15 000 m
<i>Slope</i>								
a) T-VASIS and AT-VASIS	— ^c	1.9°	1.9°	1.9°	—	1.9°	1.9°	1.9°
b) PAPI ^d	—	A-0.57°	A-0.57°	A-0.57°	A-0.57°	A-0.57°	A-0.57°	A-0.57°
c) APAPI ^d	A-0.9°	A-0.9°	—	—	A-0.9°	A-0.9°	—	—

a. This length is to be increased to 150 m for a T-VASIS or AT-VASIS.

b. This length is to be increased to 15 000 m for a T-VASIS or AT-VASIS.

c. No slope has been specified if a system is unlikely to be used on runway type/code number indicated.

d. Angles as indicated in MOS Figure 9.8-5.

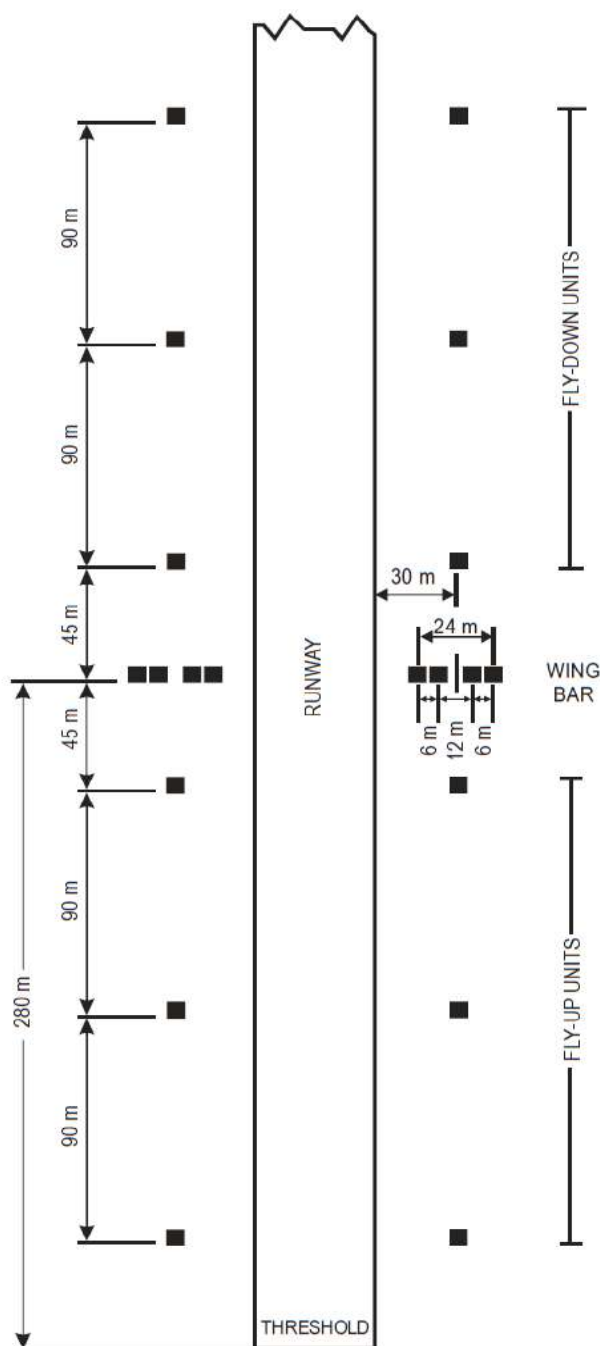
e. D₁ is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the OPS (refer MOS Figure 9.8-3). The start of the OPS is fixed to the visual approach slope indicator system location, such that displacement of the PAPI results in an equal displacement of the start of the OPS. See MOS 9.8.2.5 (e).

Table 9.8-1: Dimensions and slopes of the obstacle protection surface

9.8.3 T-VASIS and AT-VASIS

9.8.3.1

A T-Visual Approach Slope Indicator System (T-VASIS) is a set of lights so arranged that the pattern seen by the pilot varies according to his position (up or down, left or right) relative to the desired approach path. Where installed in the runway strip, it provides the pilot with visual cues about his or her actual descent path relative to the desired descent path.



INSTALLATION TOLERANCES

The appropriate authority may:

a) vary the nominal eye height over the threshold of the on-slope signal between the limits of 12 m and 16 m, except in cases where a standard ILS glide path is available; the height over threshold should be varied to avoid any conflict between the visual approach slope indications and the usable portion of the ILS glide path indications;

b) vary the longitudinal distance between individual light units or the overall length of the system by not more than 10 per cent;

c) vary the lateral displacement of the system from the runway edge by not more than ± 3 m;

Note: - The system must be symmetrically displaced about the runway centerline.

d) where there is a longitudinal slope of the ground, adjust the longitudinal distance of a light unit to compensate for its difference in level from that of the threshold; and

e) where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of MOS 9.8.3.6 (h).

The distance between the wing bar and the threshold is based on an approach slope of 3° to a level runway with a nominal eye height over the threshold of 15 m. In practice, the threshold to wing bar distance is determined by:

a) the selected approach slope;

b) the longitudinal slope of the runway; and

c) the selected nominal eye height over the threshold.

Figure 9.8-2: Siting of light units for T-VASIS

- 9.8.3.2 A T-VASIS must consist of twenty light units symmetrically disposed about the runway centerline in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, and laid out as shown in MOS Figure 9.8-2.
- 9.8.3.3 An AT-VASIS must consist of ten light units arranged on one side of the runway in the form of a single wing bar of four light units with a bisecting longitudinal line of six lights.
- 9.8.3.4 The light units must be constructed and arranged in such a manner that the pilot of an aeroplane during an approach will:
- (a) When above the correct approach slope, see an inverted white 'T' pattern comprising the white wing bar(s) lights, and one, two or three white 'fly-down' lights, the more fly-down lights being visible, the higher the pilot is above the correct approach slope.
 - (b) When on the correct approach slope, see a line of white wing bar(s) lights.
 - (c) When below the correct approach slope, see a white 'T' pattern comprising the white wing bar(s) lights and one, two or three white 'fly-up' lights, the more fly-up lights being visible the lower the pilot is below the correct approach slope; and when well below the correct approach slope, see a red 'T' pattern with the wing bar(s) and the three fly-up lights showing red.

When on or above the approach slope, no light shall be visible from the fly-up light units; when on or below the approach slope, no light shall be visible from the fly-down light units.

9.8.3.5 **Siting a T-VASIS or AT-VASIS**

The siting of a T-VASIS or AT-VASIS must be such that:

- (a) The light units must be located as shown in MOS Figure 9.8-2, subject to the installation tolerances given therein.
- (b) The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, must be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units must be mounted as low as possible and must be frangible.

Note: - The siting of T-VASIS will provide, for a 3° slope and a nominal eye height over the threshold of 15 m MOS 9.8.3.2 and 9.8.3.7(b), a pilot's eye height over threshold of 13 m to 17 m when only the wing bar lights are visible. If increased eye height at the threshold is required (to provide adequate wheel clearance), then the approaches may be flown with one or more fly-down lights visible. The pilot's eye height over the threshold is then of the following order:

Wing bar lights and one fly-down light visible 17 m to 22 m

Wing bar lights and two fly-down lights visible 22 m to 28 m

Wing bar lights and three fly-down lights visible 28 m to 54 m.

9.8.3.6 **Characteristics of the T-VASIS light units.** The characteristics of the TVASIS light units must be such that:

- (a) The system must be suitable for both day and night operations.

- (b) The light distribution of the beam of each light unit must be of fan shape showing over a wide arc in azimuth in the approach direction. The wing bar light units shall produce a beam of white light from $1^{\circ} 54'$ vertical angle up to 6° vertical angle and a beam of red light from 0° to $1^{\circ} 54'$ vertical angle. The fly-down light units must produce a beam of white light extending from an elevation of 6° down to approximately the approach slope, where it must have a sharp cut-off. The fly-up light units must produce a beam of white light from approximately the approach slope down to $1^{\circ} 54'$ vertical angle and a beam of red light below $1^{\circ} 54'$ vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with MOS 9.8.3.7 (e).
- (c) The light intensity distribution of the fly-down, wing bar and fly-up light units shall be as shown in MOS Figures 9.8-9A & 9B.
- (d) The color transition from red to white must be so as to appear to an observer at a distance of not less than 300 m, to occur over a vertical angle of not more than $15'$. Immediately below this transition sector the intensity of the completely red beam must not be less than 15% of the intensity of the completely white beam immediately above the transition sector.
- (e) At full intensity the red light shall have a Y coordinate not exceeding 0.320.
- (f) A suitable intensity control shall be provided to allow adjustments to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.
- (g) The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.
- (h) The light units must be so designed that deposits of condensation, dirt, etc. on optically transmitting or reflecting surfaces must interfere to the least possible extent with the light signals and must in no way affect the elevation of the beams or the contrast between the red and white signals.
- (i) The beam of light produced by the light units must show through an angle of at least $1^{\circ} 30'$ above and below the approach slope both by day and by night and in azimuth through not less than 10° by day and not less than 15° by night. The effective visual range of the light units in clear weather must be at least 7.4 km over the above angles.

Note: - 1. Past practice, has been to increase the night azimuth to 30° .

Note: - 2. Where obstacles infringe into this wider azimuth, the obstacles shall be removed where practicable. Alternatively, the azimuth spread may be suitably restricted.

9.8.3.7

Approach slope and elevation settings of light beams. The approach slope and elevation settings of light beams must be such that:

- (a) An approach slope that is operationally satisfactory is to be selected for each runway. The standard approach slope is 3° (1:19 nominal), and with an eye height over threshold of 15 m.
- (b) When the runway on which a T-VASIS is provided is equipped with an ILS, the siting and elevation of the light units must be such that the T-VASIS

approach slope is compatible with the ILS glide path. A T-VASIS eye-height over the threshold 1 m higher than the ILS glide path has been found to satisfy most aeroplanes.

- (c) The light beams from the corresponding light units on opposite sides of the runway must have the same recognition angle. The fly-up and fly-down light units of the 'T' must appear with uniform steps as the approach slope changes.
- (d) The elevation of the beams of the wing bar light units on both sides of the runway must be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and the bottom of the beam of the fly-down light unit nearest to each wing bar, must be equal and must correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up units shall decrease by $5'(\pm 1/2')$ of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units must increase by $7'(\pm 1/2')$ of arc at each successive unit away from the wing bar.
- (e) The elevation setting of the top of the red light beams of the wing bar and fly-up light units must be such that, during an approach, the pilot of an aeroplane, to whom the wing bar and three fly-up units are visible, would clear all objects in the approach area by a safe margin, if any such light did not appear red.
- (f) The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object can adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

Note: - MOS 9.8.2.1 to 9.8.2.5 concerning the related obstacle protection surface.

- 9.8.3.8 **Clearance from movement areas.** Light unit must not be sited closer than 15 m from the edge of the runway. Light units should be sited at least 15 m from the edge of a taxiway but should circumstances require units to be closer than this distance the particular case should be referred to CAAP.
- 9.8.3.9 **System dimensions.** Tabulated below are system dimensions, with allowable tolerances. These values apply to design, installation and subsequent maintenance:
- 9.8.3.10 The aerodrome operator must ensure that the immediate surround of each unit is kept free of grass. Tall grass immediately in front of the light unit could provide conflicting light signals. Grass growing near to the box on any side could result in the fine settings being disturbed during power mowing operations.

The following information is provided for guidance only of aerodrome operators. For existing installations, the recommended lamp current, the approximate series current and approximate light intensities are shown in Table 9.8-3 and 9.8-4.

Item	Standard	Allowable Tolerance
Eye height over threshold	15 m ^{1, 2}	+1 m – 3 m
Approach slope ³	3° (1: 19 nominal)	
Distance of longitudinal line of light units from runway edge ⁴	30 m	±3 m
Leg light unit spacing	45 m 90 m	±4.5 m ±9 m
Clearance from pavements	15 m ⁵	
Alignment of each light unit	Parallel to runway centerline	±1°
Light units in a wing bar Fronts of light units Height of light units	Aligned Aligned	±25 mm ±25 mm
Levelling of light units	Level	To the accuracy of the precision engineers level. ⁶
¹ When the runway on which a T-VASIS is provided is equipped with an ILS, the siting and elevations of the TVASIS shall be such that the visual approach slope conforms as closely as possible to the Glide Path of the ILS. ² A T-VASIS eye height over threshold 1 m higher than the ILS Glide Path satisfies most aircraft. ³ The use of a different approach slope requires prior approval from CAAP. ⁴ The edge of the runway is defined as the distance from the runway centerline, which is half the nominal width of the runway and ignores sealed shoulders. ⁵ A minimum clearance between any part of a T-VASIS light unit (but not the foundation slab) and an adjacent runway or taxiway pavement. ⁶ This includes end-for-ending the level to ensure no inaccuracy of the instrument.		

Table 9.8-2

Intensity stage	Lamp Current	Series Circuit Current	Light Unit Intensity
6	6.2 amps	6.2 amps	80,000 cd
5	5.0 amps	5.0 amps	20,000 cd
4	4.0 amps	4.0 amps	5,000 cd
3	2.4 amps	6.1 amps	450 cd
2	2.05 amps	5.2 amps	140 cd
1	1.65 amps	4.2 amps	50 cd
<i>Note: - For intensity stage 6, experiments have shown that lamp current down to 6.05 amps did not adversely affect visual acquisition from the 4 NM range in bright sunlight conditions. Hence if preservation of lamp life is desired, reduction of lamp current for stage 6 down to 6.05 amps is acceptable.</i>			

Table 9.8-3: Using 021027.8 Day Lamps and 020946-1 Night Lamps

Intensity stage	Lamp Current	Series Circuit Current	Light Unit Intensity
6	6.85 amps	5.4 amps	80,000 cd
5	5.65 amps	4.5 amps	20,000 cd
4	4.8 amps	3.8 amps	5,000 cd
3	2.4 amps	6.1 amps	450 cd
2	2.05 amps	5.2 amps	140 cd
1	1.65 amps	4.2 amps	50 cd
<i>Note: - For intensity stage 6, experiments have shown that lamp current down to 6.35 amps did not adversely affect visual acquisition from the 4 NM range in bright sunlight conditions. Hence if preservation of lamp life is desired, reduction of lamp current for stage 6 down to 6.35 amps is acceptable.</i>			

Table 9.8-4: Using 020975.2 Day Lamps (with 074315.4 transformer) and 020946-1 Night Lamps

9.8.4 Precision Approach Path Indicator (PAPI) / Abbreviated PAPI (APAPI) System

9.8.4.1 The PAPI system must consist of a row, also termed 'wing bar', of 4 equally spaced sharp transition multi-lamp (or paired single lamp) units. The system must be located on the left side of the runway, as viewed by an aircraft approaching to land, unless it is impracticable to do so.

Note: - Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

9.8.4.2 The APAPI system shall consist of a wing bar of two sharp transition multi-lamp (or paired single lamp) units. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note: - Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

9.8.4.3 The PAPI system must be sited and adjusted so that a pilot making an approach will:

- when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;
- when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white;
- when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.

9.8.4.4 The wing bar of an APAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

- when on or close to the approach slope, see the unit nearer the runway as

red and the unit farther from the runway as white;

- (b) when above the approach slope, see both the units as white; and
- (c) when below the approach slope, see both the units as red.

9.8.4.5 Where it is impracticable to install the PAPI on the left side of the runway, and it has been installed on the right, the usual order of the light units must be reversed, so that the on-slope indication is still given by the two units nearest the runway showing red.

9.8.4.6 Where a double-sided PAPI is provided, indications seen by the pilot must be symmetrical.

9.8.4.7 The following requirements are applicable to the siting of a PAPI:

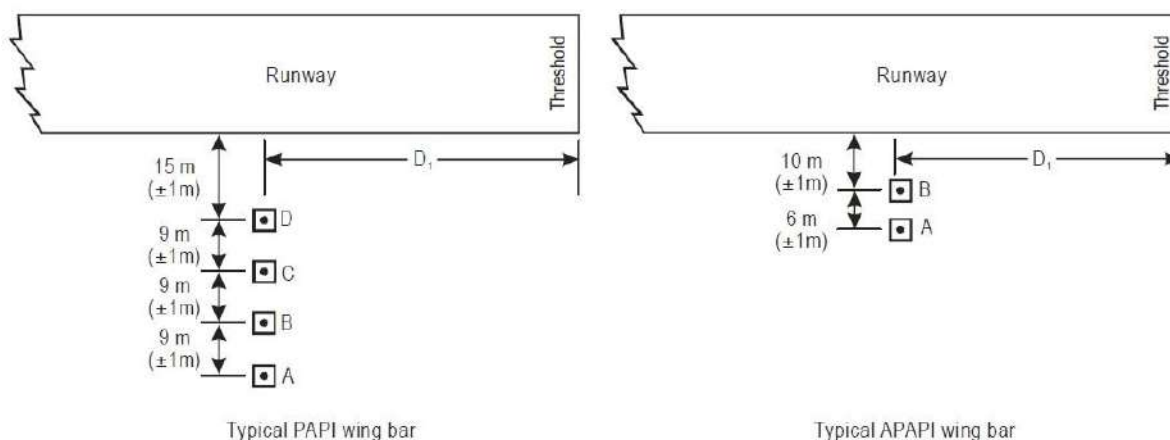
- (a) The light units must be located as in the basic configuration illustrated in MOS Figure 9.8-3, subject to the installation tolerances given therein.
- (b) The light units forming a wing bar must be mounted so as to appear to a pilot of an approaching aeroplane to be substantially in a horizontal line. The light units must be mounted as low as possible and must be frangible.

9.8.4.8 The characteristics of the PAPI light units must be such that:

- (a) The system must be suitable for both day and night operations.
- (b) The color transition from red to white in the vertical plane must be such that as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3'.
- (c) At full intensity the red light must have a Y co-ordinate not exceeding 0.320.
- (d) The light intensity distribution of the light units must be as shown in MOS Figure 9.8-4.

Note: - See the Aerodrome Design Manual (Doc 9157), Part 4, for additional guidance on the characteristics of light units.

- (e) Suitable intensity control must be provided to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.
- (f) Each light unit must be capable of adjustment in elevation so that the lower limit of the white part of the beam must be fixed at any desired angle of elevation between 1°30' and at least 4°30' above the horizontal.
- (g) The light units must be so designed that deposits of condensation, snow, ice, dirt, etc., on optical transmitting or reflecting surfaces must interfere to the least possible extent with the light signals and must not affect the contrast between the red and white signals and the elevation of the transition sector.



- a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS, the distance D_1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (MOS Figure 9.8-5), angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in MOS Table 9.8-5) for the most demanding amongst aeroplanes regularly using the runway.
- b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and, the distance D_1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. The distance shall be equal to that between the threshold and the effective origin of the ILS glide path, plus a correction factor for the variation of eye-to-antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. However, the distance shall be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of MOS Table 9.8-5.
- c) If a wheel clearance, greater than that specified in a) above is required for specific aircraft, this can be achieved by increasing D_1 .
- d) Distance D_1 shall be adjusted to compensate for differences in elevation between the lens centers of the light units and the threshold.
- e) To ensure that units are mounted as low as possible and to allow for any transverse slope, small height adjustments of up to 5 cm between units are acceptable. A lateral gradient not greater than 1.25 per cent can be accepted provided it is uniformly applied across the units.
- f) A spacing of 6 m (± 1 m) between PAPI units should be used on code numbers 1 and 2. In such an event, the inner PAPI unit shall be located not less than 10 m (± 1 m) from the runway edge.
- g) The lateral spacing between APAPI units may be increased to 9 m (± 1 m) if greater range is required or later conversion to a full PAPI is anticipated. In the latter case, the inner APAPI unit shall be located 15 m (± 1 m) from the runway edge.

Note: - Reducing the spacing between light units results in a reduction in usable range of the system.

Note: - See MOS 8.3.7 for specifications on aiming point marking. Guidance on the harmonization of PAPI, ILS signals is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

Figure 9.8-3: Siting of PAPI and APAPI Light Units

Note: - 1. The edge of the runway is defined as the distance from the runway centerline, which is half the nominal width of the runway and ignores sealed shoulders.

Note: - 2. In the case of runways where the row of edge lights is located beyond the standard 3 m specified in MOS 9.10.5.1, for example those runways in accordance with the Note following MOS 9.10.5.1, or those in accordance with MOS 9.10.5.2, the PAPI should be located with the inner

light unit 13 ± 1 m from the line of the edge lights, rather than 15 ± 1 m from the runway edge. (The reason for this is because reducing the spacing between PAPI in usable range of the system). In the case of the Note following MOS 9.10.5.1, when the runway edge lights are relocated to the standard location, the PAPI should also be relocated to the standard location.

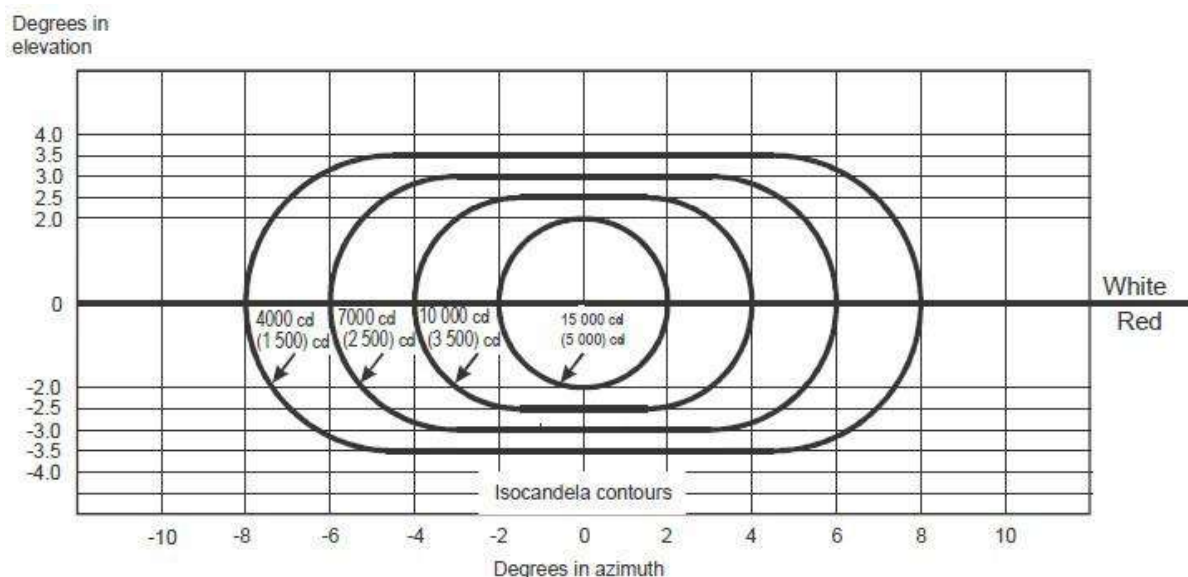


Figure 9.8-4: Light intensity distribution of PAPI and APAPI

Note: -

1. These curves are for minimum intensities in red light.
2. The intensity value in the white sector of the beam is no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.
3. The intensity values shown in brackets are for APAPI.

9.8.4.9

The requirements for the approach slope and elevation setting of light units are:

- (a) The approach slope, as defined in MOS Figure 9.8-5, must be appropriate for use by the aeroplanes using the approach. The standard approach slope is 3° .
- (b) When the runway on which a PAPI is provided is equipped with an ILS, the siting and the angle of elevation of the light units must be such that the PAPI approach slope conforms as closely as possible with the ILS glide path.
- (c) The angle of elevation settings of the light units in a PAPI wing bar must be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin. See MOS Table 9.8-5 concerning the raising of the approach slope.
- (d) The angle of elevation settings of the light units in an APAPI wing bar shall be such that, during an approach, the pilot of an aeroplane observing the lowest on slope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin (see MOS Table 9.8-5).
- (e) The azimuth spread of the light beam must be suitably restricted where an

object located outside the obstacle protection surface of the PAPI or APAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object can adversely affect the safety of operations. The extent of the restriction must be such that the object remains outside the confines of the light beam.

Note: - See MOS 9.8.2.1 to 9.8.2.5 concerning the related obstacle protection surface.

- (f) Where a double-sided PAPI is provided for roll guidance, corresponding units must be set at the same angle so that the signals of each wing bar change symmetrically at the same time.

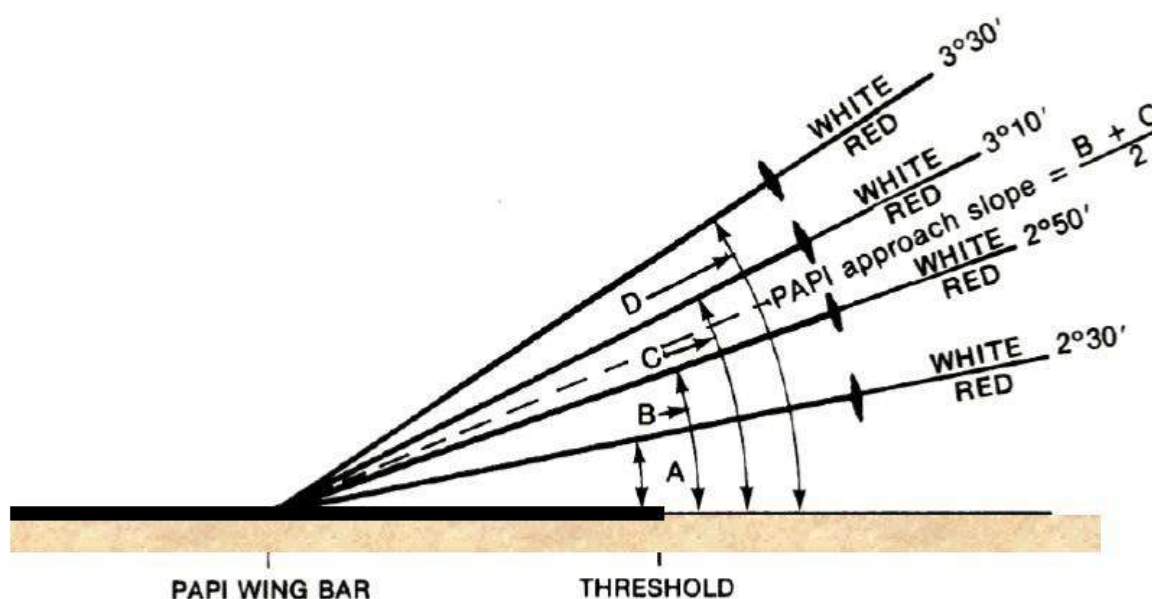


Figure 9.8-5: Light beams and angle of elevation setting for PAPI 3° approach slope

- 9.8.4.10 The optimum distance of PAPI wing bar from the runway threshold is determined by:
- the requirement to provide adequate wheel clearance over the threshold for all types of aircraft landing on the runway;
 - the operational desirability that PAPI is compatible with any non-visual glide path down to the minimum possible range and height; and
 - any difference in elevation between the PAPI units and the runway threshold.
- 9.8.4.11 The distance of the PAPI units from the threshold must be modified from the optimum after consideration of:
- the remaining length of runway available for stopping the aircraft; and,
 - obstacle clearance.

- 9.8.4.12 MOS Table 9.8-5 specifies the standard wheel clearance over the threshold for the most demanding amongst the aircraft regularly using the runway, for four aircraft eye-to-wheel height groups. Where practicable, the standard wheel clearance shown in column (2) must be provided.
- 9.8.4.13 Where the landing run may be limited, especially at smaller aerodromes, a reduction in wheel clearance over the threshold may be more acceptable than a loss of landing distance. The special minimum wheel clearance shown in column (3) may be used in such a situation, if an aeronautical study indicates such reduced clearances to be acceptable. As guidance, these wheel clearances are unlikely to be acceptable where there are objects under the approach near the threshold, such as approach light supporting structures, boundary fences, roads, etc.
- 9.8.4.14 The final location of the units is determined by the relationship between the approach angle, the difference in levels between threshold and the units, and the minimum eye height over the threshold (MEHT). The angle M used to establish the MEHT is 2' of arc less than the setting angle of the unit which defines the lower boundary of the on-slope indication, i.e. unit B, the third unit from the runway. See MOS Figure 9.8-6.
- 9.8.4.15 Where a PAPI is installed on a runway not equipped with an ILS, the distance D1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication provides the wheel clearance over the threshold specified in MOS Table 9.8-5 for the most demanding amongst aeroplanes regularly using the runway.
- 9.8.4.16 Where a PAPI is installed on a runway equipped with an ILS, the distance D1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. If a wheel clearance greater than that specified in MOS 9.8.4.8(f) is required for specific aircraft, this can be achieved by increasing D1. Distance D1 shall be adjusted to compensate for differences in elevation between the lens centers of the light units and the threshold.
- 9.8.4.17 PAPI units must be the minimum practicable height above ground, and not normally more than 0.9 m. All units of a wing bar shall ideally lie in the same horizontal plane; however, to allow for any transverse slope, small height differences of no more than 50 mm between light units are acceptable. A lateral gradient not greater than 1.25% can be accepted provided it is uniformly applied across the units.
- 9.8.4.18 Procedure for establishing the distance of the PAPI wing bar from the runway threshold:
- (a) Decide on the required approach slope. The standard approach slope is 3°.
 - (b) On runways where no ILS is installed, refer to MOS Table 9.8-5 to determine the aeroplane eye-to-wheel group and the wheel clearance to be provided at the threshold. The MEHT, which provides the appropriate wheel clearance over the threshold, is established by adding the approach configuration eye-to-wheel height of the most demanding amongst the aircraft regularly using the runway to the required threshold wheel clearance.

- (c) The calculation of the nominal position of the PAPI is made on the assumption that the PAPI units are at the same level as the runway centerline adjacent to them, and this level, in turn, is the same as that of the runway threshold. The nominal distance of the PAPI is derived by multiplying the required MEHT by the cotangent of the angle M in MOS Figure 9.8-6.
- (d) Where there is a difference in excess of 0.3 m between the elevation of the runway threshold and the elevation of unit B at the nominal distance from the threshold, it will be necessary to displace the PAPI from its nominal position. The distance will be increased if the proposed site is lower than the threshold and will be decreased if it is higher. The required displacement is determined by multiplying the difference in level by the cotangent of the angle M.
- (e) Where a PAPI is installed on a runway equipped with an ILS, the distance D1 must be equal to that between the threshold and the effective origin of the ILS glide path, plus a correction factor for the variation of eye-to- antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. The PAPI is then aimed at the same angle as the ILS glide slope. Harmonization of the PAPI signal and the ILS glide path to a point closer to the threshold may be achieved by increasing the width of the PAPI on-course sector from 20' to 30'. However, the distance D1 must be such that in no case will the wheel clearance over the threshold be lower than specified in column (3) of MOS Table 9.8-5.

Eye-to-wheel height of aeroplane in the approach configuration ^a	Standard wheel clearance (meters) ^b	Special minimum wheel clearance (meters) ^{c, d}
(1)	(2)	(3)
Up to but not including 3 m	6	3
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6
^a In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis shall be considered. The most demanding amongst such aeroplanes shall determine the eye-to-wheel height group. ^b Where practicable, the standard wheel clearance shown in column (2) shall be provided. ^c The wheel clearance may be reduced to not less than those in column (3) with specific agreement of CAAP, where an aeronautical study indicates that such reduced wheel clearances are acceptable. ^d Where the Special Minimum wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding Standard wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway. ^e This wheel clearance may be reduced to 1.5 m on runways used mainly by light-weight non-turbojet aeroplanes.		

Table 9.8-5: Wheel clearance over threshold for PAPI

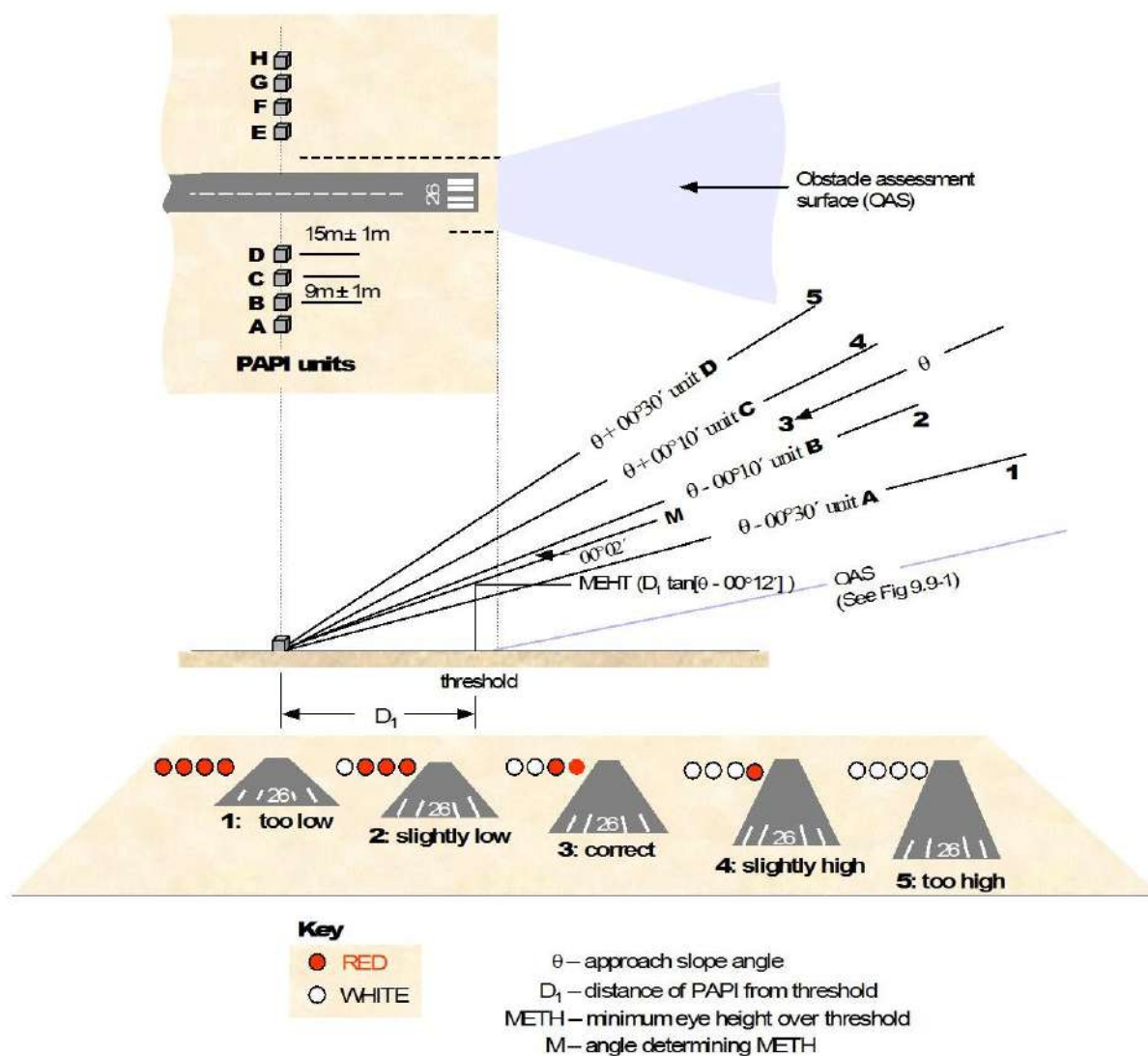


Figure 9.8-6: The arrangement of a PAPI system and the resulting display

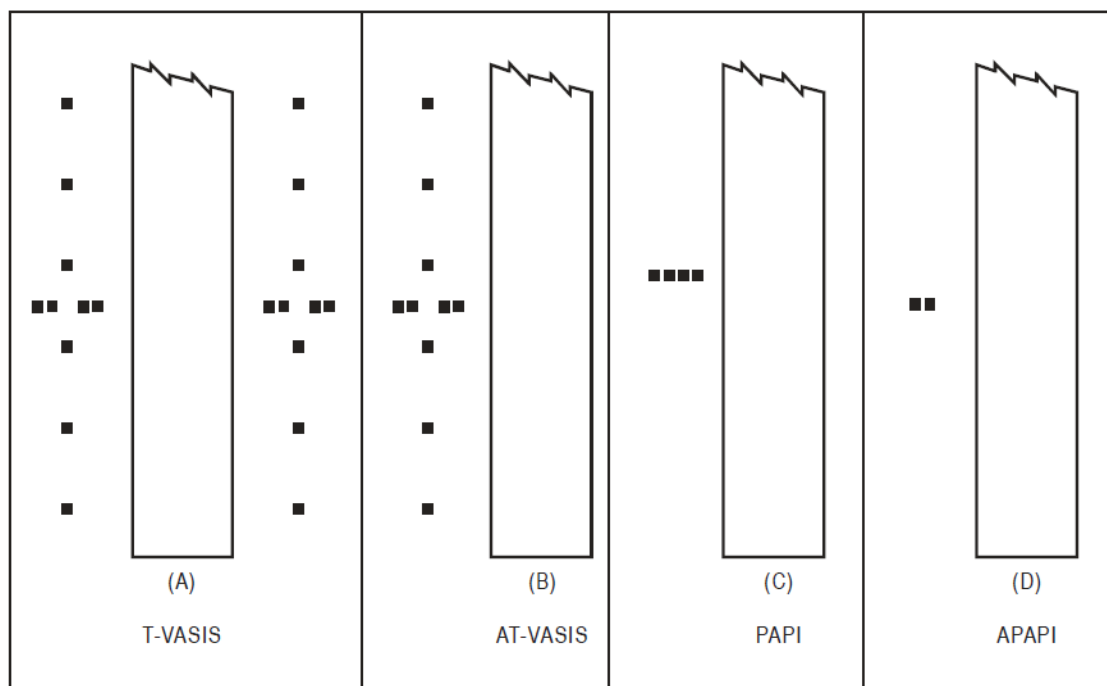


Figure 9.8-7. Visual approach slope indicator systems

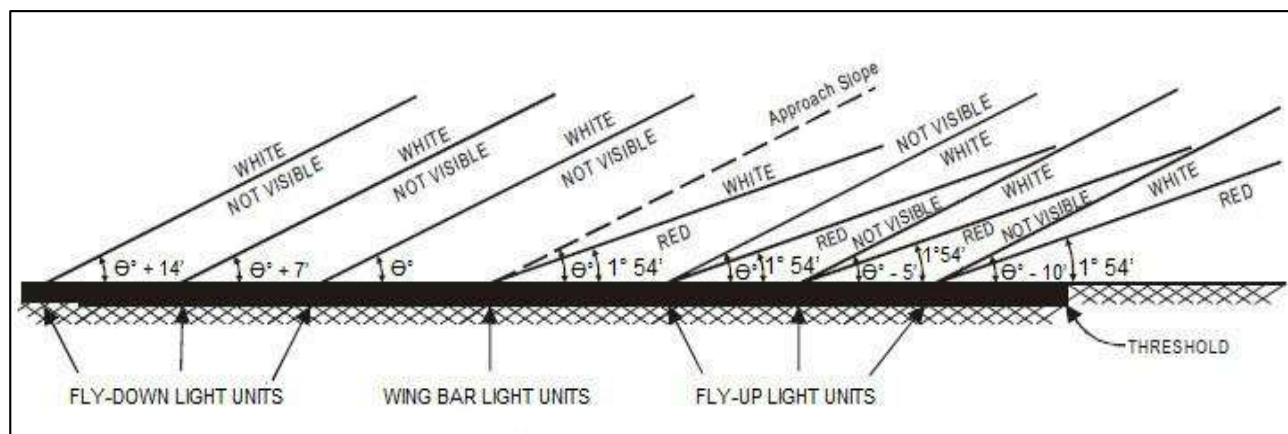
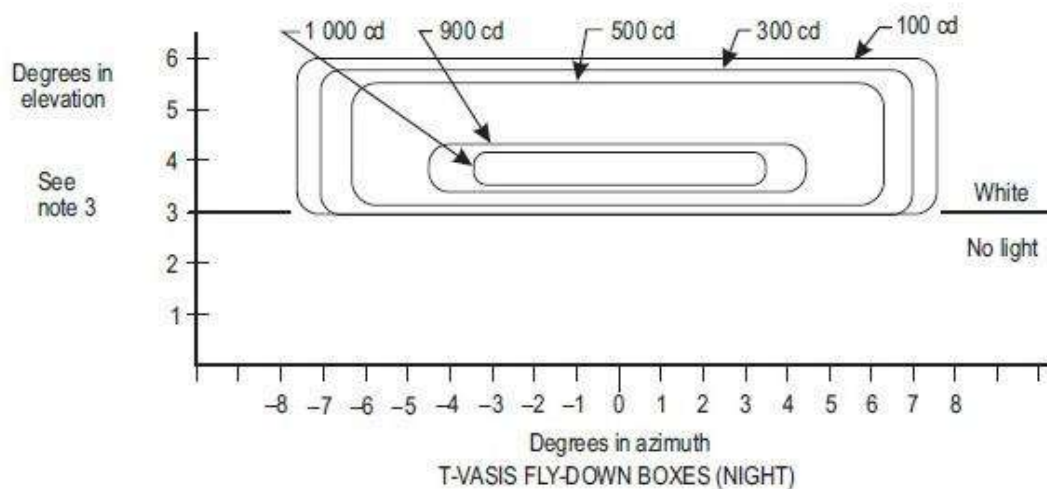
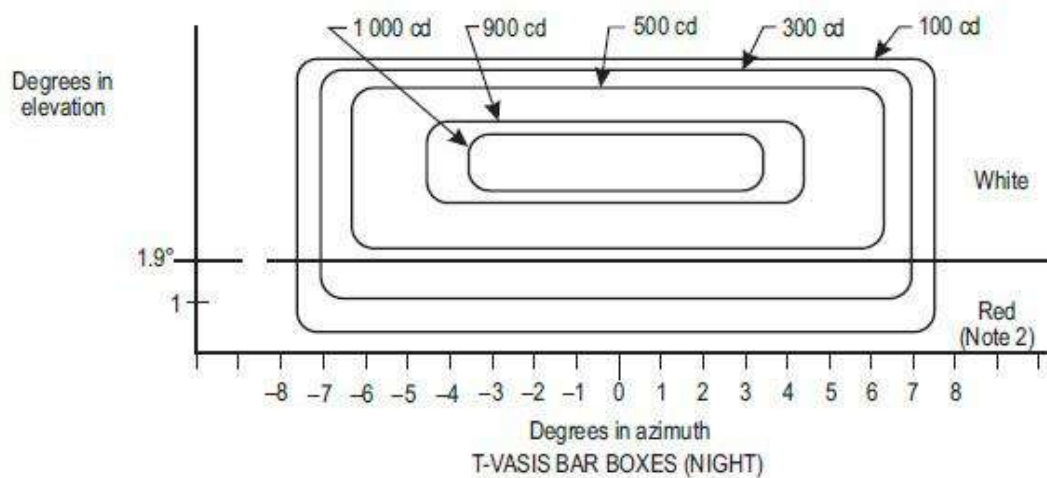
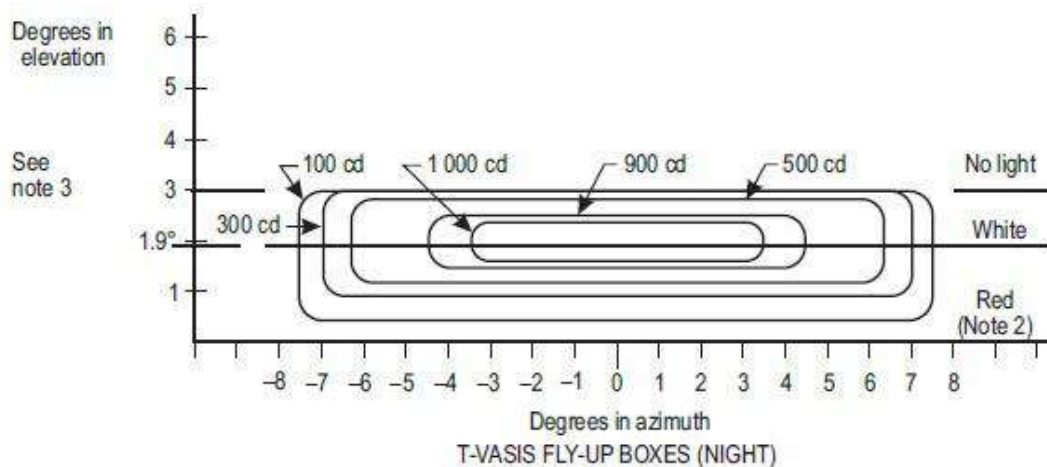


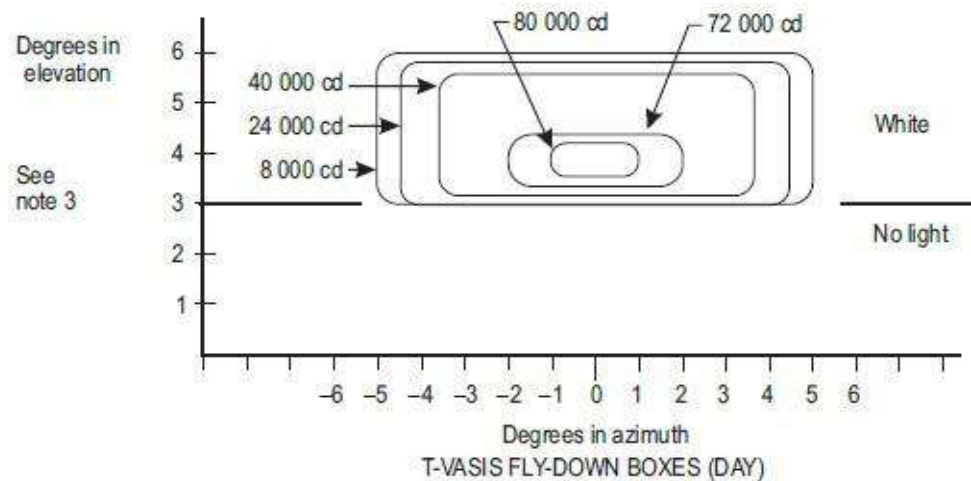
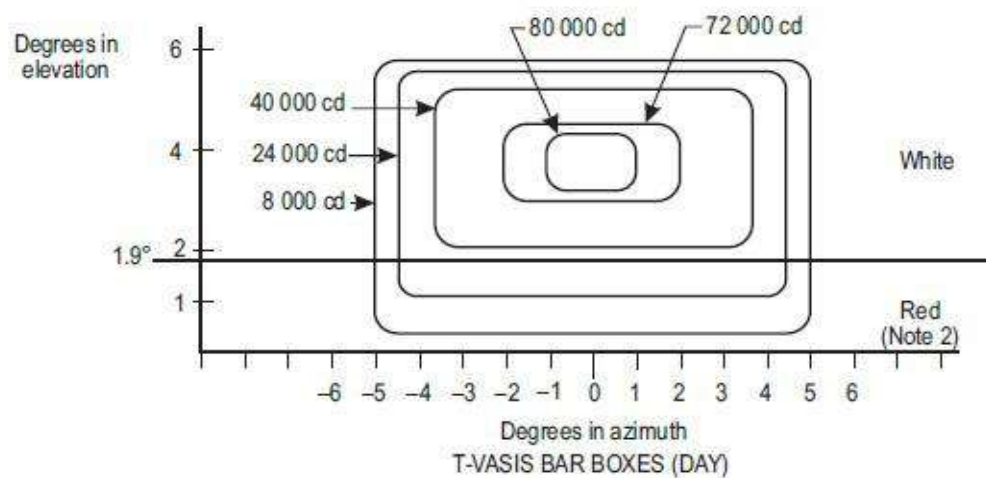
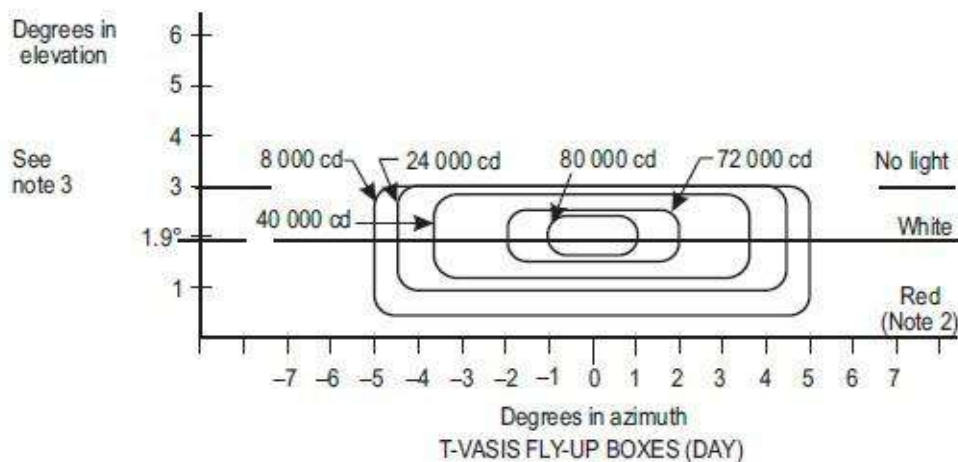
Figure 9.8-8. Light beams and elevation settings of T-VASIS and AT-VASIS



Note: - 1. These curves are for minimum intensities in white light.

Note: - 2. Filter transmissivity for all red signals is 15 per cent minimum at operating temperature.

Figure 9.8-9A. Light intensity distribution of T-VASIS and AT-VASIS (NIGHT)



Note: - 3. A sharp transition from white to no light in elevation is essential to T-VASIS operation. For exact elevation settings, see MOS Figure 9.8-7.

Figure 9.8-9B. Light intensity distribution of T-VASIS and AT-VASIS (DAY)

Section 9.9 Runway Lighting

9.9.1 Types of runway edge lighting systems

9.9.1.1 A runway edge lighting system may be of the following type:

- (a) low intensity – a single intensity lighting system suitable for a non- instrument runway or a non-precision approach runway. This is provided at an aerodrome where there is no appropriate person, such as an air traffic controller, certified air/ground radio operator, or similar, to adjust the intensity settings of the lights;
- (b) medium intensity – a 3-stage intensity lighting system suitable for a non-instrument runway or a non-precision approach runway. This is provided to enhance the lighting system particularly in marginal weather conditions. This system cannot be used at an aerodrome that does not have air traffic services or similar personnel.

Note: - This requirement is for controlling light intensity during the landing phase. This section is not to be confused with lighting systems controlled by a photo-electric cell which can provide Day, Twilight and Night intensity settings based on ambient conditions.

- (c) high intensity – a 5 or 6 stage intensity lighting system which is suitable for precision approach runways. This system cannot be used at an aerodrome that does not have air traffic services or similar personnel.

9.9.2 Runway edge lights

9.9.2.1 Runway edge lights must be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night. Unless otherwise determined by CAAP, edge lights shall also be installed on a runway intended to be used for take-off by day with an RVR of 800 meters or less.

9.9.2.2 Runway edge lighting must meet the following operational requirements:

- (a) for every runway intended for use at night, omnidirectional lights meeting the characteristics requirements of MOS 9.9.6 shall be provided to cater for both visual circling after an instrument approach to circling minima, and circuits in VMC;
- (b) for a precision approach runway, in addition to (a) above, unidirectional lights meeting the characteristics requirements of MOS 9.9.7 and 9.9.8, if applicable, shall also be provided.

Note: - Successful past practice has been for separate light fittings, one to satisfy the omnidirectional characteristic, and another to satisfy the unidirectional characteristic, to be provided

9.9.3 Location of runway edge lights

9.9.3.1 Runway edge lights must be placed along both sides of the runway, in two parallel straight rows equidistant from the centerline of the runway, commencing one-light spacing from the threshold and continuing to one-light spacing from the runway end.

9.9.4 Longitudinal spacing of runway edge lights

9.9.4.1 The longitudinal spacing of runway edge lights must be uniform and be:

- (a) for an instrument runway, intervals of not greater than 60 m (+0 / -5 m);
- (b) for a non-instrument runway, intervals not greater than 100 m (+0/ - 10m), or 60 m +0 / -5 m if there is an intention to upgrade the runway to an instrument runway at some time in the future.
- (c) for non-precision instrument runways intended to be used in visibility conditions of 1.5 km or greater, where existing edge lights are spaced at 90 m \pm 10 m, it is acceptable to retain this spacing until the next replacement or improvement of the edge lighting system. (This situation typically arises from an existing non-instrument runway being upgraded to a non-precision instrument runway, but without re-installing the runway edge lights to the 60 m +0 / -5 m standard.)

Note: - 1. With GPS technology, virtually any runway can become an instrument runway. Accordingly, it is recommended that any new runway edge lights should be spaced in accordance with Paragraph 9.9.4.1(a).

Note: - 2. Existing lights spaced in accordance with previous standards of 200 ft or 300 ft imperial measurements may exceed 60 m or 100 m respectively. They are deemed to comply with the standards of this paragraph, until the next replacement or upgrade of the edge lighting system.

9.9.4.2 Where the runway is a non-instrument or a non-precision instrument runway, and it is intersected by other runways or taxiways:

- (a) within 600 m of the threshold, lights may be spaced irregularly, but not omitted, and
- (b) more than 600 m from the threshold, lights may be spaced irregularly or omitted, but no two consecutive lights may be omitted; provided that such irregular spacing or omission does not significantly alter the visual guidance available to a pilot using the runway.

9.9.4.3 Runway edge lights must not to be omitted on a precision approach runway.

9.9.4.4 Where a runway edge light cannot be omitted, inset runway edge lights must be provided in place of elevated lights.

9.9.4.5 Unless a light is omitted or displaced in accordance with paragraph 9.9.4.2, a runway edge light must be aligned with a light on the opposite side of the runway.

9.9.5 Lateral Spacing of Runway Edge Lights

9.9.5.1 Subject to Paragraph 9.9.5.2, runway edge lights must be placed along the edges of the area declared for use as the runway or outside the edges of the area at a distance of not more than 3 m.

Note: - Existing edge lights located beyond 3 m from the edge of runway as a result of a reduction in the declared runway width do not need to be relocated until they are being replaced.

- 9.9.5.2 If the width of a runway is less than 30 m in width, the runway edge lights must be placed as if the runway is 30 m in width, and in accordance with Paragraph 9.9.5.1.
- 9.9.5.3 If a runway is provided with both low or medium intensity and high intensity runway light units, the row of high intensity light units shall be placed closer to the runway centerline. The two rows of light units are to be parallel, separated by a distance of at least 0.5 m.

9.9.6 Characteristics of low and medium intensity runway edge lights

- 9.9.6.1 Low intensity and medium intensity runway edge lights must be fixed omnidirectional lights that show variable white. Elevated omni-directional lights must have light distribution that is uniform for the full 360° horizontal coverage. Where elevated lights are impracticable and inset lights are used, the photometric characteristics of the inset lights are to be as close as practicable to those of the elevated lights.
- 9.9.6.2 The minimum light intensity for low intensity runway edge lights is to be in accordance with MOS 9.10.2, Figure 9.10-13. The main beam, between 0° and 7° above the horizontal, is to have a minimum average intensity of not less than 100 cd, and a maximum average intensity of not more than 200 cd.
- 9.9.6.3 Low intensity runway edge lights are to have a single intensity for all lights in the same runway lighting system.
- 9.9.6.4 The minimum light intensity for medium intensity runway edge lights is to be in accordance with 9.10.2, Figure 9.10-14. The main beam, between 0° and 7° above the horizontal, is to have a minimum average intensity of not less than 200 cd, and a maximum average intensity of not more than 600 cd.

9.9.7 Characteristics of high intensity runway edge lights

- 9.9.7.1 High intensity runway edge lights must be fixed unidirectional lights with the main beam directed towards the threshold.
- 9.9.7.2 High intensity runway edge light beam coverage shall be toed in towards the runway as follows:
- (a) 3.5° in the case of a 30-45 m wide runway;
 - (b) 4.5° in the case of a 60 m wide runway.
- 9.9.7.3 Runway edge lights shall be fixed lights showing variable white except for those located within 600 m from the runway end, except that:
- (a) in the case of a displaced threshold, the lights between the beginning of the runway and the displaced threshold shall show red in the approach direction; and
 - (b) a section of lights 600m or one third of the runway length, whichever is the lesser, at the remote end of the runway from which take-off is started shall show yellow, unless otherwise directed by CAAP.

- 9.9.7.4 The minimum light intensity for high intensity runway edge lights that show variable white is to be in accordance with MOS 9.10.2.
- (a) Figure 9.10-15 for 30 m to 45 m wide runways; and
 - (b) Figure 9.10-16 for 60 m wide runways.
- 9.9.7.5 The minimum light intensity for high intensity runway edge lights that show yellow is the standard set out in Figure 9.10-15 or Figure 9.10-16, whichever is applicable, multiplied by 0.4.
- 9.9.8 Use of bi-directional or back-to-back light fittings**
- 9.9.8.1 On a runway where high intensity edge lights are intended to be used from either direction, separate high intensity runway edge light fittings must be provided back-to-back, or bi-directional light fittings with the correct toe-in angle built in, must be used.
- 9.9.9 Runway threshold lights**
- 9.9.9.1 Runway threshold lights must be provided on a runway that is equipped with runway edge lights, except on a non-instrument or non-precision approach runway where the threshold is displaced and wing bar lights are provided. (See MOS Figure 9.9-1.)
- 9.9.10 Location of runway threshold lights**
- 9.9.10.1 Runway threshold lights must be located in a straight line at right angles to the centerline of the runway and:
- (a) when the threshold is at the extremity of a runway, as near to the extremity as possible and not more than 3 m outside; or
 - (b) when the threshold is a displaced threshold, at the displaced threshold with a tolerance of ± 1 m.
- 9.9.10.2 Threshold lighting shall consist of:
- (a) on a non-instrument or non-precision approach runway, at least 6 lights;
 - (b) on a precision approach runway category I, at least the number of lights that would be required if the lights were spaced at intervals of 3 m between the rows of runway edge lights; and
 - (c) on a precision approach runway category II or III, lights uniformly spaced at intervals of 3 m between the runway edge lights.
- 9.9.10.3 The lights prescribed in MOS 9.9.10.2 (a) and (b) shall be either:
- (a) equally spaced between the rows of runway edge lights; or
 - (b) symmetrically disposed about the runway centerline in two groups, with the lights uniformly spaced in each group and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.

9.9.11 Wing bar lights

- 9.9.11.1 Wing bar lights shall be provided on a non-instrument or non-precision approach runway where the threshold is displaced and threshold lights are required, but not provided. If directed by CAAP due to a need for increased conspicuity, wing bar lights are to be provided on a precision approach runway. (See MOS Figure 9.9-1.)
- 9.9.11.2 Where provided wing bar lights shall be symmetrically disposed about the runway centerline at the threshold in two groups. Each wing bar shall be formed by a group of at least five lights extending at least 10m outward from, and at right angles to, the runway centerline with the innermost light of each wing bar in the line of the runway edge lights.

9.9.12 Characteristics of runway threshold lights

- 9.9.12.1 Runway threshold and wing bar lights must have the following characteristics:
- (a) the lights must be fixed unidirectional lights showing green in the direction of approach over not less than 38° or more than 180° of azimuth;
 - (b) the light distribution in the direction of approach must be as close as practicable to that of the runway edge lights;
 - (c) the intensity of the green lights must be in the range of 1 to 1.5 times the intensity of the runway edge lights.
- Note: - Older installations with the intensity of green light in the range of 0.5 to 1 times the intensity of the runway edge lights are acceptable, until the next replacement or upgrade of the runway and/or threshold lighting system.*
- 9.9.12.2 Runway threshold lights on a precision approach runway shall be in accordance with the specifications of MOS Figure 9.10-5.
- 9.9.12.3 Threshold wing bar lights on a precision approach runway shall be in accordance with the specifications of MOS Figure 9.10-6.

9.9.13 Reserved**9.9.14 Characteristics of high intensity runway threshold lights**

- 9.9.14.1 Runway threshold lights on a precision approach runway must be fixed lights showing green in the direction of approach and in accordance with the specifications of MOS 9.10.2, Figure 9.10-17.
- 9.9.14.2 Wing bar lights on a precision approach runway must be fixed lights showing green in the direction of approach and in accordance with the specifications of MOS 9.10.2, Figure 9.10-18.

RUNWAY TYPE					
CONDITION	LIGHTS	NON-INSTRUMENT AND NON-PRECISION APPROACH RUNWAYS	PRECISION APPROACH RUNWAYS CATEGORY I	PRECISION APPROACH RUNWAYS CATEGORY II	PRECISION APPROACH RUNWAYS CATEGORY III
THRESHOLD AT RUNWAY EXTREMITY	RUNWAY THRESHOLD AND RUNWAY END LIGHTS	 9.9.10.1, 9.9.10.2 a, 9.9.10.3, 9.9.16.2, 9.9.16.3	 9.9.10.1, 9.9.10.2 b, 9.9.10.3, 9.9.11.2, 9.9.16.2, 9.9.16.3	 9.9.10.1, 9.9.10.2 c, 9.9.11.2, 9.9.16.2, 9.9.16.3	 9.9.11.2, 9.9.10.2 c, 9.9.11.2, 9.9.16.2, 9.9.16.3
THRESHOLD DISPLACED FROM RUNWAY EXTREMITY	RUNWAY THRESHOLD LIGHTS	 9.9.10.1, 9.9.10.2 a, 9.9.10.3, 9.9.11.2	 9.9.10.1, 9.9.10.2 b, 9.9.10.3, 9.9.11.2	 9.9.10.1, 9.9.10.2 c, 9.9.11.2	 9.9.10.1, 9.9.10.2 c, 9.9.11.2
	RUNWAY END LIGHTS	 9.9.16.2, 9.9.16.3	 9.9.16.2, 9.9.16.3		 9.9.16.2, 9.9.16.3
<div><div>UNIDIRECTIONAL LIGHT</div><div>BIDIRECTIONAL LIGHT</div><div>() CONDITIONAL RECOMMENDATION</div></div> <div>Note: - The minimum number of lights are shown for a runway 45 m wide with runway edge lights installed at the edge</div>					

Figure 9.9-1. Arrangement of runway threshold and runway end lights

Figure 9.9-1. Arrangement of runway threshold and runway end lights

9.9.15 Additional lighting to enhance threshold location**9.9.15.1 Runway Threshold Identification Lights:****9.9.15.2** At an aerodrome where it is difficult to locate a runway threshold from the air such as in the case of a displaced threshold or an aerodrome with complex runway/taxiway layout in the vicinity of the threshold, runway threshold identification lights may be required.

Note: - Runway threshold identification lights may assist pilot acquisition of a threshold during daylight, twilight and at night. During these periods the lights need to be controlled such that an approaching pilot will not be dazzled by the flashing lights.

9.9.15.3 Runway threshold identification lights must be provided, during the day, to mark a temporarily displaced threshold of a runway serving international jet propelled aeroplanes conducting air transport operations.**9.9.15.4** Runway threshold identification lights, where provided, shall be positioned with one light unit on each side of the runway, equidistant from the runway centerline, on a line perpendicular to the runway centerline. The location of the light units shall be from 10 m to 15 m outside each line of runway edge lights, and in line with the threshold. Each light unit shall be a minimum of 10 m from the edge of taxiways. The elevation of both light units shall be within 1 m of a horizontal plane through the runway centerline, with the maximum height above ground not exceeding 1 m.**9.9.15.5** Runway threshold identification lights must:

- (a) be white flashing lights;
- (b) be synchronized, with a normal flash rate of 60-120 per minute;
- (c) have a minimum range in bright sunlight of approximately 7 km; and
- (d) the beam axis of each light unit shall be aimed 15° outward from a line parallel to the runway centerline and inclined at an angle of 10° above the horizontal.
- (e) the light shall be visible only in the direction of approach to the runway.

Note: - L-849 A and E light units specified in FAA AC 150/5345-51 'Specification for Discharged -Type of Flashing Light Equipment' are xenon strobe type of lights suitable for use as runway threshold identification lights.

9.9.15.6 Runway threshold identification lights shall be installed:

- (a) at the threshold of a non-precision approach runway when additional threshold conspicuity is necessary or where it is not practicable to provide other approach lighting aids; and
- (b) where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.

9.9.15.7 Temporarily displaced threshold lights for use at night. Temporarily displaced threshold lights must be provided at night to identify the new threshold location when the threshold of a runway is temporarily displaced.

Location of temporarily displaced threshold lights.

Temporarily displaced threshold lights must be provided on each side of the runway:

- (a) in line with the displaced threshold;
- (b) at right angles to the runway centerline; and
- (c) with the innermost light on each side aligned with the row of runway edge lights on that side of the threshold.

Characteristics of temporarily displaced threshold lights.

Temporarily displaced threshold lights must have the following characteristics:

- (a) each side must consist of 5 lights except that 3 lights per side is sufficient if the runway width is 30 m or less;
- (b) the lights must be spaced at 2.5 m apart;
- (c) the innermost light of each side must be a fixed omnidirectional light showing green in all angles of azimuth;
- (d) the outer 4 or 2 lights, as appropriate, of each side must be fixed unidirectional lights showing green in the direction of approach, over not less than 38° or more than 180° of azimuth;
- (e) the light distribution in the direction of approach must be as close as practicable to that of the runway edge lights;
- (f) the light intensity must be as close as practicable to 1.5 times, and not less than, that of the runway edge lights.

Note: - Temporary [not exceeding seven (7) days unless otherwise approved by CAAP] displaced threshold lights are associated only with low intensity or medium intensity runway lighting systems. They are not associated with high intensity runway lighting systems. If a precision approach runway has the threshold temporarily displaced, it renders ILS unavailable for precision approaches, which changes the runway to a non-precision or non-instrument runway.

9.9.15.8

Runway lighting with a displaced threshold

- (a) If the part of runway located before a displaced threshold is available for aircraft use, i.e. for take-offs toward and through the displaced threshold, and landings from the opposite direction, runway edge lights in this part of runway must:
 - (i) show red in the direction of approach to the displaced threshold; and
 - (ii) precision approach runway.
- (b) The intensity of the red runway edge lights required under paragraph 9.9.15.8 (a) (i) must not be less than one-quarter, and not more than one-half, that of the white runway edge lights.
- (c) Runway edge lights may be bi-directional light fittings or separate light fittings installed back to back.

- (d) If the portion of runway before a displaced threshold is closed to aircraft operations, all the runway lights thereon must be extinguished.

9.9.15.9 The lights shall be visible only in the direction of approach to the runway.

9.9.16 Runway end lights

9.9.16.1 Runway end lights must be provided on a runway equipped with runway edge lights. (See MOS Figure 9.9-1)

Note: - When the threshold is at the runway extremity, fittings serving as threshold lights may be used as runway end lights.

9.9.16.2 Runway end lights must be located in a straight line at right angles to the runway centerline, and:

- (a) when the runway end is at the extremity of the runway – as near to the extremity as possible and not more than 3 m outside, or 1 m inside the extremity;
- (b) when the runway end is not at the extremity of the runway, at the runway end, with a tolerance of ± 1 m; and
- (c) with respect to taxiways intended for exiting the runway, be located such that any aircraft exiting the runway will not be required to cross the row of red lights comprising the runway end lights.

Note: - The universally accepted convention in aerodrome lighting is that a pilot is never required to cross a row of red lights.

9.9.16.3 Runway end lights shall be fixed unidirectional lights showing red towards the runway. Runway end lights must consist of six lights. The lights shall be either:

- (a) spaced at equal intervals between the rows of runway edge lights; or
- (b) symmetrically disposed about the runway centerline in two groups with the lights uniformly spaced in each group and with a gap between the groups not more than half the distance between the rows of runway edge lights.

For a precision approach runway category III, the spacing between runway end lights, except between the two innermost lights if a gap is used, should not exceed 6 m.

9.9.16.4 Low intensity and medium intensity runway end lights must have the following characteristics:

- (a) the lights must be fixed unidirectional showing red in the direction of the runway over not less than 38° or more than 180° of azimuth;
- (b) the intensity of the red light must not be less than one-quarter, and not more than one-half, that of the runway edge lights;
- (c) the light distribution in the direction of the runway must be as close as practicable to that of the runway edge lights.

9.9.16.5 Low intensity and medium intensity runway end lights must be inset lights if:

- (a) the runway is also equipped with high intensity runway end lights; or
- (b) it is impracticable for elevated lights to be installed.

- 9.9.16.6 If the runway end coincides with the runway threshold, bidirectional light fittings may be used or separate light fittings installed back to back.
- 9.9.16.7 Runway end lights installed on a precision approach runway category III must have the following characteristics:
- (a) the lights must be inset, fixed unidirectional showing red in the direction of the runway;
 - (b) the minimum light intensity must be in accordance with MOS 9.10, Figure 9.10-7: and
 - (c) the spacing between runway end lights, except between the two innermost lights if a gap is used, shall not exceed 6m.
- 9.9.16.8 Runway end lights on a precision approach runway shall be in accordance with the specifications of MOS Figure 9.10-7.
- 9.9.17 Runway turning area edge lights / turn pad lights**
- 9.9.17.1 Where an aircraft turning area is provided on a runway, the edge of the turning area must be provided with blue edge lights if the runway is provided with edge lights.
- 9.9.17.2 Runway turning area edge lights must be located not less than 0.6 m, and not more than 1.8 m, outside the edge of the turning area.
- 9.9.17.3 If the beginning of the splay into a runway turning area is more than 10 m from the previous runway edge light, a blue edge light must be located where the turning area commences.
- 9.9.17.4 Turning area edge lights must be provided to mark any change of direction along the side of the turning area.
- 9.9.17.5 When a side of the turning area is longer than 30 m, equally spaced blue edge lights must be provided along that side, with spacing not exceeding 30 m.
- 9.9.17.6 Runway turning area edge lights must have the same characteristics as taxiway edge lights, in accordance with MOS 9.12.15.
- 9.9.17.7 Runway turn pad lights shall:
- (a) be provided for continuous guidance on a runway turn pad intended for use in runway visual range conditions less than a value of 350 m, to enable an aeroplane to complete a 180-degree turn and align with the runway centerline.
 - (b) be provided on a runway turn pad intended for use at night;
 - (c) normally be located on the runway turn pad marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking;
 - (d) on a straight section of the runway turn pad marking, be spaced at

longitudinal intervals of not more than 15 m;

- (e) on a curved section of the runway turn pad marking, not exceed a spacing of 7.5 m;
- (f) be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or approaching the runway turn pad; and
- (g) be in accordance with the specifications of MOS Figures 9.13-3, 9.13-4 or 9.13-1, as appropriate.

9.9.18 Stopway lights

9.9.18.1 Stopway lights must be provided on a stopway that is intended for use at night.

9.9.18.2 The spacing of stopway lights must be uniform and not more than that of the runway edge lights, with the last pair of lights located at the stopway end.

9.9.18.3 Stopway lights shall be placed along the full length of the stopway and shall be in two parallel rows that are equidistant from the centerline and coincident with the rows of the runway edge lights. Stopway lights shall also be provided across the end of a stopway on a line at right angles to the stopway axis as near to the end of the stopway as possible and, in any case, not more than 3 m outside the end.

9.9.18.4 Stopway lights must have the following characteristics:

- (a) the lights must be fixed and unidirectional showing red in the direction of the runway, and not visible to a pilot approaching to land over the stopway; and
- (b) the light distribution in the direction of the runway must be as close as possible to that of the runway edge lights;

9.9.19 Runway Centerline Lights

9.9.19.1 Runway centerline lights shall be provided on a precision approach runway Category II or III, and on a runway intended to be used for take-off with an operating minimum RVR lower than 400 m.

Note: - Provision of runway centerline lights on a precision approach runway Category I where the width between the runway edge lights is greater than 50 m is recommended.

9.9.19.2 Runway centerline lights shall be located along the centerline of the runway, except that the lights may be uniformly offset to the same side of the runway centerline by not more than 60 cm where it is not practicable to locate them along the centerline. Runway centerline lights must be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centerline lights specified as maintenance objectives in MOS 9.1.15.3 or 9.1.15.11, as appropriate, can be demonstrated, and the runway is intended for use in RVR conditions exceeding 350 m, the longitudinal spacing may be increased to approximately 30 m.

Note: - Existing centerline lighting where lights are spaced at 7.5 m need not be replaced.

- 9.9.19.3 The runway centerline lights may be offset by not more than 0.6 m from the true runway centerline, for maintenance of runway marking purposes.
- 9.9.19.4 The offset shall be on the left hand side of the landing aircraft, where practicable. Where the runway is used in both directions, the direction from which the majority of landings will take place shall prevail.
- 9.9.19.5 Runway centerline lights must be inset, fixed lights showing variable white from the threshold to a point 900 m from the runway end. From 900 m to 300 m from the runway end, the light pattern is to be alternate red and variable white lights. For the last 300 m before the runway end, the lights must show red. For runways less than 1800 meters in length, the alternate red and white lights shall extend from the midpoint of the runway length to 300 m from the runway end.
- Note: - Care is required in the design of the electrical system to ensure that failure of part of the electrical system will not result in a false indication of the runway distance remaining.*
- 9.9.19.6 The light intensity and distribution of runway centerline lights must be in accordance with:
- (a) MOS 9.11, Figure 9.11-8 for 30 m spacing;
 - (b) MOS 9.11, Figure 9.11-9 for 15 m spacing.
- 9.9.19.7 Centerline guidance for take-off from the beginning of a runway to a displaced threshold should be provided by:
- (a) an approach lighting system if its characteristics and intensity settings afford the guidance required during take-off and it does not dazzle the pilot of an aircraft taking off; or
 - (b) runway centerline lights; or
 - (c) barrettes of at least 3 m in length and spaced at uniform intervals of 30 m, as shown in MOS Figure 9.9-2, designed so that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an aircraft taking off.
- Where necessary, provision shall be made to extinguish those centerline lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case shall, only the single source runway centerline lights show from the beginning of the runway to a displaced threshold when the runway is being used for landing.

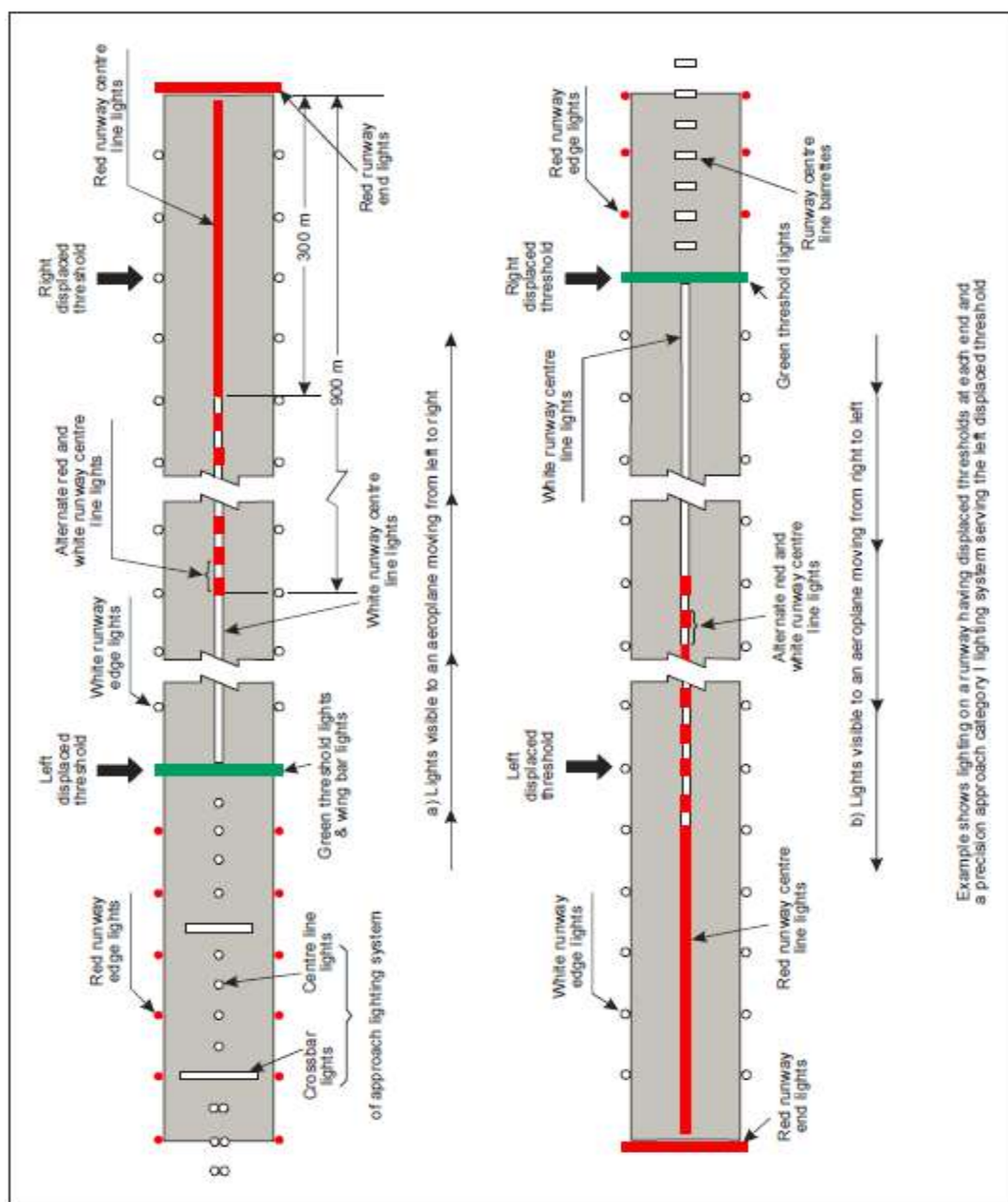


Figure 9.9-2. Example of approach and runway lighting for runway with displaced thresholds

9.9.20 Runway touchdown zone lights

- 9.9.20.1 Runway touchdown zone lights must be provided in the touchdown zone of a runway intended for precision approach Category II or III operations.
- 9.9.20.2 Runway touchdown zone lights must extend from the threshold for a distance of 900 m, except that for runways less than 1800 m in length, the system shall be shortened so that it does not extend beyond the mid-point of the runway. The lighting is to consist of a series of transverse rows of lights, or barrettes, symmetrically located on each side of the runway centerline.

- 9.9.20.3 Each barrette must consist of three light units at 1.5 m apart. The innermost light of each barrette shall be located equal to the lateral spacing of the touchdown zone marking. A barrette shall be not less than 3 m nor more than 4.5 m in length.
- 9.9.20.4 The first pair of barrettes must be located at 60 m from the threshold. Subsequent barrettes must be spaced longitudinally either 30 m or 60 m apart.
Note: - To allow for operations at lower visibility minima, it may be advisable to use a 30 m longitudinal spacing between barrettes.
- 9.9.20.5 Runway touchdown zone lights must be inset, fixed unidirectional lights showing variable white.
- 9.9.20.6 Runway touchdown zone lights must be in accordance with MOS 9.11, Figure 9.11-10.

9.9.21 Simple Touchdown Zone Lights

Note: - The purpose of Simple Touchdown Zone Lights is to provide pilots with enhanced situational awareness in all visibility conditions and to help enable pilots to decide whether to commence a go around if the aircraft has not landed by a certain point on the runway. It is essential that pilots operating at aerodromes with Simple Touchdown Zone Lights be familiar with the purpose of these lights.

- 9.9.21.1 Except MOS 9.9.20, at an aerodrome where the approach angle is greater than 3.5° and/or the Landing Distance Available combined with other factors increases the risk of an overrun, Simple Touchdown Zone Lights shall be provided.
- 9.9.21.2 Simple Touchdown Zone Lights shall be a pair of lights located on each side of the runway centerline 0.3 meters beyond the upwind edge of the final Touchdown Zone Marking. The lateral spacing between the inner lights of the two pairs of lights shall be equal to the lateral spacing selected for the Touchdown Zone Marking. The spacing between the lights of the same pair shall not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure 9.9-3).
- 9.9.21.3 Where provided on a runway without TDZ markings, Simple Touchdown Zone lights shall be installed in such a position that provides the equivalent TDZ information.
- 9.9.21.4 Simple Touchdown Zone Lights shall be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.
- 9.9.21.5 Simple Touchdown Zone Lights shall be in accordance with the specifications in MOS Figure 9.10-10.
Note: - As a good operating practice, simple touchdown zone lights are supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

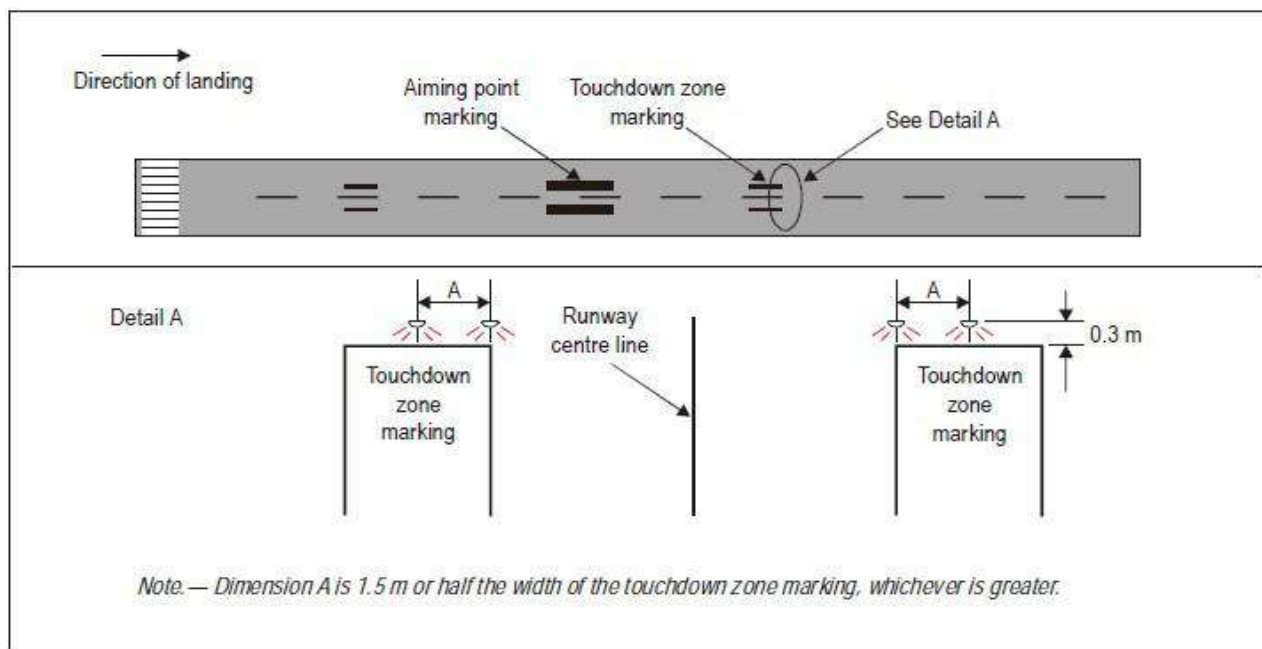


Figure 9.9-3 Simple touchdown zone lighting

9.9.22 Rapid exit taxiway indicator lights

Note: - The purpose of rapid exit taxiway indicator lights (RETILs) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with runway(s) displaying rapid exit taxiway indicator lights be familiar with the purpose of these lights.

9.9.22.1 Rapid exit taxiway indicator lights shall be installed on a runway intended for use in runway visual range conditions less than 350 meters and/or where traffic density is heavy, unless directed otherwise by CAAP.

Note: - See MOS Attachment A, Section 14.

9.9.22.2 A set of rapid exit taxiway indicator lights shall be installed on the same side of the runway as the associated rapid exit taxiway in the configuration shown in Figure 9.9-4. In each set the lights shall be located 2 meters apart and the light nearest to the runway centerline shall be displaced 2 meters from the centerline.

9.9.22.3 Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit shall not overlap when displayed.

9.9.22.4 Rapid exit taxiway indicator lights shall be fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

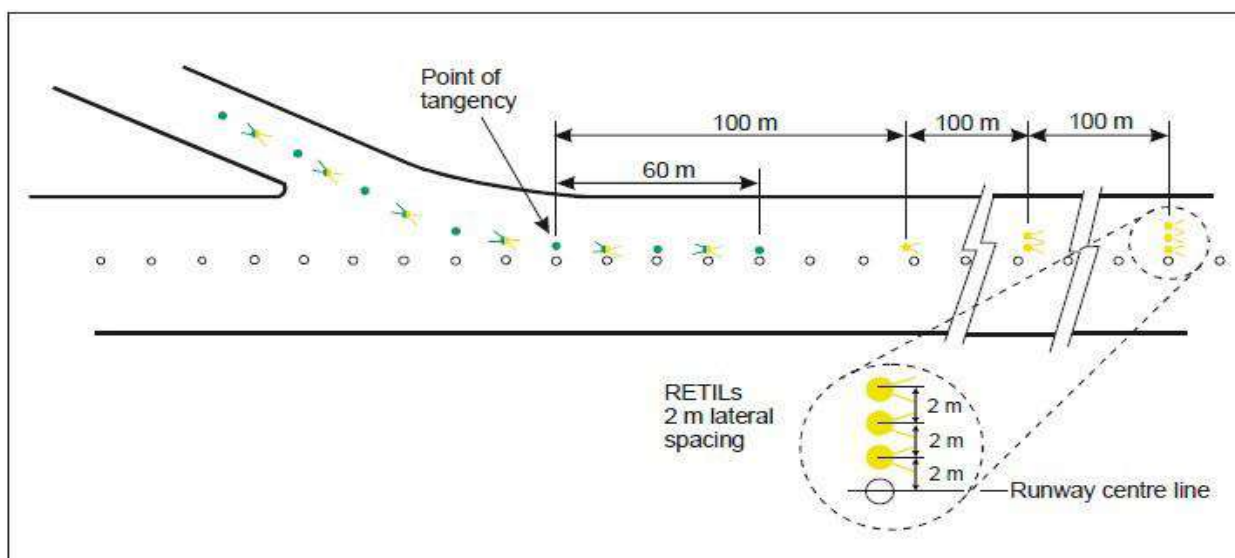


Figure 9.9-4. Rapid exit taxiway indicator lights (RETILS)

- 9.9.22.5 The light intensity and distribution of rapid exit taxiway indicator lights must be accordance with:
- MOS 9.10, Figure 9.10-8 for runways with 30 m centerline light spacing; or
 - MOS 9.10, Figure 9.10-9 for runways with 15 m centerline light spacing, as appropriate.
- 9.9.22.6 Rapid exit taxiway indicator lights shall be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.
- 9.9.23 Photometric Characteristics of Runway Lights**
- 9.9.23.1 MOS 9.10, Figure 9.10-11 shows the method of establishing the grid points for calculating the average intensity of low and medium intensity runway lights for non-instrument and instrument non-precision approach runways.
- 9.9.23.2 MOS 9.10, Figure 9.10-12 shows the method of establishing grid points for calculating the average intensity of high intensity approach and runway lights for precision approach runways.
- 9.9.23.3 The average light intensity of the main beam of a light is calculated by:
- establishing grid points in accordance with the method shown in MOS 9.10, Figure 9.10-11 or Figure 9.10-12, whichever is applicable;
 - measuring the light intensity values at all grid points within and on the perimeter of the rectangle or ellipse representing the main beam; and
 - calculating the arithmetic average of the light intensity values as measured at those grid points.
- 9.9.23.4 The maximum light intensity value measured on or within the perimeter of the main beam must not to be more than three times the minimum light intensity value so measured.

9.9.24 Installation and Aiming of Light Fittings

- 9.9.24.1 The following points must be followed in the installation and aiming of light fittings:
- (a) the lights are aimed so that there are no deviations in the main beam pattern, to within $1/2^\circ$ from the applicable standard specified in this chapter;
 - (b) horizontal angles are measured with respect to the vertical plane through the runway centerline;
 - (c) when measuring horizontal angles for lights other than runway centerline lights, the direction towards the runway centerline is to be taken to be positive;
 - (d) vertical angles specified are to be measured with respect to the horizontal plane.

9.9.25 Reserved**9.9.26 Illustrations of Runway Lighting**

- 9.9.26.1 MOS 9.11 contains illustrations of runway lighting.

Section 9.10 Isocandela Diagrams of Runway Lighting**9.10.1 Collective Notes**

- 9.10.1.1 The ellipses in each figure are symmetrical about the common vertical and horizontal axes.
- 9.10.1.2 Figure 9.10-1 to Figure 9.10-10 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing the grid points as shown in Figure 9.10-11 or Figure 9.10-12, as appropriate, and using the intensity values measured at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.
- 9.10.1.3 No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.
- 9.10.1.4 Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and average light intensity of the main beam of a new runway edge light is to be as follows:

Figure 9.10-1	Low intensity runway edge lights	1.0 (white light)
Figure 9.10-2	Medium intensity runway edge lights	1.0 (white light)
Figure 9.10-3	High intensity runway edge lights (where the width of runway is 45 m)	1.0 (white light)
Figure 9.10-4	High intensity runway edge lights (where the width of runway is 60 m)	1.0 (white light)
Figure 9.10-5	High intensity threshold lights	1.0 to 1.5 (light green)

Figure 9.10-6	High intensity threshold wing bar lights	1.0 to 1.5 (green light)
Figure 9.10-7	High intensity runway end lights	0.25 to 0.5 (red light)
Figure 9.10-8	High intensity runway centerline lights(longitudinal spacing 30 m)	0.5 to 1.0 (white light)
Figure 9.10-9	High intensity runway centerline lights(longitudinal spacing 15 m)	0.5 to 1.0 for CAT III (white light) 0.25 to 0.5 for CAT I, II (white light)
Figure 9.10-10	Runway touchdown zone lights	0.5 to 1.0 (white light)

- 9.10.1.5 The beam coverage in the figures provide the necessary guidance for approaches down to an RVR of the order of 150 m and take-off to an RVR of the order of 100 m.
- 9.10.1.6 Horizontal angles are measured with respect to the vertical plane through the runway centerline. For lights other than centerline lights, the direction towards the runway centerline is considered positive. Vertical angles are measured with respect to the horizontal plane.
- 9.10.1.7 The light units are to be installed so that the main beam is aligned within one half degree of the specified requirement.
- 9.10.1.8 On the perimeter of and within the ellipse defining the main beam in MOS Figures 9.7-1 & 9.7-2; 9.10-3 to 9.10-10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with MOS collective notes for Figures 9.7-1 & 9.7-2; 9.10-3 to 9.10-10; 9.10-12, Note 2.

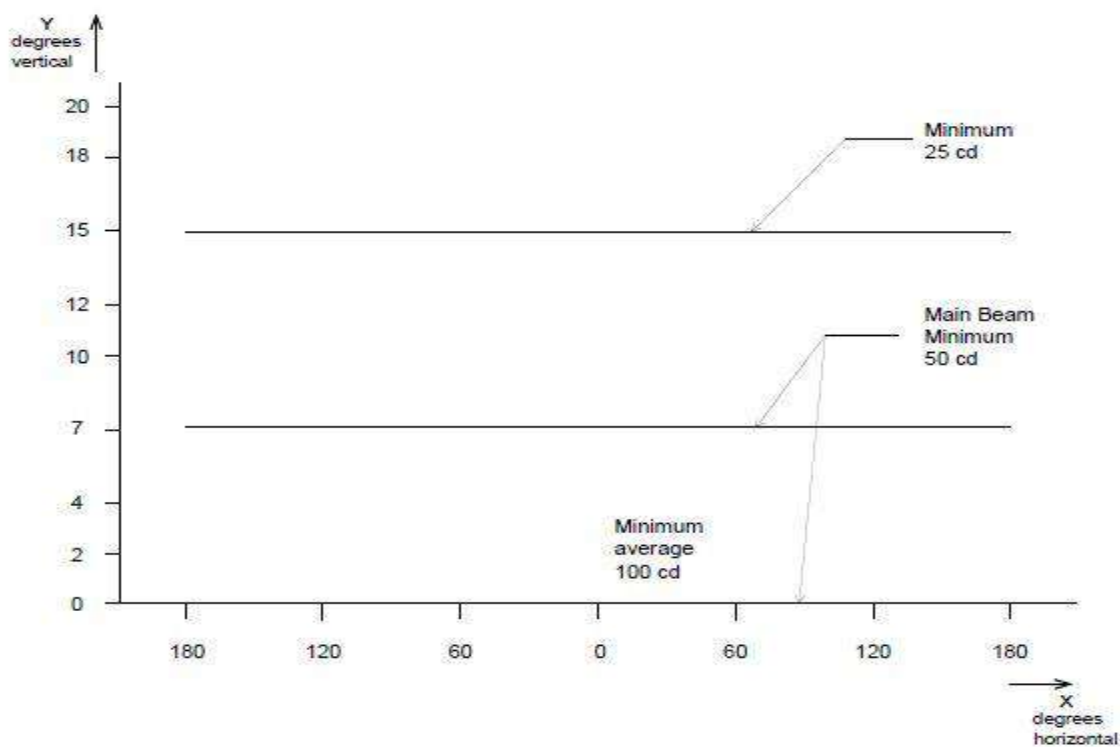


Figure 9.10-1: Isocandela Diagram for Omnidirectional Runway Edge Light – Low Intensity Runway Lighting System

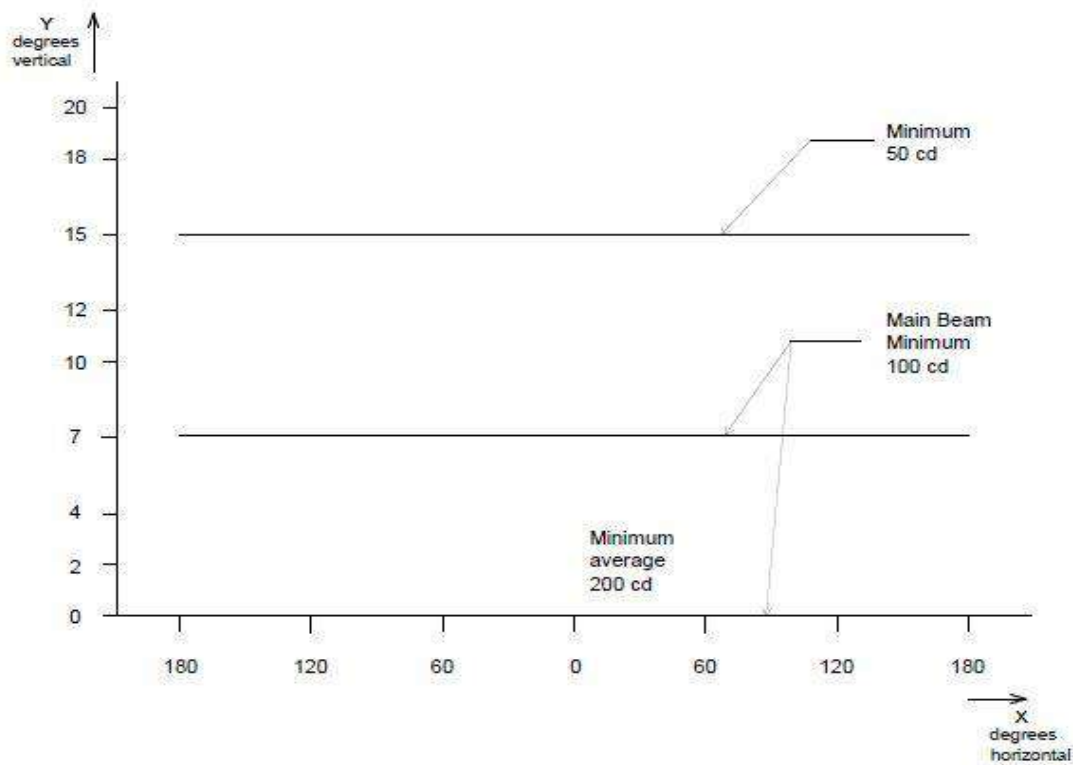


Figure 9.10-2: Isocandela Diagram for Omnidirectional Runway Edge Light – Medium Intensity Runway Lighting System

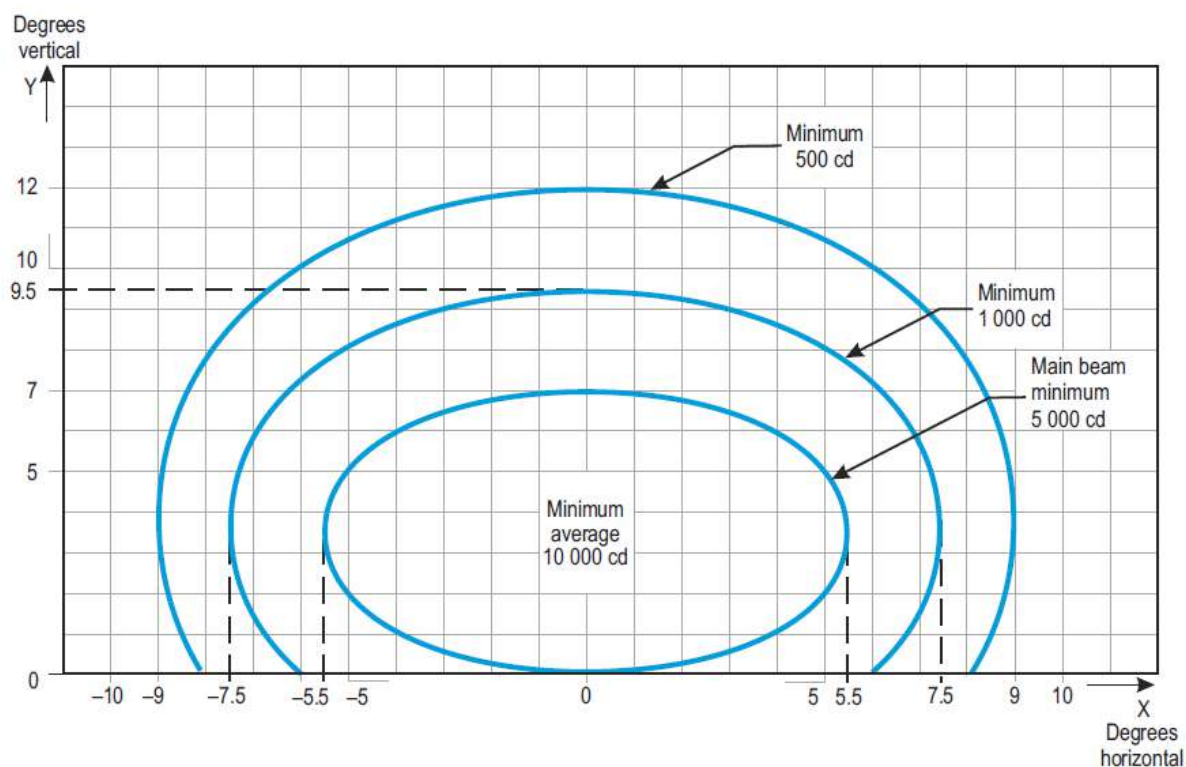


Figure 9.10-3: Isocandela Diagram for High Intensity Runway Edge Lights where the Width of the Runway is 45 meters (White Light)

Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
2. Toe-in 3.5°
3. For red light, multiply values by 0.15
4. For yellow light multiply values by 0.4
5. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

a	5.5	7.5	9.0
b	3.5	6.0	8.5

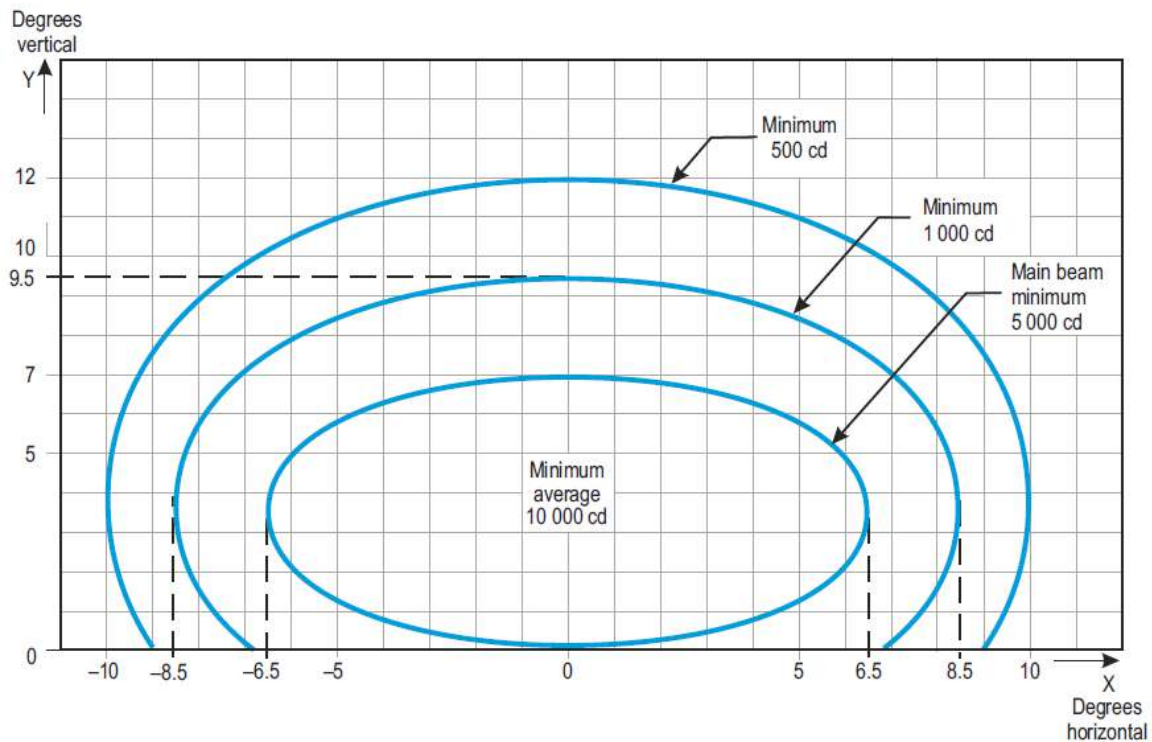


Figure 9.10-4: Isocandela Diagram for High Intensity Runway Edge Lights where the Width of the Runway is 60 m (White Light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

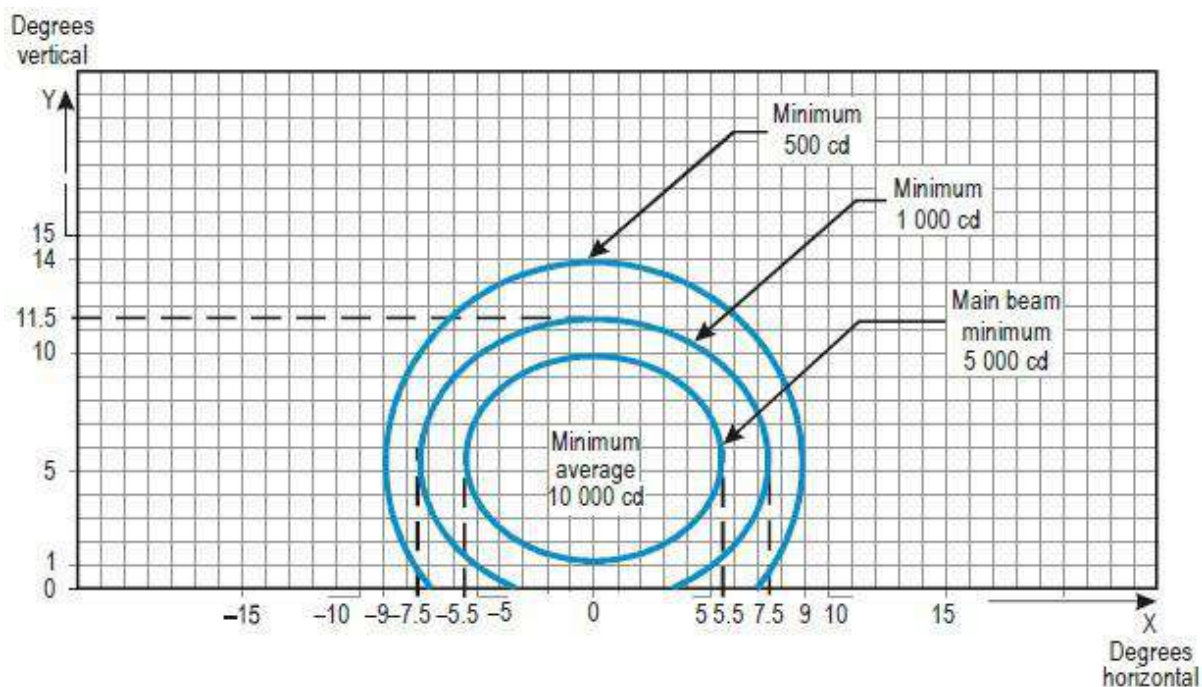
a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Toe-in 4.5°

3. For red light, multiply values by 0.15

4. For yellow light multiply values by 0.4

5. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.



**Figure 9.10-5: Isocandela Diagram for High Intensity Threshold Lights
(Green Light)**

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	5.5	7.5	9.0
b	4.5	6.0	8.5

2.

Toe-in 3.5°

3.

See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

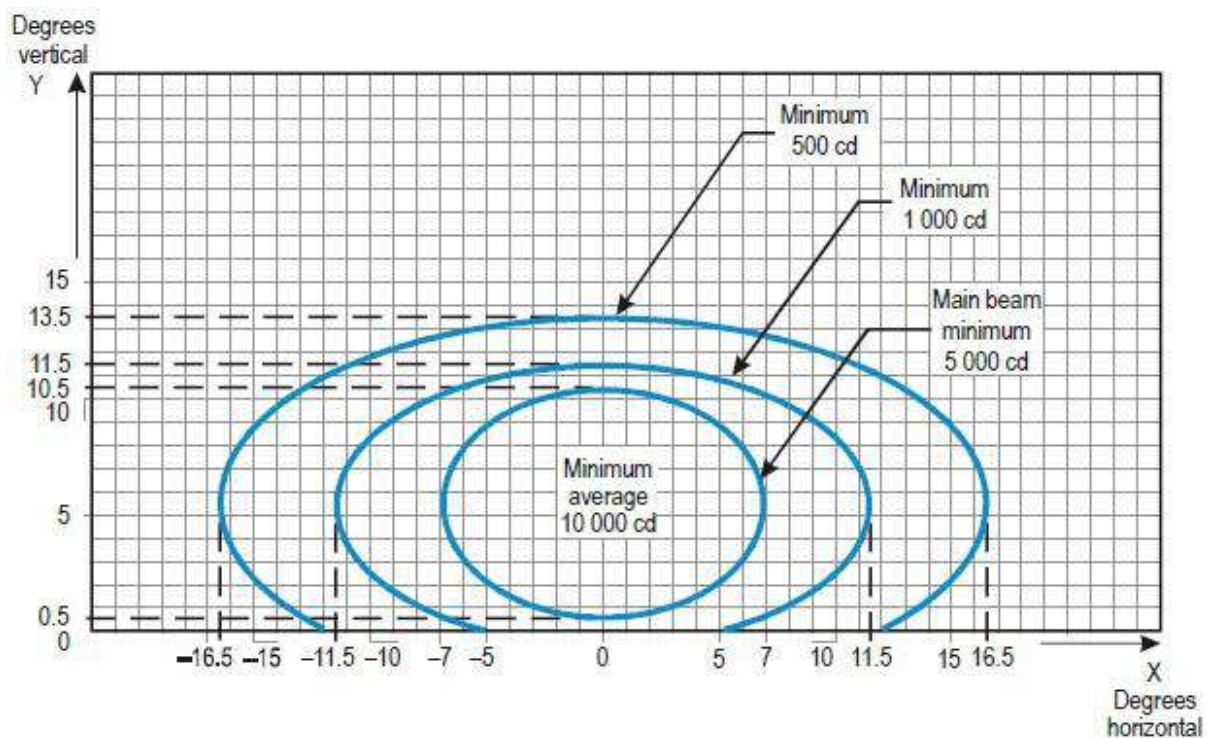


Figure 9.10-6: Isocandela Diagram for High Intensity Threshold Wing Bar Lights (Green Light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

2. Toe-in 2°

3. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

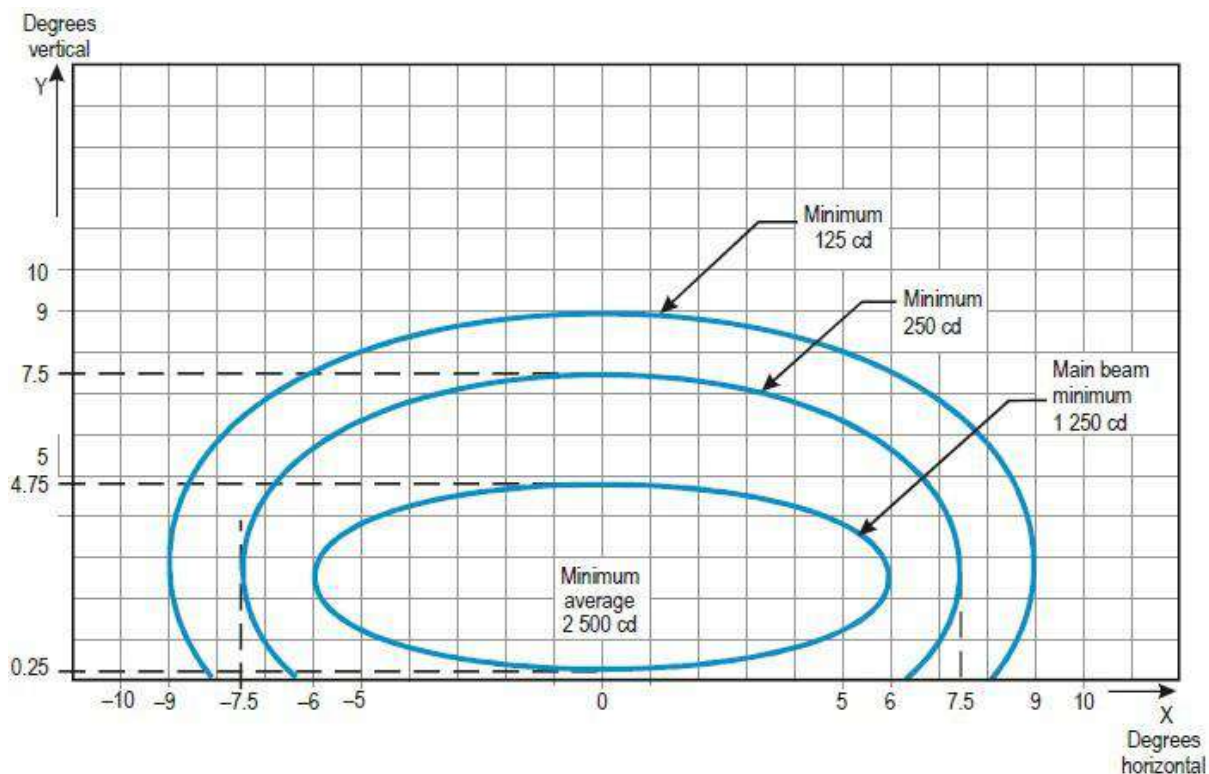


Figure 9.10-7: Isocandela Diagram for High Intensity Runway End Lights (Red Light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

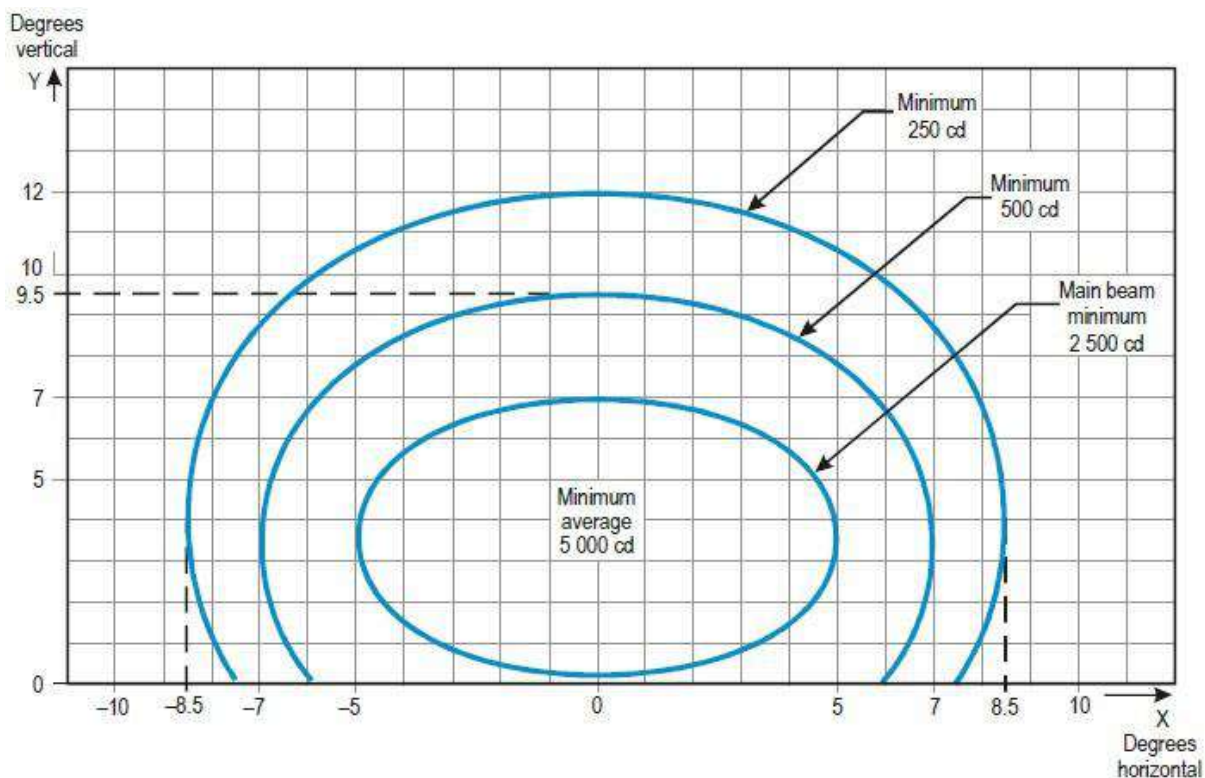


Figure 9.10-8: Isocandela Diagram for runway centerline lights with 30 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. For red light multiply values by 0.15.
3. For yellow light multiply values by 0.40.
4. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

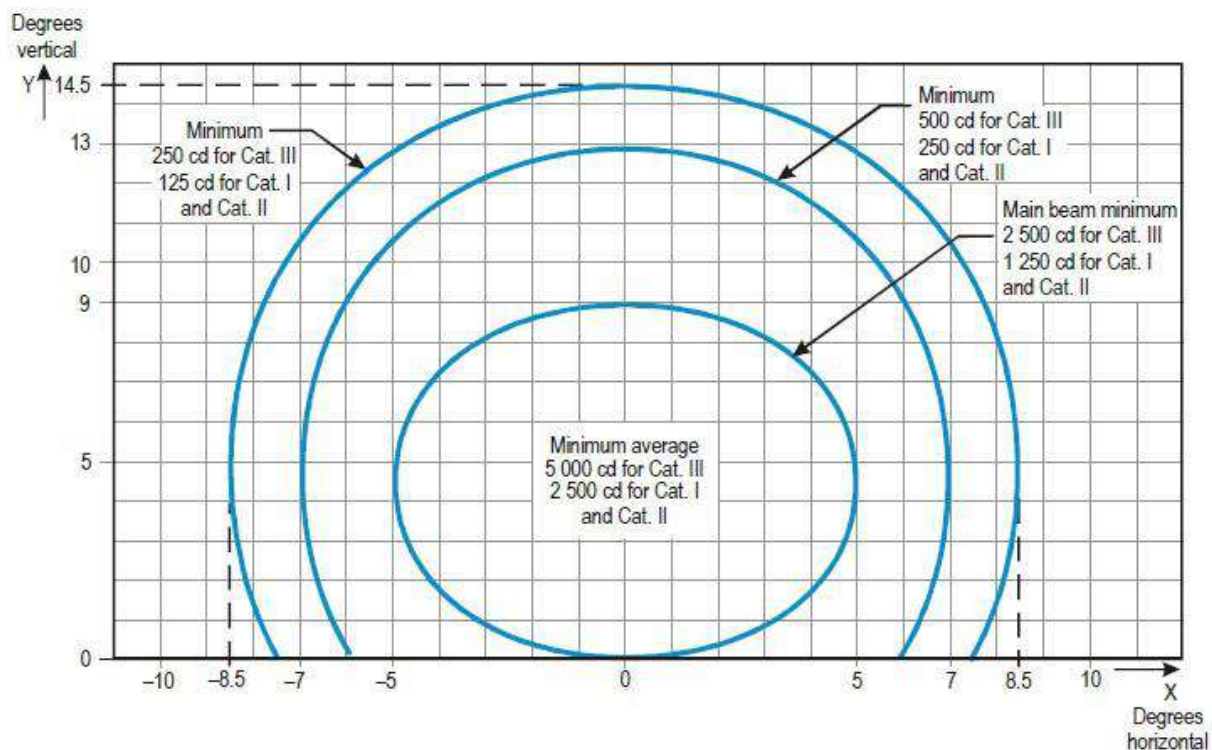


Figure 9.10-9: Isocandela Diagram for runway centerline lights with 15 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	5.0	7.0	8.5
b	4.5	8.5	10

2. For red light multiply values by 0.15.

3. For yellow light multiply values by 0.40.

4. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

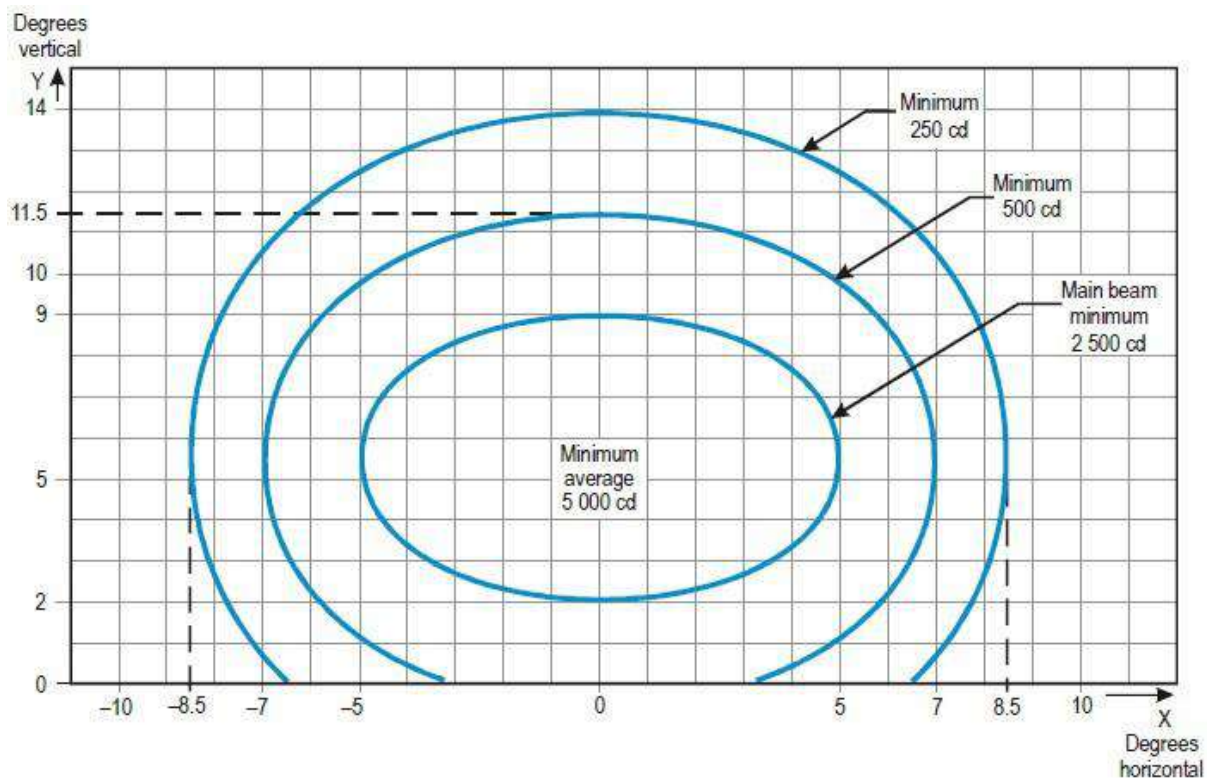


Figure 9.10-10: Isocandela Diagram for Runway Touchdown Zone Lights (White Light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Toe-in 4°.

3. See collective notes at Paragraph 9.10.1 for Figure 9.10-1 to Figure 9.10-10.

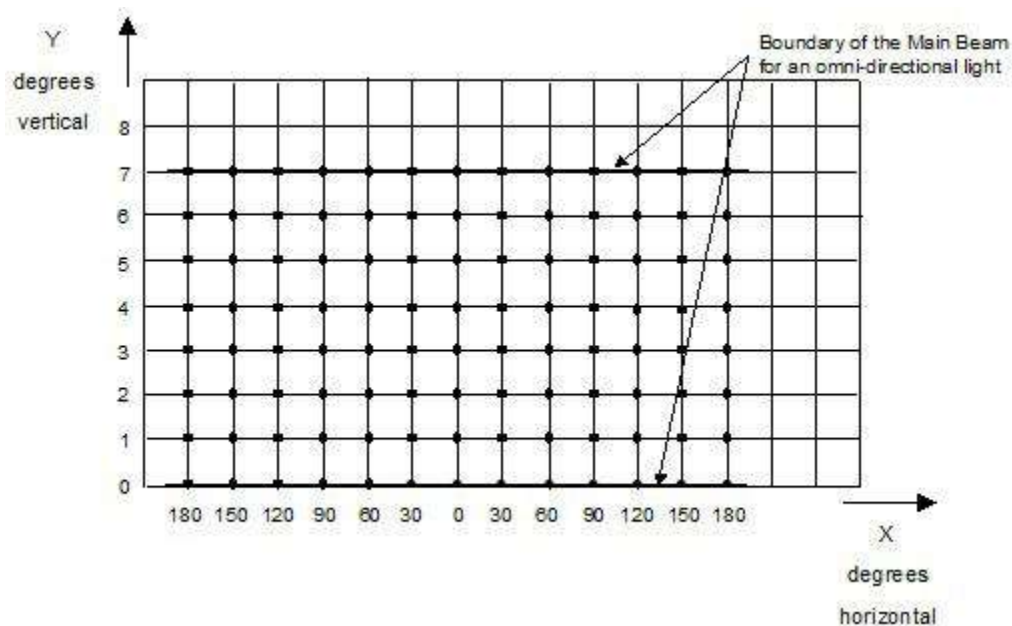


Figure 9.10-11: Method of Establishing Grid Points to be used for the Calculation of Average Intensity of Runway Lights specified by Figure 9.10-1 and Figure 9.10-2

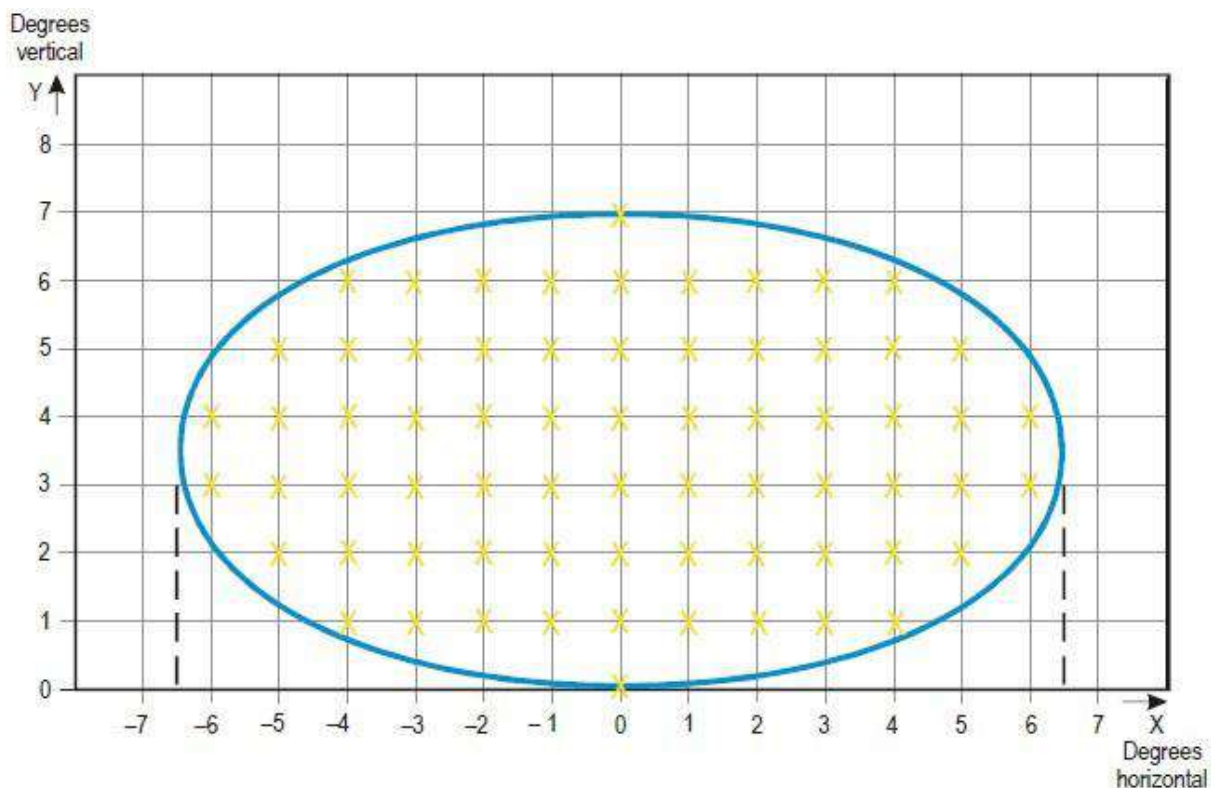


Figure 9.10-12: Method of Establishing Grid Points to be used for the calculation of Average Intensity of Approach and Runway Lights specified by Figure 9.10-3 to Figure 9.10-10

9.10.2 Illustrations of Runway Lighting

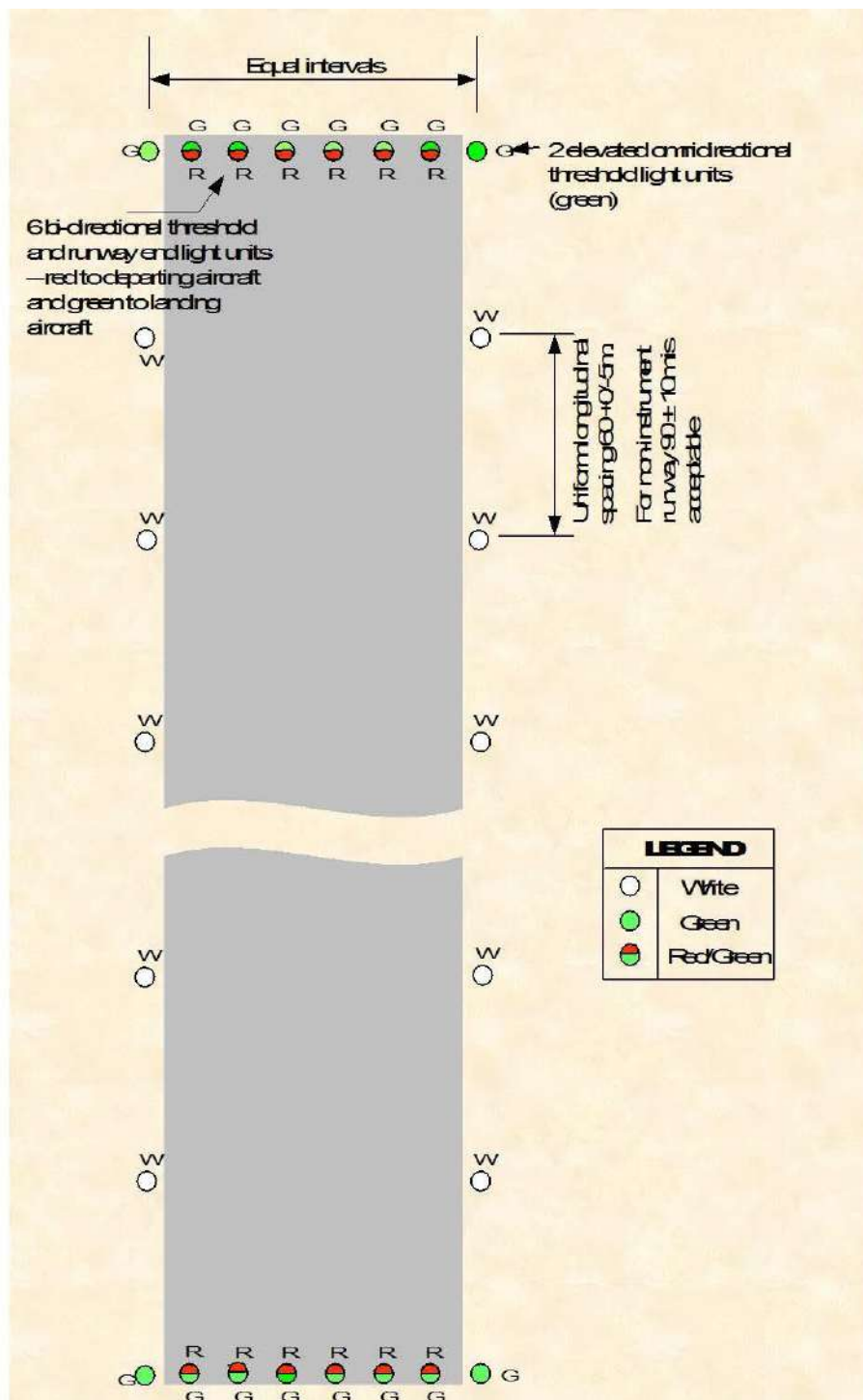


Figure 9.10-13: Runway Edge Lights, Threshold Lights and Runway End Lights Low and Medium Intensity for Non-Instrument and Non-Precision Approach Runways

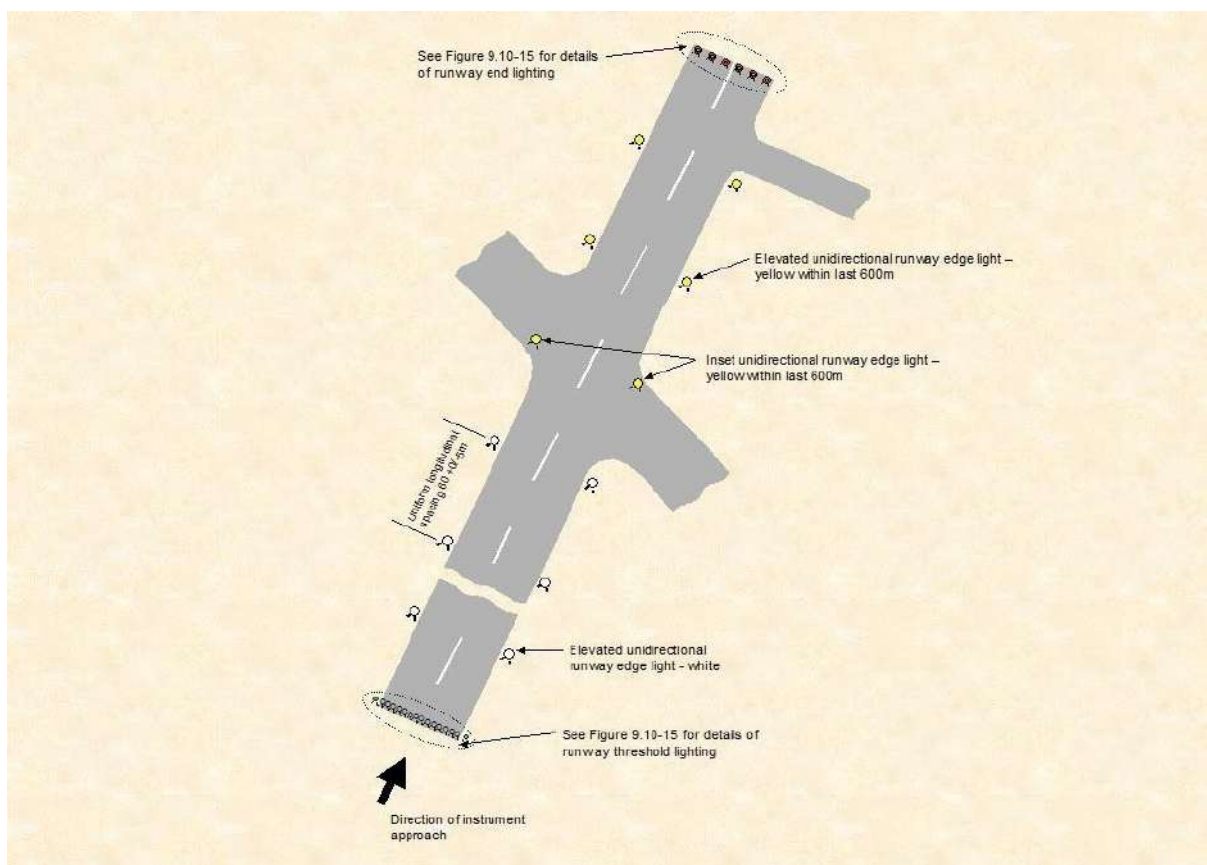


Figure 9.10-14: Runway Edge Lights High Intensity for Precision Approach Runways

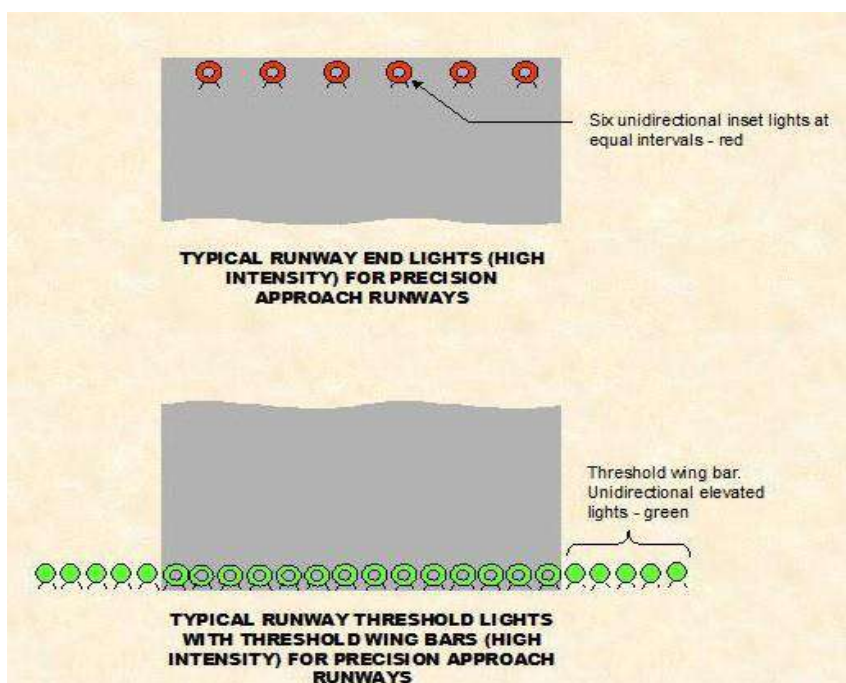


Figure 9.10-15: Typical Runway Threshold and Runway End Lights High Intensity for Precision Approach Runways

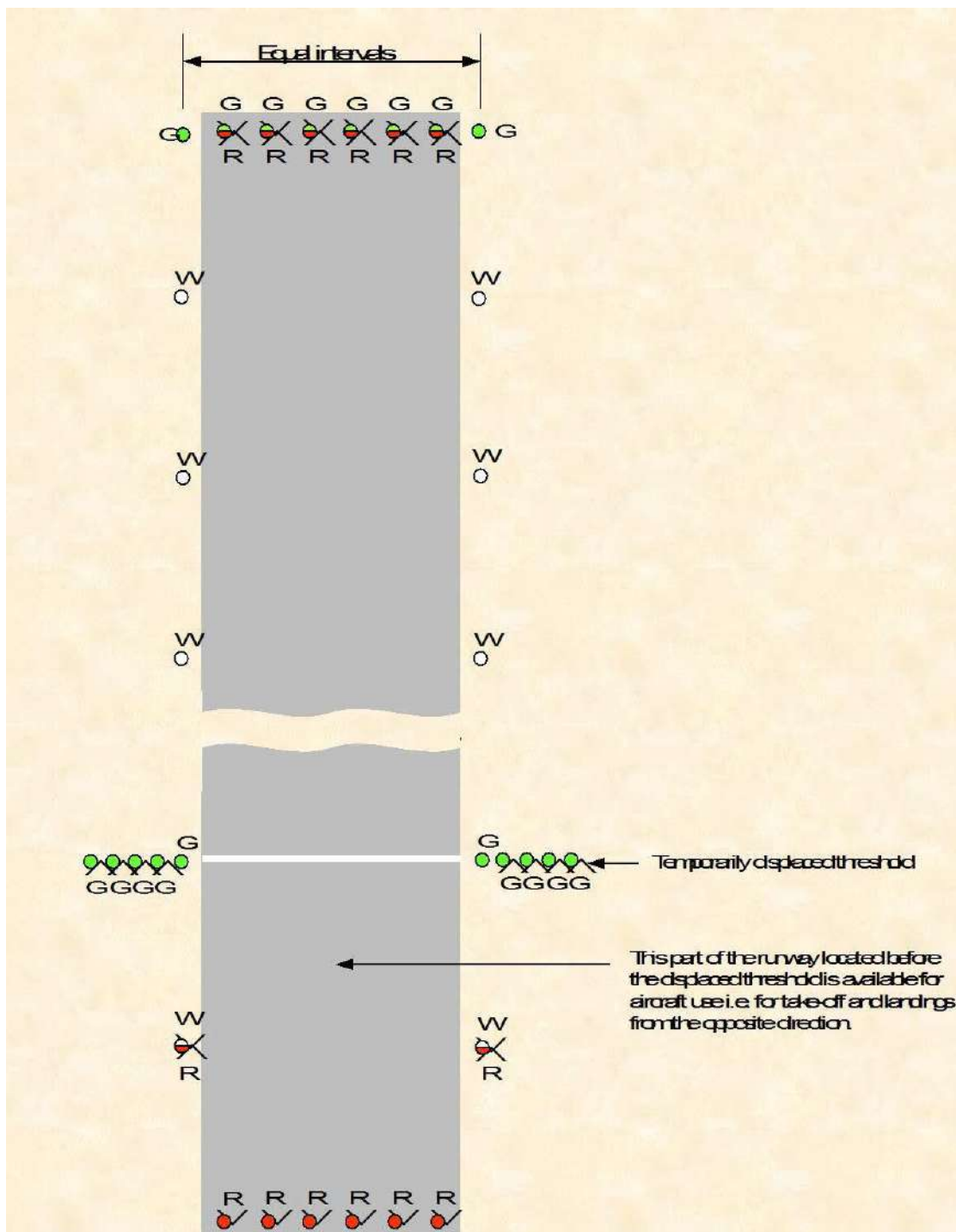


Figure 9.10-16: Typical Temporarily Displaced Threshold

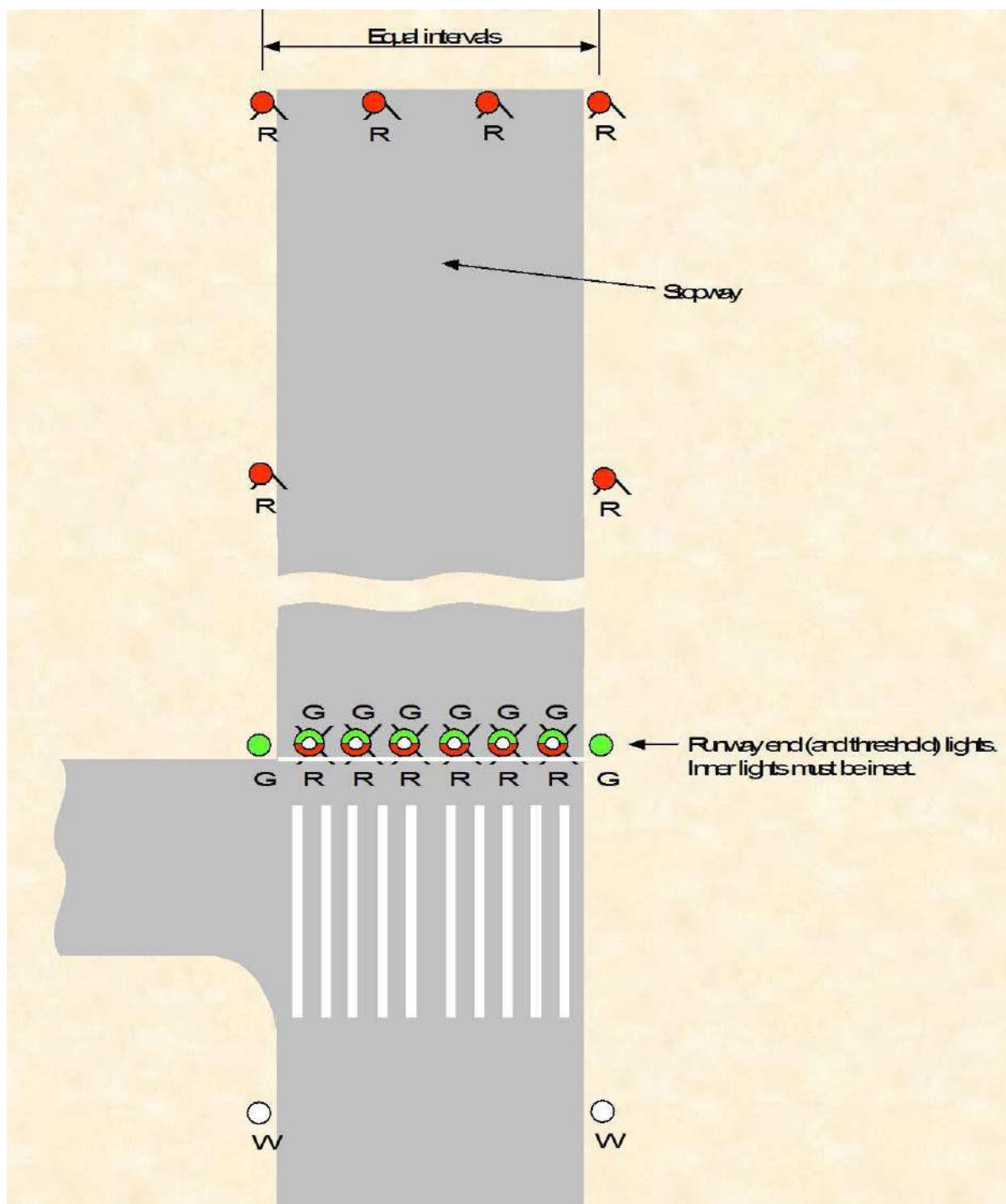


Figure 9.10-17: Typical Stopway Lights

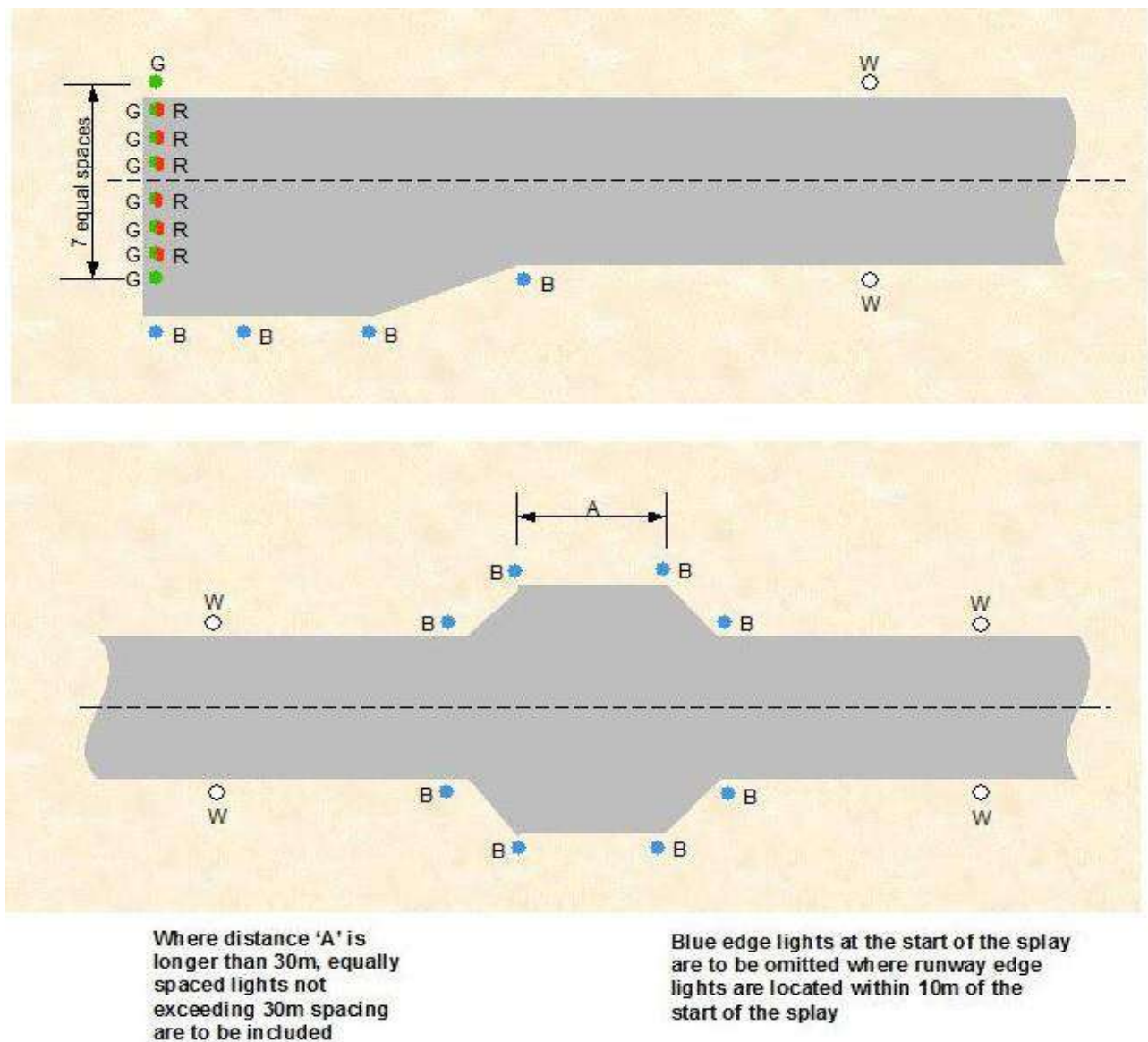


Figure 9.10-18: Typical Turning Area Edge Lights

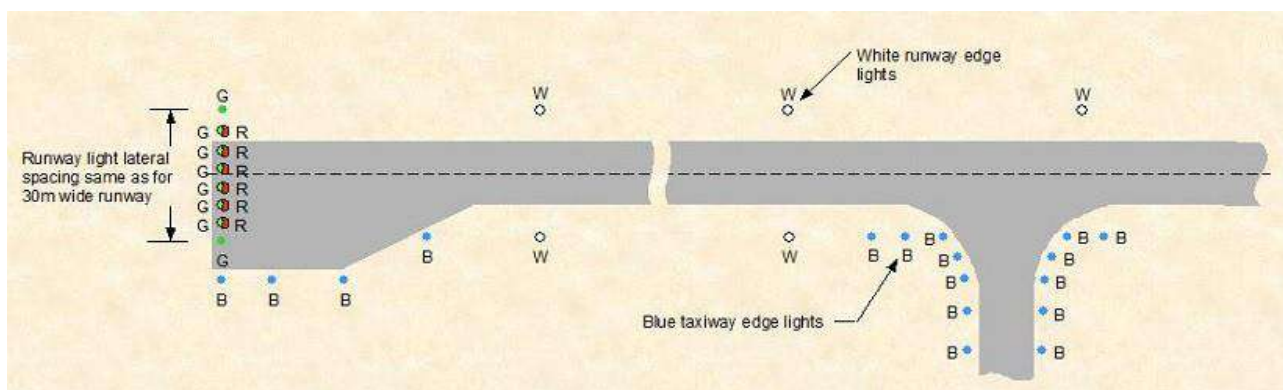


Figure 9.10-19: Typical Light Layout Where Runway Pavement is 23 m or 18 m wide

Section 9.11 Other Runway Lightings

9.11.1 Runway lead-in lighting systems

- 9.11.1.1 A runway lead-in lighting system shall be provided where it is desired to provide visual guidance along a specific approach path, for reasons such as avoiding hazardous terrain or for purposes of noise abatement.

Note: - Guidance on providing lead-in lighting systems is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- 9.11.1.2 A runway lead-in lighting system shall consist of groups of lights positioned so as to define the desired approach path and so that one group must be sighted from the preceding group. The interval between adjacent groups shall not exceed approximately 1600 m.

Note: - Runway lead-in lighting systems may be curved, straight or a combination thereof.

- 9.11.1.3 A runway lead-in lighting system shall extend from a point as determined by the appropriate authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

- 9.11.1.4 Each group of lights of a runway lead-in lighting system shall consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.

- 9.11.1.5 The flashing lights and the steady burning lights shall be white.

- 9.11.1.6 Where practicable, the flashing lights in each group shall flash in sequence towards the runway.

9.11.2 Runway status lights

Note: - Runway status lights (RWSL) is a type of autonomous runway incursion warning system (ARIWS). The two basic visual components of RWSL are runway entrance lights (RELs) and take-off hold lights (THLs). Either may be installed by itself, but the two components are designed to be complementary to each other.

- 9.11.2.1 Where provided, RELs shall be offset 0.6 m from the taxiway centerline on the opposite side to the taxiway centerline lights and begin 0.6 m before the runway-holding position extending to the edge of the runway. An additional single light shall be placed on the runway 0.6 m from the runway centerline and aligned with the last two taxiway RELs.

Note: - Where two or more runway-holding positions are provided, the runway-holding position referred is that closest to the runway

- 9.11.2.2 RELs shall consist of at least five light units and shall be spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for a single light installed near the runway centerline.

- 9.11.2.3 Where provided, THLs shall be offset 1.8 m on each side of the runway centerline

lights and extend, in pairs, starting at a point 115 m from the beginning of the runway and, thereafter, every 30 m for at least 450 m.

Note: - Additional THLs may be similarly provided at the starting point of the take-off roll.

- 9.11.2.4 Where provided, RELs shall consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway.
- 9.11.2.5 RELs shall illuminate as an array at each taxiway/runway intersection where they are installed less than 2 seconds after the system determines a warning is needed.
- 9.11.2.6 Intensity and beam spread of RELs shall be in accordance with the specifications of MOS Figure 9.13-3: and Figure 9.13-5.
Note: - Consideration for reduced beam width may be required for some REL lights at acute angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.
- 9.11.2.7 Where provided, THLs shall consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.
- 9.11.2.8 THLs shall illuminate as an array on the runway less than 2 seconds after the system determines a warning is needed.
- 9.11.2.9 Intensity and beam spread of THLs shall be in accordance with the specifications of MOS Figure 9.10-5 and 9.10-6.
- 9.11.2.10 RELs and THLs shall be automated to the extent that the only control over each system will be to disable one or both systems

Section 9.12 Taxiway Lighting

9.12.1 Provision of taxiway centerline lights

- 9.12.1.1 Taxiway centerline lights must be provided on a taxiway and apron intended for use in runway visual range conditions less than a value of 350 m (precision approach Category II or III) in such a manner to provide continuous guidance between the runway centerline and aircraft stands. Where the aerodrome traffic density is light and taxiway edge lights and centerline markings provide adequate guidance, CAAP may permit that taxiway centerline lighting not be provided.
- 9.12.1.2 Taxiway centerline lights must be provided on a runway forming part of a standard taxi route and intended for use in runway visual range conditions less than a value of 350 m (precision approach Category II or III). Where the aerodrome layout is simple, or the aerodrome traffic density is light and taxiway edge lights and centerline markings provide adequate guidance, CAAP may permit that centerline lighting not be provided.
Note: - See MOS 9.1.8.9 (c) for provisions concerning the interlocking of runway and taxiway lighting systems.
- 9.12.1.3 Taxiway centerline lights must be used on a rapid exit taxiway.

- 9.12.1.4 Taxiway centerline lights may be provided at aerodrome operator discretion or by direction from CAAP when:
- (a) runway visual range conditions are in excess of 350 m; or
 - (b) for particularly complex taxiway intersections and exit taxiways,
- except that these lights need not be provided where the traffic density is light and taxiway edge lights and centerline marking provide adequate guidance

Note: - Where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway or narrow taxiway, this may be done with taxiway edge lights or markers.

- 9.12.1.5 Taxiway centerline lights shall be provided on an exit taxiway, taxiway and apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the runway centerline and aircraft stands.
- 9.12.1.6 Taxiway centerline lights shall be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

9.12.2 Provision of taxiway edge lights

- 9.12.2.1 Except for Paragraphs 9.12.3.1 and 9.12.4.1, taxiway edge lights must be - provided at the edges of runway turn pads, taxiways, aprons and holding bays intended for use at night and not provided with centerline lights.
- 9.12.2.2 Where additional visual cues are required to delineate apron edges at night, taxiway edge lights may be used. Examples of where this requirement may occur include, but are not limited to:
- (a) aprons where taxi guidelines and aircraft parking position marking are not provided;
 - (b) aprons where apron floodlighting provides inadequate illumination at the edge of the apron; and
 - (c) where the edge of the apron is difficult to distinguish from the surrounding area at night.

9.12.3 Taxiway markers

- 9.12.3.1 For code letter A or B taxiways, reflective taxiway edge markers may be used instead of taxiway centerline or edge lights, or to supplement taxiway lights. However, at least one taxiway from the runway to the apron must be provided with taxiway lighting.

9.12.4 Apron taxiway lighting

- 9.12.4.1 Taxiway lights are not required for an apron taxiway if the apron taxiway is illuminated by apron floodlighting meeting the standards specified in MOS 9.16.

9.12.5 Use of different types of taxiway lights

- 9.12.5.1 As far as practicable, the provision of taxiway lights shall be such that taxiing aircraft do not need to alternate between taxiway centerline and edge lights.
- 9.12.5.2 Where additional guidance is required to delineate taxiway edges, taxiway edge lights may be used to supplement taxiway centerline lights. When provided, taxiway edge lights must comply with Paragraphs 9.12.13 to 9.12.15.

9.12.6 Control of lights on taxiways

- 9.12.6.1 At an aerodrome with Air Traffic Service, taxiway lights with an average intensity within the main beam of more than 20 candela must be provided with intensity control in accordance with MOS 9.1.14.6, to allow adjustment of the lighting to suit ambient conditions.
- 9.12.6.2 If it is desired to illuminate only standard taxi routes during certain period of operations, for example during low visibility operations, the taxiway lighting may be designed to allow taxiways in use to be lit and those not in use to be unlit.
- 9.12.6.3 Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems must be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.
- Note: - See MOS 9.1.8.9 (c) for provisions concerning the interlocking of runway and taxiway lighting systems.*

9.12.7 Location of taxiway centerline lights

- 9.12.7.1 Taxiway centerline lights shall normally be located on the taxiway centerline marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

9.12.8 Spacing of taxiway centerline lights

- 9.12.8.1 Except for Paragraphs 9.12.8.2 and 9.12.9.1, the longitudinal spacing of taxiway centerline lights on a straight section of taxiway must be uniform and not be more than the values specified in Table 9.12-1:
- 9.12.8.2 For the purpose of taxiway centerline lighting, a straight section of taxiway that is less than 180 meters in length is considered a short straight taxiway. Taxiway centerline lights on a short straight section of taxiway must be spaced at uniform intervals of not more than 30 m, except that:
- (a) larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;
 - (b) intervals less than 30 m shall be provided on short straight sections; and
 - (c) on a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing shall not exceed 15 m.

Type	General	Last 60 m before a runway or apron
Taxiways used in conjunction with a non-instrument, non-precision, or a precision approach Category I runway	60 m	15 m
Taxiways used in conjunction with a precision approach Category II runway	30 m	15 m
Taxiways used in conjunction with a precision approach Category III runway	15 m	7.5 m

Table 9.12-1 Maximum spacing on straight sections of taxiway

Note: - 1. The longitudinal spacing of centerline lights that will provide satisfactory guidance to pilots on curved sections of taxiway, including exit taxiways and fillets at intersections, is influenced by the width of the light beam from the centerline light fittings.

Note: - 2. There is no need to replace existing lights, or change the spacing of existing lights. The longitudinal spacing and photometric specifications herein are meant for all new taxiway centerline lights, and for replacement of existing light fittings with light fittings in compliance with ICAO standards.

- 9.12.8.3 In the case of an entry taxiway, the last light must not be more than 1 m outside the line of runway edge lights.
- 9.12.8.4 When a taxiway changes from a straight to a curved section, the taxiway centerline lights must continue on from the preceding straight section at a uniform distance from the outside edge of the taxiway. The lights shall be spaced at intervals such that a clear indication of the curve is provided.
- 9.12.8.5 The longitudinal spacing of taxiway centerline lights on a curved section of taxiway must be uniform and be not more than the values specified in MOS Table 9.12-2.

Type	On curve with radius of 400 m or less	On curve with radius greater than 400 m	On straight section before and after the curve
Taxiways used in conjunction with a non- instrument, non-precision, or a precision approach Category I or II runway	15 m <i>See Note</i>	30 m	No special requirement. Use same spacing as on the rest of the straight section.
Taxiways used in conjunction with a precision approach Category III runway	7.5 m	15 m	Same spacing as on the curve is to extend for 60 m before and after the curve
<i>Note: - At a busy or complex taxiway intersection where additional taxiing guidance is desirable, closer light spacing down to 7.5 m should be used.</i>			

Table 9.12-2: Maximum spacing on curved sections of taxiway

Note: - 1. Spacings on curves that have been found suitable for a taxiway intended for use in RVR conditions of 350 m or greater are:

<i>Curve radius</i>	<i>Light spacing</i>
<i>up to 400 m</i>	<i>7.5 m</i>
<i>401 m to 899 m</i>	<i>15 m</i>
<i>900 m or greater</i>	<i>30 m</i>

Note: - 2. See MOS 6.7.3 and MOS Figure 6.7-1.

9.12.9 Location of taxiway centerline lights on other exit taxiways

9.12.9.1 Taxiway centerline lights on exit taxiways, other than rapid exit taxiways, must:

- (a) start at the tangent point on the runway;
- (b) have the first light offset 1.2 m from the runway centerline on the taxiway side; and
- (c) be spaced at uniform longitudinal intervals of not more than 7.5 m.

Note: - See MOS Figure 9.12-4 for offset runway and taxiway centerline lights.

9.12.10 Location of taxiway centerline lights on rapid exit taxiways

9.12.10.1 Taxiway centerline lights on a rapid exit taxiway must:

- (a) start at least 60 m before the tangent point;
- (b) on that part of taxiway marking parallel to the runway centerline, be offset 1.2 m from the runway centerline on the taxiway side; and
- (c) continue at the same spacing to a point on the centerline of the taxiway at which an aeroplane can be expected to have decelerated to normal taxiing speed.

Note: - See MOS Figure 9.12-4 for offset runway and taxiway centerline lights.

- 9.12.10.2 Taxiway centerline lights for a rapid exit taxiway must be spaced at uniform longitudinal intervals of not more than 15 m if the runway has centerline lighting installed, otherwise the spacing may be up to a maximum of 30 m.

9.12.11 Characteristics of taxiway centerline lights

- 9.12.11.1 Except as provided for in MOS 9.12.11.3, taxiway centerline lights are to be inset fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or in the vicinity of the taxiway on:

- (a) a taxiway other than an exit taxiway; and
- (b) a runway forming part of a standard taxi-route.

- 9.12.11.2 Taxiway centerline lights on exit taxiways, including rapid exit taxiways, must be inset fixed lights (See Figure 9.12-1):

- (a) showing green and yellow alternately, from the point where they begin to the perimeter of the ILS critical area or the lower edge of the inner transitional surface, whichever is farther from the runway;
- (b) showing green from that point onwards; and
- (c) the first light in the exit centerline shall always show green and the light nearest to the perimeter shall always show yellow.

Note: - 1. For yellow filter characteristics see MOS 9.2.1.2.

Note: - 2. The size of the ILS critical/sensitive area depends on the characteristics of the associated ILS and other factors. Guidance is provided in CAR-ANS Part 6, Attachment B.

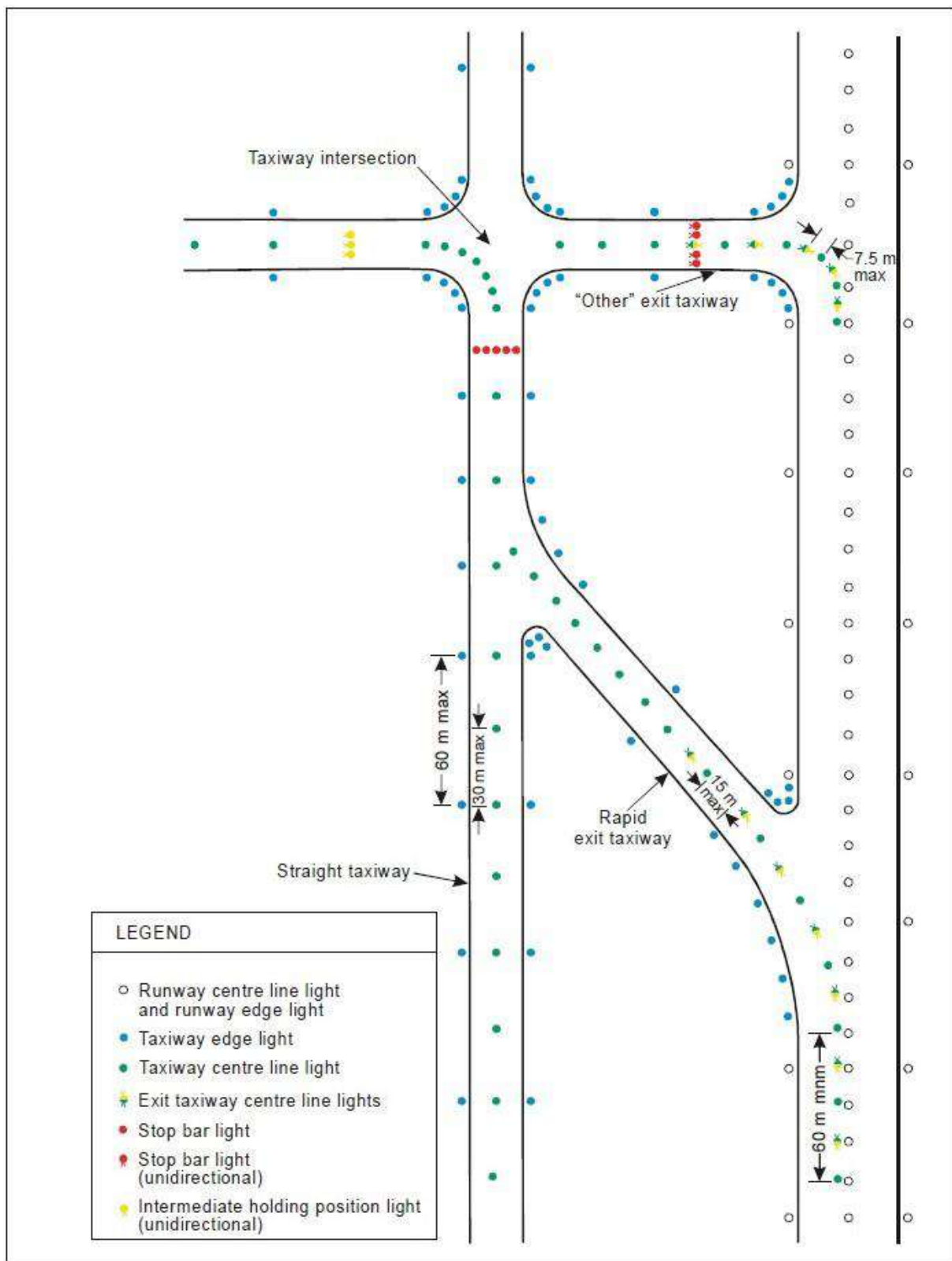
Note: - 3. See MOS 8.6.20 for specifications on runway vacated signs

- 9.12.11.3 Where it is necessary to denote the proximity to a runway, taxiway centerline lights shall be fixed lights showing alternating green and yellow from the perimeter of the ILS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:

- (a) their end point near the runway centerline; or
- (b) in the case of the taxiway centerline lights crossing the runway, to the opposite perimeter of the ILS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.

Note: - 1. Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note: - 2. The provisions of MOS 9.12.11.3 can form part of effective runway incursion prevention measures.



9.12-1: Taxiway Lighting

9.12.11.4 Where the taxiway centerline lights are used for both runway exit and entry purposes, the color of the lights viewed by a pilot of an aircraft entering the runway must be green. The color of the lights viewed by a pilot of an aircraft exiting the runway is to be green and yellow alternately. See MOS Figures 9.14- 1 and 9.14-2.

9.12.11.5 Where higher intensities are required, from an operational point of view, taxiway centerline lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of 350 m shall be in accordance with the specifications of MOS Figure 9.13-3. The number of levels of brilliancy settings for these lights shall be the same as that for the runway centerline lights.

9.12.11.6 Where taxiway centerline lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centerline lights shall be in accordance with the specifications of MOS Figures 9.13-6, 9.13-7 or 9.13-8.

Note: - High-intensity centerline lights shall only be used in case of an absolute necessity and following a specific study.

9.12.12 Beam dimensions and light distribution of taxiway centerline lights

9.12.12.1 The beam dimensions and light distribution of taxiway centerline lights must be such that the lights are visible only to pilots of aircraft on, or in the vicinity of, the taxiway.

9.12.12.2 Care is necessary to limit the light distribution of the green taxiway centerline lights on or near a runway, or in the vicinity of a threshold so as to avoid possible confusion with the runway threshold lights.

9.12.12.3 On a taxiway intended for use in conjunction with a non-instrument, non- precision or a precision approach Category I or II runway, taxiway centerline lights must comply with the specifications set out in MOS 9.13, Figure 9.13-1 or, whichever is applicable.

9.12.12.4 On a taxiway that is intended for use in conjunction with a precision approach Category III runway, the taxiway centerline lights must comply with the specifications set out in MOS 9.13, Figures 9.13-3, 9.13-4, 9.13-5 or 9.13-6, whichever is applicable.

Note: - 1. Light units meeting the intensity standards of Figure 9.13-3, Figure 9.13-4 and Figure 9.13-5, are specifically designed for use in low visibility conditions. For the normal range of visibilities experienced most of the time, these lights, if operated on maximum intensity, would cause dazzle to pilots. If these lights are installed, it may be necessary to provide additional intensity control stages, or otherwise limit the maximum intensity at which they can be operated.

Note: - 2. Very high intensity taxiway light units are also available. These lights can have main beam intensities of the order of 1800 cd. These lights are unsuitable for use unless specific prior approval from CAAP is obtained prior to installation.

9.12.13 Location of Taxiway Edge Lights

- 9.12.13.1 Taxiway edge lights shall be provided at the edges of a runway turn pad, holding bay or apron intended for use at night and on a taxiway not provided with taxiway centerline lighting and intended for use at night. Taxiway edge lights need not be provided where CAAP is satisfied that adequate guidance can be achieved using surface illumination or other means.

Note: - See MOS 9.12.28 for taxiway edge markers.

- 9.12.13.2 A taxiway light may be omitted if it would otherwise have to be located on an intersection with another taxiway or runway.

- 9.12.13.3 Taxiway edge lights must be located outside the edge of the taxiway, being:

- (a) equidistance from the centerline except where asymmetric fillets are provided; and
- (b) as close as practicable to 1.2 m from the taxiway edge, but no further than 1.8 m, or nearer than 0.6 m.

- 9.12.13.4 Where a taxiway intersects a runway, the last taxiway edge lights shall be aligned with the line of runway edge lights, and must not encroach beyond the line of runway edge lights into the area outlined by the runway edge lights.

- 9.12.13.5 Taxiway edge lights shall be provided on a runway forming part of a standard taxi route and intended for taxiing at night if the runway is not provided with taxiway centerline lights.

Note: - See MOS 9.1.8.9 (c) for provisions concerning the interlocking of runway and taxiway lighting systems.

9.12.14 Spacing of taxiway edge lights

- 9.12.14.1 Spacing of taxiway edge lights must be in accordance with Figure 9.12-2:

- 9.12.14.2 On a curved section of taxiway, the edge lights must be spaced at uniform longitudinal intervals in accordance with Curve A in Figure 9.12-2 above, so that a clear indication of the curve is provided.

Note: - Guidance on the spacing of taxiway edge lights on curves is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- 9.12.14.3 On a straight section of taxiway, the edge lights must be spaced at uniform longitudinal intervals, not exceeding 60 m, in accordance with Curve B in Figure 9.12-2.

- 9.12.14.4 Where a straight section joins a curved section, the longitudinal spacing between taxiway edge lights must be progressively reduced, in accordance with Paragraphs 9.12.14.5 and 9.12.14.6, over not less than 3 spacings before the tangent point.

- 9.12.14.5 The last spacing between lights on a straight section must be the same as the spacing on the curved section.

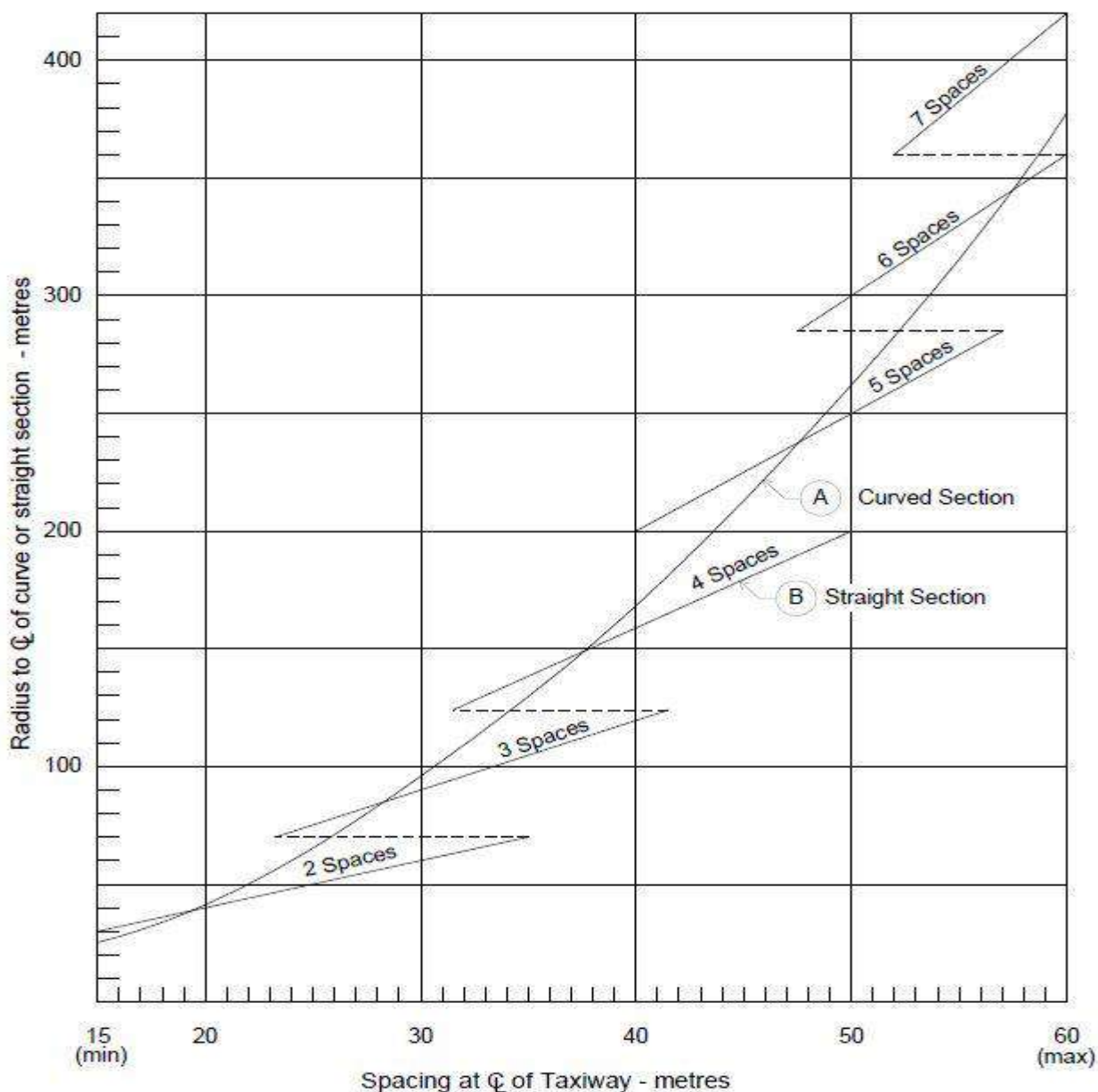


Figure 9.12-2: Longitudinal Spacing for Taxiway Edge Lights

- 9.12.14.6 If the last spacing on the straight section is less than 25 m, the second last spacing on the straight section must be no greater than 25 m.
- 9.12.14.7 If a straight section of taxiway enters an intersection with another taxiway, a runway or an apron, the longitudinal spacing of the taxiway edge lights must be progressively reduced over not less than 3 spacings, before the tangent point, so that the last and the second last spacings before the tangent point are not more than 15 m and 25 m respectively.
- 9.12.14.8 The taxiway edge lights must continue around the edge of the curve to the tangent point on the other taxiway, the runway or apron edge.

- 9.12.14.9 Taxiway edge lights on a holding bay or apron edge are to be spaced at uniform longitudinal intervals not exceeding 60 m, and in accordance with Curve B in MOS Figure 9.12-2.
- 9.12.14.10 Taxiway edge lights on a runway turn pad shall be spaced at uniform longitudinal intervals of not more than 30 m.
- 9.12.14.11 The lights shall be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, apron or runway, etc., or outside the edges at a distance of not more than 3 m. [See also 9.12.13.3 (b)]

9.12.15 Characteristics of Taxiway Edge Lights

- 9.12.15.1 Taxiway edge lights must be fixed omnidirectional lights showing blue. The lights must be visible:
- (a) up to at least 75° above the horizontal; and
 - (b) at all angles in azimuth necessary to provide guidance to the pilot of an aircraft on the taxiway.
- 9.12.15.2 At an intersection, exit or curve, the lights must be shielded, as far as is practicable, so they cannot be seen where they may be confused with other lights.
- 9.12.15.3 The intensity of blue taxiway edge lights must be at least 2 cd from 0° to 6° vertical and 0.2 cd at any vertical angle from 6° to 75°.

9.12.16 Provision of runway guard lights

Note: - 1. Runway guard lights are sometimes referred to as 'wig wags'. The effectiveness of this lighting system in preventing runway incursions has been successfully proven in a number of countries and this lighting system has been adopted by ICAO as a standard. Provision of runway guard lights will bring aerodrome lighting in line with international practices.

Note: - 2. Runway incursions may take place in all visibility or weather conditions. The use of runway guard lights at runway-holding positions can form part of effective runway incursion prevention measures. Runway guard lights warn pilots, and drivers of vehicles when operating on taxiways, that they are about to enter a runway. There are two standard configurations of runway guard lights as illustrated in MOS Figure 9.12-3.

- 9.12.16.1 Runway guard lights Configuration A must be provided at each runway/taxiway intersection when the runway is intended for use in:
- (a) runway visual range conditions less than a value of 550m where a stop bar is not installed; and
 - (b) runway visual range conditions of values between 550m and 1200m where the traffic density is heavy.

Note: - 1. Runway guard lights, Configuration B may supplement Configuration A when deemed necessary.

Note: - 2. Guidance on the design, operation and the location of runway guard lights Configuration B is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- 9.12.16.2 If directed by CAAP, runway guard lights Configuration A must be used at each runway/taxiway intersection associated with a runway intended for use in:
- runway visual range conditions between 550m and 1200m where the traffic density is medium or light.

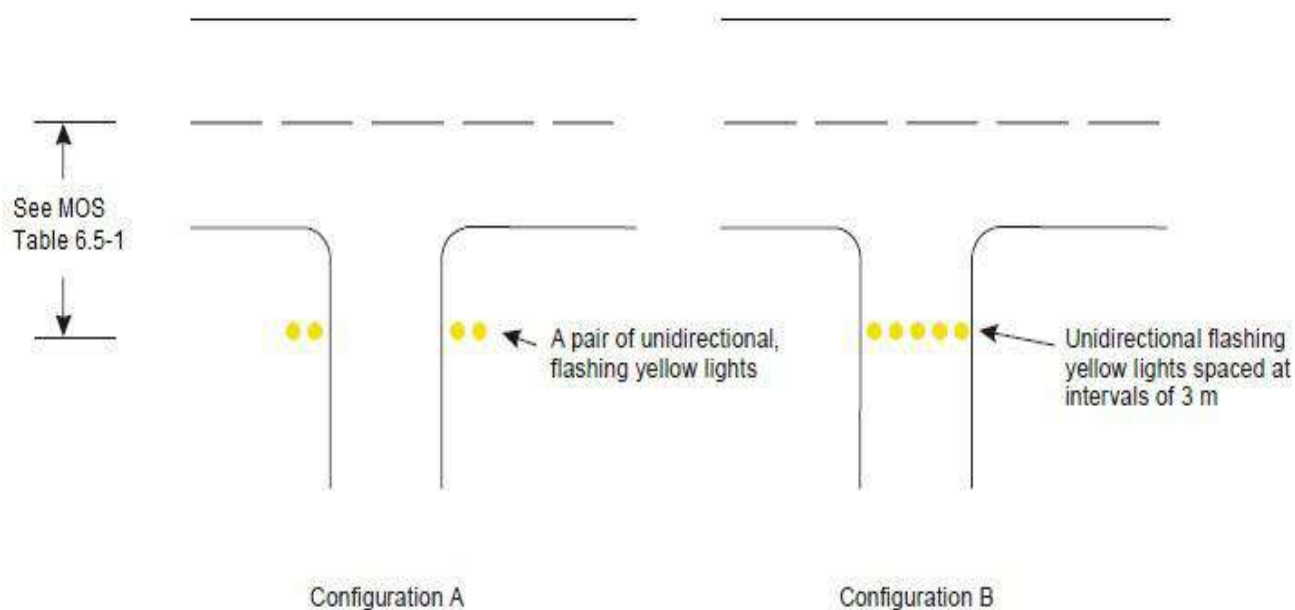


Figure 9.12-3: Runway Guard Lights

9.12.17 Pattern and location of runway guard lights

- 9.12.17.1 There are two standard configurations of runway guard lights:
- Runway guard lights, Configuration A, shall be located at each side of the taxiway on the holding side of the runway-holding position marking.
 - Runway guard lights, Configuration B, shall be located across the taxiway on the holding side of the runway-holding position marking.
- 9.12.17.2 As part of runway incursion prevention measures, runway guard lights, Configuration A or B, shall be provided at each taxiway/runway intersection where runway incursion hot spots have been identified, and used under all weather conditions during day and night.
- 9.12.17.3 Configuration A runway guard lights must be located on both sides of the taxiway, at the runway holding position closest to the runway, with the lighting on both sides:
- equidistant from the taxiway centerline;
 - not less than 3 m, and not more than 5 m, outside the edge of the taxiway; and
 - at a distance from the runway centerline not less than that specified for a

take-off runway in MOS Table 6.5-1.

- 9.12.17.4 Configuration B runway guard lights must be located across the entire taxiway, including fillets, holding bays, etc. at the runway holding position closest to the runway:
- (a) with the lights spaced at uniform intervals of 3 m; and
 - (b) at a distance from the runway centerline not less than that specified for a take-off runway in MOS Table 6.5-1.

- 9.12.17.5 Configuration B shall not be colocated with a stop bar installation.

- 9.12.17.6 Where more than one runway-holding positions exist at a runway/taxiway intersection, only the set of runway guard lights associated with the operational runway-holding position shall be illuminated.

9.12.18 Characteristics of runway guard lights

- 9.12.18.1 Configuration A runway guard lights must consist of two pairs of elevated lights showing yellow, one pair on each side of the taxiway.

- 9.12.18.2 Where there is a need to enhance the contrast between the on and off state of runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture should be located above each lamp.

Note: - Some other device or design, e.g. specially designed optics, may be used in lieu of the visor.

- 9.12.18.3 Configuration B runway guard lights must consist of yellow lights spaced at intervals of 3 m across the taxiway.

- 9.12.18.4 The light beam shall be unidirectional and shall show yellow in the direction of approach to the runway- holding position.

Note: - For guidance on orientation and aiming of runway guard lights, see the Aerodrome Design Manual (Doc 9157) Part 4.

- 9.12.18.5 The intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in MOS Figure 9.13-11.

- 9.12.18.6 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in MOS Figure 9.13-12.

- 9.12.18.7 Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in MOS Figure 9.13-12.

Note: - Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities.

- 9.12.18.8 The intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in MOS Figure 9.13-9.
- 9.12.18.9 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in MOS Figure 9.13-9.
- 9.12.18.10 Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in MOS Figure 9.13-9.
- 9.12.18.11 The lights in each unit of Configuration A shall be illuminated alternately.
- 9.12.18.12 For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.
- 9.12.18.13 The lights shall be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods shall be equal and opposite in each light.
- 9.12.19 Control of runway guard lights**
- 9.12.19.1 Runway guard lights are to be electrically connected such that all runway guard lights protecting a runway can be turned on when the runway is active, day or night.
- 9.12.20 Provision of Intermediate Holding Position Lights**
- Note: - See MOS 8.4.4. for specifications on intermediate holding position marking.*
- 9.12.20.1 Intermediate holding position lights must be provided at each intermediate holding position marking.
- 9.12.20.2 Except where a stop bar has been installed, intermediate holding position lights shall be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of 350 m.
- 9.12.20.3 Intermediate holding position lights shall be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.
- 9.12.21 Pattern and Location of Intermediate Holding Position Lights**
- 9.12.21.1 On a taxiway equipped with centerline lights, the intermediate holding position lights must consist of 3 inset lights, spaced 1.5 m apart, disposed symmetrically about, and at right angles to, the taxiway centerline, located not more than 0.3 m before the intermediate holding position marking or the taxiway intersection marking, as appropriate.
- 9.12.21.2 With prior CAAP approval, on a taxiway equipped with edge lights, the intermediate holding position lights may consist of 1 elevated light on each side of the taxiway, located in line with the taxiway edge lights and the intermediate holding

position.

9.12.22 Characteristics of Intermediate Holding Position Lights

9.12.22.1 Inset intermediate holding position lights must:

- (a) be fixed, unidirectional lights showing yellow;
- (b) be aligned so as to be visible to the pilot of an aircraft approaching the holding position; and
- (c) have light distribution as close as practicable to that of the taxiway centerline lights.

9.12.22.2 Elevated intermediate holding position lights must:

- (a) be fixed, unidirectional lights showing yellow; and
- (b) have light distribution as close as practicable to that of the taxiway edge lights.

9.12.23 Stop bars

Note: - 1. A stop bar is intended to be controlled either manually or automatically by air traffic services.

Note: - 2. Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway holding positions and their use at night and in visibility conditions greater than 550 m runway visual range can form part of effective runway incursion prevention measures

9.12.23.1 A stop bar must be provided at every runway holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 550 m, except where:

- (a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the runway; or
- (b) operational procedures exist to limit, in runway visual range conditions less than a value of 550m, the number of:
 - (i) aircraft on the maneuvering area on one at a time; and
 - (ii) vehicles on the maneuvering area to the essential minimum.

9.12.23.2 Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be illuminated at any given time.

9.12.23.3 Where provided, the control mechanism for stop bars must meet the operational requirements of the Air Traffic Service at that aerodrome.

9.12.23.4 A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

9.12.24 Location of stop bars

9.12.24.1 Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in MOS 9.12.25.2 are provided,

these lights shall be located not less than 3 m from the taxiway edge.

9.12.25 Characteristics of Stop Bars

9.12.25.1 Stop bars shall consist of lights spaced at uniform intervals of no more than 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

Note: - Where necessary to enhance conspicuity of an existing stop bar, extra lights are installed uniformly

9.12.25.2 A pair of elevated lights should be added to each end of the stop bar where the in-pavement stop bar lights might be obscured from a pilot's view, for example, by rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

9.12.25.3 Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

9.12.25.4 Where the additional lights specified in MOS 9.12.25.2 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

9.12.25.5 The intensity and beam spread of the stop bar lights must be in accordance with the applicable specifications in MOS 9.13, Figure 9.13-1 through Figure 9.13-5, as appropriate.

9.12.25.6 Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of MOS 9.13, Figure 9.13-8, Figure 9.13-9 or Figure 9.13-10.

Note: - High-intensity stop bars shall only be used in case of an absolute necessity and following a specific study.

9.12.25.7 Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of MOS 9.13, Figure 9.13-9 or Figure 9.13-10.

9.12.25.8 The lighting circuit must be designed so that:

- (a) stop bars located across entrance taxiways are selectively switchable;
- (b) stop bars located across taxiways used as exit taxiways only are switchable selectively or in groups;
- (c) when a stop bar is illuminated, any taxiway centerline lights immediately beyond the stop bar are to be extinguished for a distance of at least 90 m; and
- (d) stop bars are interlocked with the taxiway centerline lights so that when the centerline lights beyond the stop bar are illuminated the stop bar lights are extinguished and vice versa.

Note: - Care is required in the design of the electrical system to ensure that all of the lights of a stop bar will not fail at the same time. Guidance on this issue is given in the Aerodrome Design Manual (Doc 9157), Part 5.

9.12.26**No - entry Bars**

Note: - Runway incursions may take place in all visibility or weather conditions. The use of no entry bars can form part of effective runway incursion prevention measures.

- 9.12.26.1 A no-entry bar shall be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.
- 9.12.26.2 A no-entry bar shall be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.
- 9.12.26.3 A no-entry bar should be co-located with a no-entry sign and/or a no-entry marking.
- 9.12.26.4 A no-entry bar should consist of unidirectional lights spaced at uniform intervals of no more than 3 m showing red in the intended direction(s) of approach to the runway.
- Note: - Where necessary to enhance conspicuity, extra lights are installed uniformly.*
- 9.12.26.5 A pair of elevated lights should be added to each end of the no-entry bar where the in-pavement no entry bar lights might be obscured from a pilot's view, for example, by rain or any climatic conditions, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.
- 9.12.26.6 The intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications in MOS 9.13 Figure 9.13-1 through Figure 9.13-5 as appropriate.
- 9.12.26.7 Where no-entry bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of MOS 9.13 Figure 9.13-6, Figure 9.13-7 or Figure 9.13-8.
- Note: - High-intensity no-entry bars are typically only used in case of an absolute necessity and following a specific study.*
- 9.12.26.8 Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of MOS 9.13 Figure 9.13-6 or Figure 9.13-8.
- 9.12.26.9 Taxiway center line lights installed beyond the no-entry bar, looking in the direction of the runway, shall not be visible when viewed from the taxiway.

9.12.27 Taxiway edge markers

- 9.12.27.1 Taxiway edge markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway centerline or edge lights or taxiway centerline markers are not provided.
- 9.12.27.2 Taxiway edge markers shall be installed at least at the same locations as would the taxiway edge lights had they been used.
- 9.12.27.3 Taxiway edge markers must be retro-reflective blue.
- 9.12.27.4 The surface of a taxiway edge marker as viewed by the pilot must be a rectangle with a height to width ratio of approximately 3:1 and a minimum viewing area of 150 cm².
- 9.12.27.5 Taxiway edge markers must be lightweight, frangible and low enough to preserve adequate clearance for propellers and for the engine pods of jet aircraft.

9.12.28 Taxiway centerline markers

- 9.12.28.1 Taxiway centerline markers must be used on sections of the taxiway as a supplement to taxiway edge markers or taxiway edge lights, e.g. on curves or intersections. When used, taxiway centerline markers must not be spaced greater than the spacing for centerline lights.
- 9.12.28.2 Taxiway centerline markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway centerline or edge lights or taxiway edge markers are not provided.
- 9.12.28.3 Taxiway centerline markers shall be provided on a taxiway where the code number is 3 or 4 and taxiway centerline lights are not provided if there is a need to improve the guidance provided by the taxiway centerline marking.
- 9.12.28.4 Taxiway centerline markers shall be installed at least at the same location as would taxiway centerline lights had they been used.
Note: - See MOS 9.12.7 for the spacing of taxiway centerline lights.
- 9.12.28.5 Taxiway centerline markers shall normally be located on the taxiway centerline marking except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

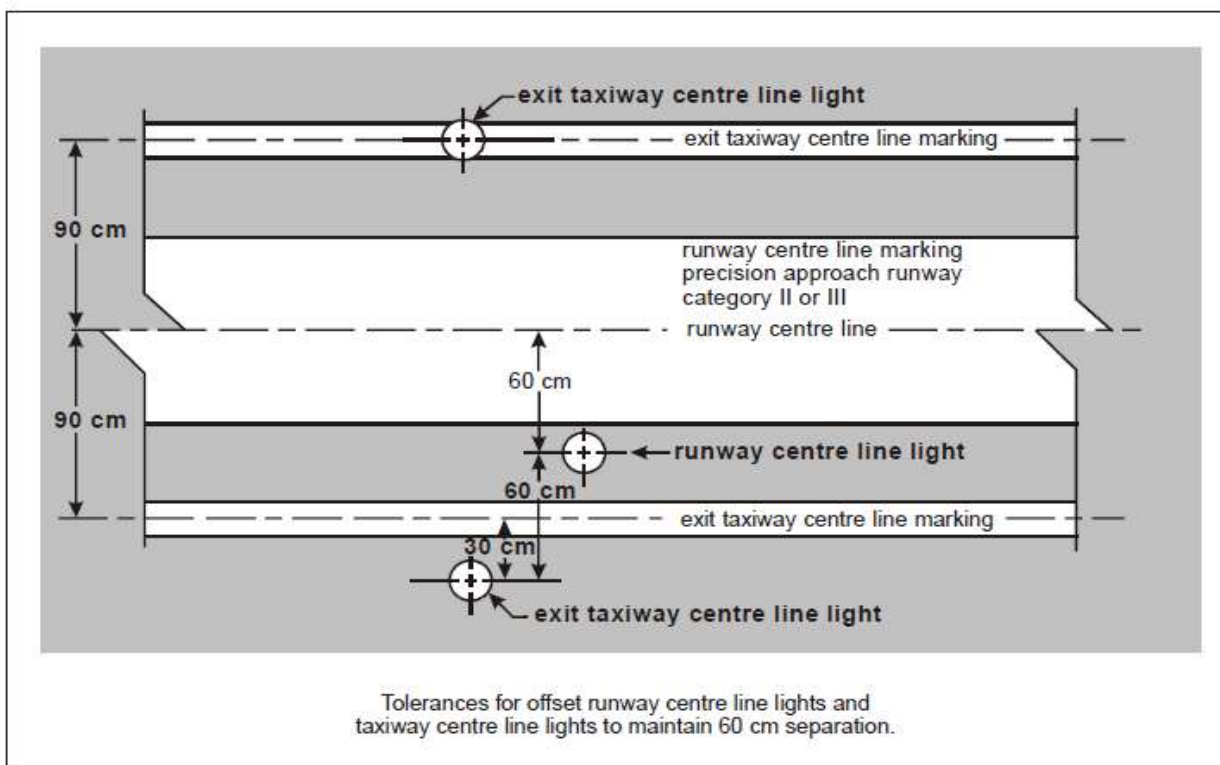


Figure 9.12-4. Offset runway and taxiway centerline lights

9.12.29 Characteristics of taxiway centerline markers

- 9.12.29.1 Taxiway centerline markers must be retro-reflective green.
- 9.12.29.2 The marked surface as viewed by the pilot must be a rectangle and must have a minimum viewing surface of 20 cm².
- 9.12.29.3 Taxiway centerline markers must be able to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

9.12.30 Photometric characteristics of taxiway lights

- 9.12.30.1 The average intensity of the main beam of a taxiway light is calculated by:
 - (a) establishing the grid points in accordance with the method shown in MOS 9.13, Figure 9.13-7;
 - (b) measuring the light intensity values at all grid points located within and on the perimeter of the rectangle representing the main beam;
 - (c) calculating the arithmetic average of the light intensity values as measured at those grid points.
- 9.12.30.2 The maximum light intensity value measured on or within the perimeter of the main beam must not be more than three times the minimum light intensity values so measured.

9.12.31 Installation and aiming of light fittings

- 9.12.31.1 The following points must be followed in the installation and aiming of light fittings:
- (a) the lights are aimed so that there are no deviations in the main beam pattern, to within $\frac{1}{2}^\circ$ from the applicable standard specified in this Chapter;
 - (b) horizontal angles are measured with respect to the vertical plane through the taxiway centerline;
 - (c) when measuring horizontal angles for lights other than taxiway centerline lights, the direction towards the taxiway centerline is to be taken to be positive.
 - (d) vertical angles specified are to be measured with respect to the horizontal plane.

9.12.32 Illustrations of Taxiway Lighting

- 9.12.32.1 MOS 9.14 contains illustrations of taxiway lighting.

Section 9.13 Isocandela Diagrams for Taxiway Lights**9.13.1 Collective Notes**

- 9.13.1.1 The intensities specified in Figures 9.13-1 to 9.13-9 are in green and yellow light for taxiway centerline lights, yellow light for runway guard lights and red light for stop bar lights.
- 9.13.1.2 MOS Figure 9.13-1 to Figure 9.13-9 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure 9.13-10, and using the intensity values measured at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of the light intensities measured at all considered grid points.
- 9.13.1.3 No deviations are acceptable in the main beam when the lighting fixture is properly aimed.
- 9.13.1.4 Horizontal angles are measured with respect to the vertical plane through the taxiway centerline except on curves where they are measured with respect to the tangent to the curve.
- 9.13.1.5 Vertical angles are measured from the longitudinal slope of the taxiway surface.
- 9.13.1.6 The light unit shall be installed so that the main beam or the innermost beam, as applicable, is aligned within one half degree of the specified requirement.
- 9.13.1.7 On the perimeter of and within the rectangle defining the main beam in MOS Figures 9.13-3 to 9.13-9, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with MOS collective notes for Figures 9.13-3 to 9.13-10, Note 2.

9.13.1.8

The importance of adequate maintenance cannot be overemphasized. The intensity, either average where applicable or as specified on the corresponding isocandela curves, should never fall to a value less than 50 per cent of the value shown in the figures, and it should be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.

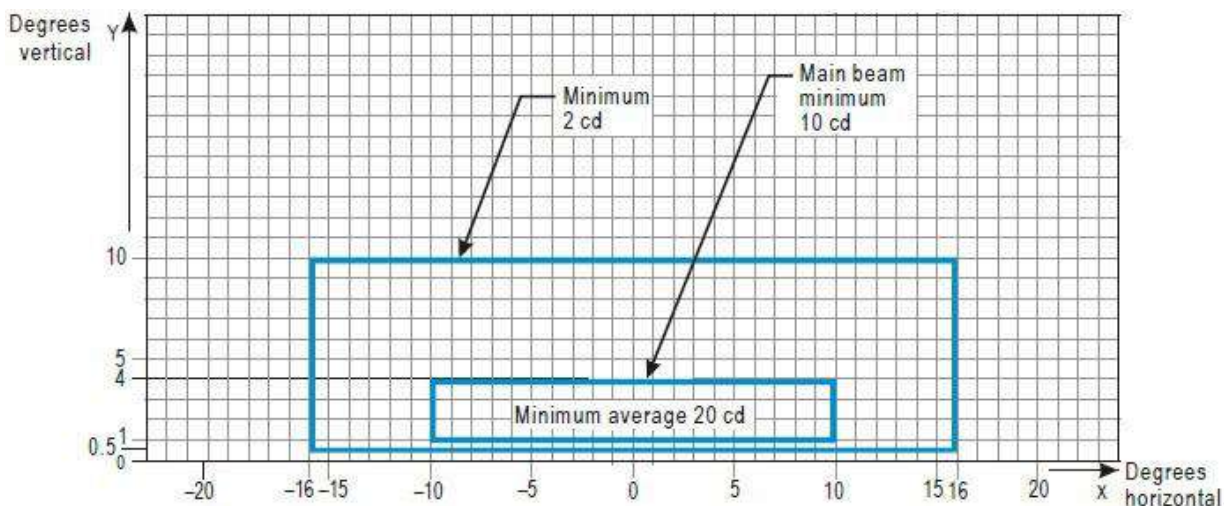


Figure 9.13-1: Isocandela diagram for taxiway centerline (30 m, 60 m spacing), no-entry bar and stop bar lights in straight sections of Taxiways intended for use in conjunction with a Non-Precision or Precision Approach Category I or II Runway

Note: - 1. At locations where high background luminance is usual and where deterioration of light output resulting from dust and local contamination is a significant factor, the cd values should be multiplied by 2.5

Note: - 2. Where omnidirectional lights are used they must comply with the vertical beam spread.

Note: - 3. See the collective notes at MOS 9.13.1 for these isocandela diagrams.

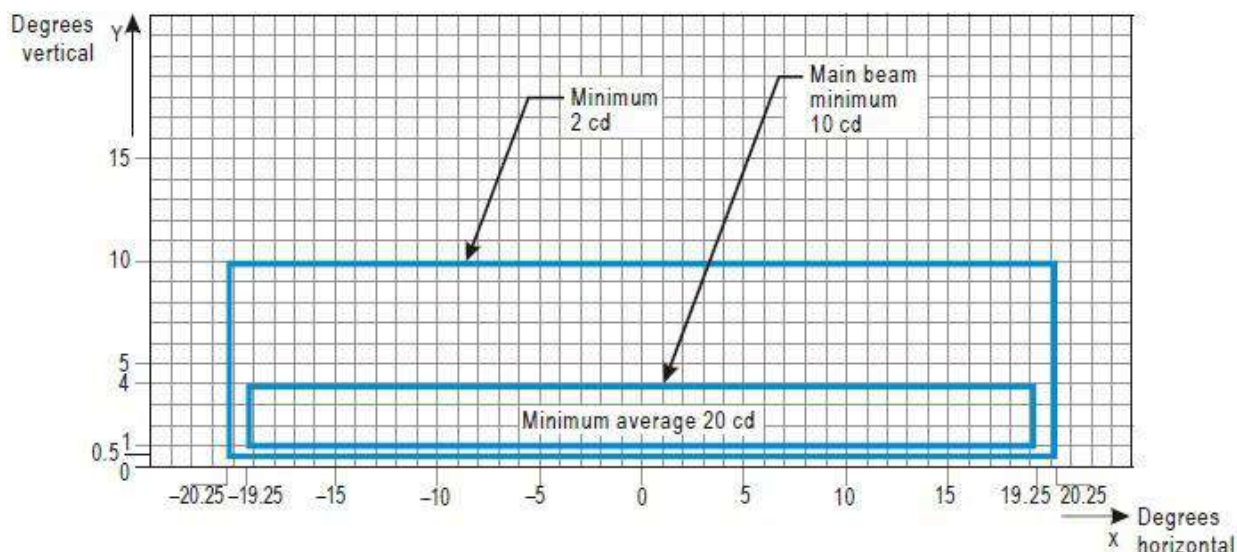


Figure 9.13-2: Isocandela Diagram for Taxiway Centerline Lights (7.5 m, 15 m, 30 m spacing), 6 no-entry bar and Stop Bar Lights on Curved Sections of Taxiways intended for use in conjunction with a Non-Precision or Precision Approach Category I or II Runway

Notes:

1. *Lights on curves to have light beam toed-in 15.75° with respect to the tangent of the curve.*
2. *At locations where high background luminance is usual and where deterioration of light output resulting from dust and local contamination is a significant factor, the cd values should be multiplied by 2.5.*
3. *These beam coverages allow for displacement of the cockpit from the centerline up to distance of the order of 12 m as could occur at the end of curves*
4. *See collective notes at MOS 9.13.1 for these isocandela diagrams.*

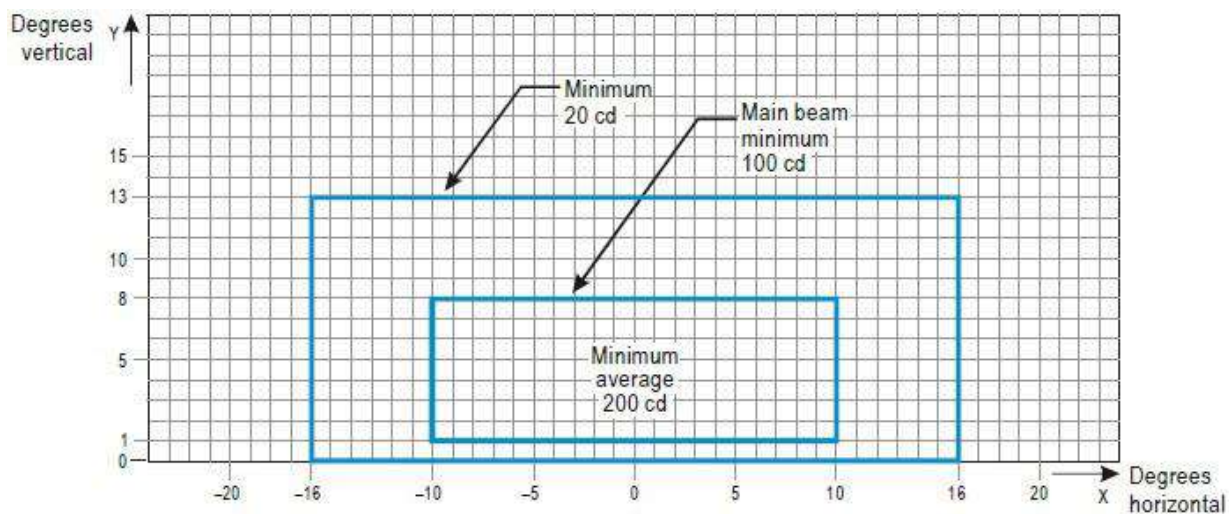


Figure 9.13-3: Isocandela diagram for taxiway centerline (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in conjunction with a Precision Approach Category III Runway where large offsets can occur and for low-intensity runway guard lights, Configuration B

Notes:

1. *These beam coverages are suitable for a normal displacement of the cockpit from the centerline of up to 3 m.*
2. *See collective notes at MOS 9.13.1 for these isocandela diagrams.*
3. *Increased intensities for enhanced rapid exit taxiway centerline lights as recommended in MOS 9.9.22.5 are four times the respective intensities in the figure (i.e. 800 cd for minimum average main beam).*

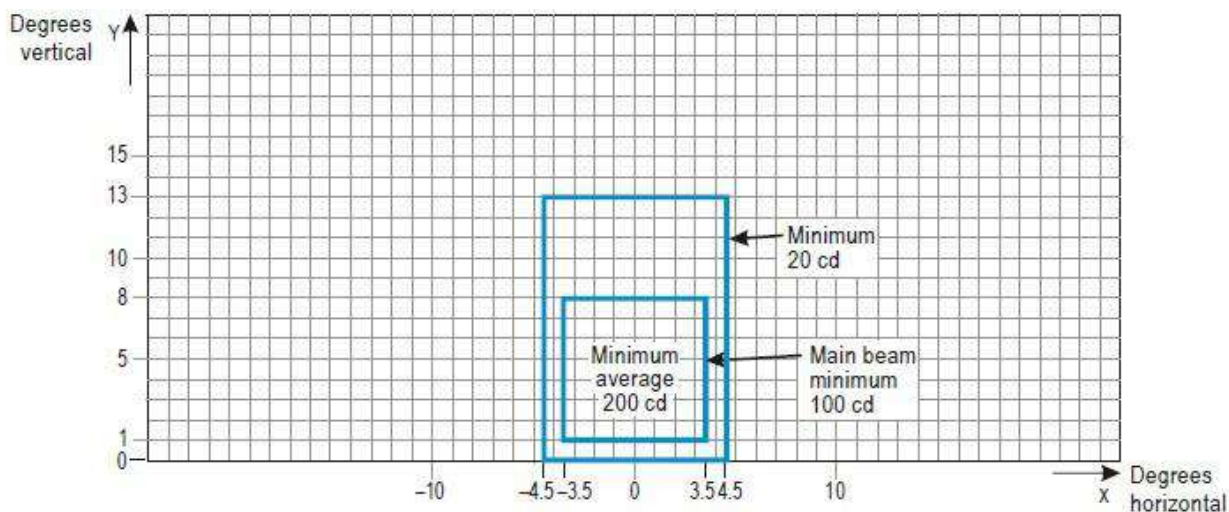


Figure 9.13-4: Isocandela diagram for taxiway centerline (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in conjunction with a Precision Approach Category III Runway

Notes:

1. *These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit from the centerline of approximately 3 m.*
2. *See collective notes at MOS 9.13.1 for these isocandela diagrams.*

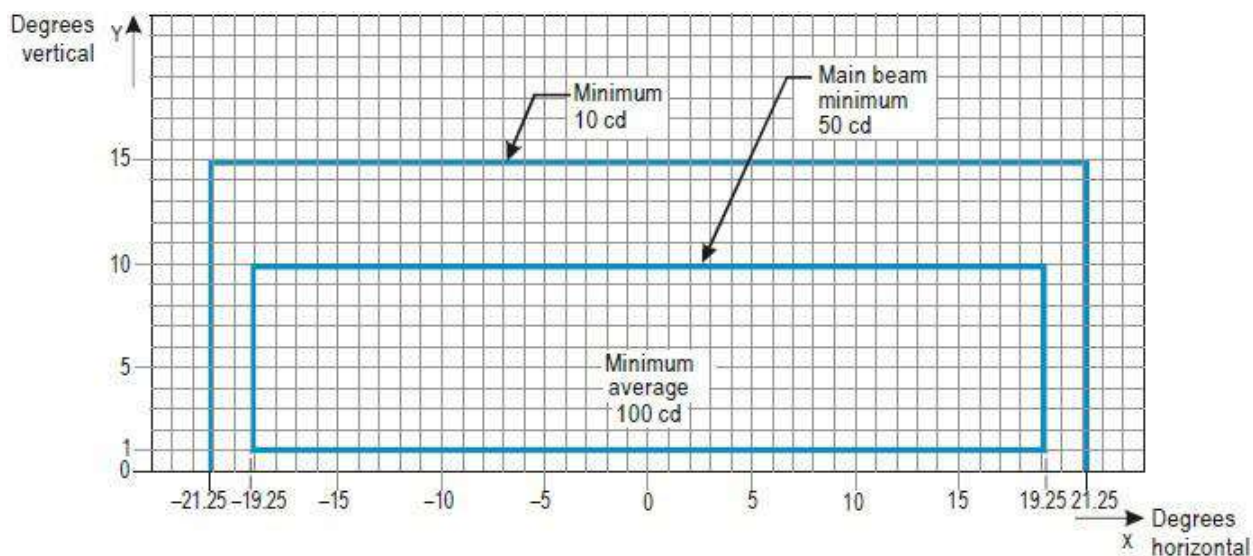
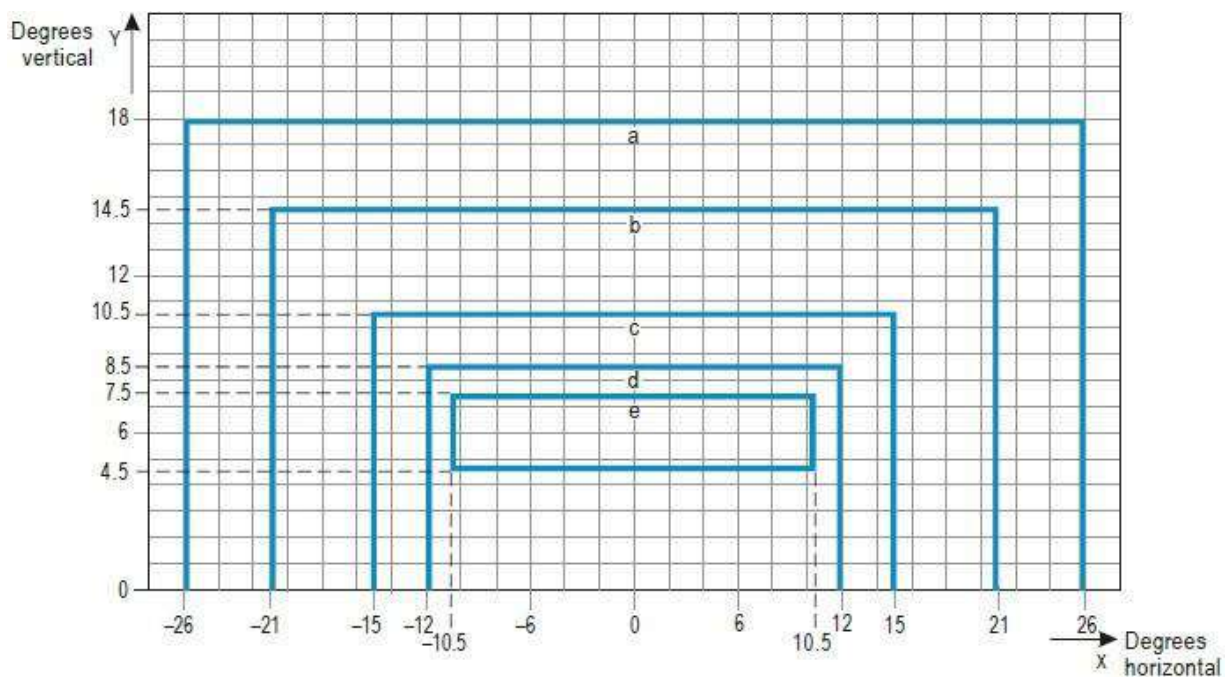


Figure 9.13-5: Isocandela diagram for taxiway centerline (7.5 m spacing), no-entry bar and stop bar lights in curved sections intended for use in conjunction with a Precision Approach Category III Runway

Notes:

1. *Lights on curves to have light beam toed-in 15.75° with respect to the tangent of the curve.*
2. *See collective notes at MOS 9.13.1 for these isocandela diagrams.*

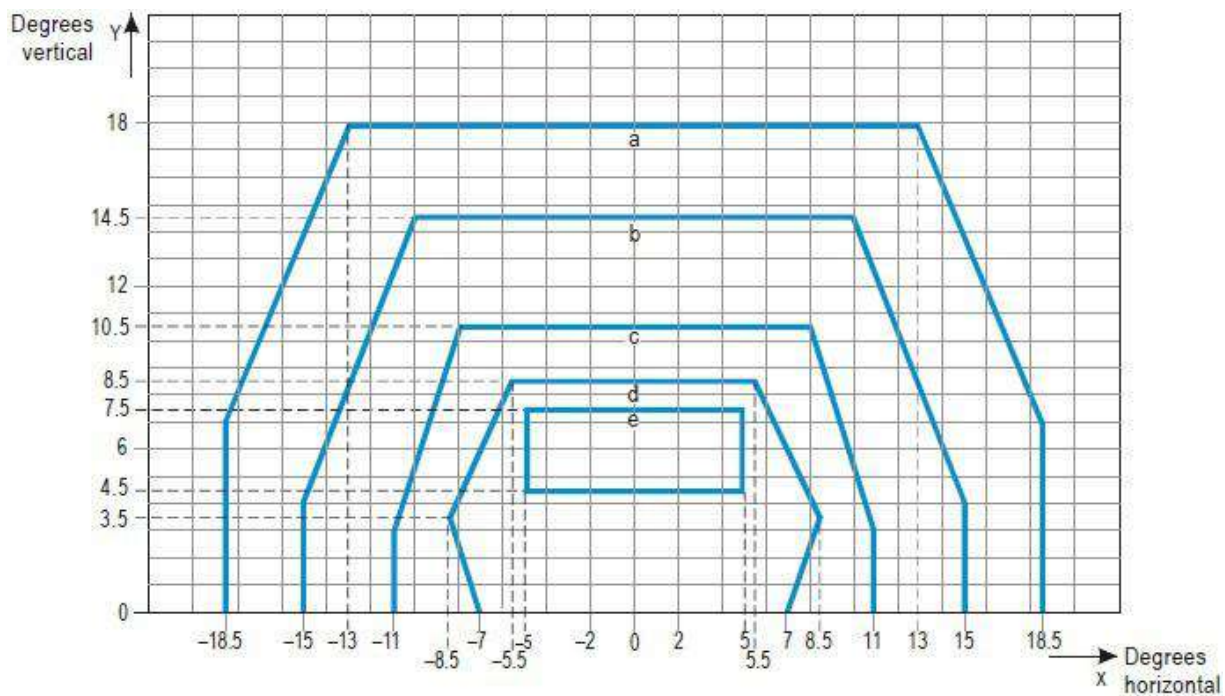


Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Figure 9.13-6: Isocandela diagram for high-intensity taxiway centerline (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required and where large offsets can occur

Notes:

1. These beam coverages allow for displacement of the cockpit from the centerline up to distances of the order of 12 m and are intended for use before and after curves.
2. See collective notes at MOS 9.13.1 for these isocandela diagrams.

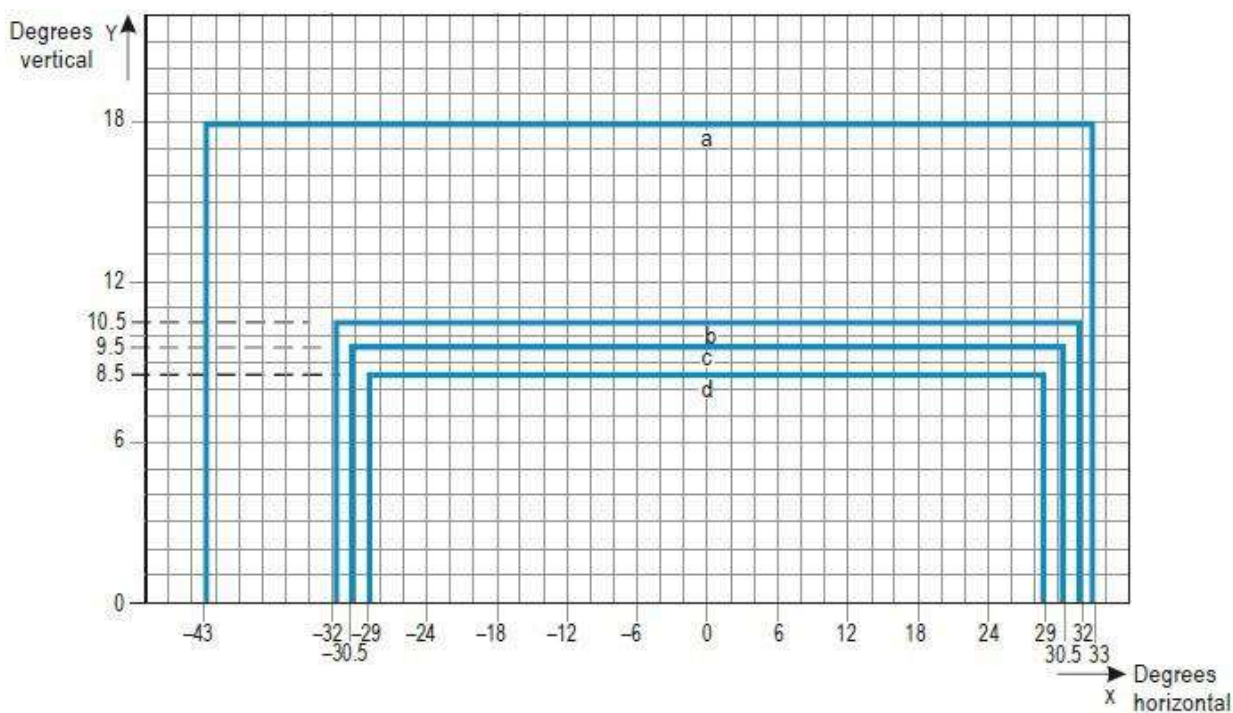


Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Figure 9.13-7: Isocandela diagram for high-intensity taxiway centerline (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required

Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit corresponding to the outer main gear wheel on the taxiway edge.
2. See collective notes at MOS 9.13.1 for these isocandela diagrams.



Curve	a	b	c	d
Intensity (cd)	8	10	200	400

Figure 9.13-8: Isocandela diagram for high-intensity taxiway centerline (7.5 m spacing), no-entry bar and stop bar lights in curved sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required

Notes:

1. Lights on curves to be toed-in 17 degrees with respect to the tangent of the curve.
2. See collective notes at MOS 9.13.1 for these isocandela diagrams.

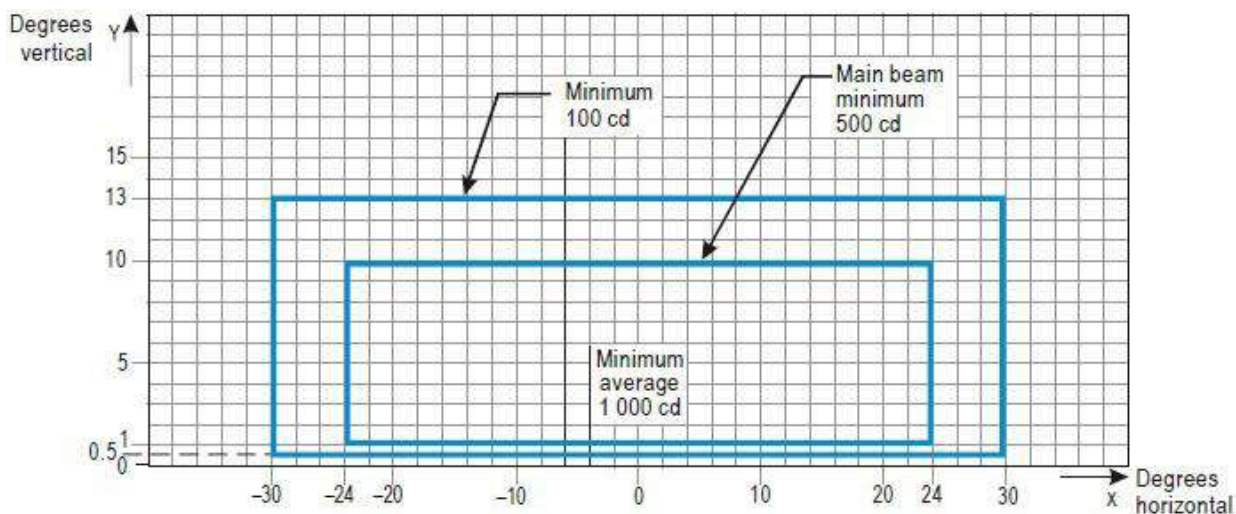


Figure 9.13-9: Isocandela diagram for high-intensity runway guard lights, Configuration B

Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.
2. See collective notes for MOS Figures 9.13-3 to 9.13-5, 9.13-1& 9.13-2 and 9.13-6 to 9.13-10.

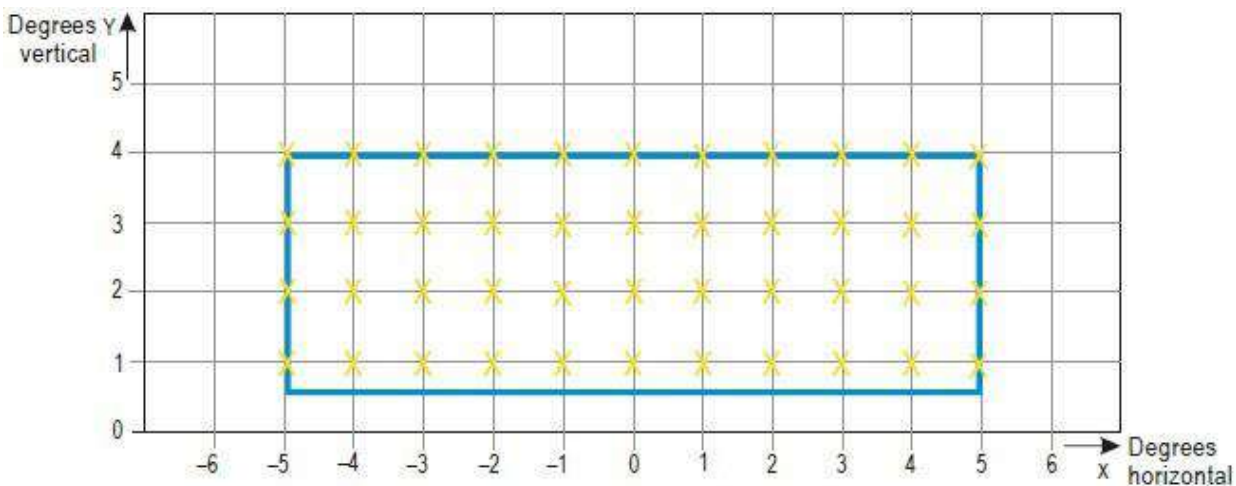


Fig. 9.13-10 Grid points to be used for calculation of average intensity of taxiway centerline and stop bar lights

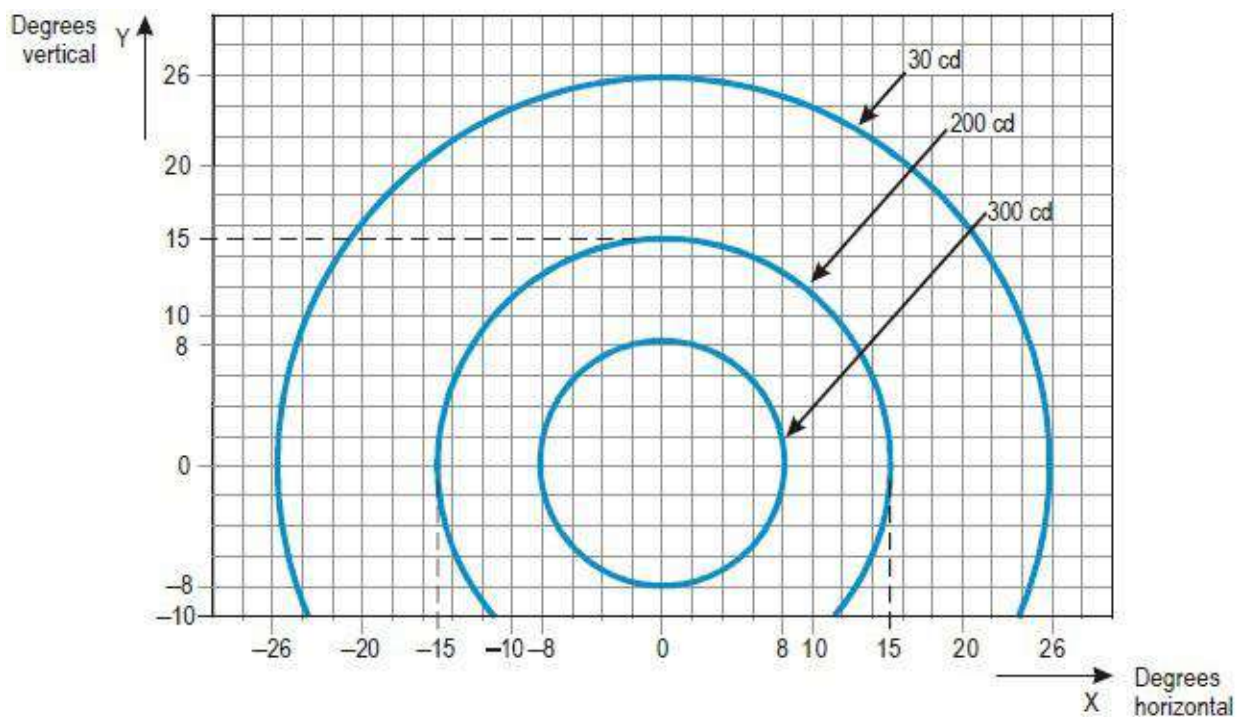


Figure 9.13-11: Isocandela diagram for each light in low-intensity runway guard lights, Configuration A

Notes:

1. *Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.*
2. *The intensities specified are in yellow light.*

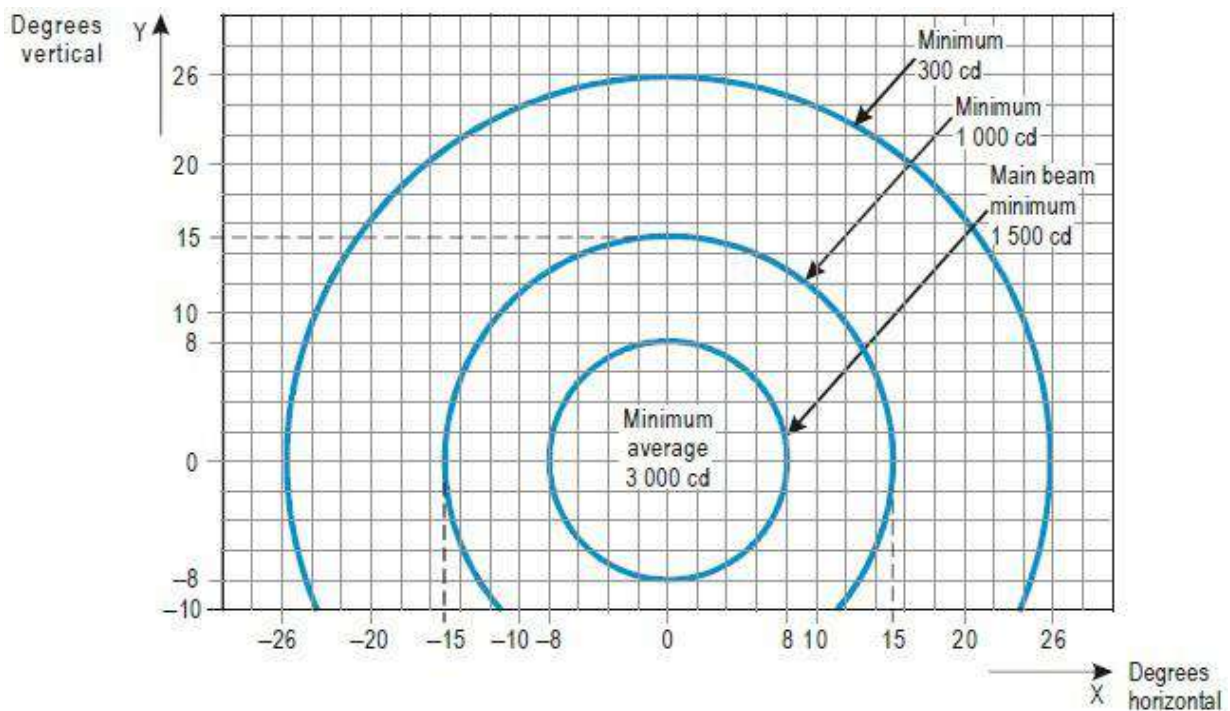


Figure 9.13-12: Isocandela diagram for each light in high-intensity runway guard lights, Configuration A

Notes:

1. *Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.*
2. *The intensities specified are in yellow light.*

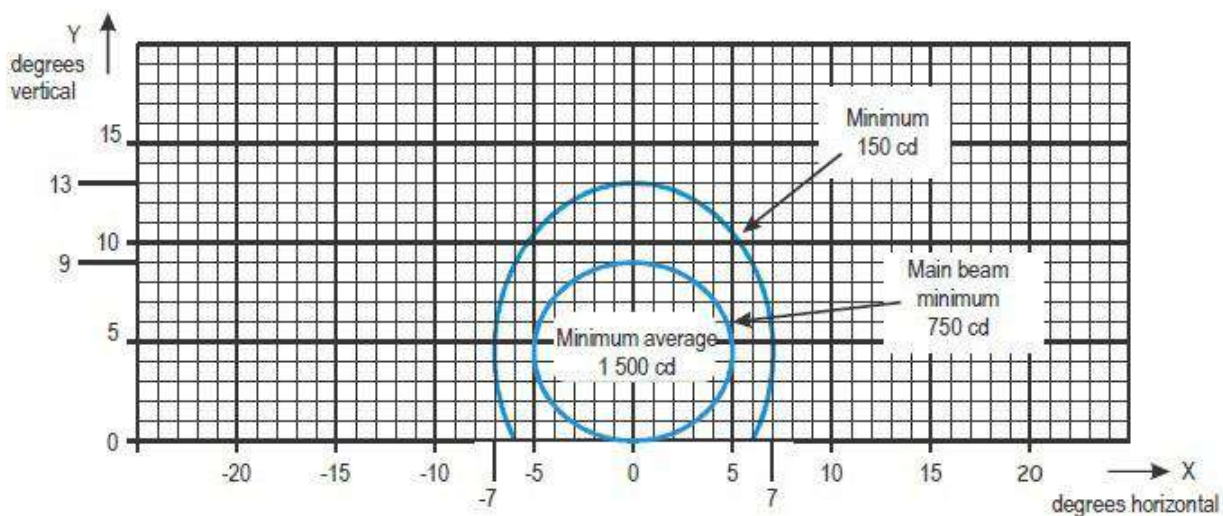


Figure 9.13-13: Isocandela diagram for take-off and hold lights (THL) (red light)

Notes:

1.

Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	5.0	7.0
b	4.5	8.5

2.

See collective notes for MOS 9.7-1 & 9.7-2; MOS 9.10-3 to 9.10-10 & 9.10-12 and MOS 9.13-13.

Figure 9.14-1: Typical Taxiway Centerline Lights Layout

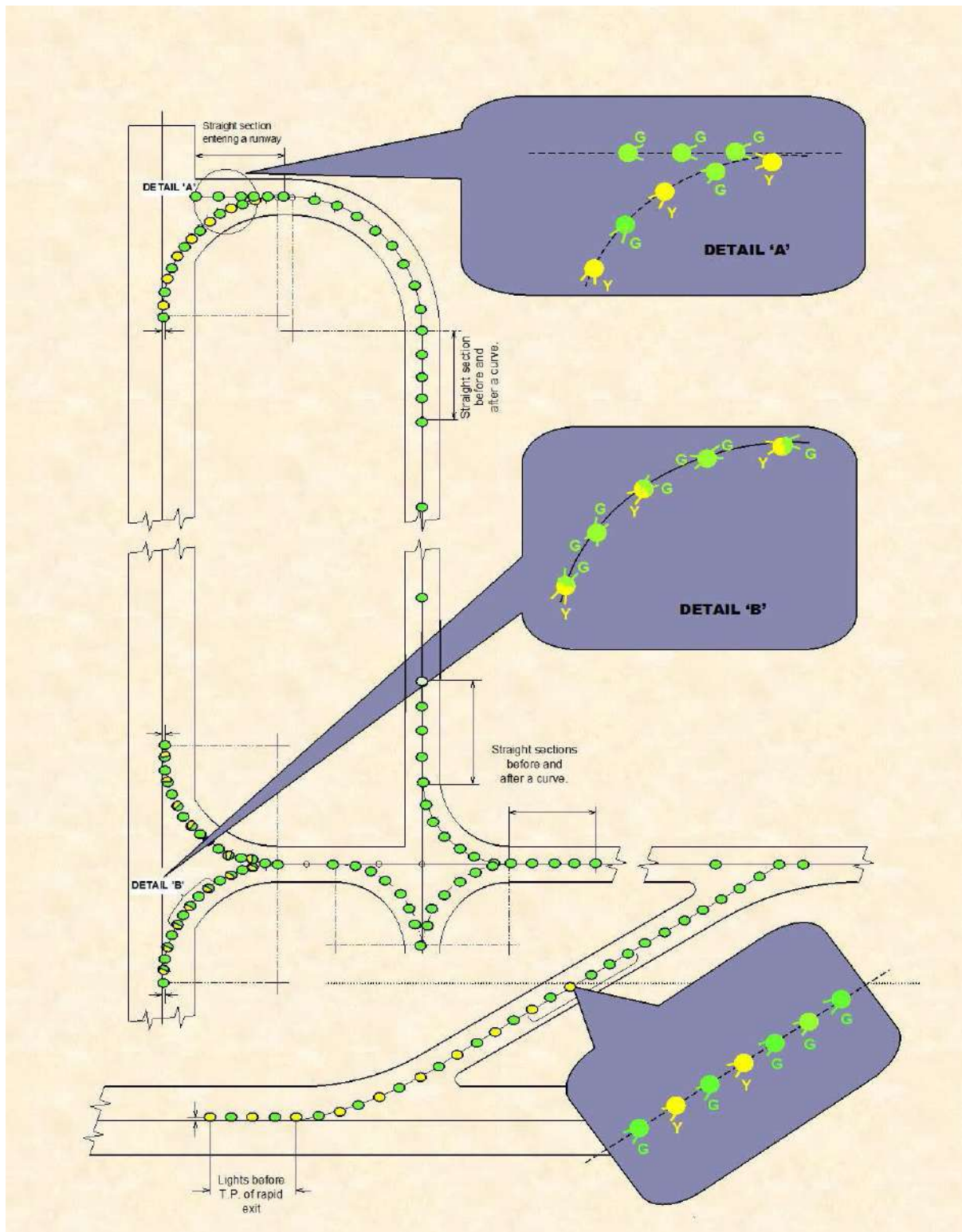


Figure 9.14-1: Typical Taxiway Centerline Lights Layout

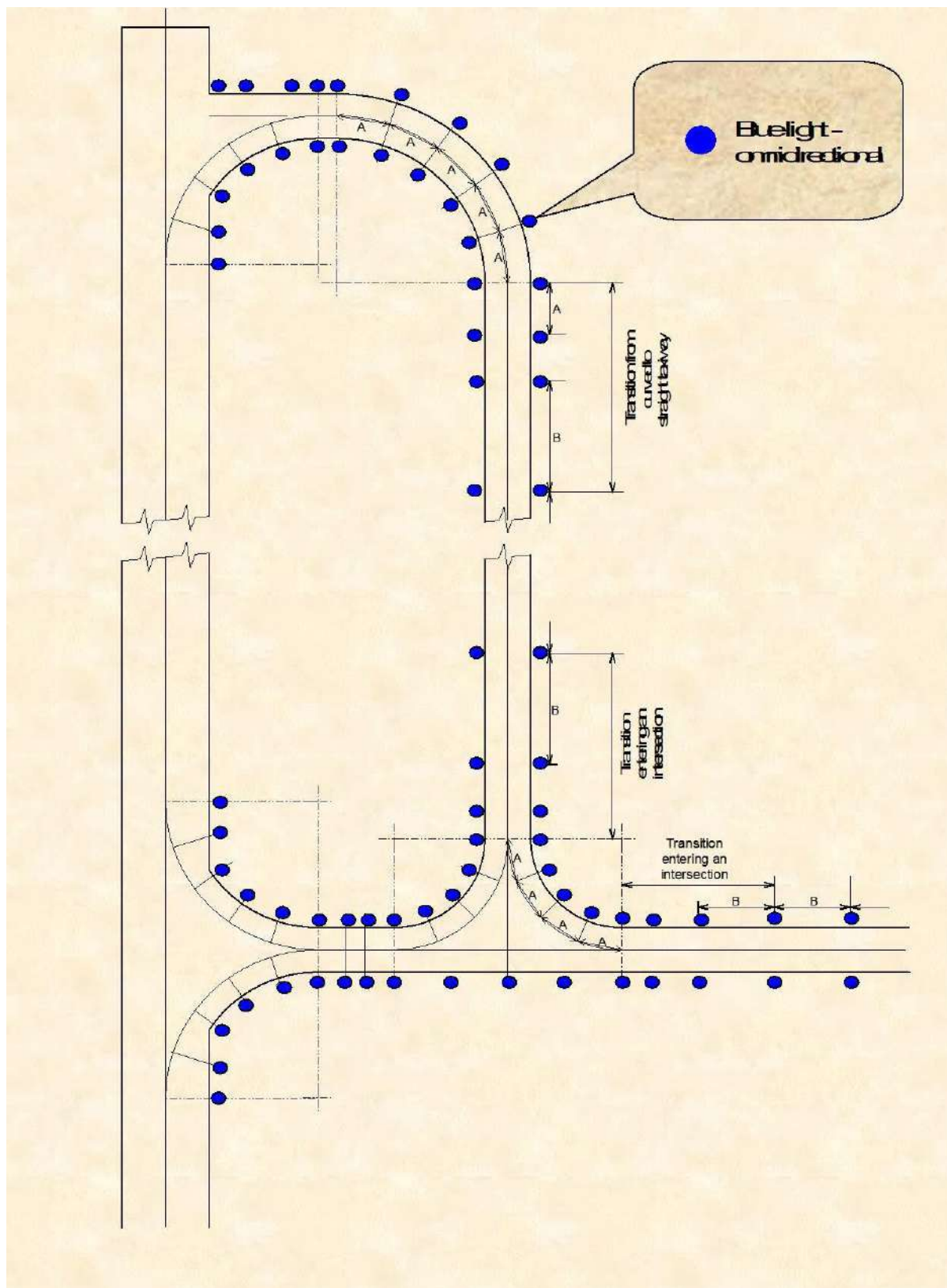


Figure 9.14-2: Typical Taxiway Edge Lights Layout

Section 9.15 Apron Floodlighting

9.15.1 Introduction

- 9.15.1.1 ICAO establishes only one apron floodlighting standard. For the purpose of this Section, aeroplanes bigger than code 3C are treated as larger aeroplanes. Code 3C aeroplanes and aeroplanes smaller than code 3C are treated as smaller aeroplanes.

Note: - This Section will use aeroplane size as the criterion for illuminance specification.

- 9.15.1.2 An existing floodlighting system on an apron currently used by larger aeroplanes which does not meet the specifications of this Section does not need to be replaced until the system is due for replacement, or until determined by CAAP based on a significant change in the usage of the apron by larger aeroplanes.

9.15.2 Provision of apron floodlighting

- 9.15.2.1 Apron floodlighting, in accordance with this Section, must be provided on an apron, or part of an apron and on a designated isolated aircraft parking position intended for use at night.

Note: - 1. The designation of an isolated aircraft parking position is specified in MOS 6.11.

Note: - 2. Guidance on apron floodlighting is given in the Aerodrome Design Manual (Doc 9157), Part 4.

9.15.3 Location of apron floodlighting

- 9.15.3.1 Apron floodlighting must be located so as to provide adequate illumination on all the apron service areas that are intended for use at night.

- 9.15.3.2 If an apron taxiway is not provided with taxiway lighting, then it must be illuminated by the apron floodlighting in accordance with either 9.15.4.3(b) or 9.15.4.4(b).

- 9.15.3.3 Apron floodlights must be located and shielded so that there is a minimum of direct or reflected glare to pilots of aircraft in flight and on the ground, air traffic controllers, and personnel on the apron.

Note: - See also MOS 9.21 in regard to upward component of light.

- 9.15.3.4 An aircraft parking position must receive, as far as practicable, apron floodlighting from two or more directions to minimize shadows.

Note: For apron floodlighting purpose, an aircraft parking position means a rectangular area subtended by the wing span and overall length of the largest aircraft that is intended to occupy that position.

- 9.15.3.5 Apron floodlighting poles or pylons must not penetrate the obstacle limitation surfaces.

9.15.4 Characteristics of apron floodlighting

9.15.4.1 To minimize the chance of an illuminated rotating object such as a propeller appearing stationary, at major aerodromes, the apron floodlighting is to be distributed across the phases of a three-phase power supply system to avoid a stroboscopic effect.

9.15.4.2 The spectral distribution of apron floodlights must be such that the colors used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified. Monochromatic lights must not to be used.

9.15.4.3 The average illuminance of an apron intended for larger aeroplanes must be:

- (a) at an aircraft parking position: (aircraft stand)
 - (i) for horizontal illuminance – 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
 - (ii) for vertical illuminance – 20 lux at a height of 2 m above the apron in the relevant parking direction, parallel to the aeroplane centerline;
- (b) at other apron areas:
 - (i) horizontal illuminance at 50 per cent of the average illuminance on the aircraft parking position with a uniformity ratio (average to minimum) of not more than 4 to 1.

Note: - The uniformity ratio between the average of all values of illuminance, measured over a grid covering the relevant area, and the minimum illuminance within the area. A 4:1 ratio does not necessarily mean a minimum of 5 lux. If an average illuminance of say 24 lux is achieved, then the minimum should be not less than $24/4 = 6$ lux.

9.15.4.4 The average illuminance of an apron intended to be used only by smaller aeroplanes must be at least as follows:

- (a) at an aircraft parking position (aircraft stand):
 - (i) for horizontal illuminance – 5 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
 - (ii) for vertical illuminance – 5 lux at a height of 2 m above the apron in the relevant parking direction, parallel to the aeroplane centerline;
- (b) at other apron areas:
 - (i) horizontal illuminance graded to a minimum of 1 lux at the apron extremities or 2 lux for apron edge taxiways which do not have taxiway lights.

9.15.4.5 A dimming control may be provided to allow the illuminance of an aircraft parking position on an active apron that is not required for aircraft use to be reduced to not less than 50 per cent of its normal values.

9.15.4.6 For aprons used by larger aeroplanes, the apron floodlighting must:

- (a) be included in the aerodrome secondary power supply system; and

- (b) be capable, following a power interruption of up to 30 seconds, of being re-lit and achieving not less than 50 per cent of normal illuminance within 60 seconds.

9.15.4.7 If existing floodlights cannot meet the requirement of paragraph 9.15.4.6, auxiliary floodlighting must be provided that can immediately provide at least 2 lux of horizontal illuminance of aircraft parking positions. This auxiliary floodlighting must remain on until the main lighting has achieved 80 per cent of normal illuminance.

Section 9.16 Visual Docking Guidance Systems

9.16.1 Provision of visual docking guidance systems

9.16.1.1 A visual docking guidance system must be provided at an apron aircraft parking position equipped with a passenger loading bridge, where the characteristics of the passenger loading bridge require precise positioning of an aircraft./ and other alternative means, such as marshallers, are not practicable.

Note: - The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for maneuvering into the parking position due to aircraft servicing installation, passenger loading bridges, etc. See the Aerodrome Design Manual (Doc 9157), Part 4 — Visual Aids for guidance on the selection of suitable systems.

9.16.1.2 The provisions of this Section do not, of themselves, require the replacement of existing installations. When existing installations are to be replaced due to obsolescence, facility upgrade, change of apron layout, change of passenger loading bridge, change of aircraft category, change of operational requirements, or similar reasons, all new and/or replacement visual docking guidance systems must comply with this Section.

9.16.2 Characteristics of visual docking guidance systems

9.16.2.1 The system must provide both azimuth and stopping guidance.

9.16.2.2 The azimuth guidance unit and the stopping position indicator must be adequate for use in all weather, visibility, background lighting, and pavement conditions for which the system is intended, both by day and night, but must not dazzle the pilot.

Note: - Care is required in both the design and on-site installation of the system to ensure that reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

9.16.2.3 The azimuth guidance unit and the stopping position indicator must be of a design such that:

- (a) a clear indication of malfunction of either or both is available to the pilot; and
- (b) they can be turned off.

- 9.16.2.4 The azimuth guidance unit and the stopping position indicator must be located in such a way that there is continuity of guidance between the aircraft parking position markings, the aircraft stand Maneuvering guidance lights, if present, and the visual docking guidance system.
- 9.16.2.5 The accuracy of the system must be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.
- 9.16.2.6 The system must be usable by all types of aircraft for which the aircraft parking position is intended, preferably without selective operation.
- 9.16.2.7 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system must provide an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly

9.16.3 Azimuth Guidance Unit - location

- 9.16.3.1 The azimuth guidance unit must be located on or close to the extension of the parking position centerline ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking maneuver and aligned for use at least by the pilot occupying the left seat.
- 9.16.3.2 Systems with azimuth guidance aligned for use by the pilots occupying both the left and right seats are acceptable.

9.16.4 Azimuth Guidance Unit - characteristics

- 9.16.4.1 The azimuth guidance unit must provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over controlling.
- 9.16.4.2 When azimuth guidance is indicated by color change, green must be used to identify the centerline and red for deviations from the centerline.

9.16.5 Stopping Position Indicator - location

- 9.16.5.1 The stopping position indicator must be located in conjunction with, or sufficiently close to, the azimuth guidance unit so that a pilot can observe both the azimuth and stop signals without turning the head.
- 9.16.5.2 The stopping position indicator must be usable at least by the pilot occupying the left seat.
- 9.16.5.3 Systems with stopping position indicator usable by the pilots occupying both the left and right seats are acceptable.

9.16.6 Stopping Position Indicator - characteristics

- 9.16.6.1 The stopping position information provided by the indicator for a particular aircraft type must account for the anticipated range of variations in pilot eye height and/or viewing angle.

- 9.16.6.2 The stopping position indicator must show the stopping position of the aircraft for which the guidance is being provided, and must provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.
- 9.16.6.3 The stopping position indicator must provide closing rate information over a distance of at least 10 m.
- 9.16.6.4 When stopping guidance is indicated by color change, green must be used to show that the aircraft can proceed and red to show that the stop point has been reached except that for a short distance prior to the stopping point a third color may be used to warn that the stopping point is close.

9.16.7 Parking position identification sign

- 9.16.7.1 A parking position identification sign must be provided at an aircraft parking position equipped with a visual docking guidance system.
- 9.16.7.2 A parking position identification sign must be located so as to be clearly visible from the cockpit of an aircraft prior to entering the parking position.
- 9.16.7.3 A parking position identification sign is to consist of a numeric or alphanumeric inscription, in black on a yellow background. When a parking position is to be used at night the identification sign shall be illuminated by a continuous line of green light outlining the inscription.
Note: - Green neon tubing illumination is satisfactory.

9.16.8 Notification of type of aircraft docking guidance systems

- 9.16.8.1 Due to the large variety of different type of visual docking guidance systems to be found in operation at aerodromes, information on particular types installed is to be published in aeronautical information publications for use by pilots.
- 9.16.8.2 Aerodrome operators must notify CAAP of the details of their aircraft docking guidance system intended for use for International operations.
- 9.16.8.3 The visual docking guidance system information must be recorded in the Aerodrome Manual. The information to be provided is to include:
- (a) type of visual docking guidance system;
 - (b) descriptive information, including illustrations where appropriate, for any type of installed system; and
 - (c) parking positions at which the system is installed.
- 9.16.8.4 Notification about the details of visual docking systems must be made to AIS in accordance with Chapter 5, Aerodrome Information for AIP and Chapter 10, Operating Standards for Certified Aerodromes.

Section 9.17 Lighting associated with closed and unserviceable areas**9.17.1 Closed runway or taxiway**

9.17.1.1 When a runway or taxiway, or portion thereof is closed, all aerodrome lighting thereon is to be extinguished. The lighting is to be electrically isolated or disabled, to prevent inadvertent activation of the lights.

Note: - 1. Restricted operation of the lights is permissible for maintenance or related purposes.

Note: - 2. It is acceptable for short time periods, to cover lights with an opaque cover provided that:

- (a) the cover is firmly attached to the ground, so that it cannot be unintentionally dislodged; and*
- (b) the cover, and its means of attachment to the ground, do not pose a hazard to aircraft, and do not constitute an object that is not lightweight and frangible.*

9.17.1.2 Where a closed runway, taxiway, or portion thereof, is intercepted by a useable runway or taxiway which is used at night, unserviceability lights are to be placed across the entrance to the closed area at intervals not exceeding 3 m.

9.17.2 Unserviceable areas

9.17.2.1 When any portion of a taxiway, apron, or holding bay is unfit for movement of aircraft, but it is still possible for aircraft to bypass the area safely, and the movement area is used at night, unserviceability lights are to be used.

9.17.2.2 The lights are to be placed at intervals sufficiently close so as to delineate the unserviceable area and, in any case, must not be more than 7.5 m apart.

9.17.3 Characteristics of unserviceability lights

9.17.3.1 Unserviceability lights are to be steady red lights.

9.17.3.2 The lights are to have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which they would normally be viewed. In no case is the intensity to be less than 10 cd of red light.

Section 9.18 Other Lights on an Aerodrome**9.18.1 Vehicle warning lights**

9.18.1.1 Vehicle warning lights, as required by MOS 10.9.2, are provided to indicate to pilots and others the presence of moving vehicles or equipment on the movement area.

9.18.1.2 A vehicle warning light or lights must be mounted on the top of the vehicle, so as to provide 360° visibility.

9.18.1.3 The lights must be amber/yellow/orange, and be flashing or rotating of a type acceptable to CAAP.

Note: - International experience has shown the following specification to be particularly suitable. Yellow light, with a flash rate of between 60 and 90 flashes per minute, with a peak intensity of between 40 cd and 400 cd, a vertical beam spread of 12°, and with the peak intensity located at approximately 2.5° vertical.

- 9.18.1.4 For emergency or security vehicles not dedicated to aerodrome use, vehicle warning lights complying with the local traffic code are acceptable for on aerodrome operation.

9.18.2 Works limit lights

- 9.18.2.1 Works limit lights are provided to indicate to persons associated with the works organization the limit of the works area.
- 9.18.2.2 Works limit lights must be portable, amber/yellow/orange lights of a standard type commercially available as works warning lights.

9.18.3 Road holding position lights / Road and Car Park Lighting

- 9.18.3.1 A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m.

- 9.18.3.2 A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m.

- 9.18.3.3 A road-holding position light shall be located adjacent to the holding position marking 1.5 m (± 0.5 m) from one edge of the road, i.e. left or right as appropriate to the local traffic regulations.

Note: - See MOS 11.1.1 for the mass and height limitations and frangibility requirements of navigation aids located on runway strips.

- 9.18.3.4 The road-holding position light shall comprise:
- (a) a controllable red (stop)/green (go) traffic light; or
 - (b) a flashing-red light.

Note: - It is intended that the lights specified in sub-paragraph a) be controlled by the air traffic services.

- 9.18.3.5 The road-holding position light beam shall be unidirectional and aligned so as to be visible to the driver of a vehicle approaching the holding position.

- 9.18.3.6 The intensity of the light beam shall be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended, but shall not dazzle the driver.

Note: - The commonly used traffic lights are likely to meet the requirements in MOS 9.18.3.5 and 9.18.3.6.

- 9.18.3.7 The flash frequency of the flashing-red light shall be between 30 and 60 flashes per minute.

9.18.3.8 CAAP does not regulate the lighting of roads and car parks, other than ensuring compliance with MOS 9.20.

9.18.3.9 Where road and car park lighting is required on an aerodrome, aerodrome operator is advised to consult with the relevant local road authority.

9.18.4 Lights which may endanger the safety of aircraft

9.18.4.1 A non-aeronautical ground light near an aerodrome which might endanger the safety of aircraft shall be extinguished, screened or otherwise modified so as to eliminate the source of danger.

9.18.4.2 Laser emissions which may endanger the safety of aircraft

(a) To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones shall be established around aerodromes:

- (i) a laser-beam free flight zone (LFFZ);
- (ii) a laser-beam critical flight zone (LCFZ);
- (iii) a laser-beam sensitive flight zone (LSFZ).

Note: - 1. MOS Figures 9.20-1, 9.20-2 and 9.20-3 must be used to determine the exposure levels and distances that adequately protect flight operations.

Note: - 2. The restrictions on the use of laser beams in the three protected flight zones, LFFZ, LCFZ and LSFZ, refer to visible laser beams only. Laser emitters operated by the authorities in a manner compatible with flight safety are excluded. In all navigable airspace, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE) unless such emission has been notified to the authority and permission obtained.

Note: - 3. The protected flight zones are established in order to mitigate the risk of operating laser emitters in the vicinity of aerodromes.

Note: - 4. Further guidance on how to protect flight operations from the hazardous effects of laser emitters is contained in the Manual on Laser Emitters and Flight Safety (Doc 9815).

Note: - 5. See also CAR-ANS Part 11.2 — Air Traffic Services.

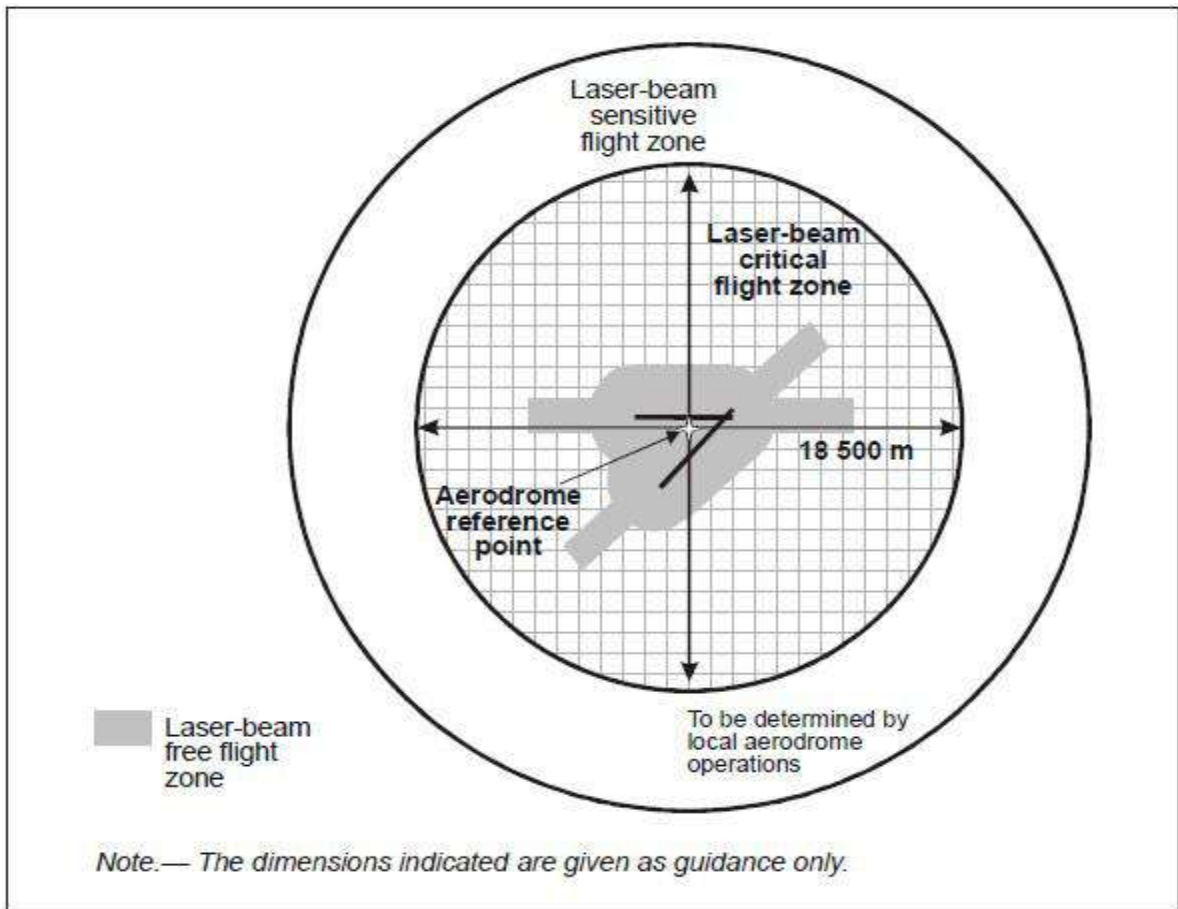


Figure 9.20-1: Protected flight zones

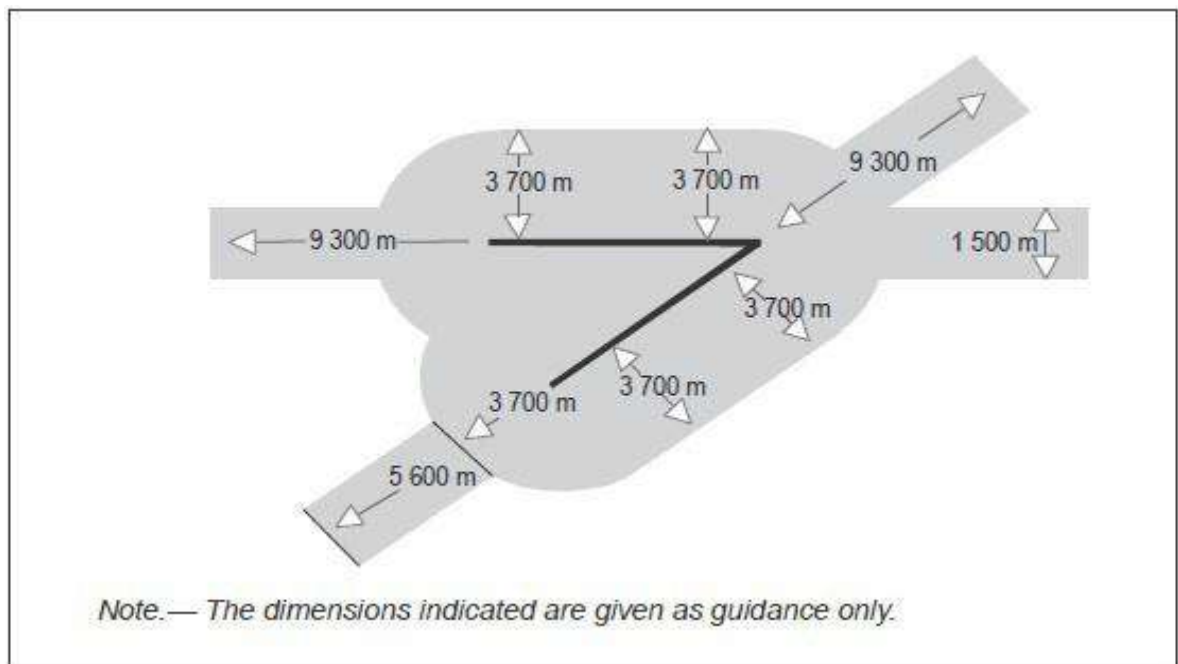


Figure 9.20-2: Multiple runway laser-beam free flight zone

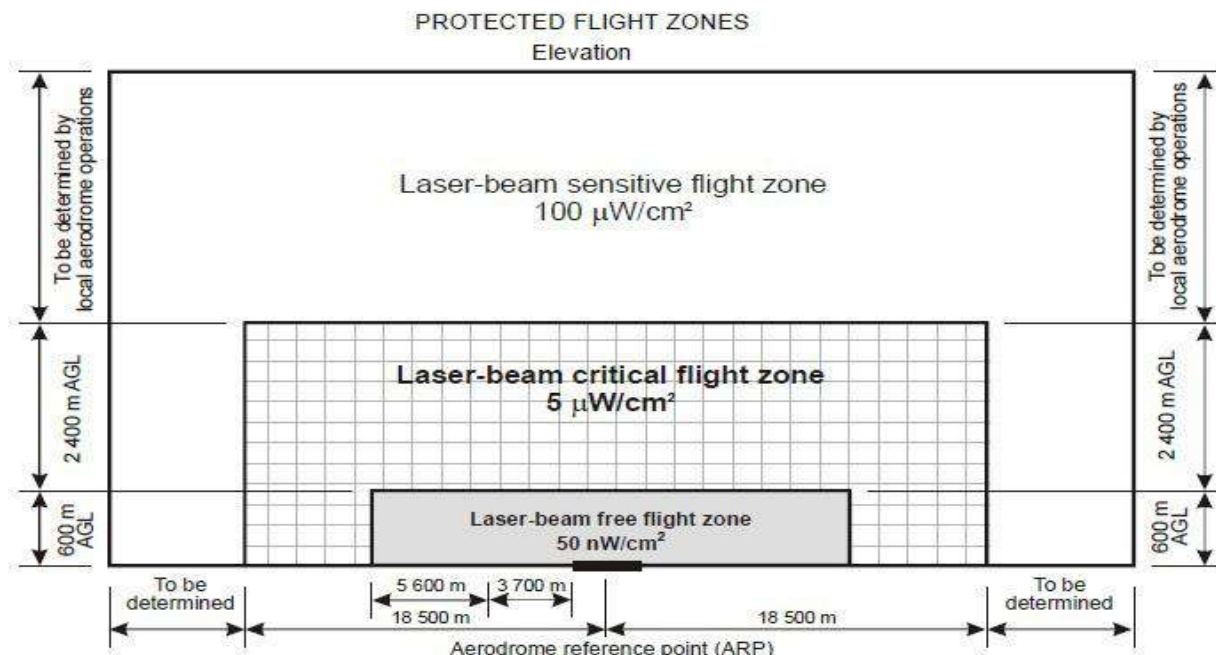


Figure 9.20-3: Protected flight zones with indication of maximum irradiance levels for visible laser beams

9.18.4.3

Lights which may cause confusion

- (a) A non-aeronautical ground light which, by reason of its intensity, configuration or color, might prevent, or cause confusion in, the clear interpretation of aeronautical ground lights shall be extinguished, screened or otherwise modified so as to eliminate such a possibility. In particular, attention shall be directed to a non-aeronautical ground light visible from the air within the areas described hereunder:
 - (i) Instrument runway — code number 4:
within the areas before the threshold and beyond the end of the runway extending at least 4500 m in length from the threshold and runway end and 750 m either side of the extended runway centerline in width.
 - (ii) Instrument runway — code number 2 or 3:
as in a), except that the length shall be at least 3000 m.
 - (iii) Instrument runway — code number 1; and non-instrument runway:
within the approach area

Note: - Aerodrome operators shall liaise with local electricity and planning authorities, so that they can be alerted of lighting proposals in the vicinity of their aerodromes. Proposals for lighting roadways are particularly of concern.

- b) Aeronautical ground lights which may cause confusion to mariners

Note:- In the case of aeronautical ground lights near navigable waters, consideration needs to be given to ensuring that the lights do not cause confusion to mariners.

- (c) Light fixtures and supporting structures

Note: - 1. See MOS 11.1.1 for information regarding siting of equipment and installations on operational areas, and the Aerodrome Design Manual (Doc 9157), Part 6, for guidance on frangibility of light fixtures and supporting structures.

Note: - 2. See also MOS 9.1.11 for detailed information on light fixtures and supporting structures.

- 9.18.4.4 An existing or proposed non-aeronautical ground light in the vicinity of an aerodrome, must be notified to the relevant CAAP office for a safety assessment.

Section 9.19 Monitoring, Maintenance and Serviceability of Aerodrome Lighting

9.19.1 General

- 9.19.1.1 The aerodrome operator must monitor and maintain all lights and lighting systems associated with the aerodrome visual ground aids, both day and night, on a continuing basis for correctness and so that they are easily seen. Monitoring of lighting systems such as T-VASIS, PAPI and approach lighting must be carried out in accordance with the frequencies and procedures set out in the Aerodrome Manual. Other aerodrome lights must be monitored during the daily serviceability inspections and they must be switched on for this purpose.

- 9.19.1.2 Grass areas around lights must be maintained such that the lights are not in any way obscured. Lights must be kept free from dirt so as not to degrade their color and conspicuousness. Damage to lights, including loss or degradation of light must be made good.

9.19.2 Reporting of aerodrome lighting outage

- 9.19.2.1 Any aerodrome light outage detected must be fixed as soon as is practicable. The specifications below are intended to define the maintenance performance levels objectives. They are not intended to define whether the lighting system is out of service. Nor are they meant to condone outage but are intended to indicate when lighting outage must be notified to the NOTAM Office. The specifications must be used as triggers for NOTAM action to advise pilots of actual outage, unless the outage can be rectified before the next period of use.

- 9.19.2.2 For details of the raising of NOTAMs, refer to MOS 10.3.

- 9.19.2.3 A light is deemed to be on outage when the main beam is out of its specified alignment or when the main beam average intensity is less than 50 per cent of the specified value. For light units where the designed main beam average intensity is above the specified value, the 50 per cent value shall be related to that design value.

Note: - For existing installations where the design main beam average intensity values are unknown and/or unobtainable, the 50 per cent value shall be related to the specified value.

- 9.19.2.4 A flashing or occulting light is deemed to be on outage when:
- (a) the light ceases to flash or occult; or

- (b) the frequency and/or duration of flash is outside the specified range by a factor of 2 to 1 or greater; or
- (c) within a 10 minute period, more than 20% of flashes fail to occur.

9.19.2.5

A lighting system is deemed to be on outage when:

- (a) in the case of a lighting system comprising less than 4 lights (e.g. intermediate holding position lights or runway threshold identification lights), any of the lights are on outage;
- (b) in the case of a lighting system comprising 4 or 5 lights (e.g. wind direction indicator lights or runway guard lights), more than 1 light is on outage;
- (c) in the case of a lighting system comprising 6 to 13 lights (e.g. threshold lights), more than 2 lights are on outage, or 2 adjacent lights are on outage;
- (d) in the case of a lighting system comprising more than 13 lights, more than 15% of the lights are on outage, or two adjacent lights are on outage.

Note: - A lighting system here means lights used to illuminate a particular facility, e.g. all the lights used to mark a threshold or runway end, runway edge lights on a runway, taxiway lights on a length of taxiway between intersections, a T-VASIS or a PAPI system.

9.19.2.6

For a T-VASIS, the outage standards take into account both the number of outage lamps within a light unit, and also the number of light units within the T-VASIS system. The standards are:

- (a) A T-VASIS light unit is deemed on outage when 3 or more lamps in the electrical (day) circuit are on outage, or when any of the lamps in the electrical (night) circuit is on outage.
- (b) A T-VASIS system is deemed on outage when:
 - (i) bar units — more than 2 light units or two adjacent light units are on outage;
 - (ii) fly-up units — more than 1 light unit are on outage;
 - (iii) fly-down units — more than 1 light unit are on outage.
- (c) An AT-VASIS system is deemed on outage when:
 - (i) bar units — more than 1 light unit is on outage, or
 - (ii) fly-up units — any light unit is on outage, or
 - (iii) fly-down units — any light unit is on outage.
- (d) Whenever a red filter has deteriorated such that it does not produce the correct color light beam, is missing or is damaged, all the lamps within the affected light unit must be extinguished until the red filter is rectified. The affected light unit is included as an outage light unit when applying (b) or (c) above.

9.19.2.7

For a PAPI, the outage standards take into account both the number of lamps on outage within a light unit, and also the number of light units within the PAPI system. The standards are:

- (a) A PAPI light unit is deemed on outage when more than 1 lamp in a 3-or more lamp light unit is on outage, or any lamp in a less-than-3-lamp light unit is on outage.
- (b) Whenever a red filter has deteriorated such that the correct color is not showing, is missing or is damaged; all the lamps associated with that filter must be extinguished until the red filter is rectified. The affected lamps are included in outage when determining (a) above.
- (c) A double-sided PAPI system (i.e. 8 light units) is:
 - (i) deemed on outage but useable when all light units in one bar are fully functioning, and any light units in the other wing bar are on outage. The system must remain in use, but a NOTAM must be issued, detailing the number of lights on outage and on which side the outage has occurred; and
 - (ii) deemed on outage when one or more lights in each wing bar is on outage. The double-sided PAPI must be extinguished until the system is rectified.
- (d) A single-sided PAPI system (i.e. 4 light units) is deemed on outage when any light unit is on outage. The PAPI system must not be used in normal service until the deficiency is rectified.

9.19.2.8 At an aerodrome where the lighting system is provided with interleaf circuitry, the lighting system is deemed to be on outage when any one of the circuits fails.

Section 9.20 Lighting in the vicinity of aerodromes (Guidance for Designers and Installation contractors)

9.20.1 General requirement

9.20.1.1 Advice for the guidance of designers and installation contractors is provided for situations where lights are to be installed within a 6 km radius of a known aerodrome. Lights within this area fall into a category most likely to be subjected to the provisions of CAR-Aerodromes Within this large area there exists a primary area which is divided into four light control zones: A, B, C and D. These zones reflect the degree of interference ground lights can cause as a pilot approaches to land.

9.20.1.2 The primary area is shown in MOS Figure 9.20-4. This drawing also nominates the intensity of light emission above which interference is likely. Lighting projects within this area shall be closely examined to see they do not infringe the provision of CAR-Aerodromes.

9.20.1.3 The fact that a certain type of light fitting already exists in an area is not necessarily an indication that more lights of the same type can be added to the same area.

9.20.1.4 Even though a proposed installation is designed to comply with the zone intensities shown in MOS Figure 9.20-4, designers are advised to consult with CAAP as there must be overriding factors which require more restrictive controls to avoid conflict.

9.20.2 Light fittings

- 9.20.2.1 Light fittings chosen for an installation shall have their isocandela diagram examined to ensure the fitting will satisfy the zone requirements. In many cases the polar diagrams published by manufacturers do not show sufficient detail in the sector near the horizontal, and therefore careful reference shall be made to the isocandela diagram.
- 9.20.2.2 For installations where the light fittings are selected because their graded light emission above horizontal conform with the zone requirement, no further modification is required.
- 9.20.2.3 For installations where the light fitting does not meet the zone requirements, then a screen shall be fitted to limit the light emission to zero above the horizontal. The use of a screen to limit the light to zero above the horizontal is necessary to overcome problems associated with movement of the fitting in the wind or misalignment during maintenance.

9.20.3 Colored lights

- 9.20.3.1 Colored lights are likely to cause conflict irrespective of their intensity as colored lights are used to identify different aerodrome facilities. Proposals for colored lights shall be referred to the CAAP for detailed guidance.

MAXIMUM INTENSITY OF LIGHT
SOURCES MEASURED AT 3°
ABOVE THE HORIZONTAL

ZONE A	0 cd
ZONE B	50 cd
ZONE C	150 cd
ZONE D	450 cd

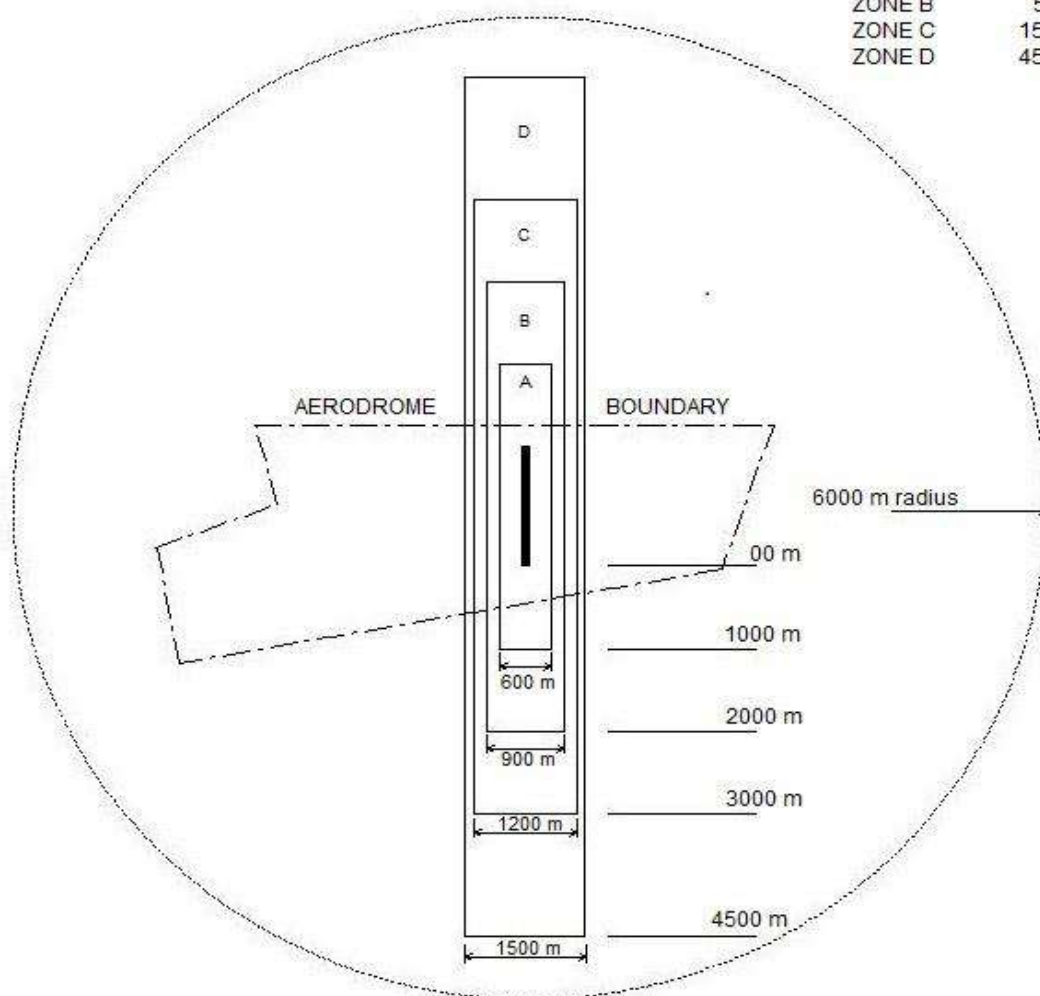


Figure 9.20-4: Maximum lighting intensities

Section 9.21 Circling guidance lights

- 9.21.1.1 Circling guidance lights should be provided when existing approach and runway lighting systems do not satisfactorily permit identification of the runway and/or approach area to a circling aircraft in the conditions for which it is intended the runway be used for circling approaches.
- 9.21.1.2 The location and number of circling guidance lights should be adequate to enable a pilot, as appropriate, to:
- join the downwind leg or align and adjust the aircraft's track to the runway at a required distance from it and to distinguish the threshold in passing; and

- (b) keep in sight the runway threshold and/or other features which will make it possible to judge the turn on to base leg and final approach, taking into account the guidance provided by other visual aids.

9.21.1.3 Circling guidance lights should consist of:

- (a) lights indicating the extended centerline of the runway and/or parts of any approach lighting system; or
 - (b) lights indicating the position of the runway threshold; or
 - (c) lights indicating the direction or location of the runway;
- or a combination of such lights as is appropriate to the runway under consideration.

Note: - Guidance on installation of circling guidance lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

9.21.1.4 Circling guidance lights should be fixed or flashing lights of an intensity and beam spread adequate for the conditions of visibility and ambient light in which it is intended to make visual circling approaches. The flashing lights should be white, and the steady lights either white or gaseous discharge lights.

9.21.1.5 The lights should be designed and be installed in such a manner that they will not dazzle or confuse a pilot when approaching to land, taking off or taxiing.

Section 9.22 Advanced visual docking guidance system

Note: - 1. Advanced visual docking guidance systems (A-VDGS) include those systems that, in addition to basic and passive azimuth and stop position information, provide pilots with active (usually sensor-based) guidance information, such as aircraft type indication (in accordance with Doc 8643 - Aircraft Type Designators), distance-to-go information and closing speed. Docking guidance information is usually provided on a single display unit.

Note: - 2. An A-VDGS may provide docking guidance information in three stages: the acquisition of the aircraft by the system, the azimuth alignment of the aircraft, and the stopping position information.

9.22.1.1 An A-VDGS shall be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand centerline in use, where more than one is provided for.

9.22.1.2 The A-VDGS shall be suitable for use by all types of aircraft for which the aircraft stand is intended.

9.22.1.3 The A-VDGS shall be used only in conditions in which its operational performance is specified.

Note: - 1. The use of the A-VDGS in conditions such as weather, visibility and background lighting, both by day and night, would need to be specified.

Note: - 2. Care is required in both the design and on-site installation of the system to ensure that glare, reflection of sunlight, or other light in the vicinity,

does not degrade the clarity and conspicuity of the visual cues provided by the system.

9.22.1.4 The docking guidance information provided by an A-VDGS shall not conflict with that provided by a conventional visual docking guidance system on an aircraft stand if both types are provided and are in operational use. A method of indicating that the A-VDGS is not in operational use or is unserviceable shall be provided.

9.22.1.5 The A-VDGS shall be located such that unobstructed and unambiguous guidance is provided to the person responsible for, and persons assisting, the docking of the aircraft throughout the docking maneuver.

Note: - Usually the pilot-in-command is responsible for the docking of the aircraft. However, in some circumstances, another person could be responsible and this person may be the driver of a vehicle that is towing the aircraft.

9.22.1.6 The A-VDGS shall provide, at minimum, the following guidance information at the appropriate stage of the docking maneuver:

- (a) an emergency stop indication;
- (b) the aircraft type and model for which the guidance is provided;
- (c) an indication of the lateral displacement of the aircraft relative to the stand centerline;
- (d) the direction of azimuth correction needed to correct a displacement from the stand centerline;
- (e) an indication of the distance to the stop position;
- (f) an indication when the aircraft has reached the correct stopping position; and
- (g) a warning indication if the aircraft goes beyond the appropriate stop position.

9.22.1.7 The A-VDGS shall be capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking maneuver.

Note: - See the Aerodrome Design Manual (Doc 9157), Part 4, for an indication of the maximum aircraft speeds relative to distance to the stopping position.

9.22.1.8 The time taken from the determination of the lateral displacement to its display shall not result in a deviation of the aircraft, when operated in normal conditions, from the stand centerline greater than 1 m.

9.22.1.9 The information on displacement of the aircraft relative to the stand centerline and distance to the stopping position, when displayed, shall be provided with the accuracy specified in Table 9.22-1.

9.22.1.10 Symbols and graphics used to depict guidance information shall be intuitively representative of the type of information provided.

Note: - The use of color would need to be appropriate and need to follow signal convention, i.e. red, yellow and green mean hazard, caution and normal/correct conditions, respectively. The effects of color contrasts would also need to be considered.

- 9.22.1.11 Information on the lateral displacement of the aircraft relative to the stand centerline shall be provided at least 25 m prior to the stop position.
Note: - The indication of the distance of the aircraft from the stop position may be color-coded and presented at a rate and distance proportional to the actual closure rate and distance of the aircraft approaching the stop point.
- 9.22.1.12 Continuous closure distance and closure rate shall be provided from at least 15 m prior to the stop position.
- 9.22.1.13 Where provided, closure distance displayed in numerals should be provided in meter integers to the stop position and displayed to 1 decimal place at least 3 m prior to the stop position.
- 9.22.1.14 Throughout the docking maneuver, an appropriate means shall be provided on the A-VDGS to indicate the need to bring the aircraft to an immediate halt. In such an event, which includes a failure of the A-VDGS, no other information shall be displayed.
- 9.22.1.15 Provision to initiate an immediate halt to the docking procedure shall be made available to personnel responsible for the operational safety of the stand.
- 9.22.1.16 The word “stop” in red characters should be displayed when an immediate cessation of the docking maneuver is required.

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at 9 m from stop position	Maximum deviation at 15 m from stop position	Maximum deviation at 25 m from stop position
Azimuth	±250 mm	±340 mm	±400 mm	±500 mm
Distance	±500 mm	±1 000 mm	±1 300 mm	Not specified

Table 9.22-1. A-VDGS recommended displacement accuracy**Section 9.23 Aircraft stand maneuvering guidance lights**

- 9.23.1.1 Aircraft stand maneuvering guidance lights shall be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron or on a de-icing/anti-icing facility intended for use in poor visibility conditions, unless adequate guidance is provided by other means.
- 9.23.1.2 Aircraft stand maneuvering guidance lights shall be collocated with the aircraft stand markings.
- 9.23.1.3 Aircraft stand maneuvering guidance lights, other than those indicating a stop position, shall be fixed yellow lights, visible throughout the segments within which they are intended to provide guidance.
- 9.23.1.4 The lights used to delineate lead-in, turning and lead-out lines shall be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.

- 9.23.1.5 The lights indicating a stop position shall be fixed unidirectional lights showing red.
- 9.23.1.6 The intensity of the lights shall be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.
- 9.23.1.7 The lighting circuit shall be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.



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CHAPTER 10 Operating standards for certified aerodromes and Aerodrome Registration Type 1

Section 10.1 General

10.1.1.1 This chapter sets out the standards to be incorporated in operating procedures at certified aerodromes and Aerodrome Registration Type 1, including those procedures to be documented in the aerodrome manual.

10.1.1.2 This chapter also contains information on aerodrome Safety Management System (SMS). As prescribed in CAR-Aerodromes, an acceptable SMS shall be provided at certified aerodromes and aerodrome requiring Aerodrome Registration Type 1. Other aerodrome operators are encouraged to adopt SMS.

10.1.1.3 The standards are to be applied in a manner commensurate with the type and level of aircraft activities at the particular aerodrome. For example, MOS 10.17 on low visibility operations may not apply to all aerodromes.

10.1.2 Aerodrome Manual and Aerodrome operating procedures

10.1.2.1 As an integral part of the certification process, an aerodrome manual must be prepared for aerodromes to be certified and aerodromes requiring Aerodrome Registration Type 1. The manual is the mechanism used for setting out a range of information and operating procedures as specified in CAR-Aerodromes.

10.1.2.2 The aerodrome manual shall be in a format that can be readily updated.

10.1.2.3 The contents of the aerodrome manual may be presented in a single compiled document or in a number of separate documents. For example, at major aerodromes, the aerodrome emergency plan and the airside vehicle control handbook may each be a stand-alone publication. Where this is the case, the aerodrome manual must effectively integrate the component publications by appropriate references.

10.1.2.4 An up-to-date copy of the aerodrome manual and all of its components (if any) must be kept at the business premises of the aerodrome operator and made available for CAAP audit purposes.

10.1.3 Training of aerodrome personnel involved with safety functions

10.1.3.1 Persons engaged to perform the reporting functions, including aerodrome serviceability inspections, and other safety functions must be adequately trained for such tasks.

10.1.3.2 CAAP is primarily concerned with the competency of persons involved with aerodrome safety functions. Essential competencies will include:

- (a) inspecting and reporting on the physical characteristics and conditions of the aerodrome;
- (b) inspecting and reporting on aerodrome lighting systems;

- (c) inspecting and reporting on the OLS;
- (d) initiating a NOTAM;
- (e) utilizing radio telephony (R/T) equipment, and
- (f) supervising the safety of aerodrome works.

10.1.3.3 There are no mandatory provisions which regulate private training organizations or aerodrome operator training initiatives but aerodrome operators must be able to demonstrate that persons carrying out aerodrome safety functions have had the appropriate training and experience to undertake those functions.

Note: - Guidance on the training of aerodrome personnel can be found in the associated Advisory Circular.

10.1.4 Aerodrome Safety Management System (SMS)

10.1.4.1 A safety management system (SMS) is a systematic approach to managing safety at an aerodrome that must include the organizational structures, accountabilities, policies, procedures and documentation required by this section to manage safety in a continuous and systematic way.

10.1.4.2 The SMS shall be one that permeates throughout the aerodrome operator organization, and be implemented through a continuing safety program based on a coherent policy that leads to well-designed work procedures. The SMS shall also extend to include interfaces between the aerodrome operator and its suppliers, sub-contractors, agents, business partners and other relevant external service providers.

10.1.4.3 The SMS shall focus principally on the hazards associated with the operation of the aerodrome and their effects upon those activities critical to safety. Active monitoring and auditing processes shall be applied to validate that the necessary controls identified through the hazard management process are effectively put in place so as to ensure continuing active commitment to safety and to achieve continuous improvement in safety performance.

10.1.4.4 The safety management system required under CAR-Aerodrome sections 2.2.225 and 2.3.015 in respect of an applicant for, or a holder of, an airport certificate and Aerodrome Registration type 1.

Note: - Further guidance is available through CAAP Advisory Circular (AC) AC SMS-MNL-01: Development of an SMS Manual, as existing from time to time and freely available on the CAAP website.

10.1.5 Framework for Aerodrome Safety Management System

10.1.5.1 An aerodrome operator shall implement a SMS frame work which commensurate with the size of the airport and the complexity of the services provided. The SMS framework shall include, as a minimum, the following twelve elements:

- A. Safety policy and objectives
 - A-1 Management commitment and responsibility

- (a) An aerodrome operator shall define its safety policy. The safety policy shall:
 - (i) reflect organizational commitment regarding safety, including the promotion of a positive safety culture;
 - (ii) include a clear statement about the provision of the necessary resources for the implementation of the safety policy;
 - (iii) include safety reporting procedures;
 - (iv) clearly indicate which types of behaviors are unacceptable related to the aerodrome operator's activities and include the circumstances under which disciplinary action would not apply;
 - (v) be signed by the accountable executive;
 - (vi) Be communicated, with visible endorsement, throughout the organization; and
 - (vii) be periodically reviewed to ensure it remains relevant and appropriate to the aerodrome operator.
- (b) Taking due account of its safety policy, an aerodrome operator shall define its safety objectives. The safety objectives shall:
 - (i) form the basis for safety performance monitoring and measurement;
 - (ii) reflect the aerodrome operator's commitment to continuously improve the effectiveness of the SMS;
 - (iii) be communicated and promoted throughout the organization; and
 - (iv) be periodically reviewed to ensure the objectives remain relevant and appropriate to the operator.

A-2 Safety accountabilities

An aerodrome operator shall:

- (a) identify the accountable manager who, irrespective of other functions, has ultimate responsibility and accountability, on behalf of the aerodrome, for the implementation and maintenance of the SMS;
- (b) clearly define lines of safety accountability throughout the organization, including a direct accountability for safety on the part of senior management;
- (c) identify the accountabilities of all members of management, irrespective of other functions, as well as of employees, with respect to the safety performance of the SMS; and
- (d) document and communicate safety responsibilities, accountabilities and authorities throughout the organization.

A-3 Appointment of key safety personnel

An aerodrome operator shall appoint a safety manager who is responsible for the implementation and maintenance of an effective SMS.

Note: - Depending on the size of the aerodrome and the complexity of its operations or services, responsibility for implementation and maintenance of the SMS may be assigned to one or more persons. The role of safety manager could be a sole function, or a function combined with other duties provided the other duties did not result in a conflict of interest or adversely affect the performance of safety duties.

A-4 Coordination of emergency response planning

The aerodrome operator shall develop, coordinate and maintain an emergency response plan that addresses accidents and incidents in aircraft operations and other aviation emergencies.

An aerodrome operator shall ensure that the emergency response plan is properly coordinated with the emergency response plans of those organizations it must interface with during the provision of its services.

A-5 SMS documentation

An aerodrome operator shall develop an SMS implementation plan, formally endorsed by senior management of the airport that defines the airport's approach to the management of safety in a manner that meets the airport's safety objectives.

An aerodrome operator shall develop and maintain SMS manual that describes the following:

- (a) safety policy and objectives;
- (b) SMS requirements;
- (c) SMS processes and procedures;
- (d) accountabilities, responsibilities and authorities for SMS;
- (e) processes and procedures; and
- (f) the minimum skills and knowledge required for the primary person responsible for the SMS.

An aerodrome operator shall develop and maintain SMS operational records as part of its SMS documentation.

Note 1: - Depending on the size of the aerodrome and the complexity of its aviation services, the SMS manual may be a stand-alone document or may be integrated with aerodrome manual.

Note 2: - Relevant SMS operational records would include records, reviews, reports, assessments, analyses, verifications, investigations, training and communication programs, risk and hazard registers, safety cases, and details of persons who are or have been the primary persons responsible for the SMS.

B. Safety risk management

B-1 Hazard identification

- (a) An aerodrome operator shall develop and maintain a process for effectively collecting, recording, acting on and generating feedback about hazards associated with aerodrome operations; and
- (b) Hazard identification shall be based on a combination of reactive, proactive and predictive methods of safety data collection.

B-2 Safety risk assessment and mitigation

An aerodrome operator shall develop and maintain a process that ensures analysis, assessment and control of the safety risks associated with identified hazards.

C. Safety assurance

C-1 Safety risk assessment and mitigation

An aerodrome operator shall develop procedures to:

- (a) verify the safety performance of the airport compared to the safety policy and objectives, and to validate the effectiveness of safety risk controls.
- (b) ensure that aerodrome operator's safety performance is verified in reference to the safety performance indicators and safety performance targets of the SMS.

The SMS must include the aerodrome operator's procedures for internal audits conducted by persons or departments independent of the functions being audited, including procedures to:

- (a) to assess the effectiveness of the SMS and identify areas for potential improvement;
- (b) to ensure compliance with the state regulations;
- (c) to ensure that any safety risk controls are effectively implemented and monitored; and
- (d) The causes and contributing factors have been investigated and analyzed where non-conformances and other issues are identified.

C-2 The management of change

An aerodrome operator shall develop and maintain a formal process to:

- (a) identify changes within the organization which may affect established processes and services;
- (b) to describe the arrangements to ensure safety performance before implementing changes; and
- (c) to eliminate or modify safety risk controls that are no longer needed or effective due to changes in the operational environment.

C-3 Continuous improvement of the SMS

An aerodrome operator shall develop and maintain a process to identify the causes of sub-standard performance of the SMS, determine the implications of sub-standard performance in operations, and eliminate such causes.

D. Safety promotion**D-1 Training and education**

An aerodrome operator shall develop, maintain and deliver a safety training programme to ensure that:

- (a) the personnel are trained and competent to perform their SMS duties; and
- (b) the scope of the safety training programme is appropriate to each individual's involvement in the SMS.

D-2 Safety communication

An aerodrome operator shall develop and maintain a formal means for safety communication that:

- (a) ensures personnel are aware of the SMS to a degree commensurate with their positions;
- (b) conveys safety-critical information;
- (c) communicates safety accountabilities, responsibilities and authorities throughout the operator's organization
- (d) explains why particular safety actions are taken; and
- (e) explains why safety procedures are introduced or changed.

10.1.6 Safety Reporting System

- 10.1.6.1 The objective of safety reporting system is to contribute to the improvement of the safety at aerodromes by ensuring that relevant information on safety is reported, collected, investigated, analyzed, stored, protected and disseminated.
- 10.1.6.2 Without prejudice to PCAR Part 13 — Accident and Incident Reporting and Investigation, an aerodrome operator shall establish procedures for the notification, investigation, and reporting of any accident, serious incident and occurrence as defined in MOS 1.4, and in accordance with this regulation
- 10.1.6.3 The reports shall be made in a form and manner established by the CAAP and contain all pertinent information about the condition known to the aerodrome.
- 10.1.6.4 Reports shall be made as soon as practicable, but in any case, within 48 hours of the aerodrome operator identifying the condition to which the report relates, unless exceptional circumstances prevent this.
- 10.1.6.5 The procedures referred to in 10.1.6.2 shall include the means for immediate notification of any accident, serious incident and occurrence to the Aerodrome Registration, Certification and Inspection Division (ARCID).

10.1.6.6 The system referred to in 10.1.6.1 shall include the following as a minimum:

- (a) Description of the reporting mechanism, including reporting forms, means, and deadlines;
- (b) Contain a list of occurrences that shall be immediately notified to the CAAP;
- (c) Personnel responsible for reporting;
- (d) Description of mechanism and personnel responsibilities for identifying root causes, and the actions that may be needed to be taken to prevent similar occurrences in the future, as appropriate;
- (e) Ensure concerned personnel are educated to meet the immediate notification requirement;
- (f) Ensure their personnel of how to report an actual or potential safety deficiency through the voluntary reporting system;
- (g) Refrain from attribution of blame; and
- (h) Be documented in the aerodrome's applicable manuals.

Note: - 1 Further guidance can be found in the associated Advisory Circular, as existing from time to time and freely available on the CAAP website.

Note: - 2 Further guidance on critical data related to safety occurrences can be found in attachment B in this MOS.

10.1.6.7 Aerodrome Record Keeping

- (a) The aerodrome operator shall establish a system of record keeping for all occurrence, investigation, and analysis reports.
- (b) The record-keeping system should ensure that all records are accessible whenever needed within a reasonable time. These records should be organized in a way that ensures traceability and retrievability throughout the required retention period.
- (c) Records should be kept in paper form, or in electronic format, or a combination of both media.

10.1.6.8 Aerodrome accident/incident investigations

- (a) Incorporating into the safety management system, a procedure shall be developed to ensure, that investigations are effectively performed to find occurrences' root causes and issue targeted and feasible recommendations to implement corrective actions on due time.
- (b) In addition to the requirements in 10.1.6.2, the aerodrome operator shall produce a follow-up report to provide details of actions it intends to take to prevent similar occurrences in the future, as soon as these actions have been identified. This report shall be reported to ARCID and produced in a form and manner established by the CAAP
- (c) The lesson learnt derived from an aerodrome incident/accident investigation shall be disseminated to staff to provide feedback for safety improvement.

Section 10.2 Inspecting and Reporting Aerodrome Serviceability

10.2.1 General

- 10.2.1.1 Whilst aerodrome serviceability inspections are essentially visual checks, the process must include appropriate initial actions if the inspection findings indicate something that could have an effect on the safety of aircraft operations. If the identified fault cannot be remedied before the next aircraft operation, then the matter must be reported for NOTAM action. Examples of this type of remedial action include removal of debris from the movement area or the presence of water patches on a runway.
- 10.2.1.2 The operator of a certified aerodrome and Aerodrome Registration Type 1 are required to arrange for aerodrome serviceability inspections to be carried out at least 2 times each day including one inspection during hours of darkness, and additionally after natural phenomena such as severe wind or rain storm, earthquake, or when requested by air traffic control or by CAAP.
- 10.2.1.3 Aerodrome serviceability inspections shall be subject to CAAP agreement, and the frequency of inspections may be reduced to not less than 2 per week at aerodromes with low numbers of traffic movements. At aerodromes restricted to VFR operations, a serviceability inspection shall be conducted before the first aircraft movement during daylight hours.
- 10.2.1.4 Aerodrome reporting is the notification of changes to the published aerodrome information or any other occurrence or emergency affecting the availability of the aerodrome and safety of aircraft using the aerodrome. The occurrences may be known beforehand, as planned aerodrome works, or discovered during an inspection of the aerodrome or obstacle limitation surfaces.
- 10.2.1.5 Particulars of the procedures for carrying out serviceability inspections, including the use of a checklist, and for reporting any changes to aerodrome information or for requesting the issue of a NOTAM are to be included in the aerodrome manual.

10.2.2 Foreign Object Debris (FOD)

- 10.2.2.1 Any FOD found in the course of the inspection, including parts which may have fallen from aircraft, or the remains of birds which may have been struck by an aircraft, must be reported immediately to Air Traffic Control, where appropriate, and to the CAAP.

10.2.3 Surface conditions of the movement area, including the presence of water

- 10.2.3.1 A serviceability inspection must check for the presence of:
- (a) ponding of water;
 - (b) pavement cracking or spalling;
 - (c) rubber build up;

- (d) surface irregularities;
- (e) damage caused by spillage of corrosive fluids;
- (f) pipe drain faults particularly in fine grain non cohesive sub grades, in high rainfall areas;
- (g) scour or erosion ditches;
- (h) termite mounds or other ground obstacles obscured by long grass;
- (i) soft ground, particularly in combination with surface roughness and slipperiness; and
- (j) any other sign of pavement distress which has the potential to develop quickly into a hazardous situation.

10.2.4 Aerodrome markings, lighting, wind direction indicators and ground signals

10.2.4.1 A serviceability inspection must check for:

- (a) loss of visibility of markers and markings;
- (b) use of incorrect markers and markings;
- (c) any disturbance to level and alignment of lights;
- (d) visual light intensity consistency check (does a light stand out less bright than others in the same system?)
- (e) discoloured or dirty lenses;
- (f) outage lamps, incorrect lamps fitted, or lamps fitted wrongly;
- (g) the condition of the frangibility of light bases;
- (h) exposed edges around footings and other aerodrome installations;
- (i) damage to wind indicator assembly or mounting; and
- (j) damage to wind indicator sleeve fabric, or loss of conspicuous color.

10.2.4.2 A serviceability inspection must check for:

- (a) foreign objects, such as aircraft fastening devices and other parts,
- (b) mechanics tools, small items of equipment and personal items;
- (c) debris, such as sand, loose rocks, concrete, wood, plastic, pieces of tire and mud; and
- (d) with particular vigilance during and after construction activity, any debris or material which may have been generated by vehicle movement, spillage, storage other extraneous activity.

10.2.5 Wildlife on, or in the vicinity of, the movement area

10.2.5.1 A serviceability inspection must include:

- (a) the condition of aerodrome fencing, particularly in critical areas;
- (b) climatic or seasonal considerations, such as the presence of birds at certain times of the year, or related to the depth of water in drainage ponding areas;

- (c) possible shelter provided by aerodrome infrastructure such as buildings, equipment and gable markers;
- (d) wildlife hazard mitigating procedures incorporated in the environmental management procedures for the aerodrome;
- (e) off-airport attractors like animal sale yards, picnic areas, aeration facilities and waste disposal or landfill areas, and
- (f) use of harassment procedures where appropriate.

10.2.6 Currency of NOTAMs

- 10.2.6.1 A serviceability inspection must include checking any outstanding NOTAM for the aerodrome, including confirmation that the contents of the NOTAM, particularly the effective period(s), are still current.

10.2.7 Aerodrome fencing

- 10.2.7.1 A serviceability inspection must check for damaged fences, open gates and signs of attempted entry by either animals or humans.

- 10.2.7.2 A fence or other suitable barrier shall be provided on an aerodrome to prevent the entrance to the movement area of animals large enough to be a hazard to aircraft.

- 10.2.7.3 A fence or other suitable barrier shall be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non- public area of the aerodrome.

Note: - 1. This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.

Note: - 2. Special measures may be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

- 10.2.7.4 Suitable means of protection shall be provided to deter the inadvertent or premeditated access of unauthorized persons into ground installations and facilities essential for the safety of civil aviation located off the aerodrome.

- 10.2.7.5 The fence or barrier shall be located so as to separate the movement area and other facilities or zones on the aerodrome vital to the safe operation of aircraft from areas open to public access.

- 10.2.7.6 When greater security is thought necessary, a cleared area shall be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult. Consideration shall be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

10.2.8 Security Lighting

- 10.2.8.1 At an aerodrome where it is deemed desirable for security reasons, a fence or other barrier provided for the protection of international and domestic airports and its facilities shall be illuminated at a minimum essential level. Consideration shall be

given to locating lights so that the ground area on both sides of the fence or barrier, particularly at access points, is illuminated.

10.2.9 Inspection Records

10.2.9.1 The aerodrome operator must maintain aerodrome inspection records in the form of logbooks or similar for recording the date and time of each aerodrome serviceability inspection, the results of each inspection and any action taken. Records must be retained for at least 2 years.

10.2.10 Obstacles Infringing the take-off, approach and transitional surfaces

10.2.10.1 The aerodrome operator must have procedures in place and equipment available to enable inspection personnel to identify objects protruding through the OLS. Equipment should include appropriate instrumentation, such as:

- (a) a hand held clinometer;
- (b) 'sighting plane' installations; or
- (c) formal survey equipment.

10.2.11 Empirical assessment of the bearing strength of unrated runway pavements and runway strips

10.2.11.1 The bearing strength of a runway strip will only be required to be assessed where an unsealed runway is not marked and the whole of the runway strip is available for aircraft operations.

Section 10.3 Initiating a NOTAM

10.3.1 Introduction

10.3.1.1 A NOTAM is used to inform pilots and aircraft operators of significant changes to the aerodrome that may impact on aircraft operations. This is one of the most important aerodrome safety functions, so the process and procedures for initiating NOTAMs must be clearly set out in the Aerodrome Manual and all the persons involved must be fully informed and trained. A NOTAM may be originated and cancelled by an authorized officer or a relevant CAAP officer.

10.3.1.2 For changes to navigation aids, ATC frequencies or special procedures, NOTAM may be originated by a relevant services provider or a CAAP officer. Where a navigation aid is owned and maintained by the aerodrome operator, a NOTAM to notify changes to its status may be originated by the nominated reporting officer.

10.3.2 Changes Reported to NOTAM Office

10.3.2.1 Where a change in the aerodrome condition requires a NOTAM to be issued, the nominated reporting officer must send the notification to the NOTAM Office (NOF) by FAX or by telephone. Telephone advice must be confirmed in writing as soon as possible.

10.3.2.2 The following occurrences must be reported to the NOTAM Office:

- (a) Changes (temporary or permanent) in the published aerodrome information including additional changes to current permanent NOTAMs;
- (b) changes in the level of protection normally available at the aerodrome for rescue and firefighting;
- (c) aerodrome works affecting runways or the obstacle limitation surfaces, including time-limited works that require more than 10 minutes to re-instate to serviceable order;
- (d) unserviceable portions of the runway or failure in lighting or obstacle lighting;
- (e) temporary obstacles to aircraft operations;
- (f) a significant increase in, or concentration of birds or animals on or in the vicinity of the aerodrome;
- (g) changes in excess of 0.05% of the published gradient data;
- (h) emergence of new obstacles;
- (i) when a radio navigation aid or landing aid owned by the aerodrome operator is unserviceable or returned to service; and
- (j) any other significant event which affects the safety of aircraft using the aerodrome.

10.3.2.3 Reporting to NOTAM Office must be carried out as expeditiously as possible. If all the relevant information cannot be provided at once, the matter must still be reported, and subsequent details can be issued by further NOTAM. When in doubt, err on the side of safety.

Note: - To avoid overloading the NOTAM system, non-safety critical failures are not normally reported. For example, runway strip condition is not normally reported. Similarly, if a section of taxiway or apron is unserviceable, including some of the taxiway lighting or apron floodlighting being unserviceable, the area should be appropriately marked and lit, but the unserviceability does not normally need to be reported. If, however, the aerodrome only has one taxiway, and it is unserviceable, or only one apron, and the entire apron is unserviceable, it would be appropriate to notify these occurrences by NOTAM.

10.3.2.4 In reporting changes for NOTAM action, the aerodrome operator must submit a report which includes:

- (a) aerodrome name;
- (b) the aerodrome facility affected and details of unserviceability;
- (c) reason for change;
- (d) start time and expected end time of the unserviceability; and
- (e) daily duration or time schedule of the unserviceability, where applicable.

Note: - Use of a form with standard headings will assist reporting. A sample aerodrome report form is shown in MOS 10.4.

10.3.2.5 After making a request to the NOF for a NOTAM, the reporting officer must obtain a copy of the subsequent NOTAM, in order to check the accuracy and to keep a record of its issue.

Note: - To illustrate how changes to aerodrome information are communicated to pilots, some examples of NOTAMs are given in MOS 10.5. This Section also provides a listing of general word abbreviations and phrase contractions to minimize the length of aerodrome NOTAMs.

10.3.3 Time-limited NOTAM

10.3.3.1 A NOTAM which is not a permanent NOTAM is 'time limited'. A time-limited NOTAM will have an expected and declared ending time, and will lapse automatically.

10.3.4 Permanent NOTAM

10.3.4.1 A PERM NOTAM is originated in respect to permanent changes to aerodrome operational information published in AIP. This information is passed to the NOTAM office, which will issue the NOTAM and further pass the information on to AIS. The AIS will incorporate the changes in the following edition of AIP. The NOTAM is cancelled when the information is duly published in AIP.

10.3.5 Making changes to aerodrome information published in AIP

10.3.5.1 For changes to AIP information which does not have an immediate impact on the safety of aircraft operations, the changes are not to be notified to NOF. Instead the aerodrome operator must notify AIS directly in writing of such changes. Example: change of a fuel supplier.

10.3.5.2 Information on the status of the certification of aerodromes shall be reported by the aerodrome operator directly to AIS.

10.3.6 Wildlife Hazard Warning

10.3.6.1 At aerodromes where a standing caution is included in AIP for a bird or animal hazard, NOTAM must only be initiated where there is a significant increase of birds or animals. The NOTAM must provide specific information on species, period of concentration, likely location and flight path.

10.3.7 New or upgraded visual aids

10.3.7.1 Any AIP amendment that introduces a new visual aid, or the upgrading of an existing aid, must be referred to CAAP for clearance purposes. Certain visual aids have to be commissioned or flight checked before being brought into operational use.

10.3.8 Changes to Type A Chart Information

10.3.8.1 Changes to Type A Chart information are not notified through NOTAM, however, AIP must refer to the latest edition of the Type A Chart. Aerodrome operators must provide an amendment service for the Type A Chart information directly to holders of the charts.

10.3.9 Follow up actions

10.3.9.1 The aerodrome operator must also ensure that the Aerodrome Manual is


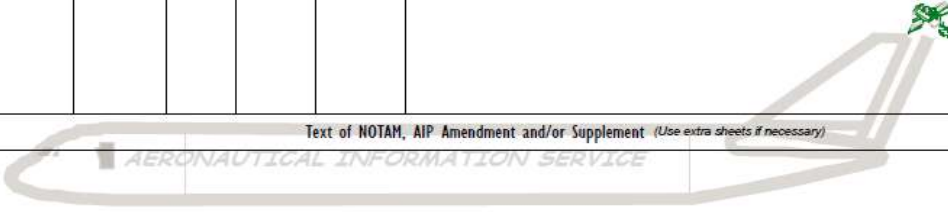
amended to reflect changes other than temporary changes.

10.3.10 Record keeping

- 10.3.10.1 Aerodrome operators must maintain a logbook showing details of all reports and check subsequent NOTAM or changes to AIP for accuracy, and keep a copy of reports and NOTAM with the logbook.

Section 10.4 Sample Aerodrome Report Forms

CAAP/AIS/QP-001 F004
Version 1.2

		Aeronautical Information Promulgation Advice Form (AIPAF)			
To: AIS Headquarters			1 Originator: _____ Date: _____ Section: _____ Contact No: _____		
2 Originator's file reference	AIP references (as applicable)				3 AI for Promulgation: <input type="checkbox"/> NEW <input type="checkbox"/> REPLACEMENT <input checked="" type="checkbox"/> CANCELLATION Reference NOTAM/AIP SUPP (as applicable): _____
	AIP Section	Page (date)*	Para.	Line	Col.
			4 Start of Activity (as applicable) (YYMMDDHHMM) UTC: _____ End of Validity (as applicable) (YYMMDDHHMM) UTC: _____		
5 Day/Time Schedule (as applicable): _____					
6 Text of NOTAM, AIP Amendment and/or Supplement (Use extra sheets if necessary)					
<div style="text-align: center; opacity: 0.5;">  </div>					
7 Lower Limit (as applicable): VALUE: _____ UNIT: _____		Upper Limit (as applicable): VALUE: _____ UNIT: _____			
8 Concurrence: The following Branches/Directorates <input type="checkbox"/> ATS <input type="checkbox"/> ADMS <input type="checkbox"/> FSIS <input type="checkbox"/> ANS <input type="checkbox"/> ATCD <input type="checkbox"/> ATMD <input type="checkbox"/> AICD <div style="display: flex; justify-content: space-around;"> <div> <input type="checkbox"/> ATS Facility <input type="checkbox"/> Policy </div> <div> <input type="checkbox"/> ANS Facility <input type="checkbox"/> Accuracy of Information </div> </div> Location (as applicable) _____ have been consulted in respect of: _____ <div style="display: flex; justify-content: space-between;"> Name/Signature _____ Designation _____ Date _____ </div>					
9 Data Originator: <div style="display: flex; justify-content: space-between;"> Name/Signature _____ Designation _____ Date _____ </div>					
10 Approving Authority: <div style="display: flex; justify-content: space-between;"> Name/Signature _____ Designation _____ Date _____ </div> <div style="text-align: center; margin-top: 5px;"> <input type="button" value="Refresh"/> <input type="button" value="Print"/> <input type="button" value="Save"/> </div>					



Aerodrome Report Form

Notification of changes to serviceability of an aerodrome

To: NOTAM Office Phone Fax

AERODROME:

Date / / 20

TIME (UTC preferred) UTC ☐ ☐ Local ☐

Purpose of Report

PROVIDE NEW INFORMATION DETAILED BELOW

EXTEND PREVIOUS ADVICE (NOTAM No) ☐ ☐ Date:CANCEL PREVIOUS ADVICE (NOTAM No) ☐ ☐ Date:

Period of Validity

Permanent or Temporary NOTAM (Delete one)

FROM (date/time) TO (date/time) Estimated ☐ ☐ (if
finish time uncertain) (temporary NOTAM only)

*Note: If time estimated, contact NOTAM OFFICE at least 2 hours before estimated
duration time and advise if NOTAM is to be extended or cancelled.*

Daily duration or time schedule (if applicable)

FROM (date/time) TO (date/time)

Text (For example of text see Section 10.5)

Please fax copy of NOTAM to originator Fax No.

This report confirms previous telephone advice: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Contact Number: Ph
Fax

Signed
Reporting Officer (Print Name)

Date/Time

CAAP advised by: Phone ☐ ☐ Fax ☐ ☐ E-mail ☐ ☐ Not advised ☐

For NOTAM Office only

NOTAM No. C

Initials

Section 10.5 Examples of NOTAM and Listing of Abbreviations

10.5.1 Examples

10.5.1.1 To illustrate how changes to aerodrome information are communicated to pilots, some examples of NOTAM are given below.

10.5.1.2 Time-limited Work

C0174/91 NOTAMN

- A) ADNAME 0174/91 (AD) 9106140900
- B) 9106211000
- C) 9106211600
- D) RWY 17/35 WIP. MAE WILL CLR IF OPRT INDICATED.

10.5.1.3 Explanations of NOTAM Format

C0174/91 — the NOTAM number;

NOTAMN — a NOTAM containing new information;

- A) ADNAME — name of aerodrome;
AD — information relating to aerodromes, or facilities thereon, including approach and landing aids, and the existence or removal of hazards or obstructions;
9106140900 — year/date/time of issue of NOTAM, in ten figures UTC, representing year, month, day, hour and minutes (Note, the year may be omitted);
- B) 9106211000 — commencement of occurrence;
- C) 9106211600 — cessation of occurrence and notification;
- D) 1000/1600 — periods of activity within the period specified in Fields B and C;
- E) The text of the NOTAM expressed as concisely as possible. "Runway 17/35 work in progress. Men and equipment will clear if an operation is indicated"

10.5.1.4 Major works in accordance with Method of Working Plan (MOWP)

(a) C0943/91 NOTAMN

- A) ADNAME 0943/91 (AD) 9105200600
- B) 9105222300
- C) 9105270800 EST
- D) RWY 06/24 NOT AVBL DUE WIP. REF MOWP 4/1987 ACT STAGE 1

(b) C0056/91 NOTAMN

- A) ADNAME 0056/91 (AD) 9106101002
- B) 9106121100
- C) 9106140600
- D) RWY 14/32 NOT AVBL DUE WIP. REF MOWP 86/7 STAGE3.

(c) C0934/95 NOTAMN

- A) ADNAME C0934/95 (AD) 9505200600
 - B) 9506032200
 - C) 9506100600
 - D) 2200/0600 DAILY
 - E) RWY 06/24 WIP. REF MOWP 4/1993 AMENDMENT 3. 360M N END NOT AVBL.
- (d) C0935/95 NOTAMN
- A) ADNAME C0935/95 (AD) 9505200600
 - B) 9506032200
 - C) 9506040600
 - D) 2200/0600 DAILY
 - E) RWY 18/36 WIP. REF MOWP 4/1993 AMENDMENT 3 (followed by lengthy text of NOTAM).

10.5.1.5 **Unserviceable movement areas.**

- (a) C0639/91 NOTAMN
- A) ADNAME 0639/91 (AD) 9107272100
 - B) 9107272100
 - C) 9108010600 EST
 - D) RWY 05/23 AND TWY ALPHA NOT AVBL DUE SOFT WET SFC. RWY 16/34 AVBL.
- (b) C0021/91 NOTAMN
- A) ADNAME 0021/91 (AD) 9103232200
 - B) 9103232200
 - C) 9103290600 EST
 - D) RWY 18/36 AMD. LEN. 140M S END NOT AVBL DUE ROUGH SFC. THR 36 DISP 200M.

10.5.1.6 **Surface bearing capacity.** If the surface or part of the Maneuvering area is not serviceable for heavy aircraft a weight restriction may be imposed to allow light aircraft to operate.

C0281/91 NOTAMN

- A) ADNAME 0281/91 (AD) 9108160400
- B) 9108160400
- C) 9108230600 EST
- D) AD NOT AVBL TO ACFT ABV 1930 KG MTOW. DUE SOFT WET SFC.

10.5.1.7 **Apron areas.** These are not part of the Maneuvering area and therefore should not normally be the subject of NOTAM, but a NOTAM may be issued at minor aerodromes to indicate temporary parking arrangements.

C0256/91 NOTAMN

- A) ADNAME 0256/91 (AD) 9108280500
- B) 9108280500
- C) 9108292600 EST
- D) APRON CLOSED DUE WIP. LOAD UNLOAD ON RWY. RWY NOT AVBL WHEN ACFT STANDING THEREON. PILOTS SHOULD MAKE PROVISION FOR ALTN.

10.5.1.8

Obstacle information

- (a) A permanent NOTAM to amend changes to declared distances owing to change in height of critical obstacle (trees).
C0166/95 NOTAMN
 - A) ADNAME CO166/95 (AD) 9501210200
 - B) 9501210200
 - C) PERM
 - D) AMD RWY 14 GRADIENTS NEW DEC DIST RWY 14 TORA 2042 (6698) TODA 2102 (6895) ASDA 2042 (6698) LDA 2042 (6698) AMD AIP DATED 12 SEP 96.
- (b) A temporary NOTAM to advise of a crane within the OLS area.
C0073/91 NOTAMN
 - A) ADNAME 0073/91 (AD) 9104200700
 - B) 9104200700
 - C) 9106210600 EST
 - D) RWY 14/32 TEMPO TEMP OBST CRANE. 300FT AMSL BRG 076 MAG 2 NM FROM SE END OF RWY 14/32. INFRINGES HZS.

10.5.1.9

Runway lighting out of service

- C0091/91 NOTAMN
- A) ADNAME 0091/91 (AD) 9108510420
 - B) 9108162200
 - C) 9108192200
 - D) RWY LGT NOT AVBL.

10.5.1.10

Temporary or permanent withdrawal of aerodrome certificate

- (a) C0037/91 NOTAMN
 - A) ADNAME 0037/91 (AD) 9109251035
 - B) 9109251035
 - C) 9109260600
 - D) AD CERTIFICATE SUSPENDED
- (b) C0048/91 NOTAMN
 - A) ADNAME 0048/91 (AD) 9103272218

- B) 9103272220
- C) PERM
- D) AD CERTIFICATE CANCELLED.

10.5.2 General abbreviations and phrase contractions to minimize message length of aerodrome NOTAMs

Words and Phrases Abbreviation

April APR
Abbreviated 'T' Visual Approach Slope Indicator System AT-VASIS
Abbreviated Visual Approach Slope Indicator System A-VASIS
Abeam ABM
About ABT
Above Aerodrome level AAL
Above ground level AGL
Above mean sea level AMSL
Accelerate-stop distance available ASDA
Accept or accepted ACPT
Active, activated, activity ACT
Actual time of arrival ATA
Actual time of departure ATD
Addition or additional ADDN
Adjacent ADJ
Advise ADZ
Aerodrome AD
Aerodrome Diagrams ADDGM
Aerodrome beacon ABN
Aerodrome control or aerodrome control tower TWR
Aerodrome Frequency Response Unit AFRU
Aerodrome obstruction chart AOC
Aerodrome reference point ARP
Aeronautical Information Circular AIC
Aeronautical Information Publication AIP
Aeronautical Information Service AIS
After....(time or place) AFT
Again AGN
Aircraft classification number (ACN)
Air Traffic Control (in general) ATC
Air traffic services ATS
Aircraft ACFT
Aircraft classification number ACN
Airport AP
Airway AWY
All-up-weight AUW
Alternate (Aerodrome) ALTN
Alternate or alternating (light alternates in color) ALTN
Altimeter sub-scale setting to obtain elevation or altitude QNH
Altitude ALT

Amend(ed) AMD
Amendment (AIP Amendment) AMDT
Approach APCH
Approach lighting system ALS
Approximate(ly) APRX
Arrange ARNG
Arrive, or arrival ARR
As soon as possible ASAP
Asphalt ASPH
Associated with ASSW
Attention ATTN
Aircraft landing area (OR Authorized landing area) ALA
Authorized or authorization AUTH
Automatic terminal information service ATIS
Auxiliary AUX
Available AVBL
Average AVG
Aviation gasoline AVGAS
Azimuth AZM
Beacon (aeronautical ground light) BCN
Bearing BRG
Becoming BECMG
Before BFR
Below BLW Between BTN
Blue B Boundary BDRY Braking BRKG
Broken BKN
Building BLDG
By way of.. VIA
Calibration CLBG
Callsign (used to request a callsign) CSGN
Category CAT
Caution CTN
Celsius (Centigrade) C
Centerline C/L
Centimeter CM
Center (runway) C
Change frequency to... CF
Channel CH
Check CK
Civil CIV
Clear, cleared to, clearance CLR
Clearway CWY
Close or closed or closing CLSD
Code number (runway) CN
Commissioned CMSD
Common Traffic Advisory Frequency CTAF
Communications COM
Completion or completed or complete CMPL
Concrete CONC
Condition COND
Confirm(ing) or I confirm CFM

Conical surface COS
Construction or constructed CONST
Contact CTC
Continue(s) or continued CONT
Continuous day and night service H24
Continuous(ly) CONS
Co-ordinated Universal Time UTC
Correction or correct or corrected COR
Cover or covered or covering COV
Cross X
Crossbar (of approach lighting system) XBAR
Crossing XNG
Customs CUST
Danger or dangerous DNG
Decommissioned DCMSD
Degrees DEG
Delay or delayed DLA
Depart or departure DEP
Departure and Approach procedures DAP
Depth DPT
Destination DEST
Deteriorate, deteriorating DTRT
Deviation or deviated DEV
Direct DCT
Displaced DISP
Distance DIST
Distance measuring equipment DME
Divert or diverting or diversion DIV
Docking DOCK
Document DOC
Domestic DOM
Doppler VOR DVOR
Duration DUR
During DRG
Dust DU
Dust storm DS
East north-east ENE
East or east longitude E
East south-east ESE
Eastbound EB
Effective operational length EOL
Elevation ELEV
Emergency EMERG
Enroute Supplement Indonesia (AIP) ERSA
En route ENRT
Engine ENG
Equipment EQPT
Estimate or estimated EST
Estimated/estimating time of arrival ETA
Estimated/estimating time of departure ETD
Every EV

Except EXC
Exercises or exercising or to exercise EXER
Expect(ed)(ing) EXP
Expected approach time EAT Extend(ed)(ing) EXT
February FEB
Facility, facilities FAC Facsimile transmission FAX
Feet (dimensional unit) FT
Field FLD
First FST
Flares FLR
Flight FLG
Flight information service FIS
Flight service (in general) FS
Flight service center FSC
Flight service unit FSU
Flight plan (domestic) PLN
Fluctuating, fluctuation, fluctuated FLUC
Fly or flying FLY
Fog FG
Follow(s), following FLW
Forecast FCST
Frequency FREQ
Frequent FRQ
Friday FRI
From FM
General GEN
General Aviation AWK or PVT
General Aviation Aerodrome Procedures GAAP
Glide path GP
Glider GLD
Glider flying GLY
Gradual(ly) GRADU
Gravel GRVL
Green G
Ground GND
Hazard beacon HBN
Haze HZ
Heading HDG
Heavy HVY
Height or height above HGT
Helicopter HEL
Helicopter Landing Site HLS
Hertz (cycles per second) HZ
High intensity approach lighting HIAL
High intensity obstacle lights HIOL
High intensity runway lighting HIRL
Higher HYR Hold(ing) HLDG
Homestead HS
Horizontal surface HZS
Hour HR
International standard atmosphere ISA

Immediate(ly) IMT
Immigration IMM Improve(ment), improving IMPR
Inbound INBD
Information INFO
Inner marker IM
Inoperative INOP
Install or installed or installation INSTL
Instrument INSTR
Instrument approach and landing charts IAL
Instrument approach chart IAC
Instrument flight rule IFR
Instrument landing system ILS
Instrument meteorological conditions IMC
Intensify(ing) INTSF
Intensity INTST
Intermittent(ly) INTER
International INTL
International Civil Aviation Organization ICAO
Interrupt(ion)(ed) INTRP
Intersection INT
Isolated ISOL
January JAN
July JULY
June JUNE
Jet barrier JBAR
Jet stream JTST
Kilogram KG
Kilometers KM
Kilometers per hour KMH
Kilopascals KPA
Kilowatts KW
Knots KT
Landing LDG
Landing direction indicator LDI
Landing distance available LDA
Latitude LAT
Leave or leaving LVE
Left (runway identification) L
Length LEN
Level LVL
Light or lighting LGT
Lighted LGTD
Limited LTD
Local mean time LMT
Local, locally, location, located LOC
Localizer LLZ
Low intensity obstacle lights LIOL
Low intensity runway lights LIRL
Longitude LONG
Magnetic MAG
Magnetic bearing QDR

Magnetic orientation of runway QFU
Magnetic variation VAR
Maintain(ed)(ing) MNTN
Maintenance MAINT
Mandatory Broadcast Zone MBZ
Manual MAN
Marker radio beacon MKR
Maximum MAX
Maximum brakes release weight MBRW
Maximum landing weight MLW
Maximum take-off weight MTOW
Maximum tire pressure MTP
Mean sea level MSL
Medical MED
Medium intensity obstacle lights MIO
Medium intensity runway lights MRL
Megahertz MHZ
Men and equipment MAE
Message MSG
Method of working plan MOWP
Meters (preceded by figures) M
Meters per second MPS
Microwave landing system MLS
Mid-point (related to RVR) MID
Middle marker MM
Military MIL
Minimum MNM
Minimum eye height over threshold (VASI system) MEHT
Minimum obstacle clearance (required) MOC
Minus MS
Minutes MIN
Miscellaneous MISC
Missed approach point MAPT
Mist BR
Moderate(ly) MOD
Modification CHG
Monitor (ed and ing) MNT
Mountain MT
Move(d)(ment), moving MOV
Nautical mile NM
Navigation NAV
Near or over large town CIT
Next NXT
Night NGT
Night visual flight rule NV
Non-scheduled commercial transport CHTR
No SAR action required NOSAR
No change NC
No or negative or permission not granted or that is not correct NEG
No specific working hours HX
Non-directional radio beacon NDB

None or nothing NIL
North north-east NNE
North north-west NNW
North or north latitude N
North-west NW
Northbound NB
NOTAM Office NOF
Not before NBFR
Notice to airmen NOTAM
Number NR
Open(ed)(ing) OPN
Obscure OBSC
Observe(d), observation OBS
Obstacle OBST
Obstacle clearance altitude/height OCA/H
Obstacle clearance limit OCL
Obstacle limitation surface (OLS)
Obstruction OBSTR
Occasional(ly) OCNL
Occulting (light) OCC
On request O/R
On top OTP
Operate, operator, operative, operating, operational OPR
Operation OPRT
Operations OPS
Outbound OUBD
Outer main gear wheel span (OMGWS)
Outer marker OM
Overhead OHD
Parallel PARL
Parking PRKG
Passengers PAX
Passing PSG
Pavement classification number PCN
Performance PER
Persons on board POB
Pilot activated lighting PAL
Plus PS
Position PSN
Power PWR
Precision approach path indicator PAPI
Prior notice required PN
Probable, probability PROB
Procedure PROC
Procedures for air navigation services PANS
Provisional PROV
Public Holidays PH
Quadrant(al) QUAD
Radial RDL
Radius RAD
Ragged RAG

Rain RA
Rapid or rapidly RAPID
Reach or reaching RCH
Read back RB
Recent (to qualify other abbreviations) RE
Reference REF
Reference datum height (for ILS) RDH
Registration REG
Remarks RMK Report(ed)(ing)(ing point) REP
Requested REQ
Require RQ
Requirements RQMNTS
Reroute RERTE
Rescue and Firefighting Services RFFS
Rescue Coordination Center RCC
Rescue Sub Center RSC
Restriction RESTR
Return to service RTS
Return(ed)(ing) RTN
Review REV
Route RTE
Runway RWY
Runway centerline RCL
Runway centerline light RCLL
Runway edge light REDL
Runway end light RENL
Runway lead in lighting system RLLS
Runway strip RWS
Runway surface condition RSCD
Runway threshold light RTHL
Runway touchdown zone light RTZL
Runway visual range RVR
Rules of the air and air traffic services (associated with AIP) RAC
Sand SA
Sandstorm SS
Scattered SCT
Scheduled SKED
Scheduled commercial air transport S
Search and Rescue SAR
Second(ary) SRY
Secondary surveillance radar SSR
Seconds SEC
Sector SECT
Service available during scheduled hours of operation HS
Service available to meet operational requirements HO
Service(ing), served SER
Serviceable SVCBL
Severe SEV
Short take-off and landing STOL
Showers SH
Simple approach lighting system SALS

Simultaneous(ly) SIMUL
Simultaneous Runway Operations SIMOPS
Slow(ly) SLW
Smoke FU
South or south latitude S
South south-east SSE
South south-west SSW
South-east SE
South-west SW
Southbound SB
Special series NOTAM (message type designator) SNOWTAM
Sport aviation SPA
Standard STD
Standard instrument arrival STAR
Standard instrument departure SID
Standard departure clearance SDC
Standby SDBY
Start of TORA (take-off run available) SOT
Start of climb SOC
Station STN
Stationary STNR
Status STS
Stop-end(related to RVR) END
Stopway SWY
Stopway light STWL
Straight in approach STA
Subject to SUBJ
Sunrise SR
Sunrise to sunset HJ
Sunset SS
Sunset to sunrise HN
Supplement (AIP Supplement) SUP
Supplementary take-off distance STODA
Surface SFC
Surface movement control SMC
Surface movement radar SMR
'T' visual approach slope indicator system T-VASIS
Take-off TKOF
Take-off distance available TODA
Take-off run available TORA
Taxiing guidance system TGS
Taxiing or taxi TAX
Taxiway TWY
Taxiway link TWYL
Technical reason TECR
Telephone TEL
Temperature T
Temporary TEMPO
Terminal area surveillance radar TAR
Terminal control area TMA
Threshold THR

Threshold crossing height TCH
Through THRU
Thunderstorm TS
Thursday THU
Time-limited WIP (work in progress) TLW
Time search action required SARTIME
To be advised TBA
Tornado TDO
Touchdown zone TDZ
Track TR
Traffic TFC
Transitional surface TNS
Trend or tending to TEND
Tropical cyclone TC
True bearing QTE
Turbulence TURB
Type of aircraft TYP
Typhoon TYPH
UHF tactical air navigation aid TACAN
Ultra high frequency (300-3000 MHz) UHF
Unable UNA
Unable to approve UNAP
Unlimited UNL
Unserviceable U/S
Until TIL
Until advised by UAB
Until further notice UFN
Upper limits UL
VHF omni-direction radio range VOR
Variable VRB
Vertical VER
Vertical take-off and landing VTOL
Very high frequency (30-300 MHz) VHF
Very important person VIP
Very low frequency (3-30 kHz) VLF
Vicinity VCY
Visibility VIS
Visual approach slope indicator system VASIS
Visual en route chart VEC
Visual flight rules VFR
Visual meteorological conditions VMC
Visual terminal chart VTC
Warning WRNG
We agree or it is correct OK
Weaken(ing) WKN
Weather WX
Weight WT
West north-west WNW
West or west longitude W
West south-west WSW
White W

Widespread WID
Wind direction indicator WDI
Wind shear WS
With effect from, or effective from WEF
Within WI
With immediate effect, or effective immediately WIE
Without WO
Work in progress WIP
World Aeronautical Chart (1:1,000,000) WAC
Yellow caution zone (runway lighting) YCZ
Yes, or affirm, or affirmative, or that is correct AFM
Yours YR

Section 10.6 Appointment of Reporting Officers

10.6.1 General

- 10.6.1.1 The aerodrome operator must appoint suitably trained person(s) as the nominated reporting officer(s). The nomination(s) must be notified in writing to the NOTAM office and CAAP.
- 10.6.1.2 Persons other than employees of the aerodrome operator may, with appropriate training and experience, also be appointed as aerodrome reporting officers.

10.6.2 Reporting Officer Qualifications

- 10.6.2.1 Aerodrome operators must ensure that any person carrying out the reporting function has been suitably trained and has the following attributes:
- (a) a sound knowledge of the physical characteristics of the aerodrome movement area, the aerodrome obstacle limitation surfaces, aerodrome markings, lighting and ground signals and essential aerodrome safety equipment;
 - (b) an understanding of the aerodrome information included in AIP;
 - (c) the ability to carry out a serviceability inspection of the aerodrome;
 - (d) a knowledge of the aerodrome emergency procedures; and
 - (e) a knowledge of the NOTAM system and the ability to carry out aerodrome reporting procedures.

10.6.3 What to report

- 10.6.3.1 Aerodrome operators must advise the ATC or the NOTAM Office of the following occurrences:
- (a) changes (temporary or permanent) in the published runway information including further changes to information contained in current permanent NOTAMs;
 - (b) aerodrome works affecting runways or the obstacle limitation surfaces, including time-limited works that require more than 10 minutes to restore normal safety standards;
 - (c) outage of aerodrome lighting or obstacle lighting beyond specified limits;

- (d) temporary obstacles to aircraft operations;
- (e) a significant increase in, or concentration of birds or animals on or near the aerodrome which is a danger to aircraft;
- (f) changes resulting in obstruction of the OLS;
- (g) emergence of new obstacles;
- (h) when a radio navigation aid owned by the aerodrome operator, or landing aid is unserviceable or returned to service; or
- (i) any other event which affects the safety of aircraft using the aerodrome.

10.6.3.2 Reporting must be carried out as soon as possible after a reportable occurrence is observed, giving as much detail as is available. Where necessary, subsequent additional detail can be reported as it becomes available for further NOTAM to be issued. Where applicable, ATC must be advised of the unserviceability and the intention to initiate a NOTAM.

10.6.3.3 Aerodrome operators must provide as much notice as possible of aerodrome works which will affect airline schedules.

10.6.4 Monitoring activities outside aerodrome

10.6.4.1 The reporting function must also include monitoring activities outside but in the vicinity of the aerodrome which may result in hazards to aircraft operations. This includes:

- (a) developments which may become obstacles;
- (b) land planning and use which may attract birds; and
- (c) installation of lighting systems which may create confusion to pilots at night.

Section 10.7 Aerodrome Emergency Planning

10.7.1 Introduction

10.7.1.1 An aerodrome emergency plan (AEP) shall be established at an aerodrome. The AEP shall be commensurate with the aircraft operations and other activity conducted at the aerodrome.

Note: - Provision relating to Aerodrome emergency exercise are contained in MOS-Aerodromes 10.8.4.

10.7.1.2 The AEP shall contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness. The currency and adequacy of the AEP must be reviewed at least once every twelve (12) months.

Note: - The AEP includes all participating agencies and associated equipment.

10.7.1.3 The plan shall be tested by conducting:

- (a) a full-scale aerodrome emergency exercise at intervals not exceeding two years and partial emergency exercises in the intervening year to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected; or

- (b) a series of modular tests commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three (3) years; and
- (c) reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

Note: - 1. The purpose of a full-scale exercise is to ensure the adequacy of the plan to cope with different types of emergencies. The purpose of a partial exercise is to ensure the adequacy of the response to individual participating agencies and components of the plan, such as the communications system. The purpose of modular tests is to enable concentrated effort on specific components of established emergency plans.

Note: - 2. Guidance material on airport emergency planning is available in the Airport Services Manual, Part 7.

- 10.7.1.4 The aerodrome operator must establish and chair an Aerodrome Emergency Committee (AEC), including representatives of agencies on and off the aerodrome that could assist in an emergency. The AEC must develop the Aerodrome Emergency Plan, including procedures for coordinating the responses of assisting agencies.
- 10.7.1.5 A full scale emergency exercise must be carried out at least once every two years, commensurate with the size and scale of operations at the airport, unless the emergency plan was activated for a major emergency within the two (2) year period. A partial exercise is to be conducted in the intervening year.
- 10.7.1.6 The AEP must include organizational and procedural arrangements for responding to at least the following situations:
- (a) aircraft emergencies;
 - (b) local standby and full emergency;
 - (c) sabotage including bomb threats;
 - (d) unlawfully seized aircraft;
 - (e) disabled aircraft;
 - (f) hazardous material incident;
 - (g) building fire and natural disaster;
 - (h) public health emergencies; or
 - (i) medical emergency.
- Note: - Examples of public health emergencies are increased risk of travellers or cargo spreading a serious communicable disease internationally through air transport and severe outbreak of a communicable disease potentially affecting a large proportion of aerodrome staff.*
- 10.7.1.7 The AEP must clearly define the activation sequence including call out arrangements for Local Standby and Full Emergency. For instance, Local Standby does not require a response from off-aerodrome agencies whereas a Full Emergency does. The activation plan will detail the action required for each type of emergency.

- 10.7.1.8 The aerodrome operator must produce a grid map (or maps) of the aerodrome and its immediate vicinity, to include detailed location of primary and secondary access gates. The grid map is to be made available to all responding agencies.
- 10.7.1.9 CAAP does not regulate AEP responding agencies and how they conduct their functions. It is the responsibility of the AEC to ensure that the level and availability of emergency equipment and services are adequate for the aerodrome.

Emergencies in difficult environment

- 10.7.1.10 The plan shall include the ready availability and coordination with appropriate specialist agencies rescue services who are able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over those these areas.
- 10.7.1.11 At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan shall include the establishment, testing and assessment at regular intervals of a predetermined response for the specialist rescue services.
- 10.7.1.12 An assessment of the approach and departure areas within 1000 m of the runway threshold shall be carried out to determine the options available for intervention.
- Note: - Guidance material on assessing approach and departure areas within 1,000 m of runway thresholds can be found in Chapter 13 of the Airport Services Manual (Doc 9137), Part 1.*
- 10.7.1.13 The plan shall coordinate the response or participation of all existing agencies which, in the opinion of the appropriate authority, could be of assistance in responding to an emergency.

Note: - 1. Examples of agencies are:

- on the aerodrome: air traffic control units, rescue and firefighting services, aerodrome administration, medical and ambulance services, aircraft operators, security services, and police;
- off the aerodrome: fire departments, police, health authorities (including medical, ambulance, hospital and public health services), military, and harbor patrol or coast guard.

Note: - 2. Public health services include planning to minimize adverse effects to the community from health-related events and deal with population health issues rather than provision of health services to individuals.

- 10.7.1.14 The aerodrome emergency plan document should include at least the following:
- (a) types of emergencies planned for;
 - (b) agencies involved in the plan;

- (c) responsibility and role of each agency, the emergency operations center and the command post, for each type of emergency;
- (d) information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and
- (e) a grid map of the aerodrome and its immediate vicinity.

10.7.2 Records

- 10.7.2.1 Records of reviews and exercises including real emergencies must be kept and retained for at least three (3) years.

10.7.3 Disabled Aircraft Removal

Note: Guidance for Developing a Disabled Aircraft Removal Plan (DARP), is given in AC 139-DARP-01. See also Annex 13 concerning protection of evidence, custody and removal of aircraft.

- 10.7.3.1 A Disabled Aircraft Removal Plan (DARP) must be prepared by aerodrome operators to ensure continuity of airport operation as part of AEP and a coordinator designated to implement the plan.

- 10.7.3.2 The disabled aircraft removal plan shall be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:

- (a) a list of equipment and personnel on, or in the vicinity of, the aerodrome which would be available for such purpose; and
- (b) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes.

Section 10.8 Guidelines for Aerodrome Emergency Plans

10.8.1 General

- 10.8.1.1 Aerodrome emergency planning is the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in its vicinity. The objective of the planning is to ensure a timely and effective response to an emergency, particularly in respect of saving lives and maintaining aircraft operations.

- 10.8.1.2 Examples of aerodrome emergencies are: crash (aircraft accident), sabotage including bomb threats, unlawfully seized aircraft, disabled aircraft, spillage of hazardous material, building fires, natural disaster and public health emergencies.

- 10.8.1.3 Examples of public health emergencies are increased risk of travellers or cargo spreading a serious communicable disease internationally through air transport and severe outbreak of a communicable disease potentially affecting a large proportion of aerodrome staff.

- 10.8.1.4 The aerodrome emergency plan shall be commensurate with the scale and type of aircraft operations, the surrounding geography and other activities conducted at

the aerodrome. With the assistance of the Aerodrome Emergency Committee, the aerodrome certificate holder shall plan for the worse type of emergency situations that might conceivably occur with respect to size, location, timing and weather.

10.8.1.5 The off-aerodrome responding agencies will have been established to deal with most, if not all, emergency situations occurring in the community. Therefore, the aerodrome emergency procedures shall have the highest degree of similarity with the procedures used in the community generally.

10.8.1.6 The best understanding of the procedures is achieved through taking part in the planning process and the most workable procedures are the ones derived by those who have to carry them out. Therefore, in the development of the procedures, certificate holders shall seek the maximum possible involvement of responding agencies and obtain their endorsement of the procedures so developed.

10.8.1.7 The plan shall provide cooperation and coordination with the rescue coordination center, as necessary.

10.8.1.8 The plan shall observe Human Factors principles to ensure optimum response by all existing agencies participating in emergency operations.

Note: - 1. Guidance material on Human Factors principles can be found in the Human Factors Training Manual (Doc 9683).

Note: - 2. General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

10.8.2 Medical Subcommittee

10.8.2.1 On larger aerodromes it is usual to delegate the preparation of the medical plan to a sub-committee. When established, the medical sub-committee shall:

- (a) plan the deployment of medical personnel called to an aircraft emergency;
- (b) develop procedures for triage, emergency treatment and movement of casualties; and
- (c) nominate a coordinator of crash site medical resources.

10.8.3 Testing facilities and reviewing roles

10.8.3.1 Facilities used in the responses by the various agencies including communications systems shall be tested at intervals not exceeding one (1) year.

10.8.3.2 Individual participants in the aerodrome emergency plan shall be encouraged to continuously review their roles (for example on a particular day each month) to ensure that they know their responsibilities and that all the information in the plan is current. It is important that all personnel who may be required to act in an emergency shall develop the correct mental attitude to aerodrome emergency planning. To that end and in spite of their self-evident nature, it is worthwhile noting

that the salient lessons to be gained from those who have experienced an airport emergency are that:

- (a) people do best in an emergency what they have been trained to do;
- (b) emergencies happen with little or no warning; and
- (c) emergencies happen to anybody.

10.8.4 Aerodrome Emergency Exercises

- 10.8.4.1 The minimum frequency of full-scale aerodrome emergency exercises of two (2) years has been set in compliance with international standards.
- 10.8.4.2 Specialty emergency exercises aimed at testing and reviewing the response of individual responding agencies, such as rescue and firefighting services, as well as parts of the emergency plan, such as the communications system, shall be held at more frequent intervals than the full-scale exercise.
- 10.8.4.3 Aerodrome certificate holders shall conduct partial or 'table-top' exercises involving the Aerodrome Emergency Committee annually between the full scale exercises, provided such exercises do not conflict with the specialty exercises.
- 10.8.4.4 Experience to be gained from exercises shall be shared by inviting other aerodrome certificate holders to attend as observers. Operators of major aerodromes shall notify the relevant pilot and cabin attendant staff associations of each planned emergency exercise to enable representatives of those organizations to observe the exercise and participate in the review shall they so desire.

10.8.5 Emergency Operations Center and Mobile Command Post

- 10.8.5.1 A fixed emergency operations center and a forward mobile command post shall be available for use in an emergency. The fixed emergency operations center shall be a part of the aerodrome facilities and be used to coordinate and direct the overall response to the emergency. The location and staffing of the emergency operations center shall be clearly identified in the plan. The forward mobile command post shall be an easily recognizable structure capable of being moved rapidly to the scene of an emergency, when required, and shall be used to control the on-scene agencies responding to the emergency.
- 10.8.5.2 The aerodrome emergency plan shall clearly set out the discrete roles of the emergency operations center and the forward command post, highlighting the physical location of the emergency coordinator.
- 10.8.5.3 A person should be assigned to assume control of the emergency operations center and, when appropriate, another person at the (mobile) command post.
- 10.8.5.4 Adequate communication systems linking the command post and the emergency operations center with each other and with the participating agencies shall be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

10.8.6 Definitions of Command, Control, and Coordination

10.8.6.1 The definitions of 'command', 'control', and 'coordination' which shall be used in the context of aerodrome emergency planning are given below.

10.8.6.2 **Command.** 'Command' is the direction of members and resources of an organization in the performance of the organization's role and tasks. Authority to command is established in legislation or by agreement with an organization. Command relates to organizations and operates vertically within organizations.

10.8.6.3 **Control.** 'Control' is the overall direction of activities. Authority for control is established in legislation or in an emergency plan and carries with it the responsibility for tasking and coordinating other organizations in accordance with the needs of the situation. In this context, tasking means telling people what to do, but not how to do it. Control relates to situations and operates horizontally across organizations.

10.8.6.4 **Coordination.** 'Coordination' is the bringing together of organizations and elements to ensure effective counter-emergency responses, and is primarily concerned with the systematic acquisition and application of resources (organization, manpower and equipment) in accordance with the requirements imposed by the threat or impact of an emergency. Coordination relates primarily to resources and operates:

- (a) vertically within an organization as a function of the authority to command; and
- (b) horizontally across organizations as a function of the authority to control.

10.8.7 Role of the Police

10.8.7.1 As soon as any police presence is established at the scene of an aerodrome emergency or exercise, the senior police officer is required to assume overall coordination of the agencies responding to the emergency. The person who initially assumes coordination of the situation should hand over to police when they arrive.

10.8.7.2 The police may be required to account for all people on board a crashed aircraft. In discharging this function it will normally be necessary to secure the crash site area and impose control over persons entering and leaving the site.

10.8.7.3 The police must also be given the responsibility of guarding any aircraft wreckage on behalf of Aircraft Accident Investigation and Inquiry Board (AAIIB).

Section 10.9 Control of Airside Access and Vehicle Control

10.9.1 Introduction

10.9.1.1 Particulars of the procedures for preventing unauthorized entry into the movement area, including the arrangements for controlling airside access, and airside vehicle control, are to be included in the aerodrome manual.

10.9.1.2 At aerodromes catering for air transport operations, a fence or other suitable barrier must be provided where practicable, around the movement area of the aerodrome.

10.9.2 Aerodrome Vehicle Operations

Note 1: — Procedures on the establishment of an airside driver permit (ADP) scheme and vehicle/equipment safety requirements, including detailed personnel training, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapter 9.

Note 2: — Guidance on aerodrome vehicle operations is contained in Attachment A, Section 19, and on traffic rules and regulations for vehicles in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

Note 3: — It is intended that roads located on the movement area be restricted to the exclusive use of aerodrome personnel and other authorized persons, and that access to the public buildings by an unauthorized person will not require use of such roads.

10.9.2.1 A vehicle shall be operated:

- (a) on a maneuvering area only as authorized by the aerodrome control tower; and
- (b) on an apron, only as authorized by the relevant designated authority.

10.9.2.2 Unless otherwise directed by CAAP the aerodrome operator must introduce and maintain a permit system for approval of airside vehicle operations.

10.9.2.3 Vehicles and ground equipment operated airside must be maintained in a sound mechanical and roadworthy condition, so as to prevent avoidable breakdowns and spillage of fuels, lubricants and hydraulic fluids.

10.9.2.4 The aerodrome operator must establish speed limits for vehicles on the movement area and a regime to enforce them.

10.9.2.5 Vehicles must not be driven under an aircraft or within 3 m of any part of an aircraft except when required for the servicing of aircraft.

10.9.2.6 Vehicles operating on the movement area by day must be marked in accordance with MOS 8.10.4.

10.9.2.7 Vehicles operating on the movement area at night, or in conditions of poor visibility, must display dipped headlights and must be lit with vehicle warning lights.

10.9.3 Airside drivers

10.9.3.1 The driver of a vehicle on the movement area must be appropriately trained for the tasks to be performed and shall comply with instructions issued by:

- (a) the aerodrome controller when on the maneuvering area; and
- (b) the appropriate authority when operating on the apron.

10.9.3.2 The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by markings and signs unless otherwise authorized by:

- (a) the aerodrome control tower when on the maneuvering area; or
- (b) the appropriate designated authority when on the apron.

10.9.3.3 The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by lights.

10.9.3.4 Any person operating vehicles and ground equipment, must hold an appropriate license to operate.

10.9.3.5 The driver of a radio equipped vehicle shall establish satisfactory two-way communications with the aerodrome controller before entering the maneuvering area, and with appropriate designated authority before entering apron. The driver shall maintain a continuous listening watch on the assigned frequency while on the maneuvering area (and/or apron).

Note: - Guidance for operators of vehicles can be referred to MOS Attachment A, Section 6.

Section 10.10 Aerodrome Works Safety

10.10.1 Introduction

10.10.1.1 The operator of a certified aerodrome must arrange aerodrome works so as not to create any hazard to aircraft or confusion to pilots. The aerodrome manual must include particulars of the procedures for planning and safely carrying out aerodrome works.

10.10.1.2 Aerodrome works must be carried out without the closure of the aerodrome, provided safety precautions are adhered to.

10.10.1.3 Aerodrome works must be carried out in the following manner:

- (a) where the works are of a nature that they will disrupt aircraft operations, they must be carried out under a scheme of arrangements called the method of working plan; and
- (b) where works are of a short term maintenance nature they may be carried out as time-limited works.

10.10.1.4 Where a threshold is required to be temporarily displaced for more than 300 m, due to aerodrome works, the matter must be referred to CAAP for assessment the operational significance of that displacement.

10.10.2 Method of Working Plans

10.10.2.1 At an aerodrome used by aircraft of more than 5,700 kg maximum take-off weight, unless the aerodrome is closed during aerodrome works, or the work is of an emergency nature, the aerodrome operator must not carry out aerodrome works, other than time-limited works, without a Method of Working Plan (MOWP) prepared for those works.

10.10.2.2 The MOWP must set out the arrangements for carrying out those works.

- 10.10.2.3 An MOWP must be prepared in accordance with MOS 10.11 to this Chapter.
- 10.10.2.4 When preparing a MOWP, an aerodrome operator must consult:
- (a) commercial air transport operators using the aerodrome;
 - (b) Air Traffic Control; and
 - (c) if the MOWP may affect its operations, the Rescue and Firefighting Service unit at the aerodrome so as to ensure the safety of aircraft operations at the aerodrome.
- 10.10.2.5 The aerodrome operator must give a copy of the MOWP, and any alteration thereof, to CAAP as soon as possible after the MOWP is prepared or altered.
- 10.10.2.6 Aerodrome works, for which a MOWP is required, must be carried out in accordance with the arrangements set out in the authorized MOWP and any subsequent amendment.
- 10.10.2.7 A MOWP is not required if the aerodrome operator closes the aerodrome to aircraft operations while aerodrome works are being carried out. CAAP, commercial air transport operators and all organizations and persons likely to be affected by the closure must be given reasonable notice of intention to close the aerodrome.
- 10.10.2.8 The operator must not close the aerodrome to aircraft operations due to aerodrome works, unless a NOTAM giving notice of the closure has been issued at least 14 days before closure takes place.
- 10.10.2.9 A MOWP is not required for emergency aerodrome works carried out to repair unforeseen damage to part of the maneuvering area, or to remove an obstacle, or if the works do not require any restrictions to aircraft operations. Where practicable, a NOTAM, giving the time and date of the commencement of the works must be issued, as early as possible, but preferably not less than 48 hours before commencement of the works.
- 10.10.3 Time-Limited Works**
- 10.10.3.1 Aerodrome works must be carried out as time-limited works, if normal aircraft operations are not disrupted, the movement area can be restored to normal safety standards in no more than 30 minutes, including the removal of any obstacle created by those works.
- 10.10.3.2 Time-limited works include the following works:
- (a) maintenance of markings and lights;
 - (b) grass mowing;
 - (c) rolling surfaces;
 - (d) sweeping pavements;
 - (e) minor repairs to pavements; and
 - (f) surveys and inspections.

- 10.10.3.3 A person must not commence time-limited works that require more than 10 minutes to restore normal safety standards to the movement area and remove obstacles, unless a NOTAM has been issued not less than 24 hours before the commencement, giving the date and time of commencement and the time required to restore normal safety standards.

10.10.4 Restrictions on Time-Limited Works

- 10.10.4.1 Subject to paragraph 10.10.4.2 time-limited works must not be carried out at night or if visibility is less than 5 kilometers.
- 10.10.4.2 Paragraph 10.10.4.1 does not apply if it is authorized by Air Traffic Control at a controlled aerodrome or in other cases if normal safety standards can be promptly restored so as to allow an aircraft operation to take place without delay.

10.10.5 Restoration of Normal Safety Standards

- 10.10.5.1 Time-limited works must be stopped and normal safety standards restored when required to allow an aircraft operation to take place.
- 10.10.5.2 All reasonable measures must be taken to complete the restoration of normal safety standards not less than 5 minutes before the scheduled or notified time of an aircraft operation.

10.10.6 Resumption of Aerodrome Works

- 10.10.6.1 Works that have been stopped to allow the restoration of normal safety standards may be resumed:
- (a) if stopped for an aircraft arrival, immediately after the arrival, if the safety of the aircraft is not endangered by the resumption; or
 - (b) if stopped for an aircraft departure, 15 minutes after the departure has taken place; or
 - (c) if stopped for an aircraft arrival that does not take place; 30 minutes after the time scheduled or notified for the arrival (when a new ETA is established).
- 10.10.6.2 Air Traffic Control may, at the request of the aerodrome operator, vary the time limits set out in paragraph 10.10.6.1 for restoring normal safety standards or resuming aerodrome works. A variation under this paragraph is subject to such conditions as Air Traffic Control may impose.
- #### **10.10.7 Management and control of aerodrome works**
- 10.10.7.1 An aerodrome operator must ensure that aerodrome works are carried out in accordance with the standards in this Chapter.
- 10.10.7.2 An aerodrome operator must appoint a person in writing as a works safety officer for the purpose of ensuring the safe conduct of aerodrome works.

- 10.10.7.3 Before appointing a person as a works safety officer, the aerodrome operator must be satisfied that the person is able to perform the functions of a works safety officer set out in MOS 10.12.
- 10.10.7.4 A works safety officer must be present at all times if aerodrome works are being carried out and the aerodrome is open to aircraft operations. For time limited work, a dedicated safety officer is not required if one of the persons conducting the work activity is competent to be a work safety officer.
- 10.10.7.5 An aerodrome operator must take all reasonable measures to ensure that the works organization carries out aerodrome works in a manner that will ensure the safety of aircraft operations.
- 10.10.7.6 Persons, vehicles, plant and equipment required for carrying out aerodrome works, must not be permitted to enter the movement area or remain on it, except for the purpose of carrying out those works.
- 10.10.7.7 Procedures for entering works areas must be stated in the MOWP.
- 10.10.7.8 The operator must allow access to works areas only along routes shown in the MOWP.
- 10.10.8 Markers, Markings and Lights**
- 10.10.8.1 Aerodrome markers, markings and lights required for, or affected by, aerodrome works must be installed, altered or removed in accordance with the appropriate standards.
- 10.10.8.2 Parts of the movement area that are unserviceable as a result of aerodrome works being carried out must be marked and lit in accordance with the appropriate standards.
- 10.10.8.3 All obstacles created as a result of aerodrome works being carried out must be marked and lit in accordance the appropriate standards in Chapter 8.
- 10.10.8.4 Vehicles and plant used in carrying out aerodrome works must be marked in accordance with MOS 8.10.4.
- 10.10.8.5 In addition to paragraph 10.10.8.4 requirements, vehicles and plant used in carrying out aerodrome works at night must be lit in accordance with MOS 9.18.1.
- 10.10.9 Communication Equipment**
- 10.10.9.1 At a controlled aerodrome, a vehicle used by a works safety officer while supervising aerodrome works must be equipped with a radio for two-way communication with Air Traffic Control.
- 10.10.9.2 For the purpose of communication with Air Traffic Control, each vehicle used by a works safety officer must be given a call sign.

- 10.10.9.3 Any vehicle or plant that is not:
- (a) marked or lit in accordance with Paragraph 10.10.8; or
 - (b) if applicable, equipped with a two-way radio may only be used in carrying out aerodrome works if it is:
 - (i) used under the direct supervision of the works safety officer; or
 - (ii) used only within the limits of appropriately marked and lit work areas.

10.10.10 Completion

- 10.10.10.1 On the completion of aerodrome works and the restoration of normal safety standards to the movement area, the aerodrome operator must initiate cancellation of any NOTAM issued to advise of those works.

10.10.11 Runway Pavement Overlays

Note: - The following specifications are intended for runway pavement overlay projects when the runway is to be returned temporarily to an operational status before resurfacing is complete. This may necessitate a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the Aerodrome Design Manual (Doc 9157), Part 3.

- 10.10.11.1 At the end of an overlay work session, when the runway is to be returned to an operational status, the new and old runway surfaces must not be left with an abrupt vertical surface of more than 25 mm. This will normally require the provision of a temporary ramp between the new and the old surfaces.
- 10.10.11.2 The longitudinal slope of the temporary ramp described in paragraph 10.10.11.1, measured with reference to the existing runway surface or previous overlay course, must be:
- (a) 0.5 to 1.0 per cent for overlays up to and including 5 cm in thickness; and
 - (b) not more than 0.5 per cent for overlays more than 5 cm in thickness.
- 10.10.11.3 Overlaying should proceed from one end of the runway toward the other end so that based on runway utilization most aircraft operations will experience a down ramp.
- 10.10.11.4 The entire width of the runway must be overlaid during each work session. Where the entire width of the runway cannot be overlaid during a work session, then at least the central two-third width of the runway is to be overlaid. In this case, a temporary transverse ramp of between 0.8 and 1.0 per cent must be provided between the edge of the new overlay surface and the existing runway surface or previous overlay course when the difference in level exceeds 25 mm.
- 10.10.11.5 Before a runway being overlaid is returned to a temporary operational status, a runway centerline marking conforming to the specifications in MOS 8.3.3 shall be provided. Additionally, the location of any temporary threshold shall be identified by a 3.6 m wide transverse stripe.

- 10.10.11.6 The overlay shall be constructed and maintained above the minimum friction level specified in MOS 10.15.2.3.

10.10.12 Works on Runway Strips

- 10.10.12.1 Works on runway strips must be carried out in the shortest possible time, and where undertaken within 23 m of the edge of the runway or runway shoulder:
- (a) works must only be undertaken on one side of the runway at any one time;
 - (b) the works area at any one time must not exceed 9 square meters, except for machine cut trenches, not exceeding a width of 100 mm and length of 280 m;
 - (c) materials such as gravel, signs and lights, etc. left within this part of the runway strip, must not exceed one half meter in height above ground. Any material likely to be affected by propeller wash or jet blast, must be removed; and
 - (d) plant and vehicles must vacate this area when the runway is in use.
- 10.10.12.2 Where works are undertaken on a runway strip between 23 m from the edge of the runway or runway shoulder and the edge of the graded runway strip, similar restriction must be applied within this area of the runway strip, as for paragraph 10.10.12.1 above, except that the works area may extend up to an area of 18 square meters at any one time, and the height of materials may extend up to one meter.
- 10.10.12.3 Where works are to be undertaken in the vicinity of navigational or landing aids located within the runway strips, care must be taken to ensure that neither the works nor vehicles or plant associated with the works, may affect the performance of the aids.

Section 10.11 Method of Working Plans

10.11.1 Introduction

- 10.11.1.1 The MOWP must be presented in sections in the following sequence:
- (a) title page
 - (b) works information
 - (c) restrictions to aircraft operations
 - (d) restrictions to works organization
 - (e) administration
 - (f) authority
 - (g) drawings
 - (h) distribution list.

10.11.2 Title Page

- 10.11.2.1 Each MOWP must be given a reference number, consisting of the code used to identify the aerodrome in the AIP, the last two digits of the year and the number given to the MOWP by the aerodrome operator.
- 10.11.2.2 MOWPs issued in relation to the same aerodrome must be numbered consecutively in the order of their issue.
- 10.11.2.3 The MOWP number, the date of issue, and the date and number of any amendment are to be set out in the top right hand corner of the title page.
- 10.11.2.4 The title must indicate the location of the work and give a short description of the project, for instance “[name Aerodrome]: Runway 07/25 repairs”.
- 10.11.2.5 The date of approval of the MOWP, the date of commencement and the date of expiry of the MOWP, and the date of completion of the works are to be set out on the title page.
- 10.11.2.6 The title page must include a list of the sections of the MOWP.
- 10.11.3 Works Information**
- 10.11.3.1 The MOWP must:
- (a) include an outline of the full scope of the works and state which aerodrome facilities are affected;
 - (b) provide the planned date and time of commencement, the duration of each stage and the time of completion;
 - (c) contain the following sentence:
 - (d) “The actual date and time of commencement will be advised by a NOTAM, to be issued not less than 48 hours before work commences”.
- 10.11.4 Restrictions to aircraft operations and issue of NOTAMs**
- 10.11.4.1 This section of the MOWP must be in a form that allows its separate issue to aircraft operators and permits those operators to have easy reference to the information as it affects them.
- 10.11.4.2 This section of the MOWP must state each restriction and each aircraft type affected by that restriction.
- 10.11.5 Work Stages**
- 10.11.5.1 Any restrictions to aircraft operations on the maneuvering area, or in the approach and take-off areas must be listed and shown on drawings of each stage of the works.
- 10.11.5.2 When complex works are being undertaken, a table showing the restrictions applicable to each stage of the works and for each type of aircraft operation must be included.

- 10.11.5.3 The table must outline the various work stages with start and completion dates and have a remarks column to list details of special restrictions and the issue of NOTAMs for the information of a pilot before a flight.
- 10.11.6 Emergencies and Adverse Weather**
- 10.11.6.1 The MOWP must outline details, if any, of special arrangements to be made during works if emergencies or adverse weather conditions occur.
- 10.11.7 NOTAMs**
- 10.11.7.1 The full text of all planned NOTAMs associated with the aerodrome works must be included.
- 10.11.8 Restrictions to Works Organizations**
- 10.11.8.1 The MOWP must provide any restrictions on the organization carrying out of aerodrome works and requirements for the restoration of normal safety standards.
- 10.11.9 Personnel and Equipment**
- 10.11.9.1 When personnel and equipment are required to vacate the movement area for certain operations, specific mention of this fact must be made, for example: "All personnel and equipment will clear runway strip 11/29 for all operations by aircraft larger than B737".
- 10.11.10 Access**
- 10.11.10.1 The MOWP must identify the routes to and from the works area and the procedures for entering the works areas within the movement area.
- 10.11.10.2 Particulars of routes to and from the works area must be shown in drawings attached to the MOWP.
- 10.11.11 Aerodrome Markers, Markings and Lights**
- 10.11.11.1 Details of arrangements for the installation, alteration and removal of aerodrome markers, markings and lights in the work areas and other areas affected by the aerodrome works must be shown in drawings attached to the MOWP.
- 10.11.12 Protection of Electrical Services**
- 10.11.12.1 The MOWP must set out procedures for ensuring that electrical services and control cables are not damaged.
- 10.11.13 Special Requirements**
- 10.11.13.1 The MOWP must provide details of any special requirements arising during or on completion of aerodrome works, for example, arrangements for leaving pavement surfaces swept and clean before evacuation of the works area.
- 10.11.14 Administration**

- 10.11.14.1 The MOWP must provide the name of the Project Manager appointed by the aerodrome operator and the means of contact, including the means outside normal working hours.
- 10.11.14.2 The MOWP must provide the names of the works safety officer or officers appointed by the aerodrome operator and the means of contact, including the means outside normal working hours.
- 10.11.14.3 The MOWP must provide the name of the works organizer (where appropriate) and the means of contact, including the means outside working hours.

10.11.15 Authority

- 10.11.15.1 Each MOWP must contain the following statement: "All works will be carried out in accordance with the MOWP".
- 10.11.15.2 Each MOWP must set out its expiry date, and any alteration of that date.
- 10.11.15.3 Each MOWP must be signed, immediately after paragraph 10.11.15 (this paragraph), by the aerodrome operator or the project manager.

10.11.16 Drawings

- 10.11.16.1 Drawings must be attached, which provide a visual reference for each stage of the works. The drawings must contain specific details such as works area, restrictions to aircraft, location of radio navigational aids, exact location of visual ground aids and markings, details of the height and location of critical obstacles, location of temporary taxiways, access routes, storage areas for material and equipment, and the location of electrical services and control cables which may be disturbed during the works.

10.11.17 Distribution List

- 10.11.17.1 The distribution list of the MOWP must include at least the following persons and organizations:
- (a) the project manager;
 - (b) the works safety officer;
 - (c) the aerodrome security manager, if any;
 - (d) the works organizer;
 - (e) the CAAP aerodrome inspector;
 - (f) ATC and the Rescue and Firefighting Service Unit for the aerodrome;
 - (g) the air transport aircraft operators using the aerodrome at which the aerodrome works are to be carried out; and
 - (h) fixed-base operators using the aerodrome at which the aerodrome works are to be carried out.

Section 10.12 Functions of a Works Safety Officer

10.12.1 Works Safety Officer

10.12.1.1 The Works Safety Officer performs the following responsibilities.

- (a) Ensure the safety of aircraft operations in accordance with the standards for aerodrome works and the applicable MOWP;
- (b) Ensure that, where applicable, the aerodrome works are notified by issue of a NOTAM and that the text of each NOTAM is exactly as set out in the applicable MOWP;
- (c) Supply the Air Traffic Controller (ATC), on a daily basis, with whatever information is necessary to ensure the safety of aircraft operations;
- (d) Discuss with the works organization, on a daily basis, any matters necessary to ensure the safety of aircraft operations;
- (e) Ensure that unserviceable portions of the movement area, temporary obstructions, and the limits of the works area are correctly marked and lit in accordance with MOS 10.10.8, and the applicable MOWP;
- (f) Ensure that the vehicles, plant and equipment carrying out aerodrome works are properly marked and lit or are under works safety officer supervision or within properly marked and lit works area;
- (g) Ensure that all other requirements of the directions and MOWP relating to vehicles, plant, equipment and materials are complied with;
- (h) Ensure that access routes to work areas are in accordance with the applicable MOWP and clearly identified and that access is restricted to these routes;
- (i) Ensure that excavation is carried out in accordance with the MOWP and, in particular, so as to avoid damage or loss of calibration to any underground power or control cable associated with a precision approach and landing system or any other navigational aid;
- (j) Report immediately to the air-traffic controller and the aerodrome operator any incident, or damage to facilities, likely to affect air-traffic control services or the safety of aircraft;
- (k) Remain on duty at the works area while work is in progress and the aerodrome is open to aircraft operations;
- (l) Ensure that the Air Traffic Controller (ATC) is kept informed of the radio call signs of the vehicles used by the works safety officer;
- (m) Require the immediate removal of vehicles, plant and personnel from the movement area where necessary to ensure the safety of aircraft operations;
- (n) Ensure that the movement area is safe for normal aircraft operations following removal of vehicles, plant, equipment and personnel from the works area;
- (o) In the case of time-limited works, ensure that the works area is restored to normal safety standards not less than 5 minutes before the time scheduled or notified for an aircraft movement; and
- (p) Ensure that floodlighting or any other lighting required for carrying out aerodrome works is shielded so as not to represent a hazard to aircraft operations.

Section 10.13 Aircraft Parking**10.13.1 Introduction**

- 10.13.1.1 This Section is applicable only at aerodromes where apron congestion is a problem.
- 10.13.1.2 The aerodrome operator must include in the aerodrome manual particulars of the procedures for aircraft parking control, on those aprons, to ensure the safety of aircraft during ground maneuvering.

10.13.2 Apron Congestion

- 10.13.2.1 Appropriate apron safety procedures must be developed by the aerodrome operator in conjunction with relevant organizations such as the airlines, ground handlers and caterers and monitored for compliance on a regular basis. Written agreements and contracts are useful components of congestion mitigation measures.

10.13.3 Apron Safety Management

- 10.13.3.1 Aerodrome operators must ensure that, irrespective of who is responsible for aircraft parking, procedures are in place and documented for aircraft docking, ground servicing, engine start and push back operations.
- 10.13.3.2 Apron safety management procedures must:
- (a) ensure that people involved are appropriately trained and experienced; and
 - (b) ensure that people engaged in these activities are provided with appropriate equipment such as communications and high visibility garments.
- 10.13.3.3 If apron operational activities are undertaken by organization(s) other than the aerodrome operator, then the aerodrome operator must ensure the apron safety management procedures are followed.
- 10.13.3.4 Ground servicing of aircraft. Fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire and personnel trained in its use shall be readily available during the ground servicing of an aircraft, and there shall be a means of quickly summoning the rescue and firefighting service in the event of a fire or major fuel spill.
- 10.13.3.5 When aircraft refuelling operations take place while passengers are embarking, on board or disembarking, ground equipment shall be positioned so as to allow:
- (a) the use of a sufficient number of exits for expeditious evacuation; and
 - (b) a ready escape route from each of the exits to be used in an emergency.

10.13.4 Apron management service

- 10.13.4.1 When warranted by the volume of traffic and operating conditions, an appropriate apron management service shall be provided on an apron by an aerodrome ATS

unit, by another aerodrome operating authority, or by a cooperative combination of these, in order to:

- (a) regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles; (a) regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;
- (b) regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and
- (c) ensure safe and expeditious movement of vehicles and appropriate regulation of other activities.

10.13.4.2 When the aerodrome control tower does not participate in the apron management service, procedures shall be established to facilitate the orderly transition of aircraft between the apron management unit and the aerodrome control tower.

Note: - Additional guidance on an apron management service is also given in AC 139-AMGT-01 (Guidance in Operational Procedures and principles for Apron management), Airport Services Manual (Doc 9137), Part 8, and in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476)

10.13.4.3 An apron management service shall be provided with radiotelephony communications facilities.

10.13.4.4 Where low visibility procedures are in effect, persons and vehicles operating on an apron shall be restricted to the essential minimum.

Note: - Guidance on related special procedures is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

10.13.4.5 An emergency vehicle responding to an emergency shall be given priority over all other surface movement traffic.

10.13.4.6 A vehicle operating on an apron shall:

- (a) give way to an emergency vehicle; an aircraft taxiing, about to taxi, or being pushed or towed; and
- (b) give way to other vehicles in accordance with local regulations.

10.13.4.7 An aircraft stand shall be visually monitored to ensure that the recommended clearance distances are provided to an aircraft using the stand.

Note: - Procedures on the training of operational personnel and on apron safety and operations, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 7.

10.13.4.8 The following traffic management control procedures/conditions are to be taken into account when a single unit takes over the responsibility for aircraft and vehicles at a pre-determined handover point between the apron and the maneuvering area:

- (a) The edge of the maneuvering area represents the handover point;
- (b) The handover point shall be clearly indicated on the ground and on aeronautical charts, for the benefit of aircraft vehicle operators;

- (c) The apron management unit will then assume responsibilities for managing and coordinating all aircraft traffic on the apron, issuing verbal instructions on an agreed radio frequency;
- (d) The apron management unit will manage all apron vehicle traffic and other apron activities in order to advise aircraft of potential hazards within the apron area; and
- (e) An arrangement with the aerodrome ATS unit, start-up and taxi clearance to the handover point shall be given to departing aircraft where the ATS unit assumes responsibility.

10.13.4.9 In case of a coordinated apron management service where radio communication with aircraft requiring start-up or push-back clearance on the apron is vested in the air traffic service unit, and the control of vehicles is the responsibility of the aerodrome authority or the operator, ATS instructions to aircraft are given on the understanding that safe separation between the aircraft and vehicles not under radio control is not included in the instruction.

10.13.4.10 Where the apron management service maintains:

- (a) close communication with the aerodrome control service and is responsible for aircraft stand allocation, dissemination of movement information to aircraft operators by monitoring ATC frequencies; and
- (b) updating basic information continuously on aircraft arrival times, landings and take-offs;

The apron management service shall ensure that the apron area is kept clean by airport maintenance and that established aircraft clearance distances are available at the aircraft stand. A marshalling service and follow-me vehicle may also be provided.

Section 10.14 Wildlife Hazard Management

10.14.1 Introduction

10.14.1.1 The aerodrome operator must monitor and record, on a regular basis, the presence of birds or animals on or in the vicinity of the aerodrome. Monitoring personnel must be suitably trained for this purpose.

10.14.1.2 Where regular monitoring confirms existence of a bird or animal hazard to aircraft operations, or when CAAP so directs, the aerodrome operator must produce a bird or animal hazard management plan, which will be included as part of the Aerodrome Manual.

10.14.1.3 To successfully deal with land-use issues, a comprehensive wildlife management plan including coordination among the aviation regulatory authority, airport operator, aircraft operators and the surrounding communities must be implemented.

10.14.1.4 If directed by the CAAP, the management plan must be prepared by a suitably qualified person such as an ornithologist or a biologist, etc.

- 10.14.1.5 The management plan must address:
- (a) hazard assessment, including monitoring action and analysis;
 - (b) pilot notification;
 - (c) liaison and working relationships with land use planning authorities;
 - (d) on-airport bird and animal attractors which provide food, water or shelter;
 - (e) suitable harassment methods; and
 - (f) an ongoing strategy for bird and animal hazard reduction, including provision of appropriate fencing.
- Note: - Guidance on the Establishment of Wildlife Hazard Management at Airports by Aerodrome Operators is provided in AC 139-05-A.*
- 10.14.1.6 The bird and animal hazard management plan must be reviewed for effectiveness, on a regular basis, at least as part of each technical inspection.
- 10.14.1.7 Where the presence of birds or animals is assessed as constituting an ongoing hazard to aircraft, the aerodrome operator must notify the CAAP in writing, and include a warning notice for publication in the AIP.
- 10.14.1.8 Where a bird or animal hazard is assessed as acute, of short term or seasonal nature, additional warning must be given to pilots by NOTAM.
- 10.14.1.9 Liaise with airport operators, local government units (LGUs), and other stakeholders to assist in identifying and managing wildlife issues at the aerodrome. Invite relevant external stakeholders to quarterly Runway Safety meetings to assist with wildlife management at off airport sites.
- 10.14.2 Wildlife strike hazard reduction**
- Note: - The presence of wildlife (birds and other animals) on and in the aerodrome vicinity poses a serious threat to aircraft operational safety.*
- 10.14.2.1 The wildlife strike hazard on, or in the vicinity of, an aerodrome shall be assessed through:
- (a) the establishment of a national procedure for recording and reporting wildlife strikes to aircraft;
 - (b) the collection of information from aircraft operators, aerodrome personnel and other sources on the presence of wildlife on or around the aerodrome constituting a potential hazard to aircraft operations; and
 - (c) an ongoing evaluation of the wildlife hazard by competent personnel.
- Note: - See CAR-ANS Part 15, 15.5.*
- 10.14.2.2 Wildlife strike reports shall be collected and forwarded to ICAO for inclusion in the ICAO Bird Strike Information System (IBIS) database.
- Note: - The IBIS is designed to collect and disseminate information on wildlife strikes to aircraft. Information on the system is included in the Manual on the ICAO Bird Strike Information System (IBIS) (Doc 9332).*

- 10.14.2.3 Action shall be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft.
Note: - Procedures on the management of wildlife hazards on and within the vicinity of aerodromes, including the establishment of a wildlife hazard management programme (WHMP), wildlife risk assessment, land-use management and personnel training, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 6. Further guidance is given in the Airport Services Manual (Doc 9137), Part 3.
- 10.14.2.4 A bird/wildlife strike control programme shall describe a process for liaison with non-airport agencies and local landowners, etc., to ensure the airport operator is aware of developments that may contribute to creating additional bird hazards in the infrastructure, vegetation, land use and activities in the airport vicinity (e.g. crop harvesting, seed planting, ploughing, establishment of land or water features, hunting, etc., that might attract birds/wildlife).
- 10.14.2.5 The appropriate authority shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any other source which may attract wildlife to the aerodrome, or its vicinity, unless an appropriate wildlife assessment indicates that they are unlikely to create conditions conducive to a wildlife hazard problem. Where the elimination of existing sites is not possible, the appropriate authority shall ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable.
- 10.14.2.6 CAAP shall give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife.
Note: - See AC 139-06-A for Land Use at or Near the Airports.

Section 10.15 Aerodrome Maintenance

10.15.1 Maintenance Programme

- 10.15.1.1 A maintenance programme, including preventive maintenance where appropriate, shall be established at an aerodrome to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation.
Note: - 1. Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities.
Note: - 2. "Facilities" are intended to include such items as pavements, visual aids, fencing, drainage systems, electrical systems and buildings.
- 10.15.1.2 The design and application of the maintenance programme should observe Human Factors principles.
Note: - 1. Guidance material on Human Factors principles can be found in the Human Factors Training Manual (Doc 9683) and in the Airport Services Manual (Doc 9137), Part 8 — Airport Operational Services.
Note: - 2. General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

10.15.2 Pavements

10.15.2.1 The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas shall be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any loose objects/debris that might cause damage to aircraft or impair the operation of aircraft systems.

Note: - 1. See MOS 5.1.5.1 & 12.1.4.1 for inspections of movement areas.

Note: - 2. Procedures on carrying out daily inspections of the movement area and control of FOD are given in the 8, PANS-Aerodromes (Doc 9981), the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and the Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830).

Note: - 3. Additional guidance on sweeping/cleaning of surfaces is contained in the Airport Services Manual (Doc 9137), Part 9.

Note: - 4. Guidance on precautions to be taken in regard to the surface of shoulders is given in MOS 6.7.11.1, and the Aerodrome Design Manual (Doc 9157), Part 2.

Note: - 5. Where the pavement is used by large aircraft or aircraft with tire pressures in the upper categories referred to in MOS 5.1.4.8 (c) (iii), particular attention should be given to the integrity of light fittings in the pavement and pavement joints.

10.15.2.2 The surface of a runway shall be maintained in a condition such as to prevent formation of harmful irregularities.

Note: - See MOS Attachment A, Section 4.

10.15.2.3 A paved runway shall be maintained in a condition so as to provide surface friction characteristics at or above the minimum friction level specified by CAAP.

Note: — 1. Until 3 November 2021, the Airport Services Manual (Doc 9137), Part 2, contains further information on this subject.

Note: — 2. As of 4 November 2021, Assessment, Measurement and Reporting of Runway Surface Conditions (Cir 355) contains further information on this subject.

10.15.2.4 Runway surface friction characteristics for maintenance purposes shall be periodically measured with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements shall be sufficient to determine the trend of the surface friction characteristics of the runway.

Note: — 1. Until 3 November 2021, guidance on evaluating the friction characteristics of a runway is provided in Attachment A, Section 7. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

Note: — 2. As of 4 November 2021, guidance on evaluating the runway surface friction characteristics is provided in Assessment, Measurement and Reporting of Runway Surface Conditions (Cir 355).

Note: — 3. Until 3 November 2021, the objective of MOS 10.15.2.3 to 10.15.2.8 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level specified by CAAP.

Note: — 4. As of 4 November 2021, the objective of MOS 10.15.2.3 to 10.15.2.8 and 10.15.2.10 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level specified by CAAP.

Note: — 5. Until 3 November 2021, guidance for the determination of the required frequency is provided in MOS Attachment A, Section 3 and in the Airport Services Manual (Doc 9137), Part 2, Appendix 5.

10.15.2.5 As of 4 November 2021, when runway surface friction measurements are made for maintenance purposes using a self-wetting continuous friction measuring device, the performance of the device shall meet the standard set or agreed by CAAP.

10.15.2.6 As of 4 November 2021, personnel measuring runway surface friction required in 10.15.2.5 shall be trained to fulfil their duties.

10.15.2.7 Corrective maintenance action shall be taken to prevent the runway surface friction characteristics for either the entire runway or a portion thereof from falling below a minimum friction level specified by CAAP.

Note: -A portion of runway in the order of 100 m long may be considered significant for maintenance or reporting action.

10.15.2.8 Until 3 November 2021, when there is reason to believe that the drainage characteristics of a runway, or portions thereof, are poor due to slopes or depressions, then the runway surface friction characteristics should be assessed under natural or simulated conditions that are representative of local rain, and corrective maintenance action should be taken as necessary.

10.15.2.9 As of 4 November 2021, the runway surface should be visually assessed, as necessary, under natural or simulated rain conditions for ponding or poor drainage and where required, corrective maintenance action taken.

10.15.2.10 As of 5 November 2020, the runway surface should be visually assessed, as necessary, under natural or simulated rain conditions for ponding or poor drainage and where required, corrective maintenance action taken.

10.15.2.11 When a taxiway is used by turbine-engined aeroplanes, the surface of the taxiway shoulders should be maintained so as to be free of any loose stones or other objects that could be ingested by the aeroplane engines.

Note: — Guidance on this subject is given in the Aerodrome Design Manual (Doc 9157), Part 2.

10.15.3 Removal of contaminants

10.15.3.1 Standing water, mud, dust, sand, oil, rubber deposits and other contaminants shall be removed from the surface of runways in use as rapidly and completely as possible to minimize accumulation.

10.15.3.2 Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, shall not be used.

10.15.4 Runway pavement overlays (Refer to MOS 10.10.11)**10.15.5 Visual aids** (Refer to MOS 9.1.15)**10.15.6 Runway Surface Friction**

10.15.6.1 The aerodrome operator must maintain runways with sealed, asphalt or concrete surfaces, in accordance with the surface texture standards specified in Chapter 6.

10.15.6.2 The Aerodrome Technical Inspection of runway surfaces must confirm that the texture standard is being met.

Note: - CAAP may require testing of part or whole of the runway surface to validate the technical inspection report, including use of continuous friction measuring equipment.

10.15.6.3 The condition of a runway pavement is generally assessed under dry conditions using a self-wetting continuous friction measuring device. Evaluation tests of runway surface friction characteristics are made on clean surfaces of the runway when first constructed or after resurfacing.

10.15.6.4 Friction measurements must be taken at intervals that will ensure identification of runways in need of maintenance or special surface treatment before the surface conditions deteriorate further. The time interval between measurements will depend on factors such as aircraft type and frequency of usage, climatic conditions, pavement type, and maintenance requirements.

10.15.6.5 When conducting friction tests using a self-wetting continuous friction measuring device, there is a drop in friction with an increase in speed. However, as the speed increases, the rate at which the friction is reduced becomes less. The macrotexture of the surface affects the relationship between friction and speed. Therefore, a speed high enough to reveal these friction/speed variations shall be used. It is desirable, but not mandatory, to test the friction characteristics of a paved runway at more than one speed.

10.15.6.6 The results of measurements will be used as follows:

- (a) to verify the friction characteristics of new or resurfaced sealed, asphalt or concrete surfaced runways, using the Design objective for new surface values in MOS Table 10.15-1.
- (b) if the measured friction level falls below the relevant Maintenance planning level values in MOS Table 10.15-1, the aerodrome operator must initiate appropriate corrective maintenance action to improve the friction.
- (c) if the measured friction level falls below the relevant Minimum friction level values in MOS Table 10.15-1, the aerodrome operator must promulgate by NOTAM, that the runway pavement falls below minimum friction level when wet. Additionally, corrective maintenance action must be taken without delay. This requirement applies when friction characteristics for either the entire runway or a portion thereof are below the minimum friction level.

Test Equipment	Test Pressure (kPa)	Test speed (km/h)	Test depth (mm)	Design objective for new surface	Maintenance Planning Level	Minimum Friction Level
Mu-meter trailer	A 70	65	1.0	0.72	0.52	0.42
	A 70	95	1.0	0.66	0.38	0.26
Skiddometer trailer	B 210	65	1.0	0.82	0.60	0.50
	B 210	95	1.0	0.74	0.47	0.34
Surface friction tester vehicle	B 210	65	1.0	0.82	0.60	0.50
	B 210	95	1.0	0.74	0.47	0.34
Runway friction tester vehicle	B 210	65	1.0	0.82	0.60	0.50
	B 210	95	1.0	0.74	0.54	0.41
TATRA friction tester vehicle	B 210	65	1.0	0.76	0.57	0.48
	B 210	95	1.0	0.67	0.52	0.42
GRIPTESTER trailer	C 140	65	1.0	0.74	0.53	0.43
	C 140	95	1.0	0.64	0.36	0.24

Table 10.15-1: Friction Values for Continuous Friction Measuring Devices

10.15.7 Deterioration of Runway Grooves

- 10.15.7.1 When a runway pavement surface has been grooved, the aerodrome operator shall periodically check the condition of the runway grooves in accordance with the US Federal Aviation Administration (FAA) advice set out in the FAA Advisory Circular AC 150/5320-12D. The Advisory Circular states that when 40 per cent of the grooves in the runway are equal to or less than 3 mm in depth and/or width for a distance of 457 m, the effectiveness of the grooves for preventing hydroplaning will have been considerably reduced. The aerodrome operator shall take immediate corrective action to reinstate the 6 mm groove depth and/or width.

10.15.8 Surface Irregularities

- 10.15.8.1 Aerodrome operators must maintain the surface of paved runways in a condition such as to preclude excessive bouncing, pitching, vibration or other difficulties with control of aircraft.

Note: - Reports of actual aircraft performance will be used to determine compliance.

- 10.15.8.2 Paved runway surfaces shall be maintained so that standing water is neither formed nor retained. "Birdbath" depressions shall be repaired at the earliest opportunity.

10.15.9 Drainage characteristics of the movement area and adjacent areas

Note: - Guidance material for Drainage characteristics is provided in MOS Attachment A Section 2.

10.15.10 Standards for Natural and Gravel Surface Runways

10.15.10.1 The surface of natural and gravel surface runways and runway strips must be maintained to the physical standards outlined in Chapter 13.

Note: - A rough surface, in combination with a soft, wet surface, is particularly hazardous for aircraft operations.

Section 10.16 Maintenance around navigational aids**10.16.1 Introduction**

10.16.1.1 Aerodrome operators must document procedures for the maintenance of the areas around navigation aids serving the aerodrome. This will include navigational aids located on or off the aerodrome, either owned by the aerodrome operator or by other service providers.

10.16.1.2 The arrangements for ground maintenance around these installations must include details of consultation with the service provider to avoid interference with operation of the aid.

10.16.1.3 Ground maintenance carried out around navigational aids must be in accordance with the agreement with the service provider.

10.16.1.4 If there is no agreed specification with the service provider, ground maintenance around new facilities is to be in accordance with manufacturers' instructions, and for pre-existing facilities where manufacturers' instructions are not available, in accordance with the following:

- (a) elimination of grass at the base of towers, fence lines and foundation of buildings, for a distance of 500 mm;
- (b) fenced areas to be kept free of grass, shrubs or other growth exceeding 300 mm in height; and
- (c) within fenced areas, or at unfenced sites within the aerodrome boundary:
 - (i) VOR installations, the height of grass within a radius of 150 m from the antenna is not to exceed 600 mm;
 - (ii) ILS localizer with a 7-element antenna, the height of grass in the area of 90 m radius behind the antenna and the area 180 m by 90 m wide in front of the antenna is not to exceed 150 mm;
 - (iii) ILS localizer with a 7-element antenna, the height of grass in the area of 90 m radius behind the antenna and the area 180 m by 90 m wide in front of the antenna is not to exceed 150 mm;
 - (iv) ILS localizer with a 7-element antenna, the height of grass in the area of 90 m radius behind the antenna and the area 180 m by 90 m wide in front of the antenna is not to exceed 150 mm;
- (d) The maintained areas described above must not be otherwise used or treated, for example by ploughing or cropping.

- 10.16.1.5 Ground maintenance procedures around navigational aids must include the provision and enforcement of appropriate signage.

Section 10.17 Aerodrome safety procedures during low visibility operations

10.17.1 Introduction

- 10.17.1.1 At an aerodrome where low visibility operations are conducted, the aerodrome operator must establish procedures for the management of ground activities during low visibility operations.
- 10.17.1.2 Aerodrome safety procedures must address the alerting procedure, and details of the ground operations procedure involving people, vehicles, removal of unnecessary people from airside, physical check of lighting installations and warning devices such as signage.
- 10.17.1.3 If the visibility operations are determined by manual measurement of RVR, the aerodrome safety procedures must include:
- (a) methods for the measurement and timely reporting of RVR;
 - (b) location of the runway observing positions; and
 - (c) requirements and training of personnel selected for RVR observer duties.

Section 10.18 Aerodrome Technical Inspections

10.18.1 Introduction

- 10.18.1.1 Aerodrome technical inspections must be carried out in accordance with the requirements of the regulations.
- 10.18.1.2 Aerodrome technical inspections must be carried out at intervals of not more than 12 months and when required as a result of the findings of the aerodrome serviceability inspections.
- 10.18.1.3 Parts of an aerodrome technical inspection must be carried out at different times from the other parts. Each part of the technical inspection must be carried out at intervals of not more than 12 months.
- 10.18.1.4 The technical inspection shall identify any shortcomings, or areas for improvement.
- 10.18.1.5 The technical inspection must include a plan(s) for corrective action.
- 10.18.1.6 CAAP audit activity will include follow-up on the progress achieved on previous reports and plans for corrective action.

Section 10.19 Surface movement guidance and control systems

10.19.1 General

- 10.19.1.1 A surface movement guidance and control system (SMGCS) shall be provided at an aerodrome.

Note: - Guidance on surface movement guidance and control systems is contained in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

10.19.2 Characteristics

- 10.19.2.1 The design of an SMGCS should take into account:

- (a) the density of air traffic;
- (b) the visibility conditions under which operations are intended;
- (c) the need for pilot orientation;
- (d) the complexity of the aerodrome layout; and
- (e) movements of vehicles.

- 10.19.2.2 The visual aid components of an SMGCS, i.e. markings and signs (Chapter 8), and lights (Chapter 9.1) shall be designed to conform with the relevant specifications..

- 10.19.2.3 An SMGCS shall be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.

- 10.19.2.4 The system shall be designed to assist in the prevention of collisions between aircraft, and between aircraft and vehicles or objects, on any part of the movement area.

Note: - Guidance on control of stop bars through induction loops and on a visual taxiing guidance and control system is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

- 10.19.2.5 Where an SMGCS is provided by selective switching of stop bars and taxiway centerline lights, the following requirements shall be met:

- (a) taxiway routes which are indicated by illuminated taxiway centerline lights shall be capable of being terminated by an illuminated stop bar;
- (b) the control circuits shall be so arranged that when a stop bar located ahead of an aircraft is illuminated, the appropriate section of taxiway centerline lights beyond it is suppressed; and
- (c) the taxiway centerline lights are activated ahead of an aircraft when the stop bar is suppressed.

Note: - 1. See MOS 9.12.1 and 9.12.23 for specifications on taxiway centerline lights and stop bars, respectively.

Note: - 2. Guidance on installation of stop bars and taxiway centerline lights in SMGCSs is given in the Aerodrome Design Manual (Doc 9157), Part 4.

- 10.19.2.6 Surface movement radar for the maneuvering area shall be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m.

- 10.19.2.7 Surface movement radar for the maneuvering area shall be provided at an aerodrome other than that in 10.19.1.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

Note: - Guidance on the use of surface movement radar is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and in the Air Traffic Services Planning Manual (Doc 9426)

Section 10.20 Autonomous runway incursion warning system

Note: - 1. The inclusion of detailed specifications for an autonomous runway incursion warning system (ARIWS) in this section is not intended to imply that an ARIWS has to be provided at an aerodrome.

Note: - 2. The implementation of an ARIWS is a complex issue deserving careful consideration by aerodrome operators, air traffic services and States, and in coordination with the aircraft operators

Note: - 3. MOS Attachment A, Section 8, provides a description of an ARIWS and information on its use.

- 10.20.1.1 Where an ARIWS is installed at an aerodrome:

- (a) it shall provide autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or vehicle operator;
- (b) it shall function and be controlled independently of any other visual system on the aerodrome;
- (c) its visual aid components, i.e. lights, shall be designed to conform with the relevant specifications in MOS 9.18.4.1; and
- (d) failure of part or all of it shall not interfere with normal aerodrome operations. To this end, provision shall be made to allow the ATC unit to partially or entirely shut down the system.

Note: - 1. An ARIWS may be installed in conjunction with enhanced taxiway centerline markings, stop bars or runway guard lights.

Note: - 2. It is intended that the system(s) be operational under all weather conditions, including low visibility.

Note: - 3. An ARIWS may share common sensory components of an SMGCS or A-SMGCS, however, it operates independently of either system.

- 10.20.1.2 Where an ARIWS is installed at an aerodrome, information on its characteristics and status shall be provided to the appropriate aeronautical information services for promulgation in the AIP with the description of the aerodrome surface movement guidance and control system and markings as specified in CAR-ANS Part 15.

Note. — Detailed specifications concerning the AIP are contained in PANS-AIM (Doc. 10066).



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CHAPTER 11. Standards for other aerodrome facilities

Section 11.1 General

Note: - This chapter contains standards on aspects of aerodrome design and operations that are not covered elsewhere in this manual.

11.1.1 Siting of equipment and installations on operational areas

Note: - 1. Requirements for obstacle limitation surfaces are specified in MOS 7.1.3.

Note: - 2. The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs, and markers, is specified in MOS 9.1, 9.8, 8.6 and 8.2 respectively. Guidance on the frangible design of visual and non-visual aids for navigation is given in the Aerodrome Design Manual (Doc 9157), Part 6.

11.1.1.1 Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be:

- (a) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in MOS Table 6.7-5 Taxiway minimum separation distances, if it would endanger an aircraft; or
- (b) on a clearway if it would endanger an aircraft in the air.

11.1.1.2 Any equipment or installation required for air navigation or for aircraft safety purposes which must be located:

- (a) on that portion of a runway strip within:
 - (i) 75 m of the runway centerline where the code number is 3 or 4; or
 - (ii) 45 m of the runway centerline where the code number is 1 or 2; or
- (b) on a runway end safety area, a taxiway strip or within the distances specified in MOS Table 6.4-5 Taxiway minimum separation distances; or
- (c) on a clearway and which would endanger an aircraft in the air; shall be frangible and mounted as low as possible.

11.1.1.3 Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip shall be regarded as an obstacle and shall be frangible and mounted as low as possible.

Note: - Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual (Doc 9157), Part 6.

11.1.1.4 Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be located within 240 m from the end of the strip and within:

- (a) 60 m of the extended centerline where the code number is 3 or 4; or
- (b) 45 m of the extended centerline where the code number is 1 or 2; of a precision approach runway category I, II or III.

- 11.1.1.5 Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:
- (a) is situated within 240 m from the end of the strip and within:
 - (i) 60 m of the extended runway centerline where the code number is 3 or 4; or
 - (ii) 45 m of the extended runway centerline where the code number is 1 or 2; or
 - (b) penetrates the inner approach surface, the inner transitional surface or the balked landing surface;
- shall be frangible and mounted as low as possible.
- 11.1.1.6 Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance in accordance with MOS 7.4.2.7, 7.4.2.5, 7.4.2.8, 7.4.1.1 and 7.4.1.2 shall be frangible and mounted as low as possible.
- 11.1.2 Standards For Siting and Clearance Areas for Airways Facilities on Airports**
- 11.1.2.1 Airways facilities at an airport permit the safe navigation of aircraft within the airspace of an airway, and include; navigation aids along the airway and for approach and landing at aerodromes, communication facilities, meteorological facilities and ATC facilities.
- 11.1.2.2 The airways facilities for the safe, efficient operation of aircraft in the terminal area surrounding an airport and on the airport maneuvering area need, in most instances, to be located on or at the perimeter of the aerodrome. Some of these facilities, in particular the precision approach facilities, must be positioned in precise geometric relativity to runways or runway centerline extensions. Most facilities have associated site clearance areas surrounding the site location to ensure proper operation of the facility.
- 11.1.2.3 The standards herein set out:
- (a) The general requirement for sites, and the specific site and clearance area dimensions (for those types of facilities for which it is possible to specify such), for existing facilities; and
 - (b) The responsibilities of the aerodrome operator for preservation of sites and their clearance areas for planned or existing facilities.
- Note: - Many of these facilities are provided and maintained by CAAP. Aerodrome operators shall also liaise with CAAP for information about the technical requirements of individual airways facilities.*
- 11.1.2.4 For new facilities follow the manufacturer's instructions.
- 11.1.2.5 Airways facilities at an aerodrome may include any or all of the following:
- (a) navigation aid facilities:

- (i) ILS
- (ii) DME
- (iii) VOR
- (iv) NDB
- (b) radar sensor sites;
- (c) air/ground and point-to-point communications systems including radio bearer systems and satellite communications sites;
- (d) air traffic services centers;
- (e) fire stations (and satellite fire station); and
- (f) ATC towers.

11.1.3 General siting requirements

11.1.3.1 The siting criteria define the minimum requirements for uncompromised performance of each facility. Non-compliance or infringement of the site criteria and associated clearance areas does not always result in a particular facility being unserviceable or unsafe, but the functions may be degraded. Such degradation may, however, necessitate the facilities removal from service in some instances. Any potential infringement by the aerodrome operator to the criteria for existing or planned facilities is to be referred to the service provider by the aerodrome operator.

11.1.3.2 The general requirements for airways facilities are a finite site for their physical installation, i.e. shelters, foundations, towers, antennae plus a reasonable service area around the physical features. In many instances, there is also a requirement for a clearance zone around this space, in some instances relatively extensive, for the purpose of ensuring transmission of electromagnetic waves without interference from extraneous sources, or for the purpose of unimpeded vision in the cases of ATC towers or RFFS stations.

11.1.3.3 The responsibilities of the aerodrome operator in complying with the requirements of this standard include:

- (a) the controls on the erection of structures, e.g. buildings, hangars, fences, roads within specified distances and height limitations, of existing or planned airways facilities;
- (b) control on vehicles or aircraft entering, traversing or parking within specified clearance areas; and
- (c) ensuring that service providers are consulted on the effect of proposed aerodrome works or developments on the airways facilities. Even temporary construction works such as stockpiling of materials may have an effect, particularly on precision approach aids.

Note: - When siting any airways facility, and in particular an ILS, consideration must be given to paragraph MOS 6.3.7 in relation to runway strip transverse slope limitations and the possible exceedance of the 5% transverse slope standard.

11.1.4 Navigation Aid Facilities

11.1.4.1 The location of the radio navigation aids is largely determined by the air route or

approach path on which they are to be used. They cannot normally be moved without some consequential change to or restriction placed on the approach path or air route.

11.1.4.2 These facilities are not to be compared with radio, television or mobile radio facilities. Except for NDBs, radio navigation aids are more complex in terms of the transmitting equipment, the antenna design and the electromagnetic fields which are created about them. The accuracy of the paths defined by a particular navigation aid is determined not only by the transmitting facility but is largely dependent on the reflection of its signals from the objects about the facility; the terrain, vegetation, buildings, power lines, aircraft, other vehicles, fences, ditches, etc. In designing a facility, the position of these objects is taken into account. For example, sites are chosen so that these objects will provide least signal degradation; the vegetation is cleared, the ground leveled in key areas, and power lines may be moved or buried.

11.1.4.3 For the facility to remain a useful part of the airways system, these environmental characteristics have to be maintained and any proposals for change need to be carefully examined.

11.1.4.4 The development constraints set out herein provide guidance to activity and development restrictions in the vicinity of radio navigation aids. In cases where a proposed or planned development is of a significant size, unusual nature or exceeds these restrictions, the service provider is to be consulted and written approval obtained before the commencement of any such developments or activities.

11.1.5 VOR Facilities

11.1.5.1 Vehicle movements. Aerodrome roadways, taxiways, public roads, tramways and railways shall not be closer than a 300 m radius. Vehicles used by aerodrome maintenance staff are not to be parked within a 300 m radius.

11.1.5.2 Restricted area. All unauthorized personnel and vehicles must be kept clear of the facility within a 300 m radius. Wooden signs or wooden fencing only may be used to clearly define the restricted area. The movement of vehicles between the VOR building and VOR antenna is prohibited.

11.1.5.3 Site maintenance. Grass and scrub within 150 m of the site must be mown or cut regularly. Grass cutting equipment is not to be parked within a 300 m radius of the VOR building.

11.1.5.4 Services. All cables (e.g. power and telephone) are to be placed underground within 300 m radius of a VOR facility. Cables can be run above the ground from 300 m to 600 m radius from a VOR, if they are aligned radially to the VOR. The height of wire lines and fences shall not subtend a vertical angle of more than 1.5° or extend more than 0.5° above the horizontal as measured from the antennae array.

11.1.5.5 Clearance zone. No structures shall be permitted within 150 m of the station. Unless otherwise approved by the Director General, no structure shall subtend a vertical angle greater than 1.2° above the horizontal as measured from the antennae array. Single trees of moderate size, up to 9m in height may be

tolerated beyond 150 m, but no groups of trees shall subtend a vertical angle of more than 2° or be located within 300 m of the station. Clearing of trees and vegetation within 600 m of the station shall be provided for, if required by CAAP.

11.1.6 DME Facilities

11.1.6.1 **Vehicle movements.** No restriction.

11.1.6.2 **Restricted area.** No restricted areas.

11.1.6.3 **Site maintenance.** There is no requirement for grass or scrub clearing, however, trees within a radius of 300 m must not be allowed to grow above the height of the DME antenna mounting point on the DME mast.

11.1.6.4 **Services.** Overhead LV power and control lines are allowable in the vicinity of the DME site provided the clearance requirements of Paragraph 11.1.6.5 are met. Overhead 2 kV-22 kV HV lines must be at least 400 m distant, while HV lines in excess of 22 kV must be at least 1 km distant from the DME antenna system.

11.1.6.5 **Clearance zone.** Small structures, small buildings, overhead lines and fences are allowable adjacent to the DME antenna location within a 600 m radius, provided that they do not project above the mounting point of the DME antenna to the DME mast.

11.1.6.6 Larger obstructions such as multi-storey buildings, hangers, bridges, etc., may interfere with DME system performance and any proposal to erect large structures above a one degree elevation angle as seen from the DME antenna within a 5 km radius from the DME antenna location may affect the performance of the system.

11.1.7 Instrument Landing System

11.1.7.1 An instrument landing system (**ILS**) has the following components:

- (a) VHF localizer equipment;
- (b) UHF glide path equipment;
- (c) VHF marker beacons or distance measuring equipment (*DME*);
- (d) monitor systems, remote control and indicator equipment.

11.1.7.2 Each component performs specific functions, and is separately located along the longitudinal axis of, or alongside, the runway.

Note: - Different siting requirements, and restrictions to access and movement, apply to each site.

11.1.7.3 Protection of ILS Installations

- (a) An aerodrome operator must consult with the relevant aeronautical telecommunications service and radio navigation service provider to establish adequate arrangements for ensuring that ILS installations are not adversely affected by:
 - (i) electromagnetic interference; or

- (ii) the presence or construction of buildings; or
- (iii) the presence of temporary or permanent structures.

Note: - 1. Electromagnetic interference (EMI) can be produced by a variety of sources including power lines, substations and some industrial-scientific-medical equipment.

Note: - 2. Buildings and other structures can reflect ILS signals in unwanted directions, distorting the information provided to aircraft.

Note: - 3. For aerodrome planning, aerodrome operators should consult relevant aeronautical telecommunications service and radio navigation service providers to ensure adequate provision is made for ILS installations and the necessary critical and sensitive areas.

11.1.7.4 Services. Within the site areas all power and control cables must be laid underground.

11.1.7.5 Aircraft. Aircraft shall not enter or remain within a critical area whilst the ILS is in use. This condition may be varied if part of an approved procedure.

11.1.7.6 Critical and Sensitive Areas.

- (a) The critical area is an area of defined dimensions about the localizer and glide path where vehicles, including aircraft, will cause unacceptable disturbances to the ILS performance.
- (b) The sensitive area is an area extending beyond the critical area where parking and/or movement of vehicles, including aircraft, may affect the ILS performance.
- (c) An aerodrome operator must consult with the relevant aeronautical telecommunications service and radio navigation service provider to establish and define appropriate:
 - (i) critical areas for each ILS installation; and
 - (ii) sensitive areas for Categories II and III ILS installations.

Note: - 1. An ILS critical area is an area about the localizer and glide path antennas where vehicles and aircraft must be excluded during all ILS operations. The critical area is protected because the presence of vehicles or aircraft inside its boundaries will cause unacceptable disturbance to the ILS signal-in-space.

Note: - 2. An ILS sensitive area is an area extending beyond the critical area where the parking and movement of vehicles and aircraft is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations. The sensitive area is protected against interference caused by large moving objects outside the critical area but still normally within the airfield boundary.

Note: - 3. The size and shape of a critical or sensitive area depends on the characteristics of the particular ILS system and the configuration of the particular environment.

Note: - 4. A critical area may separately be established for vehicles and aircraft of particular sizes.

- (d) An aerodrome operator must ensure that the boundaries of each critical

area are marked by suitable signs and visual markers to prevent unauthorized access from vehicles and persons.

- (e) An aerodrome operator must place signs at each road access point to an ILS critical area to warn drivers and pedestrians against entering the critical area without authority.
- (f) An aerodrome operator must not permit:
 - (i) vehicles and plant to enter, or remain in, an ILS critical area while the ILS is in use; or
 - (ii) construction access or variation to such access within a critical or sensitive area unless the construction access or variation has been coordinated with the relevant aeronautical telecommunications service and radio navigation service provider.
- (g) Where access to a critical area is required for a particular purpose, an aerodrome operator must arrange for the ILS to be temporarily removed from service and a NOTAM issued to inform pilots. Any subsequent related access to the critical area must be under ATC control.

Note: - An example of a particular purpose is grass cutting.

- (h) If low visibility procedures are in effect, an aerodrome operator must not permit vehicles or plant to enter, or remain in, an ILS sensitive area unless ATC has given the operator a specific clearance for the vehicles or plant to enter or remain.

11.1.8 Localizer

Note: - Refer to CAR-ANS Part 6 for details of this component.

11.1.9 Glide Path

Note: - Refer to CAR-ANS Part 6 for details of this component.

11.1.10 Obstructions around Marker Beacons

11.1.10.1 None of the following may extend above an elevation angle of 30° from a point 1.5 m above ground level at the location of a marker beacon antenna:

- (a) a building;
- (b) a power line;
- (c) a telephone line;
- (d) a tree or a clump of trees.

11.1.10.2 Vehicular movement. No special requirements.

11.1.10.3 Services. Within 15 m of the antenna, all power and telephone lines are to be laid underground. Beyond this distance any overhead construction shall meet the obstruction limits as above.

11.1.10.4 Electrical interference. No requirements.

11.1.10.5 Restricted area. No special requirements.

- 11.1.10.6 Maintenance of site. Grass, shrubs, etc., shall be kept cut to a reasonable level, e.g. less than 0.6 m. Trees on the site shall not be allowed to infringe the obstruction limits as above.
- 11.1.11 Locator Beacons**
- 11.1.11.1 All requirements as for non-directional beacons below.
- 11.1.12 Non-Directional Beacons (NDB)**
- 11.1.12.1 Obstructions. The immediate surrounding area within a radius of 150 m of the antenna shall be free of buildings exceeding 2.5 m in any dimension, vegetation shall be kept below a height of 0.6 m. Small buildings of substantially non-metallic construction extending less than 2.5 m in any dimension must be erected no closer than 60 m to the antenna.
- 11.1.12.2 Overhead power and telephone lines serving the NDB shall be kept at least 150 m clear of the antenna. Steel towers and masts shall subtend elevation angles less than 3° measured from ground level at the center of the NDB antenna system.
- 11.1.12.3 Vehicular movements. With the exception of authorized vehicles no vehicle shall approach the antenna within a distance closer than 60 m.
- 11.1.12.4 Services. Power and telephone cables shall be underground to a depth of 0.45 m within 150 m of the antenna.
- 11.1.12.5 Restricted area. No special requirements. Where necessary, fencing shall be provided to keep livestock and wildlife clear of the earthmat area.
- 11.1.12.6 Site maintenance. No special requirement other than to keep undergrowth from exceeding a height of 0.6 m and to maintain a neat appearance of the site. Ploughing is not permitted over any portion of the earthmat area.
- 11.1.13 Radar Sensor Sites**
- 11.1.13.1 Site requirements. The site requirement for existing types of radar sensors is a rectangular area about 50 m by 40 m, including sufficient space for a crane to maneuver and an antenna maintenance pad.
- 11.1.13.2 For new sites, the above dimensions may be reduced, depending on whether or not standby power generation are colocated. However, the antenna maintenance space in which a crane can maneuver may be the limiting factor.
- 11.1.13.3 Clearance requirements. Radar transmission clearance requirement are intended to prevent the following:
- (a) Holes in the coverage by new constructions blocking line of sight between radar and aircraft. Any construction, which geometrically intrudes above the existing skyline as seen by the radar, will have an effect.
 - (b) Interference with near fields of the antenna, which may disturb the antenna pattern in the far field. This applies within 500 m of most radars.

- (c) Diffraction and bending of signals by edges and thin objects which can cause incorrect radar determined location, loss or confusion of radar tracks etc. Likely hazards in this regard are poles such as lighting poles.
- (d) Reflections of the radar signals from fixed or mobile surfaces. Reflections cause aircraft to appear on radar screens in more than one location.

11.1.13.4

The following clearance requirements are to be maintained:

- (a) No intrusion within 1 km of the radar into a height surface 5 m below the bottom of the antenna. No intrusion between the radar and the possible location of any desired targets, i.e. roughly speaking above 0.5° elevation at any distance.
- (b) No metallic or other electrical reflective surfaces anywhere which subtend an angle of more than 0.5°, or as required by manufacturer's specification or other safety considerations, when viewed from the radar, e.g. fences, power lines, tanks as well as many buildings. All overhead power lines within 1 km must be aligned radially from the radar or be located at least 10° below horizontal from the antenna.
- (c) No radio interference emitters within 2 km having any component of transmission in the radar bands, e.g. welders and electrical transmission lines. No electrical transmission lines within following specified distances:

Line capacity	Distance
2 kV – 22 kV	400 m
22 kV – 110 kV	1 km
above 110 kV	2 km

Table 11.1-1

- (d) Other electronic equipment may be affected by the radar transmissions. Such equipment shall not be located where the radars may interfere with their performance.

11.1.13.5

Precautions against Exposure of Personnel to Radio Frequency Radiation from Radar Systems. The primary surveillance radar transmitters on airports radiate high power beams of radio frequency energy. In close proximity to a surveillance radar antenna, the electromagnetic field strengths within the transmitted radar beam may be such that persons could be subjected to radiation exposure levels in excess of safe limits. Airport staff, therefore, are to be cautioned against approaching any location within a 500 m radius of a primary radar antenna and which is between 5 m below and 50 m above the horizontal level of the bottom of the antenna.

11.1.14

Communications Facilities

11.1.14.1

Site requirements. The physical site requirements will vary significantly depending on the type of communications facility, and it is therefore not possible to specify a general requirement (other than for Satellite ground station sites).

11.1.14.2

Clearance requirements. Reliable VHF/UHF communications require a clear line-of-sight path between the base station and aircraft and vehicles using the facilities. The construction of buildings, towers, etc. may prevent reliable communications.

- 11.1.14.3 Satellite Ground Stations. The site requirement is a square area of dimension 25 m by 25 m. The clearances required around satellite ground stations are shown in MOS Figure 11.1-1.
- 11.1.14.4 Rescue and Fire Stations. Location of airport fire stations (or satellite fire stations) involves compliance with MOS 14.4 requirements on RFFS response times, and therefore, generally need to be reasonably centrally located with respect to runway configurations. See MOS 14.4 for details.

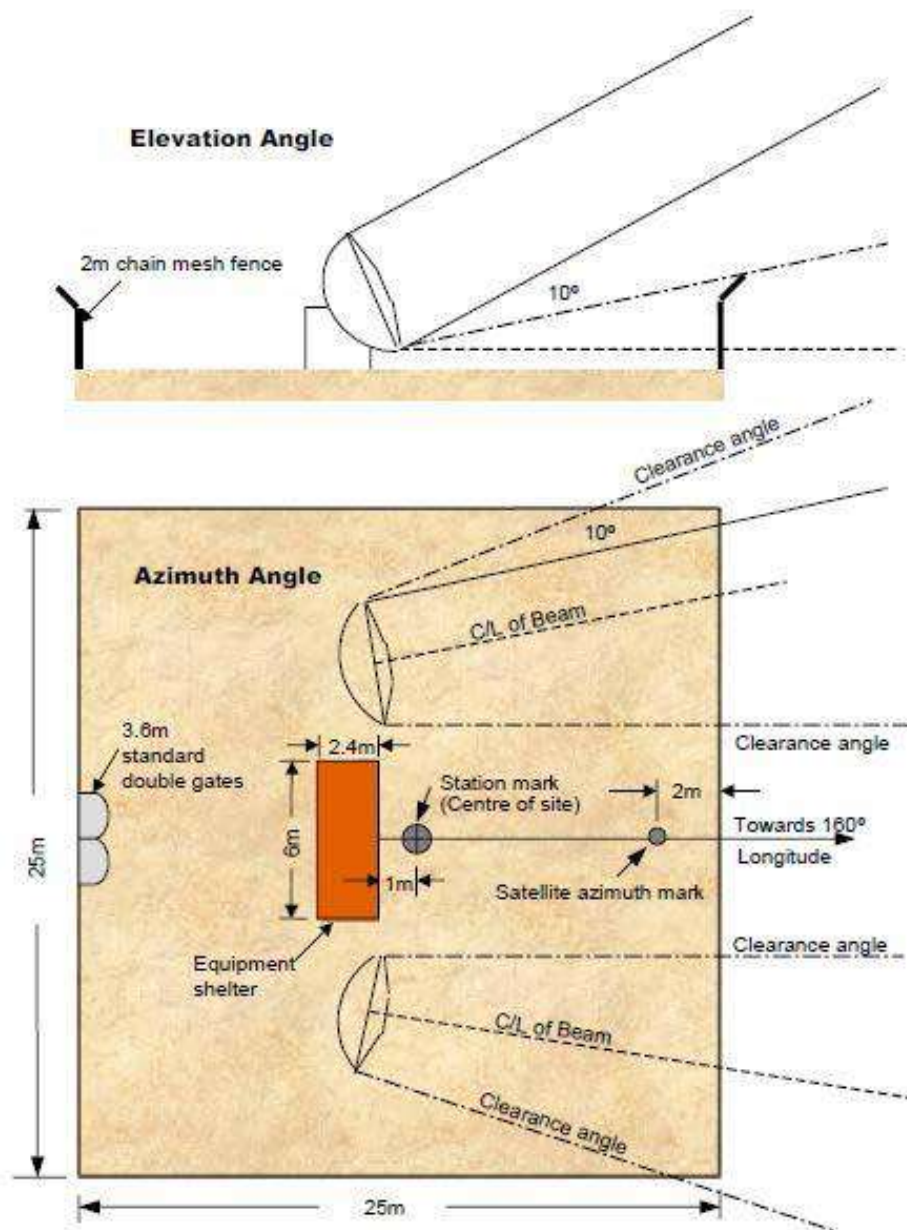


Figure 11.1-1: Typical Communications Satellite Ground Station Site

11.1.15 Ground earthing points

- 11.1.15.1 Where required, the provision of a ground earthing points must be made in agreement with the aircraft fueling service provider.
- 11.1.15.2 Where ground earthing points are provided, the resistance to earth must not exceed 10,000 ohms.
- 11.1.15.3 Where ground earthing points are provided, they must be maintained in accordance with the procedures set out in paragraphs 11.1.16.1 to 11.1.18.1.

11.1.16 Testing of ground earthing points

- 11.1.16.1 Each ground earthing point must be tested for its electrical resistance, both as part of the initial installation (or any replacement), six (6) months after the installation (or any replacement), and also thereafter, as part of the Aerodrome Technical Inspection.
- 11.1.16.2 Where testing shows that the earthing points are sound, they must be marked with a 15 cm diameter circle, painted white.

11.1.17 Inspection of ground earthing points

- 11.1.17.1 The ground earthing points must be inspected as part of the quarterly technical inspection to ensure that:
- (a) the ground earthing point is firmly connected to the earthing rod and seated on the pavement;
 - (b) the earthing rod is firmly embedded in the ground;
 - (c) the fins used for making electrical connections are free from dirt, grease, paint, or any other substances; and
 - (d) no ground earthing points have been buried or removed.

11.1.18 Remedial action

- 11.1.18.1 When the resistance to earth exceeds 10,000 ohms and the ground earthing point cannot immediately be repaired or replaced, the head of the ground earthing point must either be removed or marked with a 15 cm diameter circle, painted red, to show it cannot be used.

11.1.19 Light aircraft tie-down facilities

- 11.1.19.1 Light aircraft tie-down facilities must be provided to secure aeroplanes against possible damage if they are blown off their apron parking position by strong winds.
- 11.1.19.2 Where provided, tie down facilities must be of adequate strength for the aircraft type being secured. The design of the tie-down facilities shall be determined in consultation with an engineering consultant or manufacturer. The tie-down facilities shall be fixed to the ground using embedded anchors, and not left loose on the apron surface where they can create an FOD problem.



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CHAPTER 12. Operating standards for Aerodrome Registration Type 2

Section 12.1 General

12.1.1 Introduction

- 12.1.1.1 The aerodrome operating procedures for Aerodrome Registration Type 2 are less stringent than those required for a certified aerodrome or Aerodrome Registration Type 1.
- 12.1.1.2 The operator having an Aerodrome Registration Type 2 is required to:
- (a) Ensure that the aerodrome operational information, which has been provided and published in AIP, is current;
 - (b) When it is not, promptly advise pilots, through the NOTAM system, of changes which may affect aircraft operations; and
 - (c) Ensure an aerodrome safety inspection report is prepared annually or at a timing as agreed by CAAP.
- 12.1.1.3 To ensure that the aerodrome information provided is current, the aerodrome facilities must be maintained to the standard when the aerodrome was initially registered, or if a facility is upgraded to a new standard, to that standard.
- 12.1.1.4 To be able to promptly advise changes, operators having an Aerodrome Registration Type 2 need to have personnel and procedures to conduct timely serviceability inspections, identify changed circumstances and make reports.
- 12.1.1.5 Although formal documentation of all facets of aerodrome operations is not required, it is in the interest of the operator having an Aerodrome Registration Type 2 to be able to demonstrate the discharge of duty of care in providing a safe facility for aircraft operations. To avoid confusion and misunderstanding, all arrangements regarding aerodrome safety functions must be in writing.
- 12.1.1.6 If an operator having an Aerodrome Registration Type 2 fails to meet safety requirements, CAAP may suspend or cancel the registration. CAAP staff may conduct scheduled or unscheduled inspections of the aerodrome to assess whether it still meets safety requirements.
- 12.1.1.7 The standards and procedures of this chapter are intended to assist the operator having an Aerodrome Registration Type 2 to meet on-going aerodrome safety requirements.

12.1.2 Aerodrome Reporting Officer

- 12.1.2.1 The operator having an Aerodrome Registration Type 2 must have in place experienced or appropriately trained persons, known as reporting officers, to carry out the aerodrome safety functions. Attributes required include:
- (a) Knowledge of the standards that the aerodrome has to be maintained to;

- (b) Maturity and responsibility to ensure reliance on the conduct of regular serviceability inspections of the safety elements of the aerodrome;
- (c) Having the written and oral communication skills to initiate NOTAM or to communicate aerodrome condition status to ATC, pilots and other aerodrome users.

12.1.2.2 Reporting officers are normally directly employed by the aerodrome operator. However, at an aerodrome where aerodrome operator's employees may not be available at all times, other persons may be nominated as reporting officers. Before entrusting the reporting function to a person, the aerodrome operator must ensure that the person is trained and has the appropriate attributes.

12.1.2.3 Reporting officers must be provided with appropriate radios in their vehicles so they can maintain a listening watch of aircraft activities on and in the vicinity of the aerodrome during working hours.

12.1.3 Aerodrome serviceability inspections

12.1.3.1 Aerodrome serviceability inspections are visual checks of elements of the aerodrome which may impact on aircraft safety. A checklist of contents of the inspection must be developed, commensurate with the size and complexity of the aerodrome.

12.1.3.2 The checklist must encompass at least the following items:

- (a) Surface condition of the movement area, including cleanliness
- (b) Surface condition of the runway, particularly the usability of unsealed pavements in wet conditions;
- (c) Markings, markers, wind direction indicators and aerodrome lighting systems;
- (d) Any obstacle which may infringe the approach, take-off, transitional and inner-horizontal surfaces;
- (e) Animal or bird activities on and in the vicinity of the aerodrome;
- (f) Checking of fences or other devices that prevent persons and vehicles getting on the movement area; and
- (g) Checking the currency of any outstanding NOTAM initiated.

Note: - Elements of matters to be checked for are similar to those detailed in Chapter 10.

12.1.4 Frequency of serviceability inspection

12.1.4.1 At an aerodrome with a code number of 1 or 2 where daily air transport operations occur, serviceability inspections must be carried out daily, and prior to any scheduled operation. At aerodromes where the code number is 3 or 4, serviceability inspections of the movement area shall be carried out at least twice daily. At aerodromes where night operations are conducted the lighting systems shall be inspected for serviceability at least once during hours of darkness.

12.1.4.2 Additional serviceability inspections must be conducted after significant weather phenomena such as strong wind, earthquake, or heavy rain.

12.1.4.3 At an aerodrome without daily regular public transport operations, serviceability inspections must be conducted before each air transport operation or not less than twice per week, whichever is more.

12.1.5 Record of inspections and remedial actions

12.1.5.1 The operator having an Aerodrome Registration Type 2 must maintain an inspection logbook to demonstrate that inspections have been carried out. Besides recording the inspections, the logbook should also record significant aerodrome upgrading or remedial works.

12.1.5.2 The logbook must be kept for at least 12 months or the agreed period of the aerodrome safety inspection, whichever is longer. The logbook must be made available to any CAAP authorized person conducting inspection of the aerodrome and to any person who conducts the annual or periodic safety inspection.

12.1.6 Reporting changes

12.1.6.1 Where a change in the aerodrome conditions requires a NOTAM to be issued this must be done in accordance with MOS 10.3.

Note: - A copy of sample Aerodrome Report Form to the NOTAM Office is shown in MOS 12.2.

12.1.6.2 Record of NOTAM initiated should be kept for at least a year or the agreed period of safety inspection, whichever is longer.

12.1.7 Aerodrome Works

12.1.7.1 Aerodrome works must be arranged so as not to create any hazard to aircraft or confusion to pilots.

12.1.7.2 Aerodrome works may be carried out without closing the aerodrome provided safety precautions are adhered to.

12.1.7.3 Where aerodrome works are carried out without closing the aerodrome, the aerodrome works safety procedures specified in MOS 10.7 for certified aerodromes are equally applicable to operators having an Aerodrome Registration Type 1 and 2.

12.1.8 Safety Inspection Report

12.1.8.1 CAR-Aerodromes 2.3.155 requires the operator having an Aerodrome Registration Type 2 to prepare and submit to CAAP annually, or at another agreed period, a safety inspection of the aerodrome. Matters to be addressed in the report are also prescribed in the regulations.

12.1.8.2 The report must provide a true picture of the state of the aerodrome in its compliance with applicable standards. Where corrective action or necessary improvements are identified, the aerodrome operator must provide a statement of how the corrective action or improvements are to be addressed.

- 12.1.8.3 For an Aerodrome Registration Type 2, the approach and take-off area would still need to be checked on a regular basis for vegetation growth or new tall objects. Where another obstacle may become the critical obstacle and affect the published take-off gradient or the threshold location, the checking shall be conducted by a person with appropriate technical expertise.

Section 12.2 Sample Report Form for Aerodrome Registration Type 2

Aerodrome Registration Type 2 Report Form			
Notification of Changes to Serviceability of Aerodrome Registration Type 2			
To: NOTAM Office	Phone	Fax	
AERODROME:			
Date / / 20	TIME (UTC preferred) UTC	Local	
Purpose of Report PROVIDE NEW INFORMATION DETAILED BELOW <input type="checkbox"/>			
CANCEL PREVIOUS ADVICE (NOTAM No) <input type="checkbox"/> Date:			
EXTEND PREVIOUS ADVICE (NOTAM No) <input type="checkbox"/> Date:			
Period of Validity Permanent/Temporary NOTAM (<i>Delete one</i>)			
FROM (date/time) TO (date/time) Estimated <input type="checkbox"/> (if finish time uncertain)			
(<i>temporary NOTAM only</i>)			
Note: If time estimated, contact NOTAM OFFICE at least 2 hours before estimated duration time and advise if NOTAM is to be extended or cancelled.			
Daily duration or time schedule (<i>if applicable</i>)			
FROM (date/time) TO (date/time)			
Text (<i>For example of text see Section 10.5</i>)			
Please fax copy of NOTAM to originator Fax No.			
This report confirms previous telephone advice. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Contact Numbers Ph			
Fax			
Signed Date/Time Reporting Officer (Print Name)			
DGCA Office advised by: Phone <input type="checkbox"/> <input type="checkbox"/> Fax <input type="checkbox"/> <input type="checkbox"/> E-mail <input type="checkbox"/> <input type="checkbox"/> Not advised <input type="checkbox"/>			
For NOTAM Office only:			
NOTAM No. C Initials date/time			

CHAPTER 13. Standards for small aerodromes used for light aircraft operations

Section 13.1 General

13.1.1 Introduction

- 13.1.1.1 Pursuant to PCARs, CAAP requires organizations holding Air Operator Certificates (AOCs), or similar operational approvals, when conducting air transport or flying training operations in aeroplanes having a maximum take-off weight not exceeding 5700 kg, (light aircraft), to operate at an aerodrome which meets the standards set out in Part A of this chapter. Activities relevant to these standards include but are not limited to passenger carrying and cargo operations and flying training.
- 13.1.1.2 Pursuant to PCARs, CAAP requires a pilot conducting private operations in an aeroplane with a maximum take-off weight not exceeding 5700kg to operate at an aerodrome which meets or exceeds the standards set out in MOS 13.2.
- 13.1.1.3 Aircraft specifically used for aerial agricultural operations may operate at aerodromes which comply with the standards set out in Part B of this chapter.
- 13.1.1.4 When air transport, air cargo, flying training or commercial aerial agricultural operations are being conducted, the Chief Executive of each operating organization is responsible to ensure every pilot in command is provided with complete and current information to ensure safety of aircraft operations at any particular aerodrome.
- 13.1.1.5 The responsibility of ensuring that an aerodrome complies with the relevant standards and is adequate for safe operations rests with the pilot in command.
- 13.1.1.6 Notwithstanding paragraphs 13.1.1.4 and 13.1.1.5, a person who provides aerodrome facilities or services for aircraft operations has a duty of care to provide a safe facility or service. Activities of such a person and the condition of the aerodrome may be subject to safety oversight by CAAP. Such oversight may be effected by an audit of an AOC holder or by an aerodrome inspection by CAAP inspectors with or without notice.

Section 13.2 Part A - Aerodromes used for air transport, private or flying training activity

13.2.1 Aerodrome standards

- 13.2.1.1 The required physical dimensions and obstacle limitation surfaces (OLS) are set out in Table 13.2-1.
- 13.2.1.2 Obstacles. Where an aeroplane operation is affected by the presence of obstacles, the matter needs to be brought to the attention of the CAAP, which will determine obstacle marking and lighting requirements and any operational limitations.



Figure 13.2-1: Obstacle limitation surfaces (inner horizontal surface omitted for clarity)

Aerodrome characteristics and obstacle limitation surfaces	Aeroplanes not exceeding 5,700 kg – by night	Aeroplanes exceeding 2,000 kg but not exceeding 5,700 kg by day	Aeroplanes not exceeding 2,000 kg by day with cross- wind less than 5 knots
Runway and runway strip			
Runway width	18 m	15 m	10 m**
Runway strip width			
- graded	45 m, 80 m if practicable*	45 m, 60 m if practicable #	30 m**
- total (graded and ungraded)	80m	60 m	60 m**
	* 80 m required for flying training activity	# 60 m required for flying training activity	** not permitted for flying training activity
Runway longitudinal slope	2%	2%	2%
Runway transverse slope	2.5%	2.5%	2.5%
Runway strip transverse slope	2.5%	2.5%	2.5%
Approach and take-off climb surfaces			
Length of inner edge	80 m	60 m	30 m
Distance of inner edge before threshold	60 m	30 m	30 m
Divergence, each side	10%	10%	10%
Length of surface	2500 m	1600 m	900 m
Slope	4%	5%	5%
Transitional surface			
Slope (to 45 m height)	20%	20%	20%
Inner horizontal surface			
Height	45 m	45 m	45 m
Radius from runway strip	2,500 m	2,000 m	2,000 m

Table 13.2-1: Standards for physical dimensions and obstacle limitation surfaces

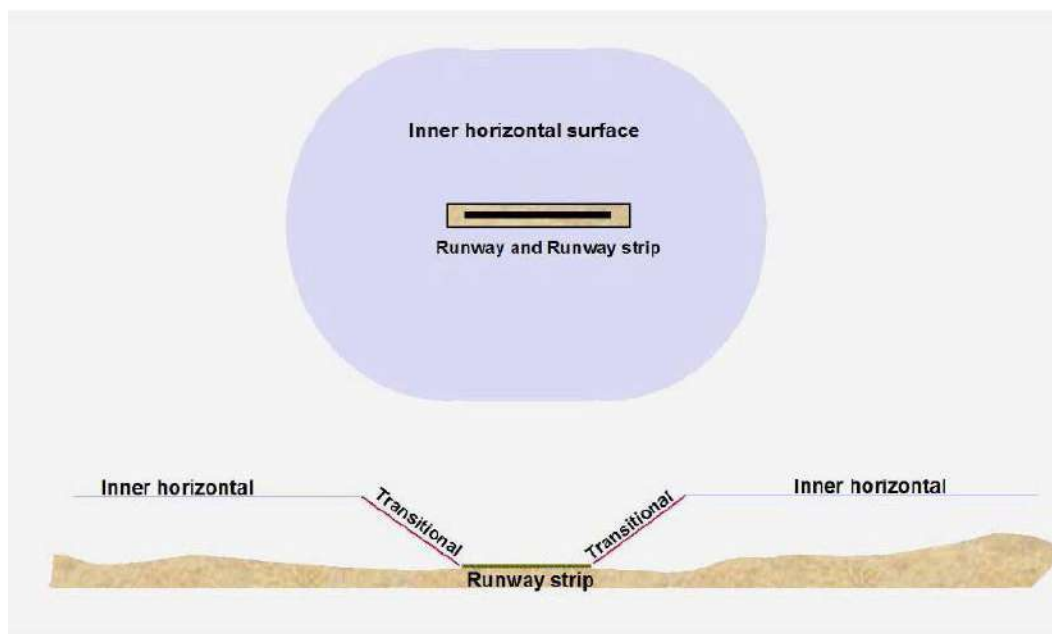


Figure 13.2-2: OLS cross-section

13.2.1.3 Runway length. The runway length requirement varies depending on aircraft type and local geography. The runway length provided needs to be adequate for the most demanding aeroplane (not necessarily operating to maximum take-off or landing weight) that the aerodrome is intended to serve.

13.2.1.4 Clearways and stopways. If a clearway or stopway is provided to it shall be provided in accordance with the standards for clearways and stopways specified in Chapter 6.

13.2.2 Aerodrome Markings

13.2.2.1 Aerodrome markings or markers shall be provided. Sealed surfaces are normally marked by painted white markings and unsealed surfaces by white markers. Instead of markers, flush markings painted white may be installed. Markers shall be frangible. Flush markings shall be maintained so as to provide adequate conspicuity.

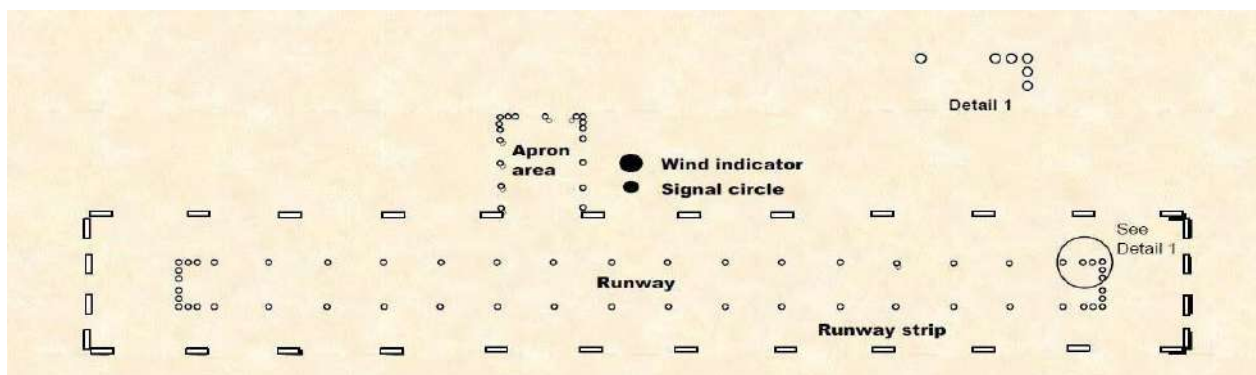


Figure 13.2-3: Aerodrome markings

13.2.2.2 For a sealed runway, the runway thresholds shall be marked in accordance with MOS

8.3.9. A runway centerline marking is not required on runways that are 18 m wide or less. White painted runway side stripe markings, 0.3 m wide, shall be provided if there is a lack of contrast between the runway surface and the surrounding area.

- 13.2.2.3 On unsealed runways, where the runway strip is not maintained to normal grading standards, the runway shall be marked using edge markers. If the full width of the runway strip is maintained so as to be suitable for aircraft operations, the runway edge markers may be omitted and the runway strip is to be marked using strip markers. Where the runway is not provided with edge markers, the threshold locations need to be marked.
- 13.2.2.4 For both sealed and unsealed runways, when operationally required, the runway strip shall also be marked by using cones, gable markers, tires, or 200 liter drums cut in half along their length and placed with the open side down, or something similar. These runway strip markers shall be white in color.
- 13.2.2.5 Runway cone markers should have a 0.4 m base diameter and be 0.3 m in height. Runway strip cone markers should have a 0.75 m base diameter and be 0.5 m in height. Gable markers should be 3 m in length.
- 13.2.2.6 Cone or similar size markers need to be spaced not more than 90 m apart. Gable or similar size markers need to be spaced not more than 180 m apart.
- 13.2.2.7 Where the edges of unsealed taxiways or aprons may not be visually clear to pilots, markers may be provided in accordance with MOS 8.2.

13.2.3 Aerodrome Lighting

- 13.2.3.1 Where a runway is intended for night operations, the runway shall be provided with runway edge lighting, spaced laterally at 30 m apart, and longitudinally at approximately 90 m apart. The edge lights on each side shall present two parallel straight rows equidistance from the runway centerline. The lights indicating runway ends shall be at right angles to the centerline.
- 13.2.3.2 Where there is no permanent electricity supply, lights of white color, powered by generators, batteries or similar items may be used. Liquid fueled flares may also be used. Preferably only one type of light source shall be used for any particular installation.

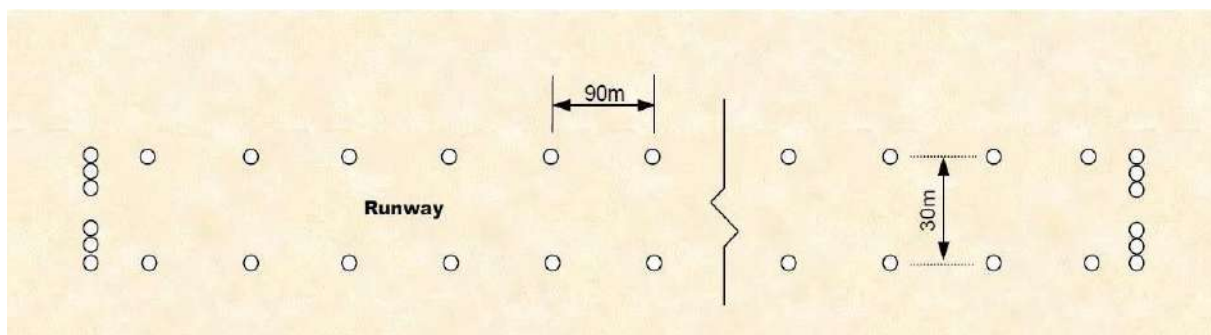


Figure 13.2-4: Aerodrome lighting

13.2.4 Wind Direction Indicator

- 13.2.4.1 It is required for small aerodrome operations to provide a wind direction indicator (WDI). It shall be located clear of the 1:5 (20%) transitional surface.
- 13.2.4.2 If the aerodrome is intended for night operations, the wind direction indicator shall be provided with illumination.
- 13.2.4.3 To enhance direction indication, the WDI shall be located within a circular area 15 m in diameter, the surface of which is appropriately blackened or provided with a contrasting color, and bounded by 15 equally spaced white markers.

13.2.5 Landing Direction Indicator

- 13.2.5.1 Where provided, a landing direction indicator shall be located in a conspicuous place on the aerodrome.
- 13.2.5.2 The landing direction indicator shall be in the form of a "T" as shown in Figure 13.2-5.

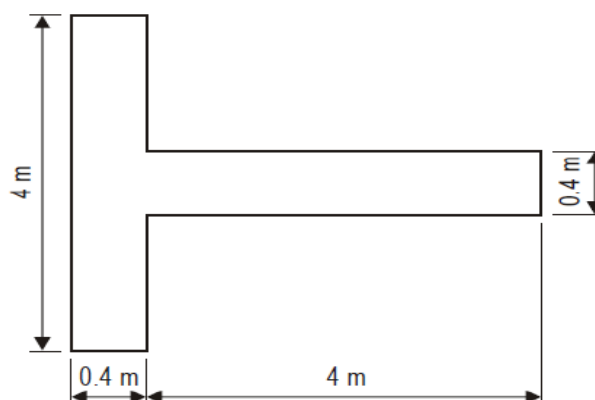


Figure 13.2-5: Landing Direction Indicator

- 13.2.5.3 The color of the landing "T" shall be either white or orange, the choice being dependent on the color that contrasts between or with the background against which the indicator will be viewed. Where required for use at night the landing "T" shall either be illuminated or outlined by white lights.

13.2.6 Signal panels and signal areas

Note: - The inclusion of detailed specifications for a signal area in this section is not intended to imply that one has to be provided. MOS Attachment A, Section 12, provides guidance on the need to provide ground signals. Annex 2, Appendix 1, Section 3 & 4.2, specifies the shape, color and use of visual ground signals. The Aerodrome Design Manual, (Doc 9157), Part 4, provides guidance on their design.

- 13.2.6.1 The signal area shall be located so as to be visible for all angles of azimuth above an angle of 100 above the horizontal when viewed for a height of 300 m.
- 13.2.6.2 The signal area shall be an even horizontal surface at least 9 m square.

- 13.2.6.3 The color of the signal area shall be chosen to contrast with the colors of the signal panels used, and it shall be surrounded by a white border not less than 0.3 m wide.

13.2.7 Ground Signal and Signal Area

- 13.2.7.1 A ground signal area detailed in MOS 8.8 shall be provided near the wind direction indicator for the purpose of displaying ground signals to pilots.
- 13.2.7.2 When an aerodrome is totally unserviceable, a white cross with each arm 6 m in length and 0.9 m in width shall be displayed on the signal circle indicating to pilots that the aerodrome is closed to aircraft operations.

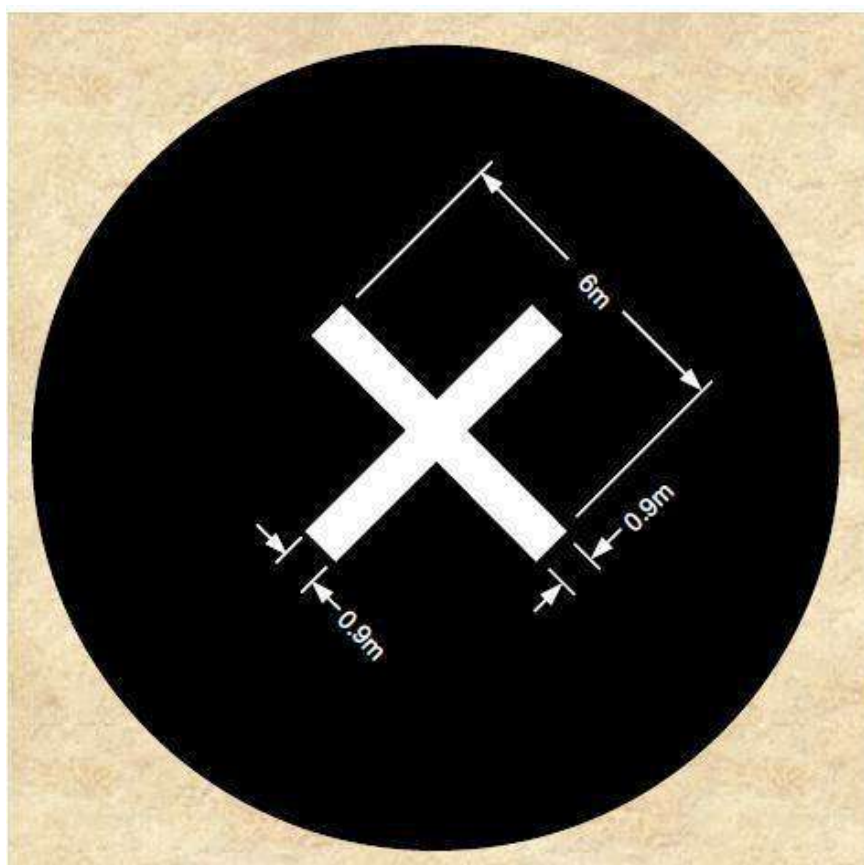


Figure 13.2-6: Total unserviceability marking

13.2.8 Runway and Runway Strip Conditions

- 13.2.8.1 The surface of the runway and runway strip need to be maintained to minimize adverse effects on aeroplane operations, as follows:

Surface	Runway	Runway strip
Sealed surface	A sealed runway surface is to be kept clean of loose stones	N/A
Height of grass		
Sparse	450 mm	600 mm
Medium	300 mm	450 mm
Dense	150 mm	300 mm
Size of loose stones		
Isolated stones on - natural surface	25 mm	50 mm
- constructed gravel surface	15 mm	75 mm
Surface cracks	40 mm	75 mm

Table 13.2-2

- 13.2.8.2 The surface of the unsealed runway shall not have irregularities, which will adversely affect the take-off and landing of an aircraft.

Note: - An empirical test for runway riding quality is to drive a stiffly sprung vehicle such as a medium size utility or unladen truck along the runway at not less than 65 kph. If the ride is uncomfortable for passengers, then the surface needs to be graded and leveled.

13.2.9 Aerodrome Serviceability Reporting

- 13.2.9.1 As these aerodromes do not have information published in AIP or are not provided with an NOTAM service, the chief executive of organizations conducting air transport or flying training operations, or the pilot in command for private operations, needs to establish a reporting process so that the pilot can be notified of any changes to the aerodrome serviceability status, preferably before embarking on a journey where the aerodrome is a destination.

- 13.2.9.2 The aircraft operator has a duty of care to provide information that is as accurate as possible. This will require physical inspection of the aerodrome, ideally before the departure of an aeroplane from its base aerodrome, but always before the arrival of any aeroplane. To maintain the accuracy of the aerodrome serviceability status, it is essential that the aerodrome be inspected after strong wind or rain. The information provided shall include:

- runway surface condition: dry, wet, soft, or slippery;
- runway strip condition: any obstruction, undue roughness, visibility of markers;
- wind direction indicator: if torn or obstructed;
- approach and take-off areas: if there are objects close to or above the obstacle surfaces; and

- (e) other hazardous condition or object known to the aerodrome operator, e.g. animal or bird hazard.

13.2.9.3 As the aerodrome information is not published in AIP, the AOC holder's Operations Manual shall indicate clearly the aerodrome information and contact details for serviceability status reports.

Note: - It is important that the person performing the inspection and reporting duties has a working knowledge of the aerodrome safety requirements and understands clearly his or her responsibilities.

13.2.9.4 For unsealed landing areas, serviceability is often affected by rain. Where the aerodrome is deemed too wet for aeroplane operations, the aerodrome operator needs to display the unserviceability signal, and notify pilots accordingly. When in doubt, always err on the side of safety.

13.2.10 Safety Inspection Report

13.2.10.1 The report shall provide a true picture of the state of the aerodrome in its compliance with applicable standards. Where corrective action or necessary improvements are identified, the aerodrome operator shall provide a statement of how the corrective action or improvements are to be addressed.

13.2.10.2 For aerodromes used by aircraft with less than 10 passenger seats, the approach and take-off area would still need to be checked on a regular basis for vegetation growth or new tall objects. Where another obstacle may become the critical obstacle and affect the published take-off gradient or the threshold location, the checking shall be conducted by a person with appropriate technical expertise.

Section 13.3 Part B - Aerodromes used for aerial agricultural activity**13.3.1 Aerodrome standards**

Aerial agricultural operations during daylight hours only and in Visual Meteorological Conditions (VMC) are permitted at aerodromes complying with the standards set out in this Part. The required physical characteristics are set out in Table 13.3-1.

13.3.1.1 Runway length. The runway length shall be equal to the minimum runway length specified in the aeroplane flight manual or approved performance chart for the prevailing conditions.

13.3.2 Aerodrome Markings

13.3.2.1 Runway markings and/or markers shall be provided if directed by CAAP. Paved/sealed runway surfaces shall be marked if there is insufficient contrast between the runway and surrounding runway strip surfaces. Where insufficient contrast exists to define the runway surface, runway markings and/or markers shall be installed. Markings or markers shall conform to the specifications of Part A of this chapter. Where runway markers are provided which are not flush with a surface, they shall be constructed of a material which is not likely to damage an aircraft.

Aerodrome characteristics and obstacle limitation surfaces	Aeroplanes not exceeding 5,700 kg by day	Aeroplanes not exceeding 2,000 kg by day and cross-wind less than 5 knots
Runway and runway strip		
Runway width	15 m	10 m
Runway strip width - graded	45 m, minimum, 60 m wherever practicable	30 m
Runway longitudinal slope	2%, no section to exceed 2.5%	2%, no section to exceed 2.5%
Runway transverse slope	3% max.	3% max.
Runway strip transverse slope	2.5%	2.5%
Approach and take off climb surfaces		
Length of inner edge	60 m	30 m
Distance of inner edge before threshold	30 m	30 m
Divergence, each side	10 %	10 %
Length of surface	1600 m	900 m
Slope	5%	5%
Inner horizontal surface	n/a	n/a

Table 13.3-1

13.3.3 Aerodrome Lighting

- 13.3.3.1 Agricultural operations are not permitted at night or in conditions below visual meteorological conditions, so lighting of aerodromes used for agricultural operations is not required.

13.3.4 Wind Direction Indicator

Refer to MOS 13.2.4

13.3.5 Ground Signal and Signal Area

Refer to MOS 13.2.7

13.3.6 Runway and Runway Strip Conditions

Refer to MOS 13.2.8

13.3.7 Aerodrome Serviceability Reporting

Details of aerodromes used for agricultural operations are not published in the AIP. These aerodromes are provided for the specific purpose of facilitating aerial agricultural activity and are not generally available for public use. Each pilot operating to or from such a place shall be responsible for determining the suitability of the place for take-off or landing safely.

CHAPTER 14. Rescue and firefighting service

Section 14.1 General

- 14.1.1 The principal objective of a rescue and firefighting service is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome. The rescue and firefighting service is provided to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their own escape without direct aid. The rescue may require the use of equipment and personnel other than those assessed primarily for rescue and firefighting purposes.
- 14.1.2 The most important factors bearing on an effective intervention in a survivable aircraft accident are the training received, the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and firefighting purposes can be put to use.
- 14.1.3 Requirements for combating building or fuel farm fires, or for foaming runways are not taken into account in these standards.
- 14.1.4 Where an aerodrome is located close to water or swampy areas, or difficult terrain, and where a significant portion of approach or departure operations takes place over these areas, specialist rescue services and firefighting equipment appropriate to the hazard and risk shall be available.
- Note: - 1. Special firefighting equipment need not be provided for water areas; this does not prevent the provision of such equipment if it would be of practical use, such as when the areas concerned include reefs or islands.*
- Note: - 2. The objective is to plan and deploy the necessary life-saving flotation equipment as expeditiously as possible in a number commensurate with the largest aeroplane normally using the aerodrome.*
- Note: - 3. Additional guidance is available in Chapter 13 of the Airport Services Manual (Doc 9137), Part 1.*
- 14.1.5 A rescue and firefighting service shall be provided at certified and registered aerodromes. Provision of a RFFS at other aerodromes will be determined by CAAP.
- 14.1.6 MOS 14.9.1 requires that sufficiently trained and competent personnel must be readily available to ride the rescue and fire fighting vehicles and operate the equipment at maximum capacity during flight operations.

Section 14.2 Level of protection

- 14.2.1 The level of protection provided at an aerodrome for rescue and firefighting shall be determined from Table 14-1 and shall be based on the longest aeroplane normally using the aerodrome and its maximum fuselage width.
- 14.2.2 If, after selecting the category appropriate to the longest aeroplane's overall length, that aeroplane's fuselage width is greater than the maximum width in

Table 14-1, column 3 for that category, then the category for that aeroplane shall actually be one category higher.

Note: - 1. See guidance in the Airport Services Manual (Doc 9137), Part 1, Sect. 2.1.2 for categorizing aerodromes, including those for all-cargo aircraft operations, for rescue and firefighting purposes.

Note: - 2. Principles and procedures on training, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981). Further guidance on the training of personnel, rescue equipment for difficult environments and other facilities and services for rescue and firefighting is given in MOS Attachment A, Section 5, and in the Airport Services Manual (Doc 9137), Part 1.

14.2.3

During periods of reduced activity, the level of protection available shall be no less than that needed for the highest category of aeroplane planned to use the aerodrome during that time, irrespective of the number of movements. If approved by CAAP, the level of protection provided when the number of movements of the highest category aircraft is less than 700 in the busiest three months may be one category below that which would be otherwise required.

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

Table 14-1 Aerodrome category for RFFS

Note: - Guidance on categorizing aerodromes for RFFS purposes is given in MOS Attachment A Section 5.3 and in the Airport Services Manual Part 1.

14.2.4

See also MOS 5.5.3

14.2.5

Any change shall be expressed in terms of the new category of level of protection available at the aerodrome.

Section 14.3 Extinguishing agents

14.3.1

Both principal and complementary agents shall be provided at an aerodrome.

Note: - Descriptions of the agents may be found in ICAO Airport Services Manual Part 1.

- 14.3.2 The principal extinguishing agent shall be:
- (a) a foam meeting the minimum performance Level A; or
 - (b) a foam meeting the minimum performance Level B; or
 - (c) a foam meeting the minimum performance Level C; or
 - (d) a combination of these agents;
- except that the principal extinguishing agent for aerodromes in categories 1 to 3 should preferably meet a performance Level B or C foam.
- Note: - Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance Level A, B or C rating is given in the Airport Services Manual (Doc 9137), Part 1.*
- 14.3.3 The complementary extinguishing agent shall be a dry chemical powder suitable for extinguishing hydrocarbon fires.
- Note: - 1. When selecting dry chemical powders for use with foam, care must be exercised to ensure compatibility.*
- Note: - 2. Alternate complementary agents having equivalent firefighting capability may be utilized. Additional information on extinguishing agents is given in the Airport Services Manual (Doc 9137), Part 1.*
- 14.3.4 The amounts of water for foam production and the complementary agents to be provided on the rescue and fire fighting vehicles shall be in accordance with the aerodrome category determined in accordance with 14.2.1 and 14.2.2 and Table 14-2, except for aerodrome categories 1 and 2, up to 100% of the water may be replaced by complementary agent.
- For the purpose of agent substitution, 1kg complementary agent is equivalent to 1 liter of water for production of a foam meeting performance Level A.
- Note: - 1. The amounts of water specified for foam production are predicated on an application rate of 8.2 L/min/m² for a foam meeting performance level A, 5.5 L/min/m² for a foam meeting performance Level B and 3.75L/min/m² for a foam meeting performance Level C.*
- Note: - 2. When any other complementary agent is used, the substitution ratios need to be checked.*
- 14.3.5 The quantity of foam concentrates separately provided on vehicles for foam production shall be in proportion to the quantity of water provided and the foam concentrate selected. The amount of foam concentrate provided on a vehicle shall be sufficient to produce at least two loads of foam solution.
- 14.3.6 The discharge rate of the foam solution and complementary agent shall not be less than the rates shown in Table 14-2.

Aerodrome Category	Foam Meeting Performance Level A		Foam Meeting Performance Level B		Foam Meeting Performance Level C		Complementary Agents	
	Water	Discharge Rate Foam Solution/Minute	Water	Discharge Rate Foam Solution/Minute	Water	Discharge Rate Foam Solution/Minute	Dry Chemical Powders	Discharge Rate
	(L) (2)	(L) (3)	(L) (4)	(L) (5)	(L) (6)	(L) (7)	(Kg) (8)	Kg./Sec. (9)
1	350	350	230	230	160	160	45	2.25
2	1,000	800	670	550	460	360	90	2.25
3	1,800	1,300	1,200	900	820	630	135	2.25
4	3,600	2,600	2,400	1,800	1,700	1,100	135	2.25
5	8,100	4,500	5,400	3,000	3,900	2,200	180	2.25
6	11,800	6,000	7,900	4,000	5,800	2,900	225	2.25
7	18,200	7,900	12,100	5,300	8,800	3,800	225	2.25
8	27,300	10,800	18,200	7,200	12,800	5,100	450	4.50
9	36,400	13,500	24,300	9,000	17,100	6,300	450	4.50
10	48,200	16,600	32,300	11,200	22,800	7,900	450	4.50

Note.— The quantities of water shown in columns 2, 4 and 6 are based on the average overall length of aeroplanes in a given category.

Table 14-2 Minimum usable amounts of extinguishant for RFFS

14.3.7 Reserved.

14.3.8 From 1 January 2015, at aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water shall be recalculated and the amount of water for foam production and the discharge rates for foam solution shall be increased accordingly.

Note: - Guidance on the determination of quantities of water and discharge rates based on the largest overall length of aeroplane in a given category is available in Chapter 2 of the ICAO Document 9137, Airport Services Manual, Part 1.

14.3.9 When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production shall be calculated for each foam type and the distribution of these quantities shall be documented for each vehicle and applied to the overall rescue and firefighting requirement.

14.3.10 Reserve Supply of Foam

(a) A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table 14-2, shall be maintained on the aerodrome for vehicle replenishment purposes.

Note: - Foam concentrate carried on fire vehicles in excess of the quantity identified in Table 14-2 can contribute to the reserve.

(b) Complementary agent, equivalent to 100 per cent of the quantity identified in Table 9-2, 14-2 shall be maintained on the aerodrome for vehicle replenishment purposes. Sufficient propellant gas shall be included to utilize this reserve complementary agent.

(c) Category 1 and 2 aerodromes that have replaced up to 100 per cent of the

water with complementary agent shall hold a reserve supply of complementary agent of 200 per cent.

- (d) Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply in 14.3.10(a), 14.3.10(b) and 14.3.10(c) shall be increased as determined by a risk assessment.

Note: - See ICAO Document 9137, Airport Services Manual, Part 1 for guidance on the conduct of a risk analysis to determine the quantities of reserve extinguishing agents.

- 14.3.11 The complementary agents shall comply with the appropriate specifications of the International Organization for Standardization (ISO).

Note: - Guidance on complementary agents is given in ISO Publication 7202 (Powder).

- 14.3.12 Dry chemical powders shall only be substituted with an agent that has equivalent or better firefighting capabilities for all types of fires where complementary agent is expected to be used.

Note: - Guidance on the use of complementary agents can be found in the Airport Services Manual (Doc 9137), Part 1.

- 14.3.13 Supplementary water supplies, for the expeditious replenishment of rescue and fire fighting vehicles at the scene of an aircraft accident, shall be provided.

- 14.3.14 Rescue equipment commensurate with the level of aircraft operations shall be provided on the rescue and fire fighting vehicle(s).

Note: - Guidance on the rescue equipment to be provided at an aerodrome is given in the Airport Services Manual (Doc 9137), Part 1.

Section 14.4 Response time

- 14.4.1 Response time is considered to be the time between the initial call to the rescue and firefighting service and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50% of the discharge rate specified in MOS Table 14-2.

- 14.4.2 The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes to any point of each operational runway, in optimum visibility and surface conditions.

- 14.4.3 The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes to any other part of the movement area, in optimum visibility and surface conditions.

Note: - Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation and with the normal response route free of surface contamination, e.g., water.

- 14.4.4 To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance,

equipment and/or procedures for rescue and firefighting services shall be provided.

Note: - Additional guidance is available in the Airport Services Manual (Doc 9137), Part 1.

- 14.4.5 Any vehicles, other than the first responding vehicles, required to deliver the amounts of extinguishing agents specified in MOS Table 14-2 shall ensure continuous agent application and shall arrive no more than four minutes from the initial call.
- 14.4.6 A system of preventive maintenance of rescue and fire fighting vehicles shall be employed to ensure the effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.
- 14.4.7 An aerodrome operator shall submit every three (3) months in a manner acceptable to CAAP for the following RFFS actual response time (if applicable) and response time exercises. All Duty shifts shall participate and experience the conduct of response time exercises.

Section 14.5 Emergency access roads

- 14.5.1 Emergency access roads shall be provided on an aerodrome where terrain conditions permit their construction so as to facilitate achieving minimum response times. Particular attention shall be made to the provision of ready access to approach areas up to 1,000 meters from the threshold, or at least within the aerodrome boundary. Where fencing is established, the need for convenient access to outside areas shall be taken into account.
- Note: - Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.*
- 14.5.2 Emergency access roads shall be capable of supporting the heaviest vehicles which will use them and be usable in all weather conditions. Roads within 90 m of a runway shall be designed, constructed and maintained to prevent surface erosion and to prevent transfer of debris to an aircraft pavement surface. Sufficient vertical clearance shall be provided from overhead obstructions for the largest vehicles.
- 14.5.3 When the surface of the road is indistinguishable from the surrounding area, edge markers shall be placed at intervals of about 10 m.

Section 14.6 Fire stations

- 14.6.1 All rescue and firefighting vehicles shall be housed in a fire station. Satellite fire stations shall be provided whenever the response time cannot be achieved from a single fire station. The fire station shall be located so that the access for rescue and firefighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.

Section 14.7 Communications and alerting systems

- 14.7.1 A discrete communication system shall be provided linking a fire station with the control tower, any other fire station on the aerodrome and rescue and firefighting vehicles.
- 14.7.2 An alerting system for rescue and firefighting personnel shall be provided at all fire stations on the aerodrome. The alerting system shall be capable of being operated from any fire station on the aerodrome and the aerodrome control tower.

Section 14.8 Rescue and Firefighting vehicles

- 14.8.1 The minimum number of rescue and firefighting vehicles provided at an aerodrome shall be in accordance with table 14-3 below.

Aerodrome category	Number of RFFS vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Table 14-3 Number of RFFS vehicles

Note: - Guidance on minimum characteristics of rescue and fire fighting vehicles is given in the Airport Services Manual (Doc 9137), Part 1.

Section 14.9 Personnel

- 14.9.1 During flight operations, sufficient trained and competent personnel shall be designated to be readily available to ride the rescue and firefighting vehicles and to operate the equipment at maximum capacity. These personnel shall be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate(s) can be fully maintained. Consideration shall also be given for personnel to use hand lines, ladders and other rescue and firefighting equipment normally associated with aircraft rescue and firefighting operations.
- 14.9.2 All RFFS personnel shall be trained to properly perform their duties in an efficient manner and shall participate in live fire drills commensurate with the type of aircraft type of rescue and firefighting equipment in use at the aerodrome, including pressure fed fuel fires. Fires associated with fuel discharged under very high pressure from ruptured fuel tanks are known as “pressure fed fuel fires”.

Note: - 1. Guidance to assist the appropriate authority in providing proper training is given in MOS Attachment A, Section 5, and the Airport Services Manual (Doc

9137), Part 1.

Note: - 2. Fires associated with fuel discharged under very high pressure from a ruptured fuel tank are known as “pressure-fed fuel fires”.

- 14.9.3 In determining the number of personnel required to provide for aircraft rescue, consideration shall be given to the types of aircraft using the aerodrome. In determining the minimum number of rescue and firefighting personnel required, a task resource analysis shall be completed and the level of staffing documented in the Aerodrome Manual.

Note: - 1. Refer to AC-139-RFFS-02 for guidance on RFFS Task Resource Analysis (TRA).

Note: - 2. Guidance on the use of a task resource analysis can be found in the ICAO Document 9137, Airport Services Manual, Part 1.

- 14.9.4 The RFFS personnel training programme shall include training in human performance, including team coordination.

Note: - Guidance material to design training programmes on human performance and team coordination can be found in the Human Factors Training Manual (Doc 9683).

- 14.9.5 All responding RFFS personnel shall be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.

Section 14.10 Administration

Note: - Guidance Material on the Administration and other safety related requirements regarding Rescue and Fire Fighting Services is provided in MOS Attachment A Section 5.

CHAPTER 15. Heliport standards

Section 15.1 General

Note: - 1. The dimensions discussed in this Chapter are based on consideration of single main-rotor helicopters. For tandem-rotor helicopters the heliport design will be based on a case-by-case review of the specific models using the basic requirement for a safety area and protection areas specified in this Annex. The specifications of the main sections of this chapter are applicable for visual heliports that may or may not incorporate the use of a Point-in-space approach or departure. Additional specifications for instrument heliports with non-precision and/or precision approaches and instrument departures are detailed in Appendix 8. The specifications of this Chapter are not applicable for water heliports (touchdown or lift-off on the surface of the water). Where a water heliport is being considered, specific criteria will be established by CAAP.

Note: - 2 Provisions for helicopter flight operations are contained in PCAR Part 8.

- 15.1.1 This chapter describes the physical characteristics, obstacle limitation surfaces and certain facilities and technical services to be provided for at heliports. It is not intended that these specifications limit or regulate the operation of aircraft, such limitations or other obligations on aircraft operations are provided for in the Civil Aviation Regulations (CAR) published by CAAP.
- 15.1.2 The specifications in this chapter, shall apply to all heliports operating or intending to operate within the Republic of the Philippines. These shall apply equally to areas for the exclusive use of helicopters at an aerodrome primarily meant for the use of aeroplanes. Where relevant, the provisions MOS Chapters 1-14, shall apply to the helicopter operations being conducted at such an aerodrome.
- 15.1.3 Where a heliport specification in this chapter is in conflict with an aerodrome specification in other chapters of this manual, the specification in this chapter will take precedence for application to heliports.
- 15.1.4 When designing a heliport, the critical design helicopter, having the largest set of dimensions and the greatest maximum take-off mass the heliport is intended to serve, will need to be considered.
- 15.1.5 The interpretation of some specifications in this chapter may expressly require the exercise of discretion, decision making or performance of a function by the appropriate authority. Where interpretation is required but not expressly invoked, the implication is that the responsibility for whatever determination or action lies with the appropriate authority. In both cases, the appropriate authority is CAAP through the Director General (DG), although the DG may choose to delegate some or all of his authority to other CAAP officers.
- 15.1.6 Unless otherwise specified, the specification for a color referred to within this chapter shall be that contained in Chapter 9.

Section 15.2 Definitions

15.2.1 MOS Chapter 15, contains definitions for the terms which are used in both volumes. Those definitions are not reproduced in this volume, with the exception of the following two, which are included for ease of reference:

D. The largest overall dimension of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane or helicopter structure.

Declared distances for heliports:

- (a) Take-off distance available (TODAH) - the length of final approach and take-off area, plus the length of helicopter clearway, (if provided) declared available and suitable for helicopters to complete the take-off.
- (b) Rejected take-off distance available (RTODAH) - The length of final approach and take-off area declared available and suitable for helicopters operated in performance class 1 to complete a rejected take-off.
- (c) Landing distance available (LDAH) - The length of the final approach and take-off area plus any additional area declared available and suitable for helicopters to complete the landing maneuver from a defined height.

Design D. The D of the design helicopter.

D-value. A limiting dimension, in terms of “D”, for a heliport, helideck or shipboard heliport, or for a defined area within.

Dynamic load bearing surface. A surface capable of supporting the loads generated by a helicopter in motion.

Elevated heliport. A heliport located on a raised structure on land.

Elongated. When used with TLOF or FATO, elongated means an area which has a length more than twice its width.

Final approach and take-off area (FATO). A defined area over which the final phase of the approach maneuver to hover or landing is completed and from which the take-off maneuver is commenced. Where the FATO is to be used by helicopters operated in performance class 1, the defined area includes the rejected take-off area available.

Helicopter clearway. A defined area on the ground or water selected and/or prepared as a suitable area over which a helicopter operated in performance class 1 may accelerate and achieve a specific height.

Helicopter stand. A defined area intended to accommodate a helicopter for purposes of: loading or unloading passengers, mail or cargo; fuelling, parking or maintenance; and, where air taxiing operations are contemplated, the TLOF..

Helicopter taxiway. A defined path on a heliport intended for the ground movement of helicopters and that may be combined with an air taxi-route to permit both ground and air taxiing.

Helicopter taxi-route. A defined path established for the movement of helicopters from one part of a heliport to another.

- a) *Air taxi-route.* A marked taxi-route intended for air taxiing.;
- b) *Ground taxi-route.* A taxi-route centered on a taxiway;

Helideck. A heliport located on fixed or floating off-shore facility such as an exploration and/or production platform used for the exploitation of oil or gas.

Heliport. An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure or surface movement of helicopters.

Heliport elevation. The elevation of the highest point of the FATO.

Heliport reference point (HRP). The designated location of a heliport.

Obstacle. (Pls. see. MOS Chapter 1-Sect. 1.4 Definitions)

Point-in-space approach (PinS). The Point-in-space approach is based on GNSS and is an approach procedure designed for helicopter only. It is aligned with a reference point located to permit subsequent flight maneuvering or approach and landing using visual maneuvering in adequate visual conditions to see and avoid obstacles.

Point-in-space (PinS) visual segment. This is the segment of a helicopter PinS approach procedure from the MAPt to the landing location for a PinS “proceed visually” procedure. This visual segment connects the Point-in-space (PinS) to the landing location.

Note: - The procedure design criteria for a PinS approach and the detailed design requirements for a visual segment are established in PANS-OPS (Doc 8168).

Protection area. A defined area surrounding a stand intended to reduce the risk of damage from helicopters accidentally diverging from the stand..

Rejected take-off area. A defined area on a heliport suitable for helicopters operating in performance class 1 to complete a rejected take-off.

Runway-type FATO. A FATO having characteristics similar in shape to a runway.

Safety area. A defined area on a heliport surrounding the FATO which is free of obstacles, other than those required for air navigation purposes, and intended to reduce the risk of damage to helicopters accidentally diverging from the FATO.

Shipboard heliport. A heliport located on a ship that may be purpose or non-purpose built. A purpose built shipboard heliport is one designed specifically for helicopter operations. A non-purpose built shipboard heliport is one that utilizes an area of the ship that is capable of supporting a helicopter but not designed specifically for that task.

Static load bearing surface. A surface capable of supporting the mass of a helicopter situated upon it.

Surface level heliport. A heliport located on the ground or on a structure on the surface of the water.

Touchdown and lift-off area (TLOF). An area on which a helicopter may touchdown or lift-off.

Touchdown/positioning circle (TDPC). A touchdown positioning marking (TDPM) in the form of a circle used for omnidirectional positioning in a TLOF.

Touchdown/positioning marking (TDPM). A marking or set of markings providing visual cues for the positioning of helicopters.

Winching area. An area prepared for the transfer by helicopter of personnel or stores to or from a ship.

Section 15.3 Aeronautical data for heliports

15.3.1 Aeronautical Data

15.3.1.1 Determination and reporting of aerodrome-related aeronautical data shall be in accordance with the accuracy and integrity classification required to meet the needs of the end-user of aeronautical data.

Note. - Specifications concerning the accuracy and integrity classification of heliport-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix I.

15.3.1.2 Digital data error detection techniques shall be used during the transmission and/or storage of aeronautical data and digital data sets.

Note: - Detailed specifications concerning digital data error detection techniques are contained in PANS-AIM (Doc 10066).

15.3.2 Heliport reference point

15.3.2.1 A heliport reference point shall be established for a heliport not collocated with an aerodrome.

Note: - When the heliport is collocated with an aerodrome, the established aerodrome reference point serves both aerodrome and heliport.

15.3.2.2 The heliport reference point shall be located near the initial or planned geometric center of the heliport and shall normally remain where first established.

15.3.2.3 The position of the heliport reference point shall be measured and reported to CAAP AIS in degrees, minutes and seconds.

15.3.3 Heliport elevations

15.3.3.1 The elevation of a heliport and geoid undulation at the heliport elevation position shall be measured and reported to CAAP AIS to the accuracy of one-half metre or foot.

- 15.3.3.2 The elevation of the TLOF and/or the elevation and geoid undulation of each threshold of the FATO (where appropriate) shall be measured and reported to the aeronautical information services authority to the accuracy of one half metre or foot.

Note: - Geoid undulation must be measured in accordance with the appropriate system of coordinates.

15.3.4 Heliport dimensions and related information

- 15.3.4.1 Geographical coordinates - latitude and longitude of the listed items as shown in MOS Appendix 7 Table A7-1. Coordinates shall be determined and reported in terms of the World Geodetic System – 1984 (WGS-84).

- 15.3.4.2 The geographical coordinates shall be measured and reported to CAAP AIS in degrees, minutes, seconds and hundredths of a second for the following items:

- (a) center of the TLOF;
- (b) thresholds of FATO (as appropriate); and
- (c) centerline points of air transit routes, ground taxiways and stands.

- 15.3.4.3 The following data elements shall be measured or described, as appropriate, for each facility provided on a heliport:

- (a) Heliport type - surface-level, elevated, shipboard or helideck;
- (b) TLOF - dimensions to the nearest meter or foot, slope, surface type, bearing strength in tons (1,000 kg);
- (c) FATO - type of FATO, true bearing to one hundredth of a degree, designation number (where appropriate), length, width (to nearest meter or foot) slope, surface type;
- (d) Safety area - length, width and surface type;
- (e) Helicopter taxiway and helicopter taxi route- designation, width, surface type;
- (f) Apron - surface type, helicopter stands
- (g) Clearway - length, ground profile; and
- (h) Visual aids for approach procedures including marking, and lighting of FATO, TLOF, helicopter ground taxiways, helicopter air taxiways and helicopter stands.

- 15.3.4.4 The geographical coordinates of the geometric center of the TLOF and/or of each threshold of the FATO (where appropriate) shall be measured and reported to the CAAP AIS in degrees, minutes, seconds and hundredths of seconds.

- 15.3.4.5 The geographical coordinates of appropriate centerline points of helicopter taxiways and helicopter taxi-routes shall be measured and reported to the CAAP AIS in degrees, minutes, seconds and hundredths of seconds.

- 15.3.4.6 The geographical coordinates of each helicopter stand shall be measured and

reported to the CAAP AIS in degrees, minutes, seconds and hundredths of second.

- 15.3.4.7 The geographical coordinates of obstacles in Area 2 (the part within the heliport boundary) and in Area 3 shall be measured and reported to CAAP AIS in degrees, minutes, seconds and tenths of a second. In addition, the top elevation, type, marking and lighting (if any) of obstacles shall be reported to the CAAP AIS.

Note: - Manual of Standards for Aeronautical Information Services, Appendix 8, provides requirements for obstacle data determination in Areas 2 and 3.

15.3.5 Declared distances

- 15.3.5.1 The following distances shall be calculated and declared, where relevant, for a heliport:

- (a) Take-off distance available;
- (b) Rejected take-off distance available; and
- (c) Landing distance available.

15.3.6 Coordination between aeronautical information services and heliport authorities

- 15.3.6.1 To ensure that aeronautical information services units obtain information to enable them to provide up-to-date pre-flight information and to meet the need for in-flight information, arrangements shall be made between aeronautical information services and heliport authorities responsible for heliport services to report to the responsible aeronautical information services unit, with a minimum of delay:

- (a) information on heliport conditions;
- (b) the operational status of associated facilities, services and navigation aids within their area of responsibility;
- (c) any other information considered to be of operational significance.

- 15.3.6.2 Before introducing changes to the air navigation system, due account shall be taken by the services responsible for such changes of the time needed by the aeronautical information service for the preparation, production and issue of relevant material for promulgation. To ensure timely provision of the information to the aeronautical information service, close coordination between those services concerned is therefore required.

- 15.3.6.3 Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the Aeronautical Information Regulation and Control (AIRAC) system, as specified in CAR-ANS Part 15.6.2. The predetermined, internationally agreed AIRAC effective dates shall be observed by the responsible heliport services when submitting the raw information/data to aeronautical information services.

Note — Detailed specifications concerning the AIRAC system are contained in PANS-AIM (Doc 10066), Chapter 6.

- 15.3.6.4 The heliport services responsible for the provision of raw aeronautical

information/data to the aeronautical information services shall do that while taking into account accuracy and integrity requirements which are vital to meet the needs of the end-user of aeronautical data.

Note 1.— Specifications concerning the accuracy and integrity classification of heliport-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1.

Note 2.— Specifications for the issue of a NOT AM is contained in CAR-ANS Part 15.5 (15.6) and PANS-AIM (Doc 10066) Appendices 3 and 4, respectively.

Note 3.— The AIRAC information is distributed by the AIS at least 42 days in advance of the AIRAC effective dates with the objective of reaching recipients at least 28 days in advance of the effective date.

Note 4.— The schedule of the predetermined internationally agreed AIRAC common effective dates at intervals of 28 days, including 19 November 2009, and guidance for the AIRAC use are contained in the Aeronautical Information Services Manual (Doc 8126, Chapter 2, 2.6).

15.3.7 Rescue and firefighting

Note: - See MOS 15.15 for information on rescue and firefighting services.

15.3.7.1 Information concerning the level of protection provided at a heliport for helicopter rescue and firefighting purposes shall be made available.

15.3.7.2 The level of protection normally available at a heliport should be expressed in terms of the category of the rescue and firefighting service as described in MOS 15.15 and in accordance with the types and amounts of extinguishing agents normally available at the heliport.

15.3.7.3 Changes in the level of protection normally available at a heliport for rescue and firefighting shall be notified to the appropriate aeronautical information services units and, where applicable, air traffic units to enable them to provide the necessary information to arriving and departing helicopters. When such a change has been corrected, the above units shall be advised accordingly.

Note: - Changes in the level of protection from that normally available at the heliport could result from, but may not be limited to, a change in the availability of extinguishing agent or equipment used to deliver agents, or of personnel used to operate the equipment.

15.3.7.4 A change should be expressed in terms of the new category of the rescue and firefighting service available at the heliport.

Section 15.4 Helicopter performance classifications

15.4.1 Helicopter performance category is established to take into account several factors associated with the unique characteristics of helicopter operations, including:

- (a) Multi-engine helicopters with a measure of one engine inoperative (OEI) accountability, i.e. with stay up ability enroute, are obviously safer than single engine helicopters of comparable size and shall not be penalized when engaged in similar operations;

- (b) It is not general manufacturing practice to produce helicopters (some late models excepted) which have full OEI accountability within the full flight envelope;
- (c) The airworthiness certification standards of major manufacturing countries do not call up comprehensive OEI performance data particularly for 'normal category' (below 6,000 lbs) helicopters;
- (d) Single engine failures in multi-engine helicopters, although not a common occurrence, are statistically predictable and operations can and shall be scheduled to minimize the danger to persons in the aircraft and to other persons and property on the ground in the event of such an occurrence; and
- (e) Other mechanical malfunctions such as tail rotor, transmission gear box or main shaft failures may be considered as relatively remote occurrences and cannot practically be scheduled into operational standards.

15.4.2

The code of performance is established by Flight Standards Inspectorate Service (FSIS) of CAAP, and the operations of helicopters are grouped into three classes. The performance class requirements applicable to take-off and landing phases of flight are reflected in the heliport standards contained in this chapter.

Performance class requirements for take-off are:

- (a) **operations in performance class 1** - The helicopter shall be able, in the event of a the failure of the critical power unit being recognized at or before the take-off decision point, to discontinue the take-off and stop within the rejected take-off area available. In the event of a failure of the critical power unit being recognized at or after the take-off decision point, the helicopter shall be able to continue the take-off and clear all obstacles along the flight path;
- (b) **operations in performance class 2** - The helicopter shall be able, in the event of a the failure of the critical power unit any time after reaching decision point after take-off (DPATO), to continue the take-off and clear all obstacles along the flight path. Failure of the critical engine before DPATO may cause the helicopter to force-land, so operations must be conducted in a manner that gives appropriate consideration for achieving a safe forced landing; and
- (c) **operations in performance class 3** - At any point of the flight path failure of a power unit will cause the helicopter to force-land, so operations must be conducted in a manner that gives appropriate consideration for achieving a safe forced landing.

15.4.2.1

Performance class requirements for landing are:

- (a) **operations in performance class 1** - In the event of failure of the critical power unit being recognized at any point in the approach and landing phase before the landing decision point, the helicopter shall, after clearing all obstacles in the approach path, be able to land and stop within the landing distance available, or to perform a bailed landing and clear all obstacles in the flight path. In the event of a failure after the landing decision point, the helicopter shall be able to land and stop in the landing distance available;

- (b) **operations in performance class 2** - In the event of failure of the critical power unit being recognized at any point in the approach and landing phase before the landing decision point, the helicopter shall, after clearing all obstacles in the approach path, be able to land and stop within the landing distance available, or to perform a balked landing and clear all obstacles in the flight path. Failure of the critical engine after landing decision point may cause the helicopter to force-land, so operations must be conducted in a manner that gives appropriate consideration for achieving a safe forced landing; and
- (c) **operations in performance class 3** - At any point of the flight path failure of a power unit will cause the helicopter to force-land, so operations must be conducted in a manner that gives appropriate consideration for achieving a safe forced landing. Refer to PCARs Part 8, Section 8.7.2.3.2 for Aircraft Performances for Helicopters.

Section 15.5 Onshore heliports

Note: - 1. The provisions given in this section are based on the design assumption that no more than one helicopter will be in the FATO at the same time.

Note: - 2. The design provisions given in this section assume when conducting operations to a FATO in proximity to another FATO, these operations will not be simultaneous. If simultaneous helicopter operations are required, appropriate separation distances between FATOs need to be determined, giving due regard to such issues as rotor downwash and airspace, and ensuring the flight paths for each FATO, defined in MOS 15.10, do not overlap. Further guidance on this issue is given in the Heliport Manual (ICAO Doc 9261).

Note: - 3. The provisions given in this section are common for surface-level heliports and elevated heliports unless otherwise specified.

Note: - 4. Guidance on the minimum size for elevated FATO/TLOFs in order to permit facilitation of essential operations around the helicopter is given in the Heliport Manual (ICAO Doc 9261).

Note: - 5. Guidance on structural design to account for the presence on elevated heliports of personnel, freight, refuelling and firefighting equipment, etc. is given in the Heliport Manual (ICAO Doc 9261).

Note: - 6. Guidance on siting of a heliport and the location of the various defined areas, with due consideration of the effects of rotor downwash and other aspects of helicopter operations on third parties is given in the Heliport Manual (ICAO Doc 9261).

15.5.1 Final approach and take-off area (FATO)

Note: - Guidance on siting and orientation of the FATO at a heliport to minimize interference of arrival and departure tracks with areas approved for residential use and other noise-sensitive areas close to the heliport is given in the Heliport Manual (ICAO Doc 9261).

15.5.1.1 A FATO shall:

(a) Provide:

- 1) an area free of obstacles, except for essential objects which because of their function are located on it, and of sufficient size and shape to ensure containment of every part of the design helicopter in the final phase of approach and commencement of take-off - in accordance with the intended procedures;

Note: - Essential objects are visual aids (e.g. lighting) or others (e.g. firefighting systems) necessary for safety purposes. For further requirements regarding penetration of a FATO by essential objects, see MOS Section 15.5.1.4.

- 2) when solid, a surface which is resistant to the effects of rotor downwash; and
 - (i) when collocated with a TLOF, is contiguous and flush with the TLOF; has bearing strength capable of withstanding the intended loads; and ensures effective drainage; or
 - (ii) when not collocated with a TLOF, is free of hazards should a forced landing be required;

Note: - Resistant implies that effects from the rotor downwash neither cause a degradation of the surface nor result in flying debris.

and

- (b) be associated with a safety area.

15.5.1.2 A heliport shall be provided with at least one final approach and take-off area (FATO), which need not be solid.

Note: - A FATO may be located on or near a runway strip or taxiway strip.

15.5.1.3 The minimum dimensions of a FATO shall be:

- (a) where intended to be used by helicopters operated in performance class 1:
 - (i) the length of the Rejected Take-Off Distance (RTOD) for the required Take-Off procedure prescribed in the helicopter flight manual (HFM) of the helicopters for which the FATO is intended, or 1.5 Design D, whichever is greater; and
 - (ii) the width for the required procedure prescribed in the HFM of the helicopters for which the FATO is intended, or 1.5 Design D, whichever is greater.
- (b) where intended to be used by helicopters operated in performance classes 2 or 3, the lesser of:
 - (i) an area within which can be drawn a circle of diameter of 1.5 Design D; or,
 - (ii) when there is a limitation on the direction of approach and touchdown, an area of sufficient width to meet the requirement of MOS Section 15.5.1.1 a) 1) but not less than 1.5 times the overall width of the design helicopter.

Note: - 1. The RTOD is intended to ensure containment of the helicopter

during a rejected take-off. Although some flight manuals provide the RTOD, in others the dimension provided is the “minimum demonstrated ... size” (where “...” could be “heliport”, “runway”, “helideck” etc.) and this may not include helicopter containment. When this is the case, it is necessary to consider sufficient safety area dimensions as well as the dimensions of 1.5-D for the FATO, should the HFM not deliver data. For further guidance see Heliport Manual (ICAO Doc 9261).

Note: - 2. Local conditions, such as elevation, temperature, and permitted manoeuvring may need to be considered when determining the size of a FATO. Guidance is given in the Heliport Manual (ICAO Doc 9261).

15.5.1.4 Essential objects located in a FATO shall not penetrate a horizontal plane at the FATO elevation by more than 5 cm.

15.5.1.5 When the FATO is solid the slope shall not:

- (a) except as provided in b) or c) below; exceed 2 percent in any direction;
- (b) when the FATO is elongated and intended to be used by helicopters operated in performance class 1, exceed 3 percent overall, or have a local slope exceeding 5 percent; and
- (c) when the FATO is elongated and intended to be used solely by helicopters operated in performance class 2 or 3, exceed 3 percent overall, or have a local slope exceeding 7 percent.

15.5.1.6 The FATO shall be located so as to minimize the influence of the surrounding environment, including turbulence, which could have an adverse impact on helicopter operations.

Note: - Guidance on determining the influence of turbulence is given in the Heliport Manual (ICAO Doc 9261). If turbulence mitigating design measures are warranted but not practical, operational limitations may need to be considered under certain wind conditions.

15.5.1.7 A FATO shall be surrounded by a safety area which need not be solid.

15.5.1.8 A surface-level heliport shall be provided with at least one final approach and take-off area (FATO).

Note: - A FATO may be located on or near a runway strip or taxiway strip

15.5.2 Helicopter clearways

Note: - The inclusion of detailed specifications for helicopter clearways in this section is not intended to imply that a clearway has to be provided.

15.5.2.1 A helicopter clearway shall provide:

- (a) an area free of obstacles, except for essential objects which because of their function are located on it, and of sufficient size and shape to ensure containment of the design helicopter when it is accelerating in level flight, and close to the surface, to achieve its safe climbing speed; and
- (b) when solid, a surface which: is contiguous and flush with the FATO; is

resistant to the effects of rotor downwash; and is free of hazards if a forced landing is required.

- 15.5.2.2 When a helicopter clearway is provided, it shall be located beyond the end of the FATO.
- 15.5.2.3 The width of a helicopter clearway should not be less than the width of the FATO and associated safety area. (see MOS Figure 15-1A).
- 15.5.2.4 When solid, the ground in a helicopter clearway should not project above a surface having an overall upward slope of 3% or having a local upward slope exceeding 5 percent, the lower limit of this surface being a horizontal line which is located on the periphery of the FATO.
- 15.5.2.5 An object situated in a helicopter clearway which will endanger helicopters in the air shall be regarded as an obstacle and shall be removed.

15.5.3 Touchdown and lift-off areas (TLOF)

15.5.3.1 A TLOF shall:

(a) Provide:

- (i) an area free of obstacles and of sufficient size and shape to ensure containment of the undercarriage of the most demanding helicopter the TLOF is intended to serve in accordance with the intended orientation;
- (ii) a surface which:
 - (1) has sufficient bearing strength to accommodate the dynamic loads associated with the anticipated type of arrival of the helicopter at the designated TLOF;
 - (2) is free of irregularities that would adversely affect the touchdown or lift-off of helicopters;
 - (3) has sufficient friction to avoid skidding of helicopters or slipping of persons;
 - (4) is resistant to the effects of rotor downwash; and
 - (5) ensures effective drainage while having no adverse effect on the control or stability of a helicopter during touchdown and lift-off, or when stationary; and

(b) be associated with a FATO or a stand.

15.5.3.2 A heliport shall be provided with at least one TLOF.

15.5.3.3 A TLOF shall be provided whenever it is intended that the undercarriage of the helicopter will touch down within a FATO or stand, or lift off from a FATO or stand.

15.5.3.4 The minimum dimensions of a TLOF shall be:

(a) when in a FATO intended to be used by helicopters operated in

performance class 1, the dimensions for the required procedure prescribed in the helicopter flight manuals (HFMs) of the helicopters for which the TLOF is intended; and:

- (b) when in a FATO intended to be used by helicopters operated in performance class 2 or 3, or in a stand:
 - (i) when there is no limitation on the direction of touchdown, of sufficient size to contain a circle of diameter of at least 0.83 D of:
 - (1) in a FATO, the design helicopter; or
 - (2) in a stand, the largest helicopter the stand is intended to serve;
 - (ii) when there is a limitation on the direction of touchdown, of sufficient width to meet the requirement of 3.1.21 a) 1) above but not less than twice the undercarriage width (UCW) of:
 - (1) in a FATO, the design helicopter; or,
 - (2) in a stand, the most demanding helicopter the stand is intended to serve.

15.5.3.5 For an elevated heliport, the minimum dimensions of a TLOF, when in a FATO, shall be of sufficient size to contain a circle of diameter of at least 1 Design-D.

15.5.3.6 Slopes on a TLOF should not:

- (a) except as provided in b) or c) below; exceed 2 percent in any direction;
- (b) when the TLOF is elongated and intended to be used by helicopters operated in performance class 1; exceed 3 percent overall, or have a local slope exceeding 5 percent; and
- (c) when the TLOF is elongated and intended to be used solely by helicopters operated in performance class 2 or 3, exceed 3 percent overall, or have a local slope exceeding 7 percent.

15.5.3.7 When a TLOF is within a FATO it should be:

- (a) centered on the FATO; or
- (b) for an elongated FATO, centered on the longitudinal axis of the FATO.

15.5.3.8 When a TLOF is within a helicopter stand, it shall be centered on the stand.

15.5.3.9 A TLOF shall be provided with markings which clearly indicate the touchdown position and, by their form, any limitations on maneuvering.

Note: - When a TLOF in a FATO is larger than the minimum dimensions, the TDPM may be offset while ensuring containment of the undercarriage within the TLOF and the helicopter within the FATO.

15.5.3.10 Where an elongated Performance Class 1 FATO/TLOF contains more than one TDPM, measures should be in place to ensure that only one can be used at a time.

15.5.3.11 Where alternative TDPMs are provided they should be placed to ensure containment of the undercarriage within the TLOF and the helicopter within the

FATO.

Note: - The efficacy of the rejected take-off or landing distance will be dependent upon the helicopter being correctly positioned for take-off, or landing.

Safety Devices

15.5.3.12 Safety devices such as safety nets or safety shelves shall be located around the edge of an elevated heliport but shall not exceed the height of the TLOF.

15.5.3.13 The safety net shall extend at least 1.5 meters in the horizontal plane and be so arranged that the outboard edge is slightly above the level of the helipad edge, but by no more than 0.25 meters having an upward and outward slope of at least 10°. The net shall be strong enough to withstand, without a damage, a 75 kg mass being dropped from a height of 1.0 m.

Note: - See Heliport Manual (Doc 9621) for further guidance.

15.5.3.14 There shall be a minimum of at least two access points to the helipad located equidistant around the perimeter. Such an arrangement will ensure that, in the event of an accident or incident on the helipad from which fire might ensue, personnel will be sure of at least one escape route upwind of the helipad.

15.5.3.15 Where handrails associated with access points exceed the elevation of the FATO by 25 cm (10 in), they shall be made collapsible or removable. They shall be collapsed or removed whilst helicopter maneuvers are in progress.

Note: - See Heliport Manual (Doc 9621) for further guidance.

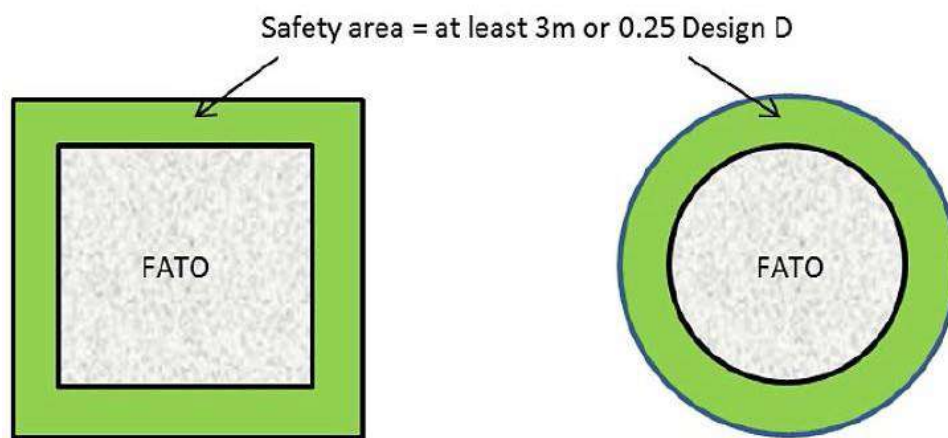


Figure 15-1A. FATO and associated safety area

15.5.4 Safety areas

15.5.4.1 A safety area shall provide:

- an area free of obstacles, except for essential objects which because of their function are located on it, to compensate for manoeuvring errors; and
- when solid, a surface which: is contiguous and flush with the FATO; is resistant to the effects of rotor downwash; and ensures effective drainage.

- 15.5.4.2 The safety area surrounding a FATO shall extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.25 Design D, whichever is greater (see MOS Figure 15-1A).
- 15.5.4.3 No mobile object shall be permitted in a safety area during helicopter operations.
- 15.5.4.4 Essential objects located in the safety area shall not penetrate a surface originating at the edge of the FATO at a height of 25 cm above the plane of the FATO sloping upwards and outwards at a gradient of 5 percent.
- 15.5.4.5 When solid, should not exceed an upward slope of 4 percent outwards from the edge of the FATO.

Protected side slope

- 15.5.4.6 A heliport shall be provided with at least one protected side slope, rising at 45 degrees outward from the edge of the safety area and extending to a distance of 10 meters (see MOS Figure 15-1B).
- 15.5.4.7 A heliport should be provided with at least two protected side slopes, rising at 45 degrees outward from the edge of the safety area and extending to a distance of 10 m.
- 15.5.4.8 The surface of a protected side slope shall not be penetrated by obstacles.

15.5.5 Helicopter taxiways and taxi-routes

Note: - 1. The specifications for ground taxi-routes and air taxi-routes are intended for the safety of simultaneous operations during the manoeuvring of helicopters. The effect of wind velocity/turbulence induced by the rotor downwash would need to be considered.

Note: - 2. The defined areas addressed in this section are taxiways and ground/air taxi-routes:

- a) *Taxiways associated with air taxi-routes may be used by both wheeled and skidded helicopters for either ground or air taxiing.*
- b) *Ground taxi-routes are meant for use by wheeled helicopters, for ground taxiing only.*
- c) *Air taxi-routes are meant for use by air taxiing only.*

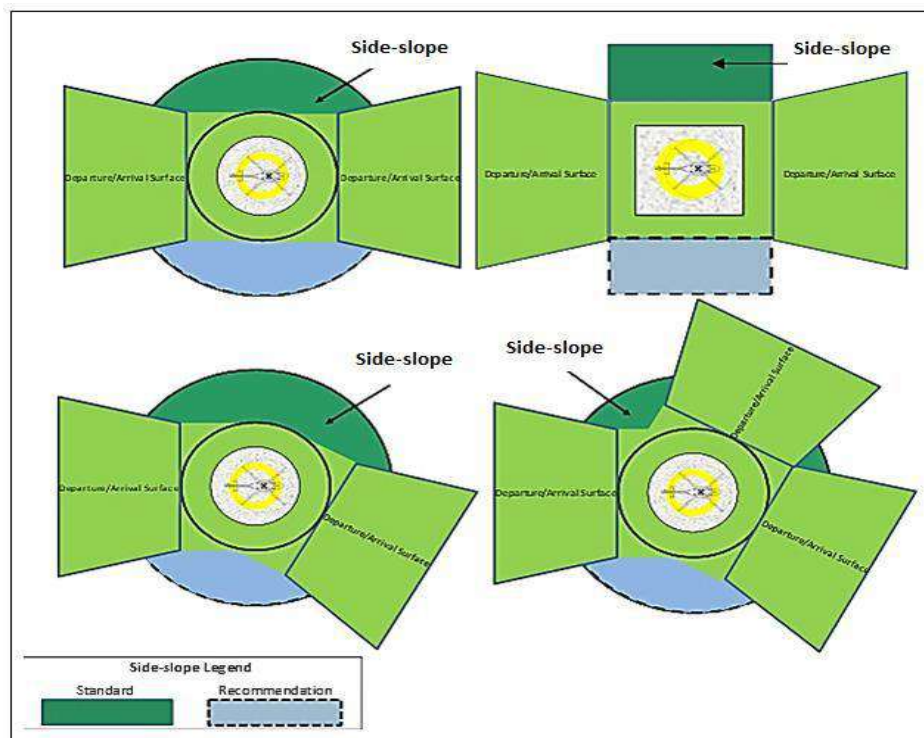
Helicopter taxiways

Note: - 1. A helicopter ground taxiway is intended to permit the surface movement of a wheeled helicopter under its own power.

Note: - 2. A helicopter taxiway can be used by a wheeled helicopter for air taxi if associated with a helicopter air taxi-route.

Note: - 3. When a taxiway is intended for use by aeroplanes and helicopters, the provisions for aeroplane taxiways; taxiway strips; helicopter taxiways; and taxi-routes will be taken into consideration and the more stringent requirements will be

applied.



Note: - These diagrams show a number of configurations of FATO/Safety Areas/Side slopes. For a more complex arrival/departure arrangement which consists of: two surfaces that are not diametrically opposed; more than two surfaces; or an extensive obstacle free sector (OFS) which abuts directly to the FATO, it can be seen that appropriate provisions are necessary to ensure that there are no obstacles between the FATO and/or safety area and the arrival/departure surfaces.

Figure 15-1B. FATO simple/complex safety area and side slope protection

15.5.5.1

A helicopter taxiway shall:

a) provide:

- (i) an area free of obstacles and of sufficient width to ensure containment of the undercarriage of the most demanding wheeled helicopter the taxiway is intended to serve;
- (ii) a surface which:
 - (1) has bearing strength to accommodate the taxiing loads of the helicopters the taxiway is intended to serve;
 - (2) is free of irregularities that would adversely affect the ground taxiing of helicopters;
 - (3) is resistant to the effects of rotor downwash; and
 - (4) ensures effective drainage while having no adverse effect on the control or stability of a wheeled helicopter when being manoeuvred under its own power, or when stationary; and

- b) be associated with a taxi-route.

15.5.5.2 The minimum width of a helicopter taxiway shall be the lesser of:

- a) two times the undercarriage width (UCW) of the most demanding helicopter the taxiway is intended to serve; or
- b) a width meeting the requirements of MOS Section 15.5.5.1 (a) (i).

15.5.5.3 The transverse slope of a taxiway should not exceed 2 percent and the longitudinal slope should not exceed 3 percent.

Helicopter taxi-routes

15.5.5.4 A helicopter taxi-route shall provide:

- a) an area free of obstacles, except for essential objects which because of their function are located on it, established for the movement of helicopters; with sufficient width to ensure containment of the largest helicopter the taxi-route is intended to serve;
- b) when solid, a surface which is resistant to the effects of rotor downwash; and
 - (i) when collocated with a taxiway:
 - (1) is contiguous and flush with the taxiway;
 - (2) does not present a hazard to operations; and
 - (3) ensures effective drainage; and
 - (ii) when not collocated with a taxiway, is free of hazards if a forced landing is required.

15.5.5.5 No mobile object shall be permitted on a taxi-route during helicopter movements operations.

Note: - See the Heliport Manual (ICAO Doc 9261) for further guidance.

15.5.5.6 When solid and collocated with a taxiway, the taxi-route should not exceed an upward transverse slope of 4 percent outwards from the edge of the taxiway.

Helicopter ground taxi-routes

15.5.5.7 A helicopter ground taxi-route shall have a minimum width of 1.5 x the overall width of the largest helicopter it is intended to serve, and be centered on a taxiway (See MOS Figure 15-2).

15.5.5.8 Essential objects located in a helicopter ground taxi-route shall not:

- a) be located at a distance of less than 50 cm outwards from the edge of the helicopter ground taxiway; and
- b) penetrate a surface 50 cm outwards of the edge of the helicopter taxiway and a height of 25 cm above the surface of the taxiway and sloping upwards and outwards at a gradient of 5 percent.

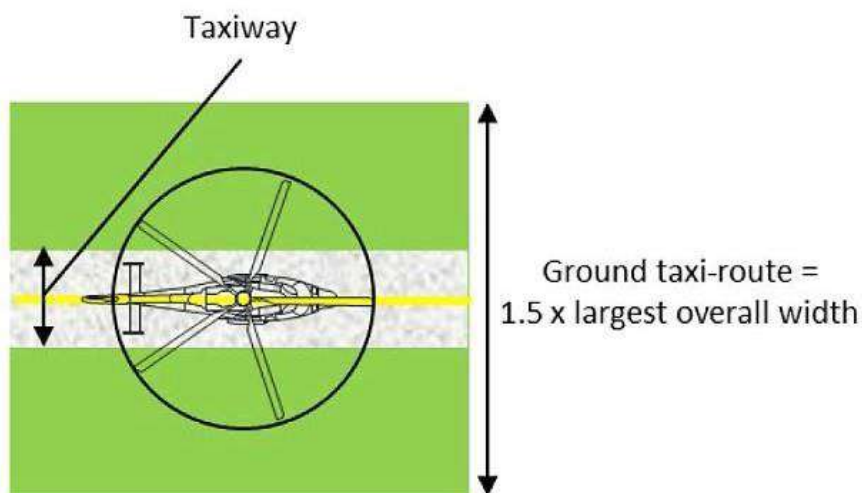


Figure 15-2. Helicopter ground taxi-route

15.5.6 Helicopter air taxi-routes

Note: - A helicopter air taxi-route is intended to permit the movement of a helicopter above the surface at a height normally associated with ground effect and at a groundspeed less than 37 kph (20 kt).

- 15.5.6.1 A helicopter air taxi-route shall have a minimum width of twice the overall width of the largest helicopter it is intended to serve.
- 15.5.6.2 If collocated with a taxiway for the purpose of permitting both ground and air taxi operations (see MOS Figure 15-4 (b):
- a) the helicopter air taxi-route shall be centered on the taxiway; and
 - b) essential objects located in the helicopter air taxi-route shall not:
 - (i) be located at a distance of less than 50 cm outwards from the edge of the helicopter taxiway; and
 - (ii) penetrate a surface originating 50 cm outwards of the edge of the helicopter taxiway and a height of 25 cm above the surface of the taxiway and sloping upwards and outwards at a gradient of 5 percent.
- 15.5.6.3 When not collocated with a taxiway, the slope of the surface of an air taxi route should not exceed the slope landing limitations of the helicopters the taxi-route is intended to serve. In any event the transverse slope should not exceed 10% and the longitudinal slope may not exceed 7%.

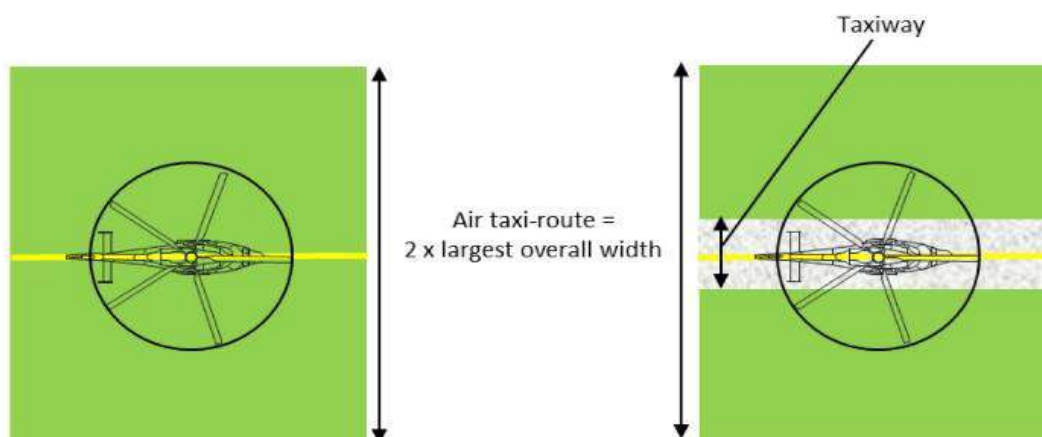


Figure 15-3 Helicopter air taxi-route and combined air taxi-route/taxiway

15.5.7 Helicopter stands

Note: - The provisions of this section do not specify the location for helicopter stands but allow a high degree of flexibility in the overall design of the heliport. However, it is not considered good practice to locate helicopter stands under a flight path. See Heliport Manual (ICAO Doc 9261) for further guidance.

15.5.7.1 A helicopter stand shall:

- a) provide:
 - (i) an area free of obstacles and of sufficient size and shape to ensure containment of every part of the largest helicopter the stand is intended to serve when it is being positioned within the stand;
 - (ii) a surface which:
 - (1) is resistant to the effects of rotor downwash;
 - (2) is free of irregularities that would adversely affect the manoeuvring of helicopters;
 - (3) has bearing strength capable of withstanding the intended loads;
 - (4) has sufficient friction to avoid skidding of helicopters or slipping of persons; and
 - (5) ensures effective drainage while having no adverse effect on the control or stability of a wheeled helicopter when being manoeuvred under its own power, or when stationary; and
- b) be associated with a protection area.

15.5.7.2 The minimum dimensions of a helicopter stand shall be:

- a) a circle of diameter of 1.2 D of the largest helicopter the stand is intended to serve; or
- b) when there is a limitation on manoeuvring and positioning, of sufficient width to meet the requirement of MOS Section 15.5.7.1 (a) (i) above but not less 1.2 times overall width of largest helicopter the stand is intended to serve.

Note: - 1. For a helicopter stand intended to be used for taxi-through only, a width less than $1.2D$ but which provides containment and still permits all required functions of a stand to be performed, might be used (in accordance with 15.5.7.1 (a)(i)).

Note: - 2. For a helicopter stand intended to be used for turning on the ground, the minimum dimensions may be influenced by the turning circle data provided by the manufacturer and are likely to exceed $1.2 D$. See the Heliport Manual (Doc 9261) for further guidance.

15.5.7.3 The mean slope of a helicopter stand in any direction should not exceed 2%.

15.5.7.4 Each helicopter stand shall be provided with positioning markings to clearly indicate where the helicopter is to be positioned and, by their form, any limitations on maneuvering.

15.5.7.5 A stand shall be surrounded by a protection area which need not be solid.

Protection areas

15.5.7.6 A protection area shall provide:

- a) an area free of obstacles, except for essential objects which because of their function are located on it; and
- b) when solid, a surface which is contiguous and flush with the stand; is resistant to the effects of rotor downwash; and ensures effective drainage.

15.5.7.7 When associated with a stand designed for turning, the protection area shall extend outwards from the periphery of the stand for a distance of $0.4D$. (See MOS Figure 15-5).

15.5.7.8 When associated with a stand designed for taxi-through, the minimum width of the stand and protection area shall not be less than the width of the associated taxi-route (see MOS Figures 15-6 and 15-6A).

15.5.7.9 When associated with a stand designed for non-simultaneous use (see MOS Figures 15-6B and 15-6C):

- a) the protection area of adjacent stands may overlap but shall not be less than the required protection area for the larger of the adjacent stands; and
- b) the adjacent non-active stand may contain a static object but it shall be wholly within the boundary of the stand.

Note: - To ensure that only one of the adjacent stands is active at a time, instruction to pilots in the AIP make clear that a limitation on the use of the stands is in force.

15.5.7.10 No mobile object shall be permitted in a protection area during helicopter operations.

15.5.7.11 Essential objects located in the protection area shall not:

- a) if located at a distance of less than $0.75D$ from the center of the helicopter

stand, penetrate a plane at a height of 5 cm above the plane of the central zone; and

- b) if located at distance of $0.75D$ or more from the center of the helicopter stand, penetrate a plane at a height of 25 cm above the plane of the central zone and sloping upwards and outwards at a gradient of 5%.

15.5.7.12

When solid, the slope of a protection area should not exceed an upward slope of 4 percent outwards from the edge of the stand.

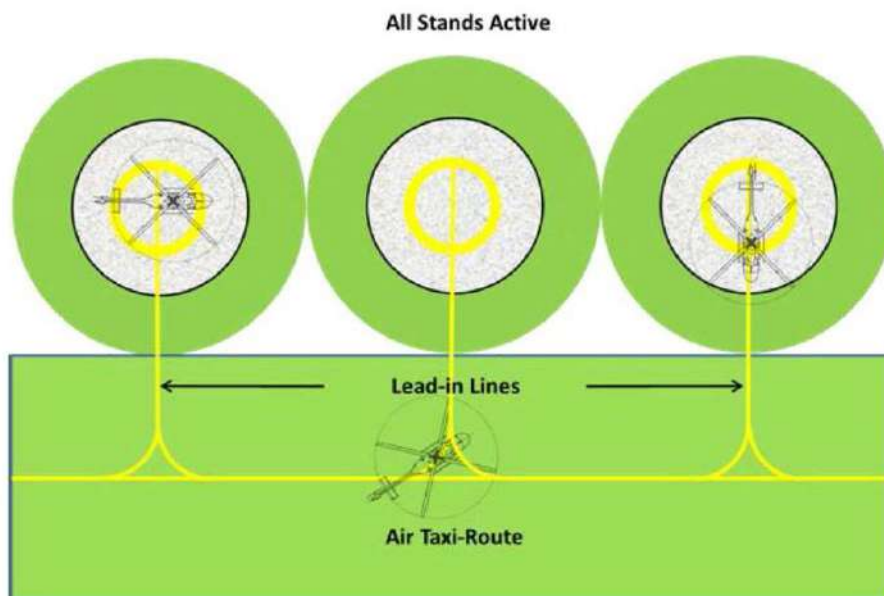


Figure 15-5. Turning stands (with air taxi-routes) simultaneous use

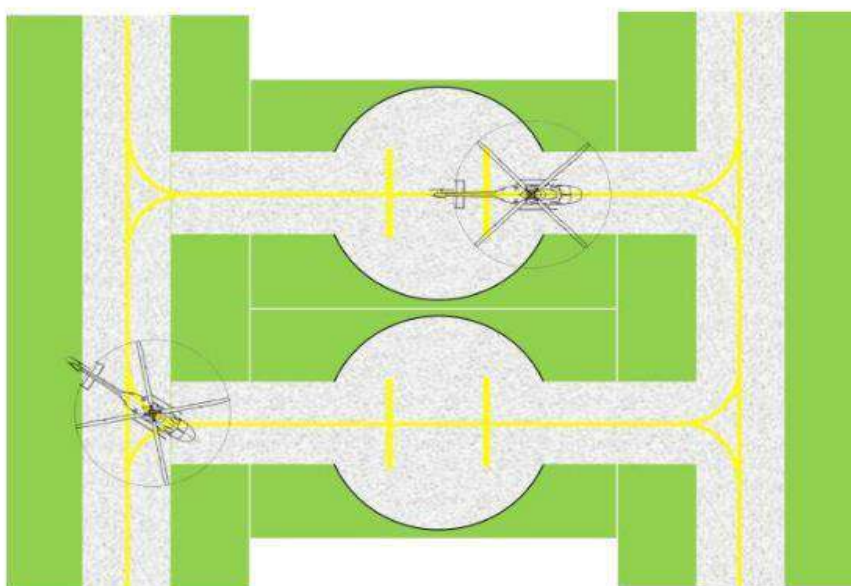


Figure 15-6 Ground taxi-through stands (with taxiway/ground taxi-route) simultaneous use

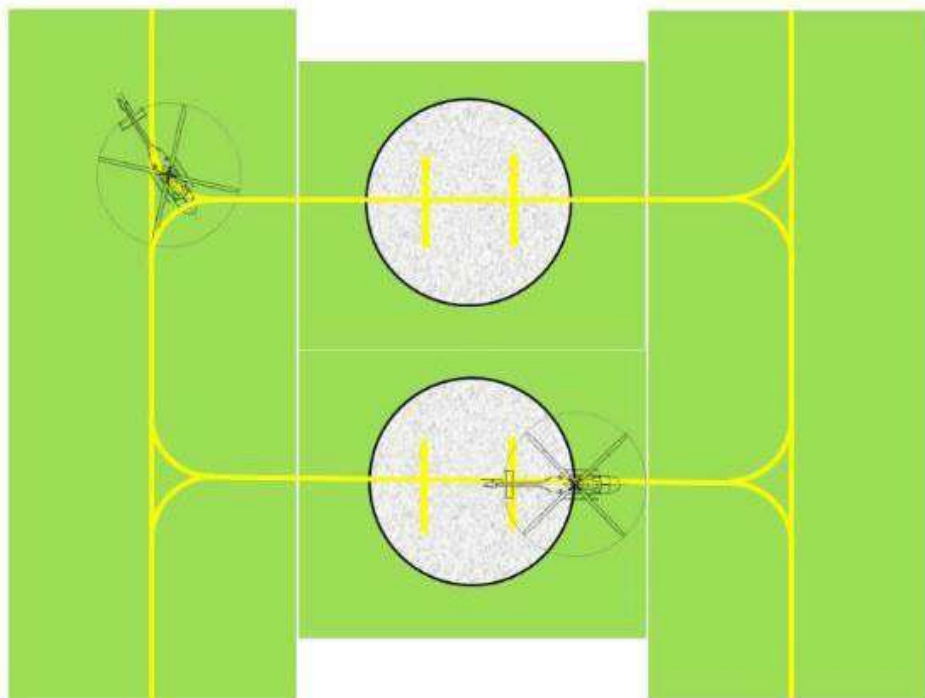


Figure 15-6A Air taxi-through stands (with air taxi-route) simultaneous use

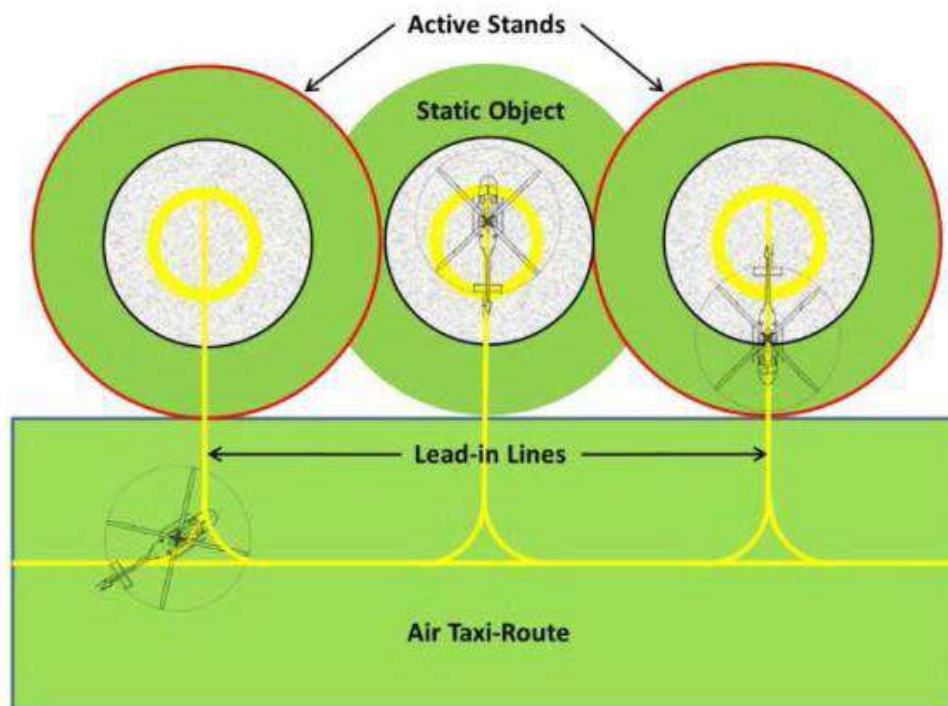


Figure 15-6B. (with air taxi-routes) use – outer stands active

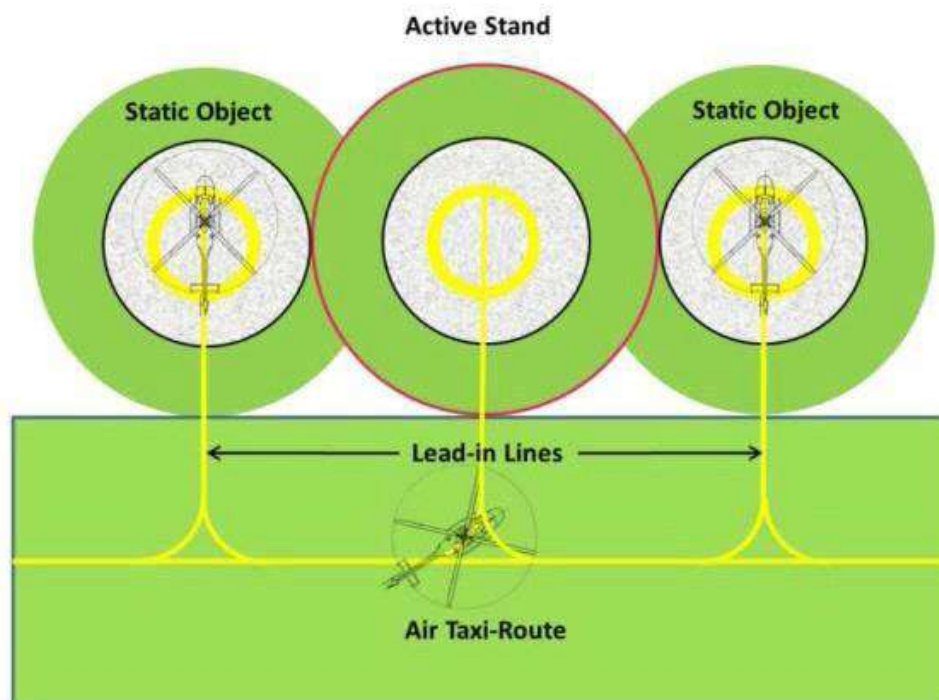


Figure 15-6C Turning stands (with air taxi-route) non-simultaneous use – inner stand active

15.5.8 Location of a final approach and take-off area in relation to a runway or taxiway

15.5.8.1 Where a FATO is located near a runway or taxiway and where simultaneous operations are planned, the separation distance between the edge of the runway or taxiway and the edge of the FATO shall be not less than the appropriate dimension in MOS Table 15-1.

15.5.8.2 A FATO shall not be located:

- (a) near taxiway intersections or holding points where jet engine efflux is likely to cause high turbulence; or
- (b) near areas where aeroplane vortex wake generation is likely to exist.

Aeroplane and or helicopter mass	Distance between edges of FATO and runway or taxiway
Up to but not including 3175 kg	60 m
3175kg up to but not including 5760 kg	120 m
5760 kg up to but not including 100,000 kg	180 m
100,000 kg and over	250 m

Table 15-1. FATO minimum separation distance for simultaneous operations

Section 15.6 Elevated heliports

(The previous standards under this section has been deleted in toto as the recent amendment to Chapter 15 is based on simplified, performance-based provisions which include a single common standard for ground-level and elevated heliports to minimize unnecessary design complexities).

Section 15.7 Helidecks

Note: - The following specifications are for helidecks located on structures engaged in such activities as mineral exploitation, research or construction. See MOS 15.8 for shipboard heliport provisions.

15.7.1 Final approach and take-off area and touchdown and lift-off area

15.7.1.1 Helidecks are considered to be only on structures engaged in such activities as mineral exploration, research or construction. Helidecks are not considered to be shipboard heliports (See MOS 15.8). On helidecks the FATO and TLOF are required to be coincidental, so reference in this section to FATO is to include TLOF.

Note: - 1. For helidecks that have a 1D or larger FATO it is presumed that the FATO and the TLOF will always occupy the same space and have the same load bearing characteristics so as to be coincidental. For helidecks that are less than 1D, the reduction in size is only applied to the TLOF which is a load bearing area. In this case, the FATO remains at 1D but the portion extending beyond the TLOF perimeter need not be load bearing for helicopters. The TLOF and the FATO may be assumed to be collocated.

Note: - 2. Guidance on the effects of airflow direction and turbulence, prevailing wind velocity and high temperatures from gas turbine exhausts or flare-radiated heat on the location of the FATO is given in the Heliport Manual (Doc 9261).

Note: - 3. Guidance on the design and markings for helideck parking areas is given in the Heliport Manual (Doc 9261).

15.7.1.2 A helideck shall be provided with one FATO and one coincident or collocated TLOF. The TLOF shall be dynamic load bearing and shall provide ground effect.

15.7.1.3 A FATO may be any shape but shall be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1.0 D of the largest helicopter the helideck is intended to serve.

15.7.1.4 A TLOF may be any shape but shall be of sufficient size to contain:

- (a) for helicopters with a MTOM of more than 3175 kg, an area within which can be accommodated a circle of diameter of not less than 1.0 D of the largest helicopter the helideck is intended to serve; and
- (b) for helicopters with a MTOM of 3175 kg or less, an area within which can be accommodated a circle of diameter of not less than 0.83 D of the largest helicopter the helideck is intended to serve.

15.7.1.5 For helicopters with a MTOM of 3175 kg or less, the TLOF shall be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1.0 D of the largest helicopter the helideck is intended to serve.

- 15.7.1.6 A helideck shall be arranged to ensure that a sufficient and unobstructed air-gap is provided which encompasses the full dimensions of the FATO.
Note: - Specific guidance on the characteristics of an air-gap is given in the Heliport Manual (Doc 9261). As a general rule, except for shallow superstructures of three stories or less, a sufficient air-gap will be at-least 3 m.
- 15.7.1.7 The FATO shall be located so as to avoid, as far as is practicable, the influence of environmental effects, including turbulence, over the FATO, which can have an adverse impact on helicopter operations.
- 15.7.1.8 No fixed object shall be permitted around the edge of the TLOF except frangible objects which, because of their function, must be located thereon.
- 15.7.1.9 For any TLOF 1D or greater and any TLOF designed for use by helicopters having a D-value of greater than 16.0 m, objects in the obstacle free sector function requires them to be located on the edge of the TLOF shall not exceed a height of 25 cm.
- 15.7.1.10 For any TLOF 1D or greater and any TLOF designed for use by helicopters having a D-value of greater than 16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF shall be as low as possible and in any case not exceed a height of 15 cm.
- 15.7.1.11 For any TLOF designed for use by helicopters having a D-value of 16.0 m or less, and any TLOF having dimensions of less than 1D, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF, shall not exceed a height of 5 cm.
Note: - Lighting that is mounted at a height of less than 25 cm is typically assessed for adequacy of visual cues before and after installation.
- 15.7.1.12 Objects whose function requires then to be located within the TLOF (such as lighting or nets) shall not exceed a height of 2.5 cm. Such objects shall only be present if they do not represent a hazard to helicopters.
Note: - Examples of potential hazards include nets or raised fittings on the deck that might induce dynamic rollover for helicopters equipped with skids.
- 15.7.1.13 Safety devices such as safety net or safety shelves shall be located around the edge of a helideck but shall not exceed the height of the TLOF.
- 15.7.1.14 The surface of the TLOF shall be skid resistant to both helicopters and persons and be sloped to prevent pooling of water.
Note: - Guidance on rendering the surface of the TLOF skid-resistant is contained in the Heliport Manual (Doc 9261).
- 15.7.1.15 The specifications in paragraphs 15.7.1.12 and 15.7.1.13 shall be applicable for helidecks completed on or after 1 January 2012.

Section 15.8 Shipboard heliports

15.8.1 Final approach & take-off area and touchdown & lift-off area

- 15.8.1.1 When helicopter operating areas are provided in the bow or stern of a ship or are purpose built above the ship's structure, they shall be regarded as purpose built shipboard heliports.

Note: - Except for the arrangement described in 15.8.1.5 (b), On for shipboard heliports it is presumed that the FATO and the TLOF will be coincidental. Guidance on the effects of airflow direction and turbulence, prevailing wind velocity and high temperature from gas turbine exhausts or flare-radiated heat on the location of the FATO is given in the Heliport Manual (Doc 9261).

- 15.8.1.2 A shipboard heliport shall be provided with one FATO and one coincidental or colocated TLOF. It shall be dynamic load bearing and provide ground effect.

- 15.8.1.3 A FATO may be any shape but shall be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1.0 D of the largest helicopter the heliport is intended to serve.

- 15.8.1.4 For purpose built shipboard heliports provided in a location other than the bow or stern, the TLOF shall be sufficient size to contain a circle with a diameter not less than 1.0 D of the largest helicopter the heliport is intended to serve.

- 15.8.1.5 For purpose built shipboard heliports provided in the bow or stern of a ship, the TLOF shall be of sufficient size to:

- (a) contain a circle with a diameter not less than 1 D of the largest helicopter the heliport is intended to serve; or
- (b) for operations with limited touchdown directions, contain an area within which can be accommodated two opposing arcs of a circle with a diameter of not less than 1 D in the longitudinal direction. The minimum width of the heliport shall be not less than 0.83D. (See MOS Figure 15-7).

Note: - 1. The ship will need to be manoeuvred to ensure that the relative wind is appropriate to the direction of the helicopter touchdown heading.

Note: - 2. The touchdown heading of the helicopter is limited to the angular distance subtended by the 1 D arcs headings, minus the angular distance which corresponds to 15 degrees at each end of the arc.

- 15.8.1.6 For non-purpose built shipboard heliports the TLOF shall be of sufficient size to contain a circle with a diameter not less than 1 D of the largest helicopter the heliport is intended to serve.

- 15.8.1.7 A shipboard heliport shall be arranged to ensure that a sufficient and unobstructed air-gap is provided which encompasses the full dimensions of the FATO.

Note: - Specific guidance on the characteristics of an air-gap is given in the Heliport Manual (ICAO Doc 9261). As a general rule, except for shallow superstructures of three stories or less, a sufficient air-gap will be at-least 3m.

- 15.8.1.8 The FATO shall be located so as to avoid, as far as is practicable, the influence of environmental effects, including turbulence, over the FATO, which will have an adverse impact on helicopter operations.
- 15.8.1.9 No fixed object shall be permitted around the edge of the TLOF except for frangible objects which, because of their function, must be located thereon.
- 15.8.1.10 For any TLOF 1D or greater and any TLOF designed for use by helicopters having a D-value of greater than 16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF shall not exceed a height of 25 cm.
- 15.8.1.11 For any TLOF 1D or greater and any TLOF designed for use by helicopters having a D-value of greater than 16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF should be as low as possible and in any case not exceed a height of 15 cm.
- 15.8.1.12 For any TLOF designed for use by helicopters having a D-value of 16.0 m or less, and any TLOF having dimensions of less than 1D, objects in the obstacle-free sector, whose function requires them to be located on the edge of the TLOF, shall not exceed a height of 5 cm.
- Note: - Lighting that is mounted at a height of less than 25 cm is typically assessed for adequacy of visual cues before and after installation.*
- 15.8.1.13 Objects whose function requires them to be located within the TLOF (such as lighting or nets) shall not exceed a height of 2.5 cm. Such objects shall only be present if they do not represent a hazard to helicopters.
- 15.8.1.14 The surface of the TLOF shall be skid-resistant to both helicopters and persons.
- 15.8.1.15 Safety devices such as safety nets or safety shelves shall be located around the edge of a shipboard heliport, except where structural protection exists, but shall not exceed the height of the TLOF.
- 15.8.1.16 The specifications in paragraph 15.8.1.13 and 15.8.1.15 shall be applicable to shipboard heliports completed on or after 1 January 2012 and 1 January 2015 respectively.

Section 15.9 Obstacle Environment

Note:- The objectives of the specifications in this chapter are to describe the airspace around heliports so as to permit the intended helicopter operations to be conducted safely by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

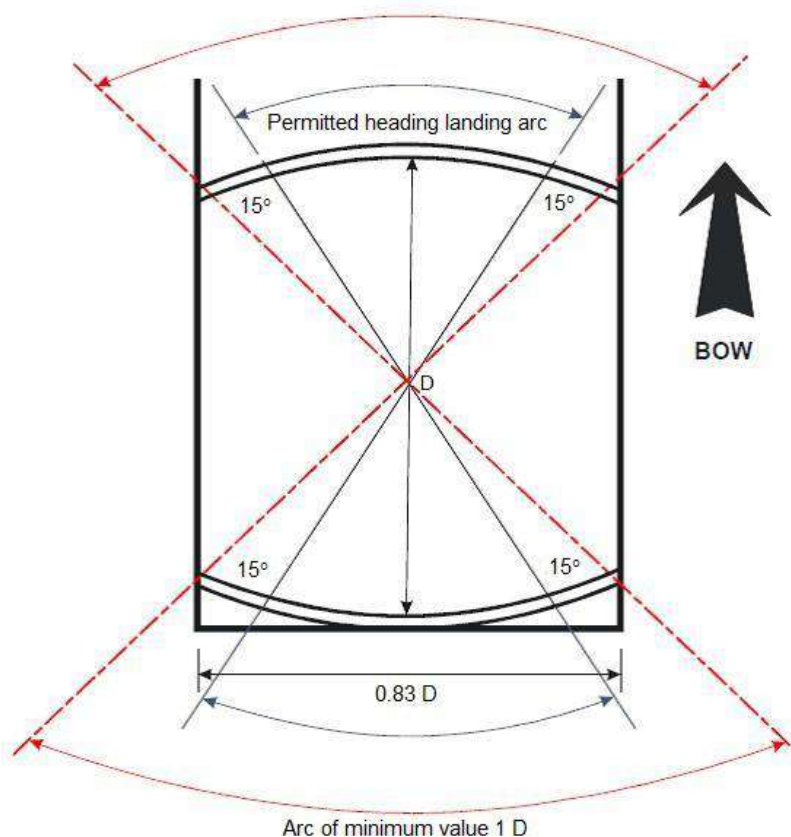


Figure 15 – 7. Shipboard permitted landing headings for limited heading operations

Section 15.10 Approach surface

15.10.1 Approach surface

15.10.1.1 The approach surface is an inclined plane or combination of planes or, when a turn is involved, a complex surface sloping upwards from the end of the safety area and centered on a line passing through the center of the FATO. (See MOS Figure 15-8).

Note: - See MOS Figures 15-8, 15-9, 15-10 and 15-11 for depiction of surfaces. See Table 15-3, for dimensions and slopes of surfaces.

15.10.1.2 The limits of an approach surface shall comprise:

- an inner edge horizontal and equal in length to the minimum specified width/diameter of the FATO plus the safety area, perpendicular to the centerline of the approach surface and located at the outer edge of the safety area;
- two sides originating at the ends of the inner edge diverging uniformly at a specified rate from the vertical plane containing the centerline of the FATO and;
- an outer edge horizontal and perpendicular to the centerline of the approach surface and to a specified height of 152 m (500 ft) above the elevation of the FATO.

- 15.10.1.3 The elevation of the inner edge shall be the elevation of the FATO at the point on the inner edge that is intersected by the centerline of the approach surface. For heliports intended to be used by helicopters operated in performance class 1 and when approved by an appropriate authority, the origin of the inclined plane must be raised directly above the FATO.
- 15.10.1.4 The slope(s) of the approach surface shall be measured in the vertical plane containing the centerline of the surface.
- 15.10.1.5 In the case of an approach surface involving a turn, the surface shall be a complex surface containing the horizontal normals to its centerline and the slope of the centerline shall be the same as that for a straight approach surface.
Note: - See MOS Figure 15-12 for curved approach and take-off climb surface for all FATOs.
- 15.10.1.6 In the case of an approach surface involving a turn, the surface shall not contain more than one curved portion.
- 15.10.1.7 Where a curved portion of an approach surface is provided the sum of the radius of arc defining the centerline of the approach surface and the length of the straight portion originating at the inner edge shall not be less than 575 m.
- 15.10.1.8 Any variation in the direction of the centerline of an approach surface shall be designed so as not to necessitate a turn radius less than 270 m.
Note: - For heliports intended to be used by helicopters operated in performance class 2 and 3, it is intended good practice for the that approach paths to be selected so as to permit safe forced landing or one-engine inoperative landings such that, as a minimum requirement, injury to persons on the ground or water or damage to property are minimized. The most critical helicopter type for which the heliport is intended and the ambient conditions may be factors in determining the suitability of such areas.
- 15.10.2 Transitional surface**
Note: - For a FATO at a heliport without a PinS approach incorporating a visual segment surface (VSS) there is no requirement to provide transitional surfaces.
- 15.10.2.1 The transitional is a complex surface along the side of the safety area and part of the side of the approach/take-off climb surface that slopes upwards and outwards to a pre-determined height of 45 m (150 ft.).
Note: - 1. See MOS Figure 15-10 Transitional Surfaces.
Note: - 2. See MOS Table 15-3 for dimensions and slopes of surfaces.
- 15.10.2.2 The limits of a transitional surface shall comprise:
- (a) a lower edge beginning of a point on the side of the approach/take-off climb surface at a specified height above the lower edge extending down the side of the approach/take-off climb surface and from there along the length of the side of the safety area parallel to the centerline of the FATO; and

- (b) an upper ledge located at a specified height above the lower edge as set out in MOS Table 15-3.

15.10.2.3 The elevation of a point on the lower edge shall be:

- (a) along the side of the approach /take-off climb surface equal to the elevation of the approach/takeoff climb surface at that point; and
- (b) along the safety area equal to the elevation of the inner edge of the approach/take-off climb surface.

Note: - 1. If the origin of the inclined plane of the approach/take-off climb surface is raised as approved by an appropriate authority, the elevation of the origin of the transitional surface will be raised accordingly.

Note: - 2. As a result of b) the transitional surface along the safety area will be curved if the profile of the FATO is curved, or a plane if the profile is a straight line.

15.10.2.4 The slope of the transitional surface shall be measured in the vertical plane at right angles to the centerline of the FATO.

15.10.3 Take-off climb surface

15.10.3.1 The take-off climb surface is an inclined plane, or a combination of planes, or, if a turn is involved, a complex surface, sloping upwards from the end of the safety area and centered on a line passing through the center of the FATO.

Note: - 1. See MOS Figures 15-8, 15-9, 15-10 and 15-11 for depiction of surfaces.

Note: - 2. See MOS Table 15-3 for dimensions and slopes of surfaces.

15.10.3.2 The limits of a take-off climb surface shall comprise:

- (a) an inner edge horizontal and equal in length to the minimum specified width/diameter of the FATO plus the safety area, perpendicular to the centerline of the take-off climb surface and located at the outer edge of the safety area;
- (b) two sides edges originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centerline of the FATO; and
- (c) an outer edge horizontal and perpendicular to the centerline of the take-off climb surface and at a specified height of 152 m (500 ft.) above the elevation of the FATO.

15.10.3.3 The elevation of the inner edge shall be the elevation of the FATO at the point on the inner edge that is intersected by the centerline of the take-off climb surface. For heliports intended to be used by helicopters operated in performance class 1 and when approved by an appropriate authority, the origin of the inclined plane must be raised directly above the FATO.

15.10.3.4 Where a clearway is provided the elevation of the inner edge of the take-off climb surface shall be located at the outer edge of the clearway at the highest point on the ground based on the centerline of the clearway.

15.10.3.5 In the case of a straight take-off climb surface the slope shall be measured in a vertical plane containing the centerline of the surface.

- 15.10.3.6 In the case of a take-off surface involving a turn, the surface shall be a complex one containing the horizontal normals to its centerline and the slope of the centerline shall be the same as that for a straight take-off climb surface.
- Note: - See Note of MOS 15.10.1.5.*
- 15.10.3.7 In the case of a take-off climb surface involving a turn, the surface shall not contain more than one curved portion.
- 15.10.3.8 Where a curved portion of a take-off climb surface is provided the sum of the radius of arc defining the centerline of the take-off climb surface and the length of the straight portion originating at the inner edge shall not be less than 575 m.
- 15.10.3.9 Any variation in the direction of the centerline of a take-off climb surface shall be designed so as not to necessitate a turn of radius less than 270 m.
- Note: - 1. Helicopter take-off performance is reduced in a curve and as such a straight portion along the take-off climb surface prior to the start of the curve allows for acceleration.*
- Note: - 2. For heliports intended to be used by helicopters operated in performance class 2 and 3 it is good practice for the departure paths to be selected so as to permit safe forced landings or one-engine-inoperative landings such that, as a minimum requirement, injury to persons on the ground or water or damage to property are minimized. The most critical helicopter type for which the heliport is intended and the ambient conditions may be factors in determining the suitability of such areas.*

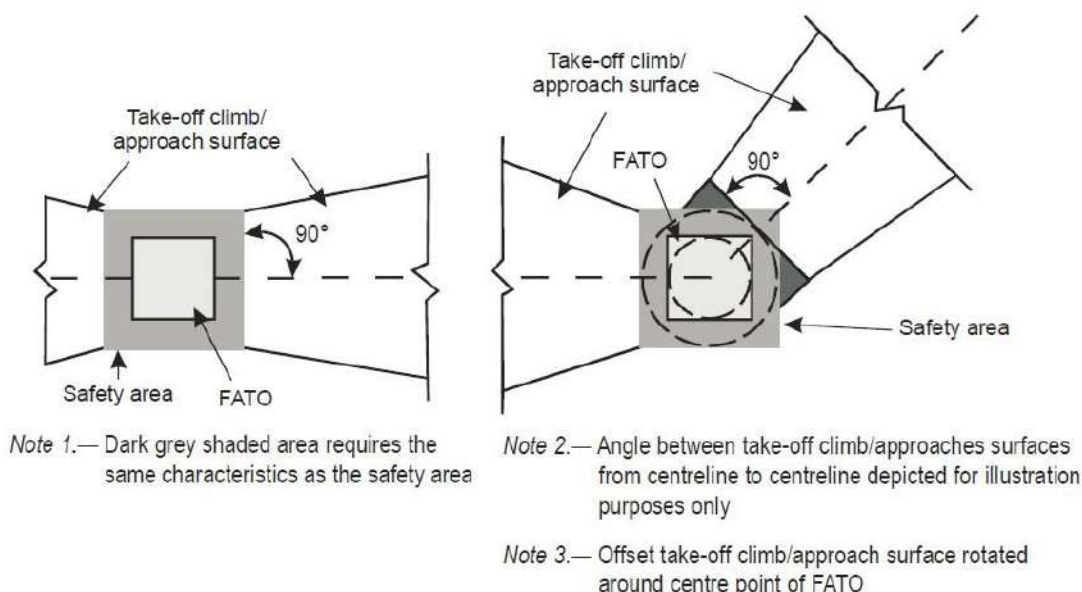


Figure 15-8. Obstacle limitation surfaces – Take-off climb and approach surface

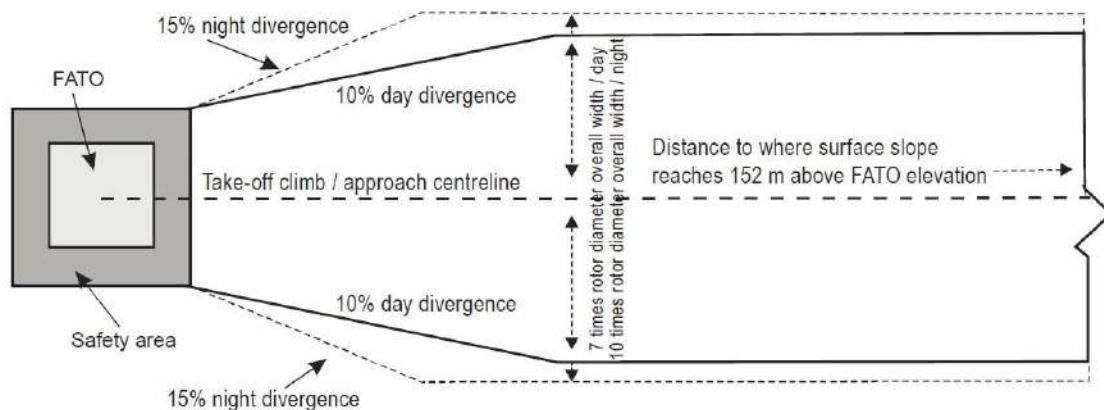
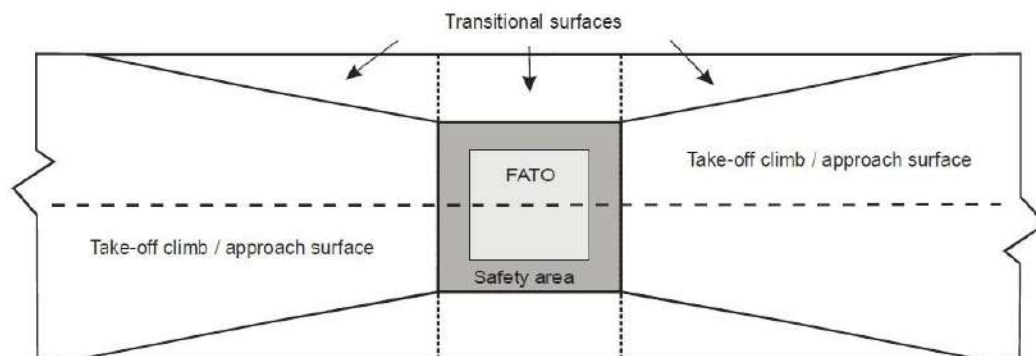


Figure 15-9. Take-off climb / Approach surface width



Note 1.— For single take-off climb / approach surface. Transition surface extends perpendicular to far side of Safety Area.

Note 2.— PANS-OPS, Doc 8168, Volume II, Part IV Helicopters, details procedure design criteria.

Note 3.— This figure shows a square FATO for illustration purposes only. For a circular FATO the transitional surface lower and upper edges would also be circular.

Figure 15-10. Transitional surface for a FATO with a PinS approach procedure with VSS

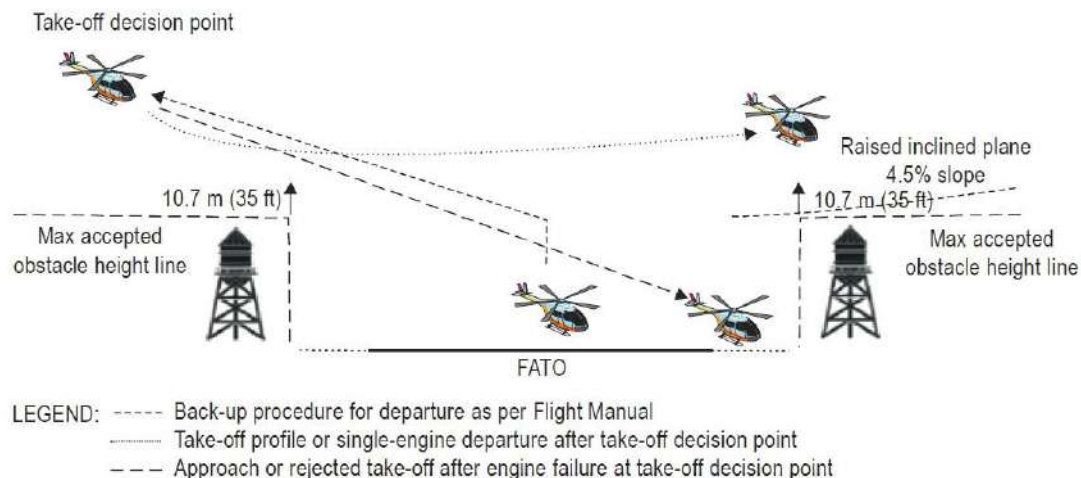
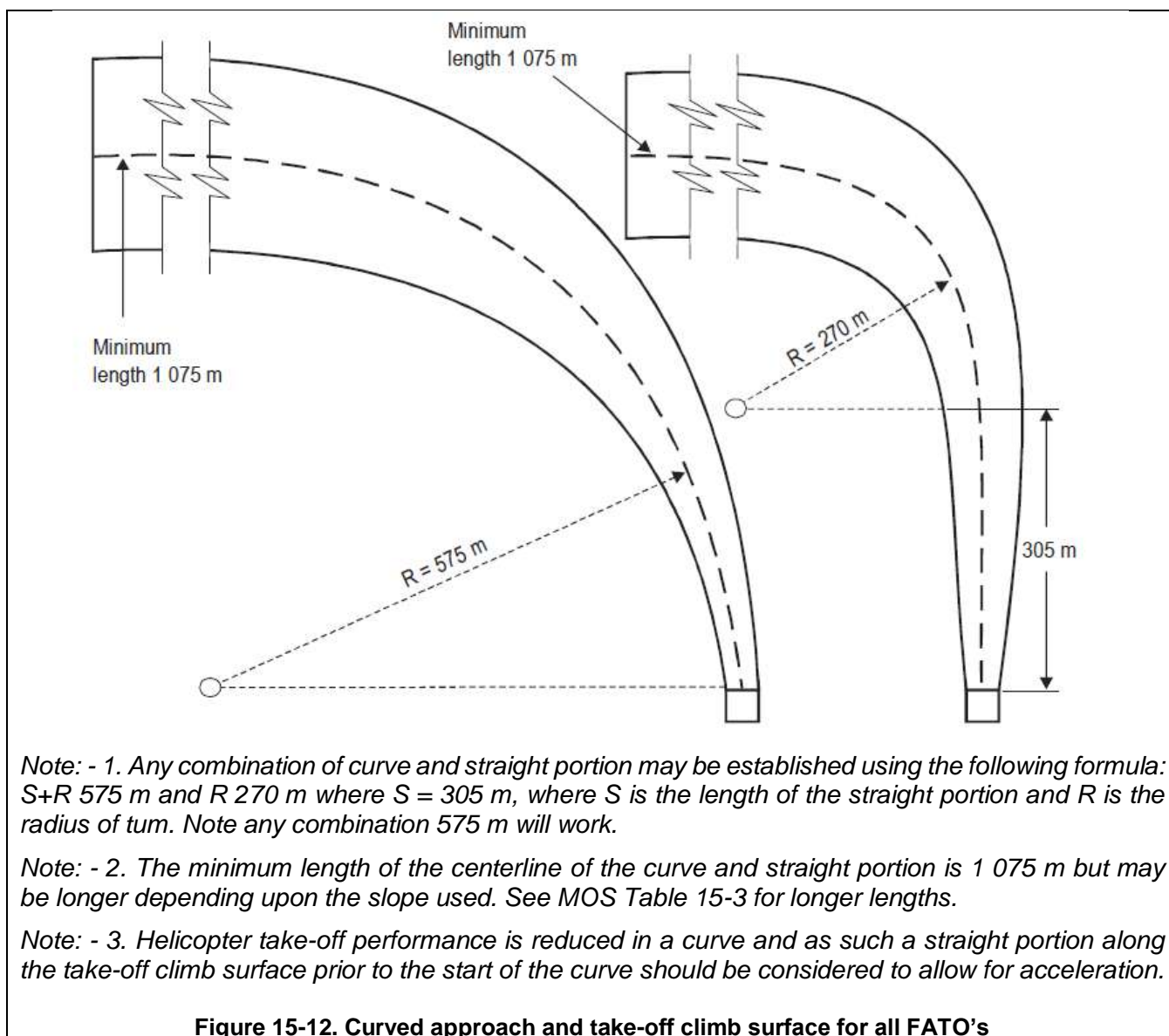


Figure 15-11. Example of raised inclined plane during operations in Performance Class 1

Note: 1. - This example diagram does not represent any specific profile, technique or helicopter type and is intended to show a generic example. An approach profile and a back-up procedure for departure profile are depicted. Specific manufacturers operations in performance class 1 may be represented differently in the specific Helicopter Flight Manual. PCARs, Part 8, provides back-up procedures that may be useful for operations in performance class 1.

Note: 2. - The approach landing profile may not be the reverse of the take-off profile.

Note: 3.- Additional obstacle assessment might be required in the area that a back-up procedure is intended. Helicopter performance and the Helicopter Flight Manual limitations will determine the extent of the assessment required.



SURFACE and DIMENSIONS	SLOPE DESIGN CATEGORIES		
	A	B	C
APPROACH and TAKE-OFF CLIMB SURFACE:			
Length of inner edge	Width of safety area	Width of safety area	Width of safety area
Location of inner edge	Safety area boundary (Clearway boundary if provided)	safety area boundary	Safety area boundary
Divergence: (1st & 2nd section)			
Day use only	10%	10%	10%
Night use	15%	15%	15%
First Section:			
Length	3386 m	245 m	1220 m
Slope	4.5% (1:2.22)	8% (1:12.5)	12.5% (1:8)
Outer Width	(b)	N/A	(b)
Second Section:			
Length	N/A	830 m	N/A
Slope	N/A	16% (1:6.25)	N/A
Outer width	N/A	(b)	N/A
Total length from inner edge (a)	3386 m	1075 m	1220 m
Transitional Surface: (FATOs with a PinS approach procedure with a VSS)			
Slope	50% (1:2)	50% (1:2)	50% (1:2)
Height	45 m	45 m	45 m

- (a) The approach and take-off climb surface lengths of 3386 m, 1075 m and 1220 m associated with the respective slopes, brings the helicopter to 152 m (500 ft) above FATO elevation.
- (b) Seven rotor diameters overall width for day operations or 10 rotor diameters overall width for night operations.

Note: - The slope design categories in MOS Table 15-3 may not be restricted to a specific performance class of operation and may be applicable to more than one performance class of operation. The slope design categories depicted in MOS Table 15- 3 represent minimum design slope angles and not operational slopes. Slope category "A" generally corresponds with helicopters operated in performance class 1; slope category "B" generally corresponds with helicopters operated in performance class 3; and slope category "C" generally corresponds with helicopters operated in performance class 2. Consultation with helicopter operators will help to determine the appropriate slope category to apply according to the heliport environment and the most critical helicopter type for which the heliport is intended.

Table 15 – 3. Dimensions and slopes of Obstacle limitation surfaces for all visual FATO's

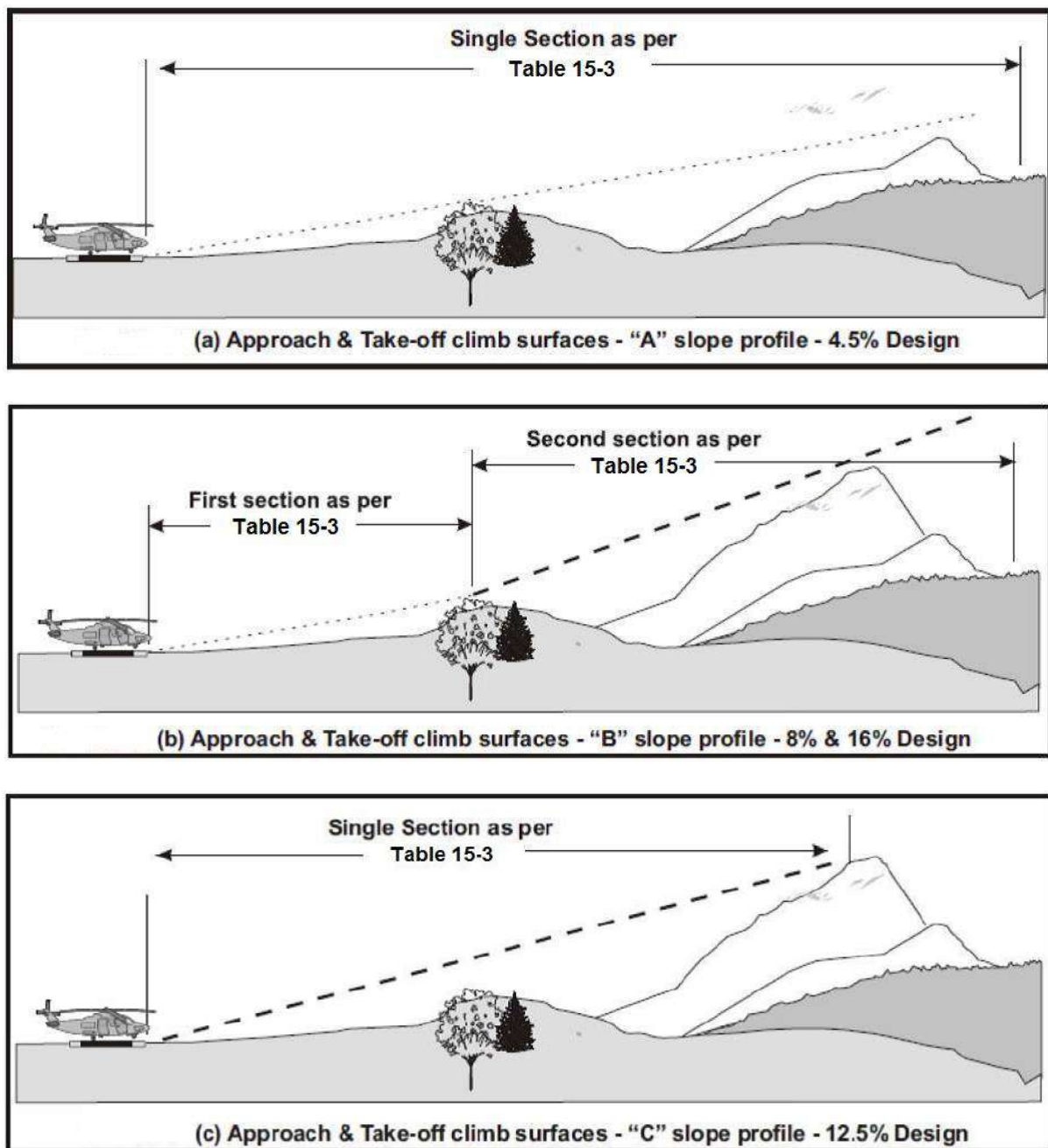


Figure 15-13. Approach and Take-off climb surfaces with different slope design categories

Section 15.11 Obstacle limitation surfaces and sectors - helidecks**15.11.1 Obstacle free sector/surface - helidecks**

15.11.1.1 This is a complex surface originating at and extending from a reference point on the edge of the FATO of a helideck. In the case of a TLOF of less than D, the reference point shall be located not less than $0.5D$ from the center of the TLOF.

15.11.1.2 An obstacle-free sector/surface shall subtend an arc of specified angle.

15.11.1.3 A helideck obstacle-free sector shall comprise two components, one above and one below the level of the helideck:

Note: - See MOS Figure 15-14 for helideck obstacle free sector.

- (a) above helideck level, the surface shall be a horizontal plane level with the elevation of the helideck surface and subtending an arc of at least 210° with the apex located on the periphery of the D reference circle and extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter the helideck is intended to serve; and
- (b) below helideck level within the minimum 210° arc, the surface shall additionally extend downward from the edge of the FATO below the elevation of the helideck surface to water level for an arc of not less than 180° that passes through the center of the FATO and outwards to a distance that will allow safe clearance from obstacles in the event of engine failure for the type of helicopter the helideck is intended to serve.

15.11.2 Limited obstacle sector/surface - helidecks

15.11.2.1 Where obstacles are, in the opinion of CAAP, necessarily located on a structure, a helideck may have a limited obstacle sector.

15.11.2.2 A limited obstacle surface is a complex surface originating at the reference point for the obstacle-free sector and extending over the arc not covered by the obstacle-free sector within which the height of obstacles above the level of the TLOF will be prescribed.

15.11.2.3 A limited obstacle sector shall not subtend an angle greater than 150° . Its dimensions and location shall be as indicated in MOS Figure 15-15. For a ID FATO with coincidental TLOF and MOS Figure 15-16 for a $0.83D$ TLOF.

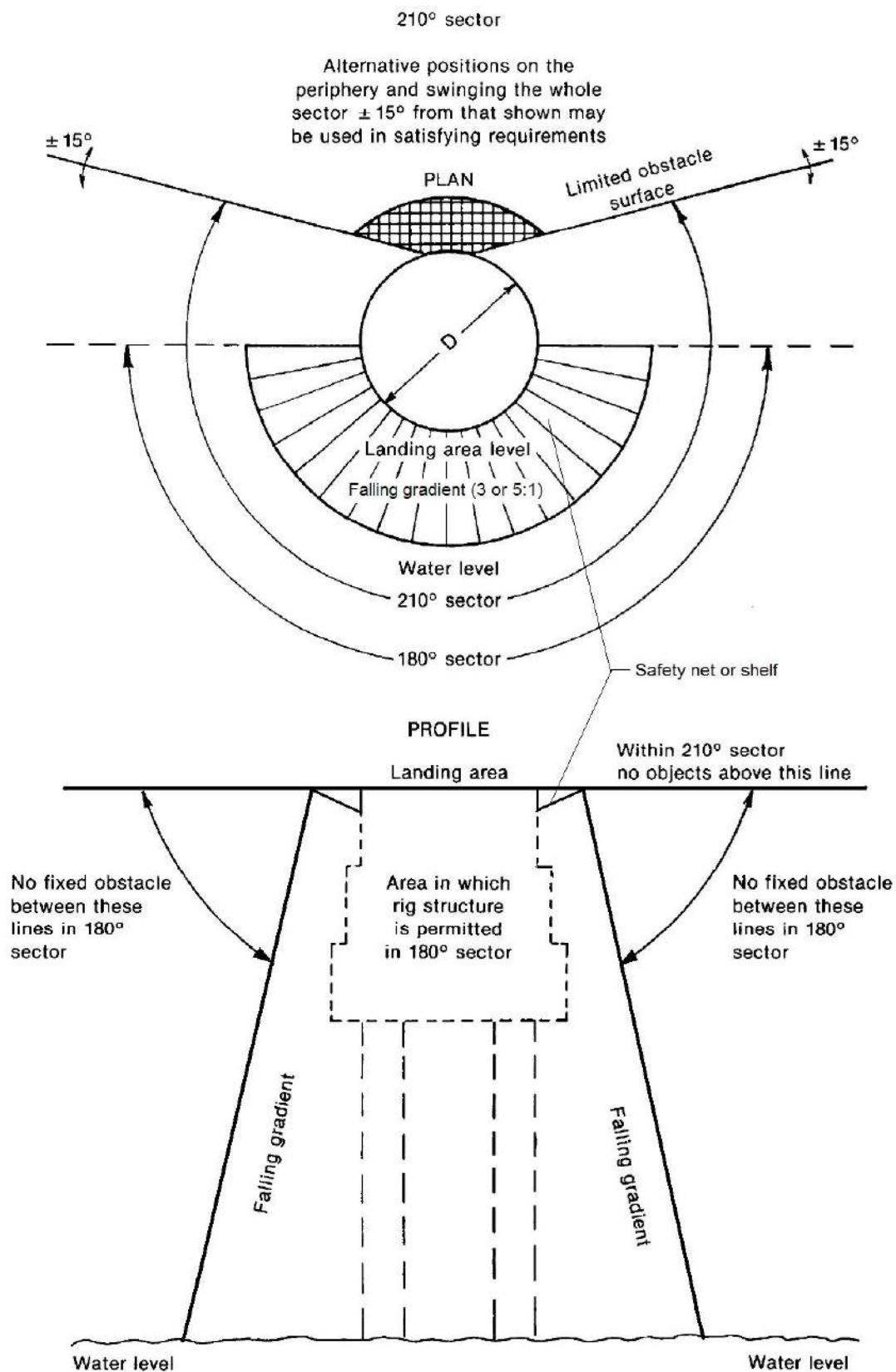


Figure 15-14. Helideck obstacle free sector

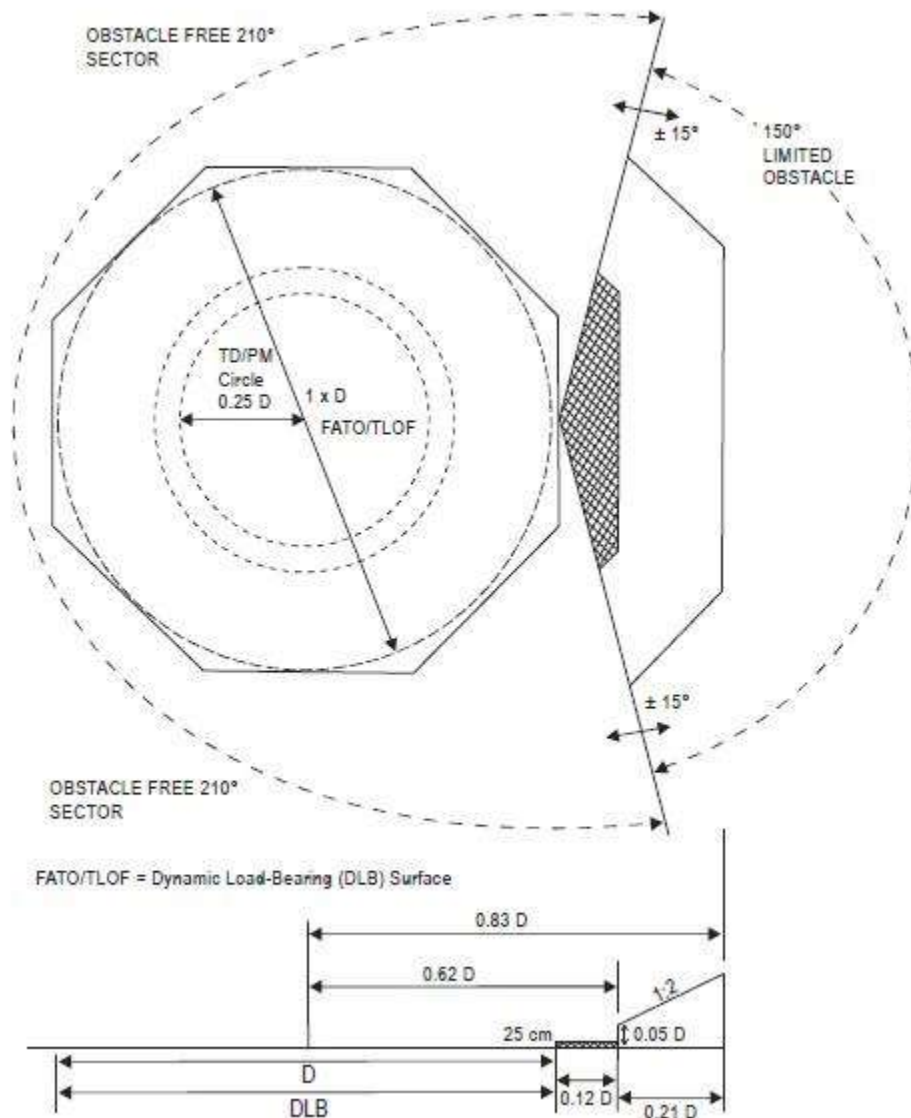


Figure 15-15. Helideck obstacle limitation sectors and surfaces for a FATO and coincidental TLOF of 1D and larger

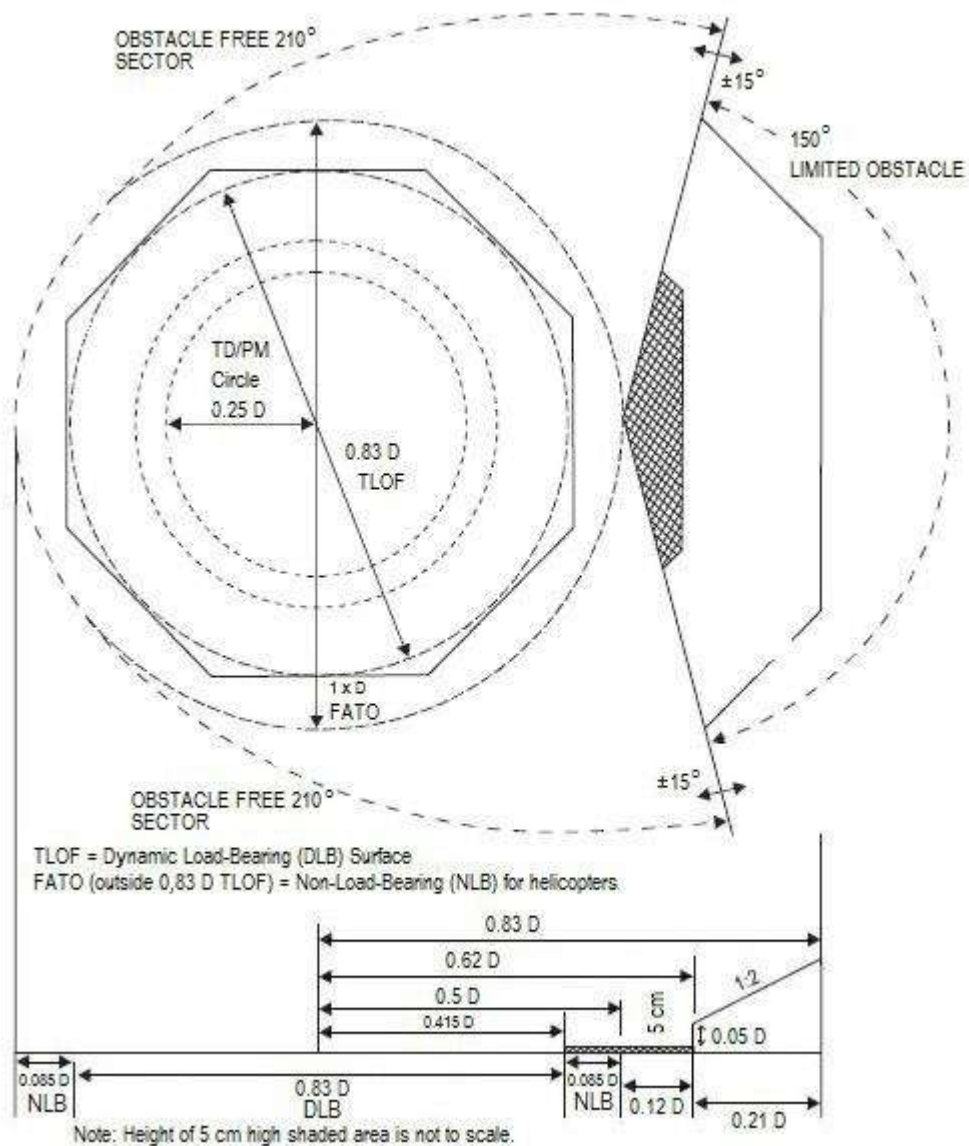


Figure 15-16. Helideck obstacle limitation sectors and surfaces for a TLOF of 0.83D and larger

Section 15.12 Obstacle limitation requirements

Note: 1. - The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a FATO, i.e. approach maneuver to hover or landing, or take-off maneuver and type of approach, and are intended to be applied when such use is made of the FATO. In cases where operations are conducted to or from both directions of a FATO, then the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

Note: 2. - Guidance on obstacle protection surfaces, for when a visual approach slope indicator (VASI) is installed, is given in the onshore Section of the Heliport Manual (Doc 9261).

15.12.1 Surface level heliports

15.12.1.1 The following obstacle limitation surfaces shall be established for a FATO: at heliports with a PinS approach procedure utilizing a visual segment surface:

- (a) take-off climb surface;
- (b) approach surface; and
- (c) transitional surfaces

Note: - 1. See MOS Figure 15-10 - Transitional Surfaces

Note: - 2. Doc 8168, Volume II, Part IV - Helicopters, details procedure design criteria.

15.12.1.2 The following obstacle limitation surfaces shall be established for a FATO at heliports, other than specified in MOS 15.15.11, including heliports with a PinS approach procedure where a visual segment surface is not provided:

- (a) take-off climb surface; and
- (b) approach surface

15.12.1.3 The slopes of the obstacle limitation surfaces shall not be greater than, and their other dimensions not less than, those specified in MOS Table 15-3 and shall be located as shown in MOS Figures 15-8 , 15-9 and 15-13.

15.12.1.4 For heliports that have an approach/take-off climb surface with a 4.5% slope design, objects shall be permitted to penetrate the obstacle limitation surface, if the results of an aeronautical study approved by an appropriate authority have reviewed the associated risks and mitigation measures.

Note: - 1. The identified objects may limit the heliport operation.

Note: - 2. PCARs Part 8 provides procedures that may be useful in determining the extent of obstacle penetration.

15.12.1.5 New objects or extensions of existing objects shall not be permitted above any of the surfaces mentioned in 15.12.1.1 to 15.12.1.2 except when shielded by an existing immovable object or after an aeronautical study approved by CAAP, determines that the object will not adversely affect the safety or significantly affect the regularity of operations of helicopter.

Note: - Circumstances in which the shielding principle may reasonably be

applied are described in the Airport Services Manual, Part 6.

- 15.12.1.6 Existing objects above any of the surfaces in 15.12.1.1 to 15.12.1.2 shall be removed except when, the object is shielded by an existing immovable object or after an aeronautical study approved by CAAP determines that the object will not adversely affect the safety or significantly affect the regularity of operations of helicopters.

Note: - The application of curved approach or take-off climb surfaces as specified in MOS 15.10.1.5 or 15.10.3.6 may alleviate the problems created by objects infringing these surfaces.

- 15.12.1.7 A surface level heliport shall have at least one take-off climb and approach surfaces. An aeronautical study shall be undertaken by an appropriate authority when only a single approach and take-off climb surface is provided considering as a minimum, the following factors:

- (a) the area/terrain over which the flight is being conducted;
- (b) the obstacle environment surrounding the heliport and the availability of at least one protected side slope;
- (c) the performance and operating limitations of helicopters intending to use the heliport; and
- (d) the local meteorological conditions including the prevailing winds.

- 15.12.1.8 A surface level heliport should have at least two approach and take-off climb surfaces to avoid downwind conditions, minimize crosswind conditions and permit for a balked landing.

Note: - See Heliport Manual (Doc 9261) for guidance.

- 15.12.1.9 Obstruction Marker Ball

- (a) For surface level which is in close proximity of the transmission line, obstruction marker balls of conspicuous color (e.g. orange, red or yellow) shall be installed in the transmission line.

Note: - See MOS 8.10.3.6 for Marking by markers.

15.12.2 Elevated heliports

- 15.12.2.1 The obstacle limitation surfaces for elevated heliports shall conform to the requirements for surface level heliports specified in 15.12.1.1. to 15.12.1.6.

- 15.12.2.2 An elevated heliport shall have at least one approach and take-off climb surface. An aeronautical study shall be undertaken by an appropriate authority when only a single approach and take-off climb surface is provided considering as a minimum, the following factors:

- (a) the area/terrain over which the flight is being conducted;
- (b) the obstacle environment surrounding the heliport and the availability of at least one protected side slope;
- (c) the performance and operating limitations of helicopters intending to use the

heliport; and

- (d) the local meteorological conditions including the prevailing winds

Note: - An elevated heliport shall have at least two approach and take-off climb surfaces to avoid downwind conditions, minimize crosswind conditions and permit for a balked landing. See Heliport Manual (Doc 9261) for guidance.

- 15.12.2.3 For obstruction marker ball requirements for elevated helipad, see MOS 8.10.3.6.

15.12.3 Helidecks

- 15.12.3.1 A helideck shall have an obstacle-free sector.

Note: - A helideck may have a limited obstacle sector (See MOS 15.11.2.2).

- 15.12.3.2 There shall not be any fixed obstacle within the obstacle-free sector above the obstacle free surface.

- 15.12.3.3 At helidecks, obstacle protection for helicopters shall be provided below the level of the heliport. The protection shall extend over an arc of at least 180° with the origin at the center of the FATO and a descending gradient having a ratio of one unit horizontally to five units vertically from the edges of the FATO within the 180° sector. The descending gradient may be reduced to a ratio of 1:3 within the 180° sector for multi-engine helicopters operated in performance class 1 or 2.

Note: - Where there is a requirement to position, at sea surface level, one or more offshore support vessel(s) (e.g. a Standby Vessel) essential to the operation of a fixed or floating offshore facility, but located within the proximity of the fixed or floating offshore facility, any offshore support vessel(s) would need to be positioned so as not to compromise the safety of helicopter operations during take-off departure and/or approach to landing.

- 15.12.3.4 For a TLOF of 1D and larger, within the 150° limited obstacle surface/sector out to a distance of 12D measured from the point of origin of the limited obstacle sector, objects shall not exceed a height of 25 cm above the TLOF. Beyond that arc, out to an overall distance of a further 0.21D measured from the end of the first sector, the limited obstacle surface rises at a rate of one unit vertically for each two units horizontally. Originating at a height 0.05D above the level of the TLOF (See MOS Figure 15-15).

Note: - Where the area enclosed by the TLOF perimeter marking, is a shape other than circular, the extent of the LOS segments are represented as lines parallel to the perimeter of the TLOF rather than arcs. MOS Figure 15-15 has been constructed on the assumption that an octagonal helideck arrangement is provided. Further guidance for square (quadrilateral) and circular FATO and TLOF arrangements is given in the Heliport Manual (Doc 9261).

- 15.12.3.5 For a TLOF less than 1D, within the 150° limited obstacle surface/sector out to a distance of 0.62D and commencing from a distance 0.5D, both measured from the center of the TLOF, objects shall not exceed a height of 5 cm above the TLOF.

Beyond that arc, out to an overall distance of $0.83D$ from the center of the TLOF, the limited obstacle surface rises at a rate of one unit vertically for each two units horizontally originating at a height $0.05D$ above the level of the TLOF (See MOS Figure 15-16).

Note: - Where the area enclosed by the TLOF perimeter marking, is a shape other than circular, the extent of the LOS segments are represented as lines parallel to the perimeter of the TLOF rather than arcs. Figure 15-16 has been constructed on the assumption that an octagonal helideck arrangement is provided. Further guidance for square (quadrilateral) and circular FATO and TLOF arrangements is given in the Heliport Manual (Doc 9261).

15.12.4 Shipboard heliports

The specification in paragraphs 15.12.4.2 (b) and 15.12.4.3 (a) shall be applicable for shipboard heliports completed on or after 1 January 2012.

15.12.4.1 Purpose built heliports located forward of aft

- (a) When helicopter operating areas are provided in the bow or stern of a ship they shall conform to the obstacle criteria given for helidecks.

15.12.4.2 A midships location – purpose built and non-purpose built

- (a) Forward and aft of the TLOF of $1D$ and larger shall be two symmetrically located sectors, each covering an arc of 150° , with their apexes on the periphery of the TLOF. Within the area enclosed by these two sectors there shall be no objects rising above the level of the TLOF, excepting those aids essential for the safe operation of a helicopter and then only to a maximum height of 25cm .
- (b) Objects whose function requires them to be located within the TLOF (such as lighting or nets) shall not exceed a height of 2.5 cm . Such objects shall only be present if they do not represent a hazard to helicopters.

Note: - Examples of potential hazards include nets or raised fittings on the deck that might induce dynamic rollover for helicopters equipped with skids.

- (c) To provide further protection from obstacles fore and aft of the TLOF, rising surfaces with a gradient of one unit vertically to five units horizontally shall extend from the entire length of the edges of the two 150° sectors. These surfaces shall extend for a horizontal distance of at least $1 D$ of the largest helicopter the TLOF is intended to serve and shall not be penetrated by any obstacle. (See MOS Figure 15-17).

15.12.4.3 Ship's side location – Non- purpose built

- (a) No objects shall be located within the TLOF except those aids essential for the safe operation of a helicopter (such as nets or lighting) and then only up to a maximum height of 2.5 cm . Such objects shall only be present if they do not represent a hazard to helicopters.
- (b) From the fore and aft midpoints of the D circle, in two segments outside the circle, limited obstacle areas shall extend to the ship's rail to a fore and aft distance of 1.5 times the diameter fore-to-aft-dimension of the TLOF, located

symmetrically about the athwartships bisector of the D circle. Within these areas there shall be no objects rising above a maximum height of 25 cm above the level of the TLOF (See MOS Figure 15-18). Such objects shall only be present if they do not represent a hazard to helicopters.

- (c) A limited obstacle sector horizontal surface shall be provided, at least 0.25 D beyond the diameter of the D circle, which shall surround the inboard sides of the TLOF to the fore and aft mid-points of the D circle. The limited obstacle sector shall continue to the ship's rail to a fore and aft distance of 2.0 times the fore-to-aft dimension of the TLOF, located symmetrically about the athwartships bisector of the D circle. Within this sector there shall be no objects rising above a maximum height of 25cm above the level of the TLOF.

Note: - Any objects located within the areas described in 15.12.4.3 (b) and 15.12.4.3 (c) that exceed the height of the TLOF are notified to the helicopter operator using a ship's helicopter landing area plan.

For notification purposes it may be necessary to consider immovable objects beyond the limit of the surface prescribed in 15.12.4.3 (c) particularly if objects are significantly higher than 25 cm and in close proximity to the boundary of the Limited Obstacle Sector. See Heliport Manual (Doc 9261) for guidance.

15.12.4.4

Winching areas

- (a) An area on board a ship designated as a winching area shall be comprised of a circular clear zone of 5 m diameter and, extending from the perimeter of the clear zone, a concentric maneuvering zone of 2D diameter. (See MOS Figure 15-19).
- (b) The maneuvering zone shall be comprised of two areas, being:
 - (i) the inner maneuvering zone, extending from the perimeter of the clear zone and of a circular diameter not less than 1.5 D; and
 - (ii) the outer maneuvering zone extending from the perimeter of the inner maneuvering zone and of circular diameter not less than 2D.
- (c) Within the clear zone of a designated winching area, no objects shall be located above the level of its surface.
- (d) Objects located within the inner maneuvering zone of a designated winching area shall not exceed a height of 3 m.
- (e) Objects located within the outer maneuvering zone of a designated winching area shall not exceed a height of 6 m.

Note: - See Heliport Manual (Doc 9261) for guidance.

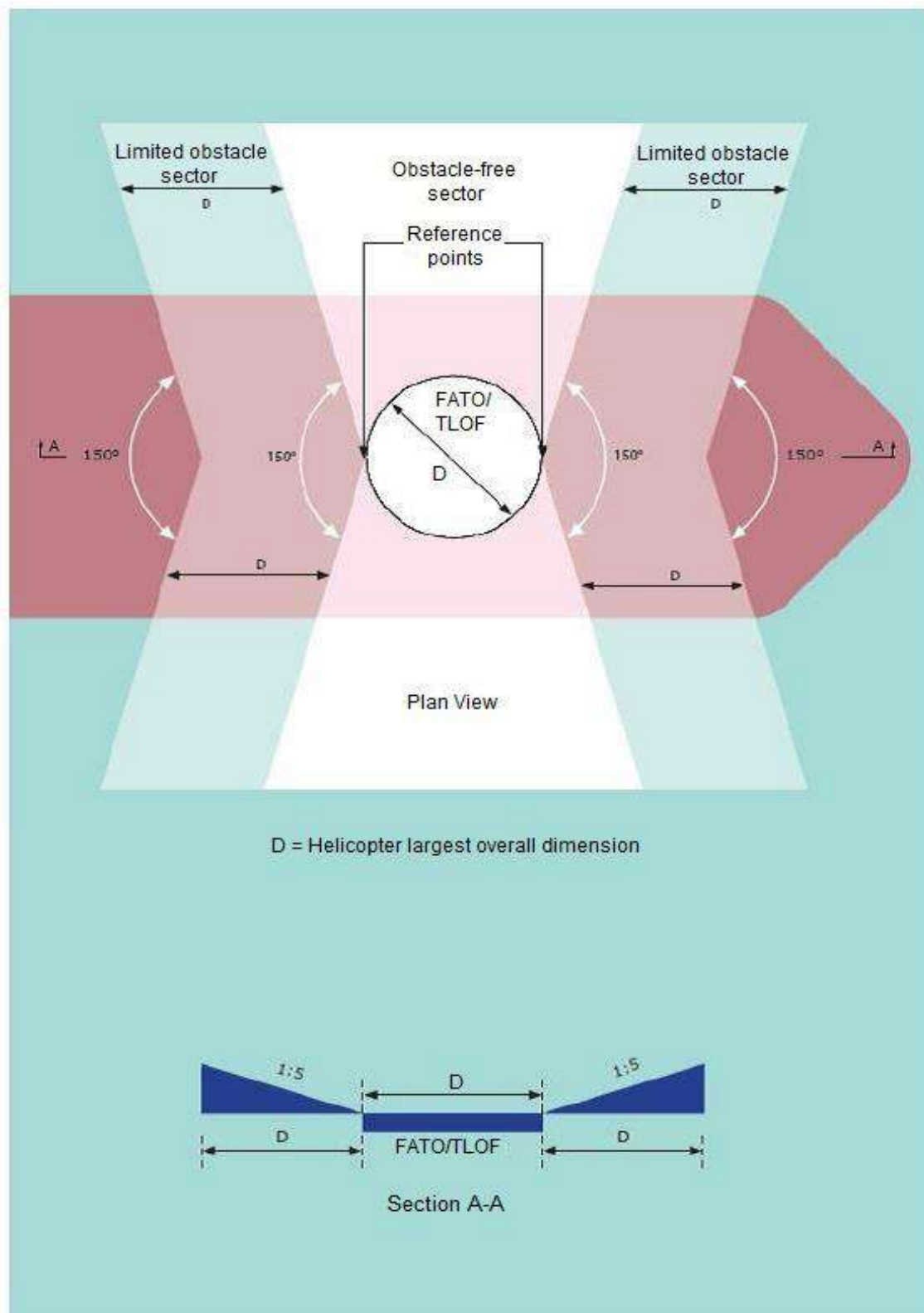


Figure 15-17. Amidship's location – Shipboard heliport obstacle limitation surfaces

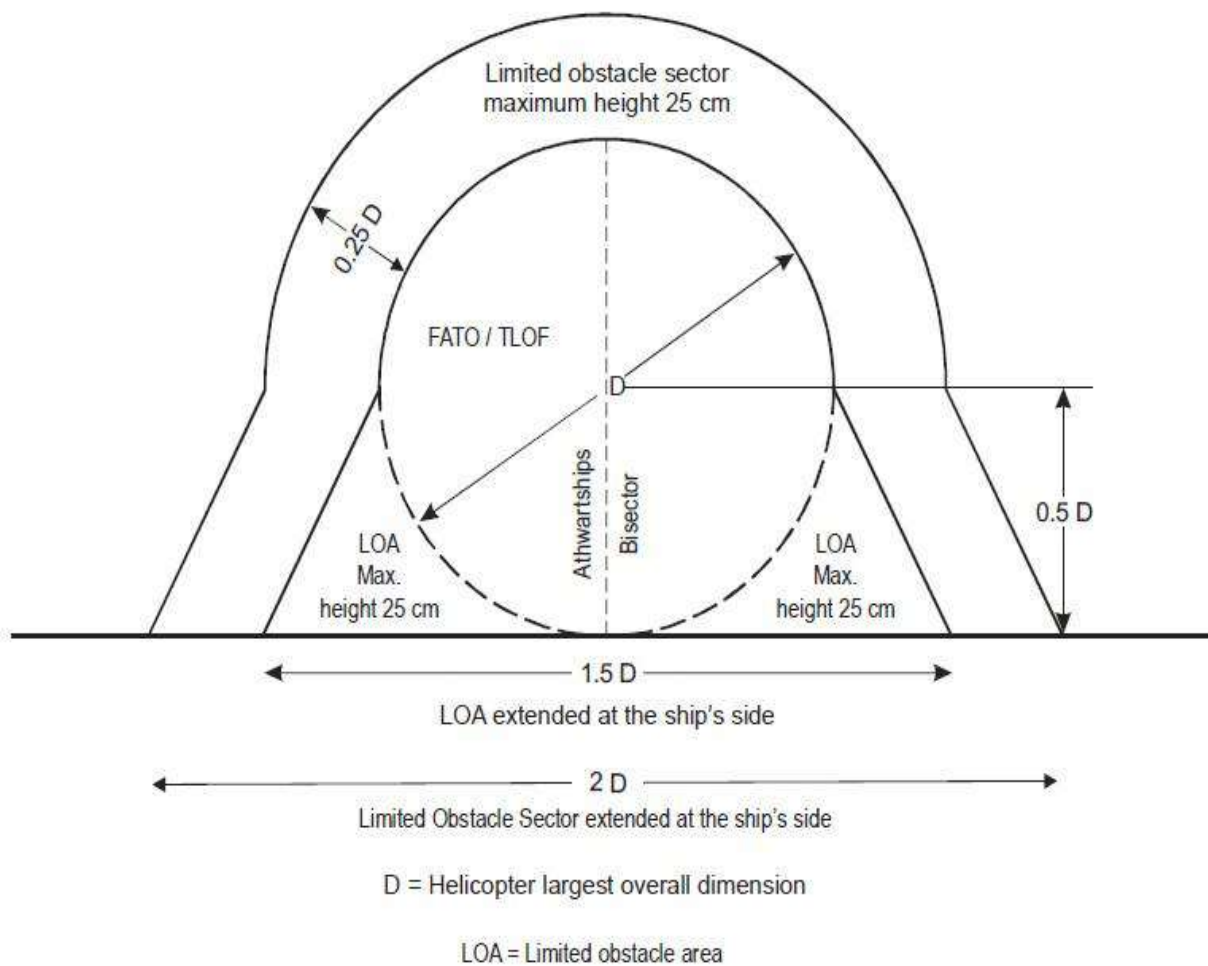


Figure 15-18. Ship-side non – purpose – built heliport obstacle limitation sectors and surfaces

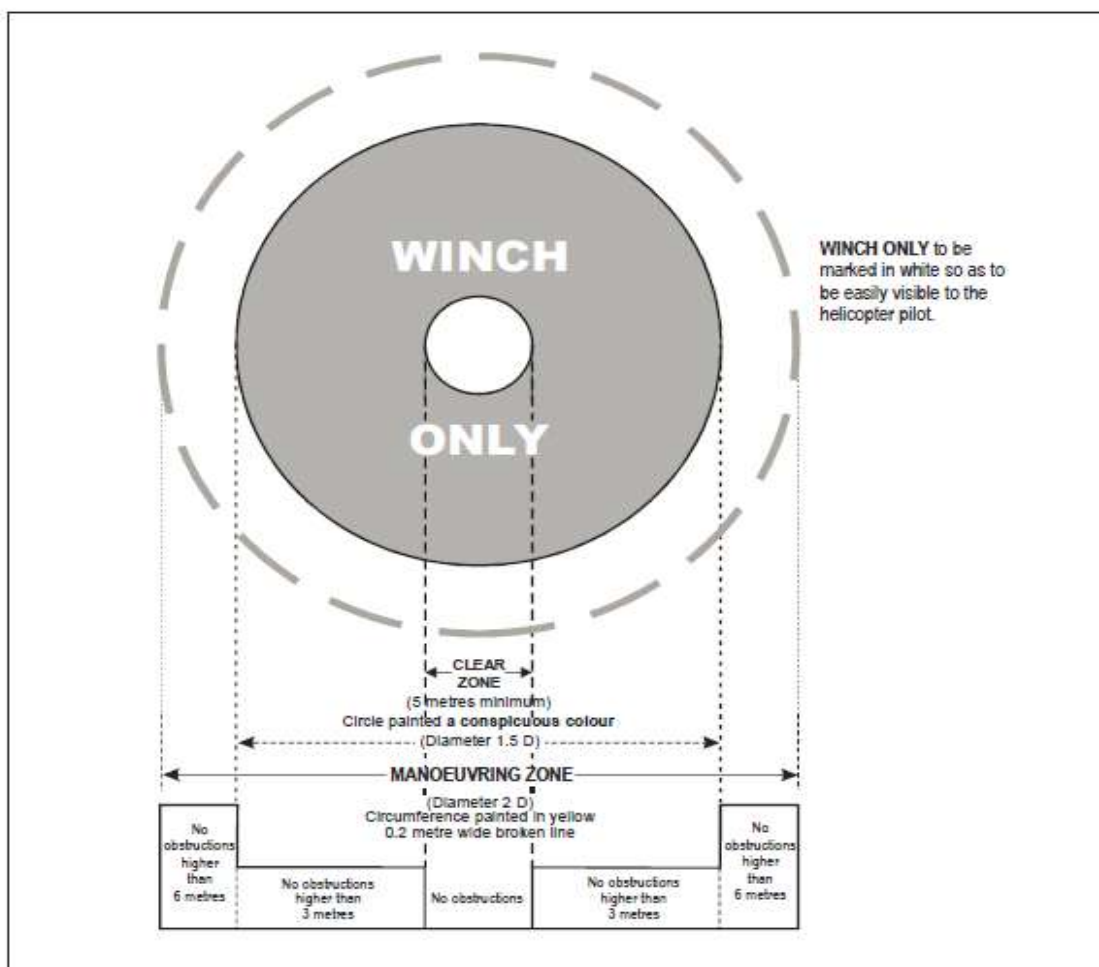


Figure 15 - 19. Winching Area of a Ship

Section 15.13 Visual aids, markings and markers

Note 1.- The procedures used by some helicopters require that they utilise a FATO having characteristics similar in shape to a runway for fixed wing aircraft. For the purpose of this chapter a FATO having characteristics similar in shape to a runway is considered as satisfying the concept for a "runway-type FATO". For such arrangements it is sometimes necessary to provide specific markings to enable a pilot to distinguish a runway-type FATO during an approach. Appropriate markings are contained within subsections entitled "Runway-type FATOs". The requirements applicable to all other types of FATOs are given within sub-sections entitled "All FATOs except runway-type FATOs."

Note 2. - It has been found that, on surfaces of light color, the conspicuity of white and yellow markings can be improved by outlining them in black.

Note 3 .- Guidance is given in the Heliport Manual (Doc.9261) on marking the maximum allowable mass (MOS Section 15.13.4) and the D-value (MOS Section 15.13.5) on the heliport surface to avoid confusion between markings where metric units are used and markings where imperial units are used.

Note 4. - For a non-purpose built heliport located on a ship's side the surface color of the main deck can vary from ship to ship and therefore some discretion may need to be exercised in the color selection of heliport paint schemes; the objective being to ensure that the markings are conspicuous against the surface of the ship and the operating background.

Note: - 5. See MOS Section 8.3.1.1, Note 1, concerning improving conspicuity of markings.

15.13.1 Wind direction indicators

15.13.1.1 A heliport shall be equipped with at least one wind direction indicator.

15.13.1.2 A wind direction indicator shall be located so as to indicate the wind conditions over the FATO and TLOF and in such a way as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash. It shall be visible from a helicopter in flight, in a hover or on the movement area.

15.13.1.3 Where a TLOF and/or FATO may be subject to a disturbed airflow, then additional wind direction indicators located close to the area shall be provided to indicate the surface wind on the area.

Note: - Guidance on the location of wind direction indicators is given in the Heliport Manual (Doc 9261).

15.13.1.4 A wind direction indicator shall be constructed so that it gives a clear indication of the direction of the wind and a general indication of the wind speed.

15.13.1.5 An indicator should shall be a truncated cone made of lightweight fabric and should have the following minimum dimensions:

	Surface level heliports	Elevated heliports and helidecks
Length	2.4.m	1.2 m
Diameter	0.6 m	0.3 m (larger end)
Diameter	0.3 m	0.15 m (smaller end)

15.13.1.6 The color of the wind direction indicator shall be so selected as to make it clearly visible and understandable from a height of at least 200 m (650 ft) above the heliport, having regard to background. Where practicable, a single color, white or orange, shall be used. Where a combination of two colors is required to give adequate conspicuity against changing backgrounds, they must be orange and white, red and white, or black and white, and should be arranged in five alternate bands the first and last band being the darker color.

15.13.1.7 A wind direction indicator at a heliport intended for use at night shall be illuminated.

15.13.2 Winching area marking

Note: - The objective of the winching area markings is to provide visual cues which assist a helicopter to be positioned over, and retained within, an area from which a passenger or equipment can be lowered or raised.

- 15.13.2.1 Winching area markings shall be provided at a designated winching area (See Figure 15-19). A winching area marking shall be located so that its center coincides with the center of the clear zone of the winching area.
- 15.13.2.2 Winching area markings shall comprise of a winching area clear zone marking and a winching area maneuvering zone marking.
- 15.13.2.3 A winching area clear zone marking shall consist of a solid circle of diameter not less than 5 m and of a conspicuous color.
- 15.13.2.4 A winching maneuvering zone marking shall consist of a broken circle line of 30 cm in width and of a diameter not less than 2D, and shall be marked in a conspicuous color. Within it "WINCH ONLY" shall be marked to be easily visible to the pilot.

15.13.3 Heliport identification marking

- 15.13.3.1 A heliport identification marking shall be provided at a heliport.

Location – All FATOs except runway-type FATOs

- 15.13.3.2 A heliport identification marking shall be located at or near the center of the FATO.

Note: - 1. The objective of a heliport identification marking is to provide to the pilot an indication of the presence of a heliport and, by its form, likely usage; the preferred direction(s) of approach; or the FATO orientation within the helideck obstacle environment.

Note: - 2. For other than helidecks, the preferred direction(s) of approach corresponds to the median of the departure/arrival surface(s).

Note: - 3. For helidecks, the bar of the "H" points to the center of the Limited Obstacle Sector.

Note: - 4. If the Touchdown/positioning marking is offset, the heliport identification marking is established in the center of the Touchdown/positioning marking.

Note: - 5. On a FATO, which does not contain a TLOF and which is marked with an aiming point marking (See MOS -15.13.8), the heliport identification marking is established in the center of the aiming point marking as shown in MOS Figures 15-20 and 15-20A.

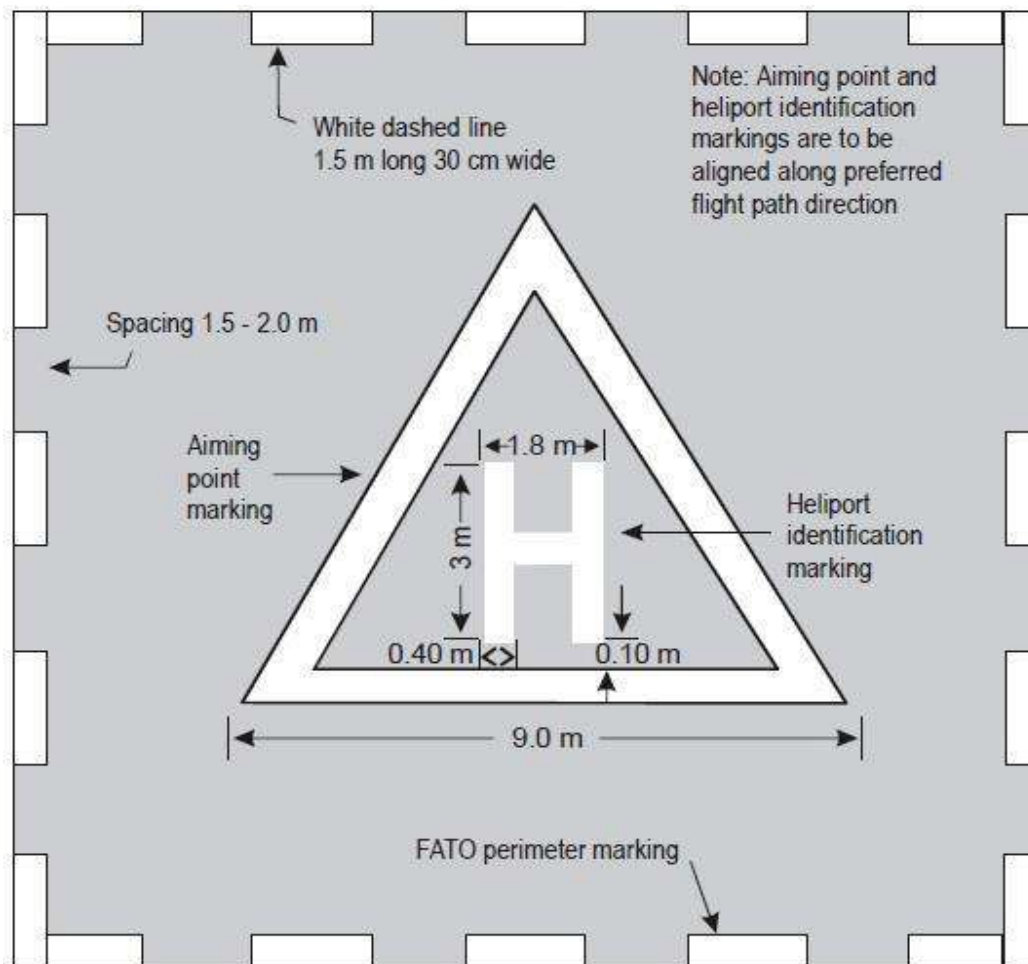
- 15.13.3.3 On a FATO which contains a TLOF, a heliport identification marking shall be located in the FATO so the position of it coincides with the center of the TLOF.

15.13.3.4 Location – Runway-type FATOs

- (a) A heliport identification marking shall be located in the FATO and when used in conjunction with FATO designation markings, shall be displayed at each end of the FATO as shown in MOS Figure 15-21.
- (b) A heliport identification marking, except for a heliport at a hospital, shall consist of a letter H, white in color. The dimensions of the marking shall be no less than those shown in MOS Figure 15-22 and where the marking is used for a runway-type FATO, its dimensions shall be increased by a factor of 3 as

shown in MOS Figure 15-21.

- (c) A heliport identification marking for a heliport at a hospital shall consist of a letter H, red in color, on a white cross made of squares adjacent to each of the sides of a square containing the H as shown in MOS Figure 15-22.
- (d) A heliport identification marking shall be oriented with the cross arm of the H at right angles to the preferred final approach direction. For a helideck the cross arm shall be on or parallel to the bisector of the obstacle-free sector. For a non-purpose built shipboard heliport located on a ship's side the cross arm shall be parallel with the side of the ship.
- (e) On a helideck or a shipboard heliport where the D value is 16.0 m or larger, the size of the heliport identification "H" marking shall have a height of 4 m with an overall width not exceeding 3 m and a stroke width not exceeding 0.75 m. Where the D value is less than 16.0 m, the size of the heliport identification H marking shall have a height of 3 m with an overall width not exceeding 2.25 m and a stroke width not exceeding 0.5 m.



Note: - The aiming point, heliport identification and FATO perimeter markings are white and may be edged with a 10 cm black border to improve contrast.

Figure 15-20. Combined heliport identification, aiming point and FATO perimeter marking

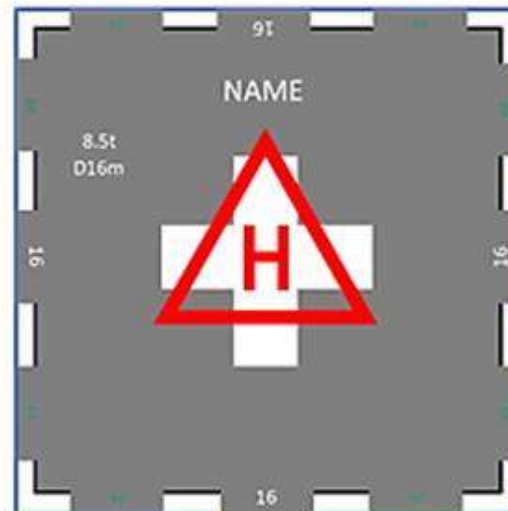
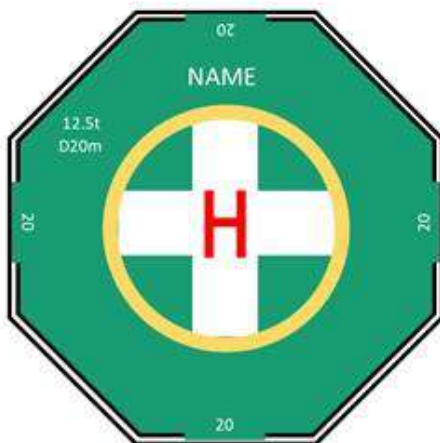
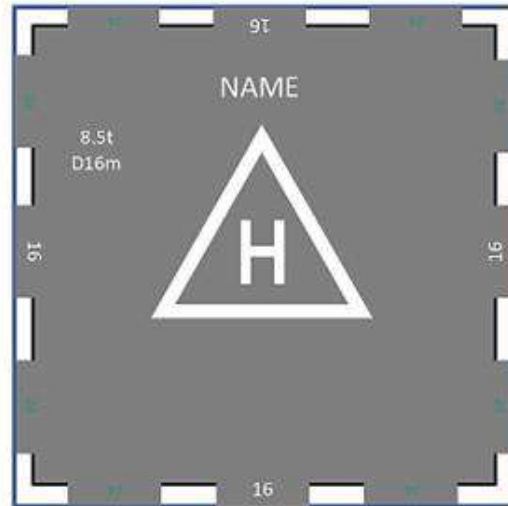
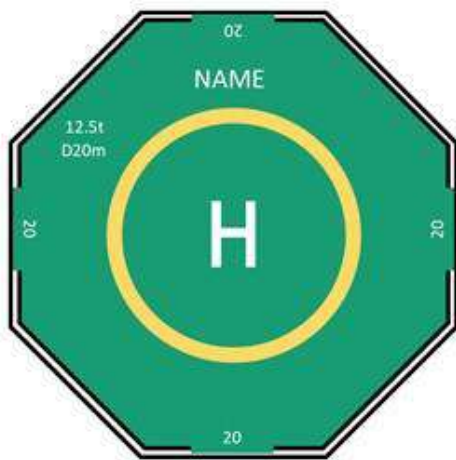


Figure 15–20A Heliport identification markings with TLOF and aiming markings for heliport and hospital heliport



Figure 15-21. FATO designation marking and heliport identification marking for a runway-type FATO

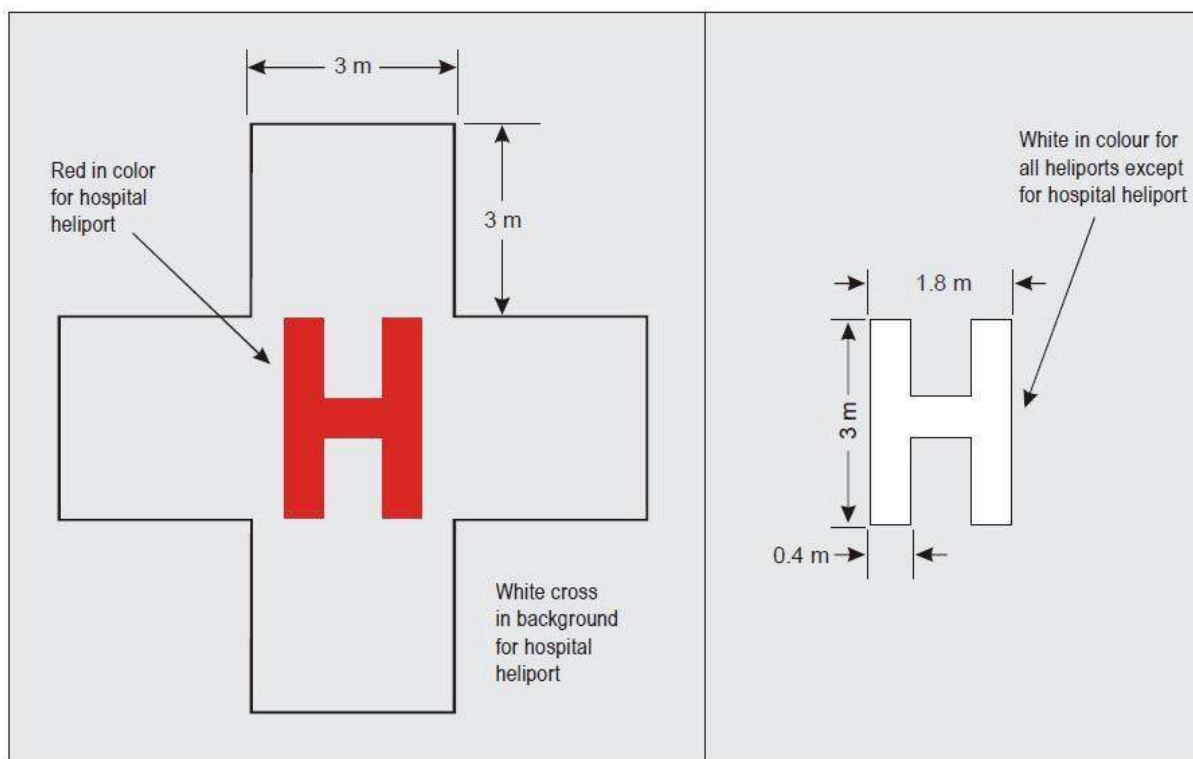


Figure 15-22. Hospital heliport identification and heliport identification marking

15.13.4 Maximum allowable mass marking

Note: - The objective of the maximum allowable mass marking is to provide the mass limitation of the heliport such that it is visible to the pilot from the preferred final approach direction.

15.13.4.1 A maximum allowable mass marking shall:

- be displayed at an elevated heliport, and at a helideck and a shipboard heliport.
- shall be displayed at a surface level heliport.
- be located within the TLOF or FATO and so arranged as to be readable from the preferred final approach direction.
- consist of a one, two or three digit number. The marking shall be expressed in tons (1000 kg) rounded to the nearest 1000 kg followed by the letter "t".
- be expressed to the nearest 100 kg. The marking shall be presented to one decimal place and rounded to the nearest 100 kg followed by the letter "t". When the maximum allowable mass is expressed to 100 kg, the decimal place shall be preceded with a decimal point marked with a 30 cm square.

15.13.4.2 All FATOs except runway-type FATOs

- The numbers and letter of the marking shall have a color contrasting with the background and be in the form and proportion shown in MOS Figure 15-23, for a *D-value* of more than 30 m. For a *D-value* between 15 m to 30 m the height of the numbers and the letter of the marking shall be a minimum of 90 cm, and for a *D-value* of less than 15 m the height of the numbers and

the letter of the marking shall be a minimum of 60 cm, each with a proportional reduction in width and thickness.

15.13.4.3 Runway-type FATOs

- (a) The numbers and the letter of the marking shall have a color contrasting with the background and shall be in the form and proportion shown in MOS Figure 15-23.

15.13.5 D-value marking

Note: - The objective of the D-value marking is to provide to the pilot the "D" of the largest helicopter that can be accommodated on the heliport. This value may differ in size from the FATO and the TLOF provided in compliance with MOS 15.5 - 15.8.

15.13.5.1 All FATOs except runway-type FATOs

- (a) The D-value shall be displayed at a helideck and at a shipboard heliport. It shall be located within the FATO and be arranged so as to be readable from the preferred final approach direction.

15.13.5.2 Runway-type FATOs

Note: - The D-value is not required to be marked on a heliport with a runway-type FATO.

- (a) The D-value marking shall:
 - (i) be displayed at surface-level and elevated heliports
 - (ii) be located within the TLOF or FATO and so arranged as to be readable from the preferred final approach direction.
 - (iii) be white in color and be rounded to the nearest whole meter or foot with 0.5 rounded down.
- (b) Where there is more than one approach direction, additional D-value markings should be provided such that at least one D-value marking is readable from the final approach directions. For a non-purpose heliport located on a ship's side, D value markings should be provided on the perimeter of the D circle at the 2 o'clock, 10 o'clock and 12 o'clock positions when viewed from the side of the ship facing towards the centerline.
- (c) The numbers of the marking should have a color contrasting with the background and should be in the form and proportion shown in MOS Figure 15-23 D-Value of more than 30 m. For D-Value with a dimension of between 15 m to 30 m the height of the numbers of the marking should be a minimum of 90 cm, and for a D-Value of less than 15 m the height of the numbers of the marking should be a minimum of 60 cm, each with a proportional reduction in width and thickness.

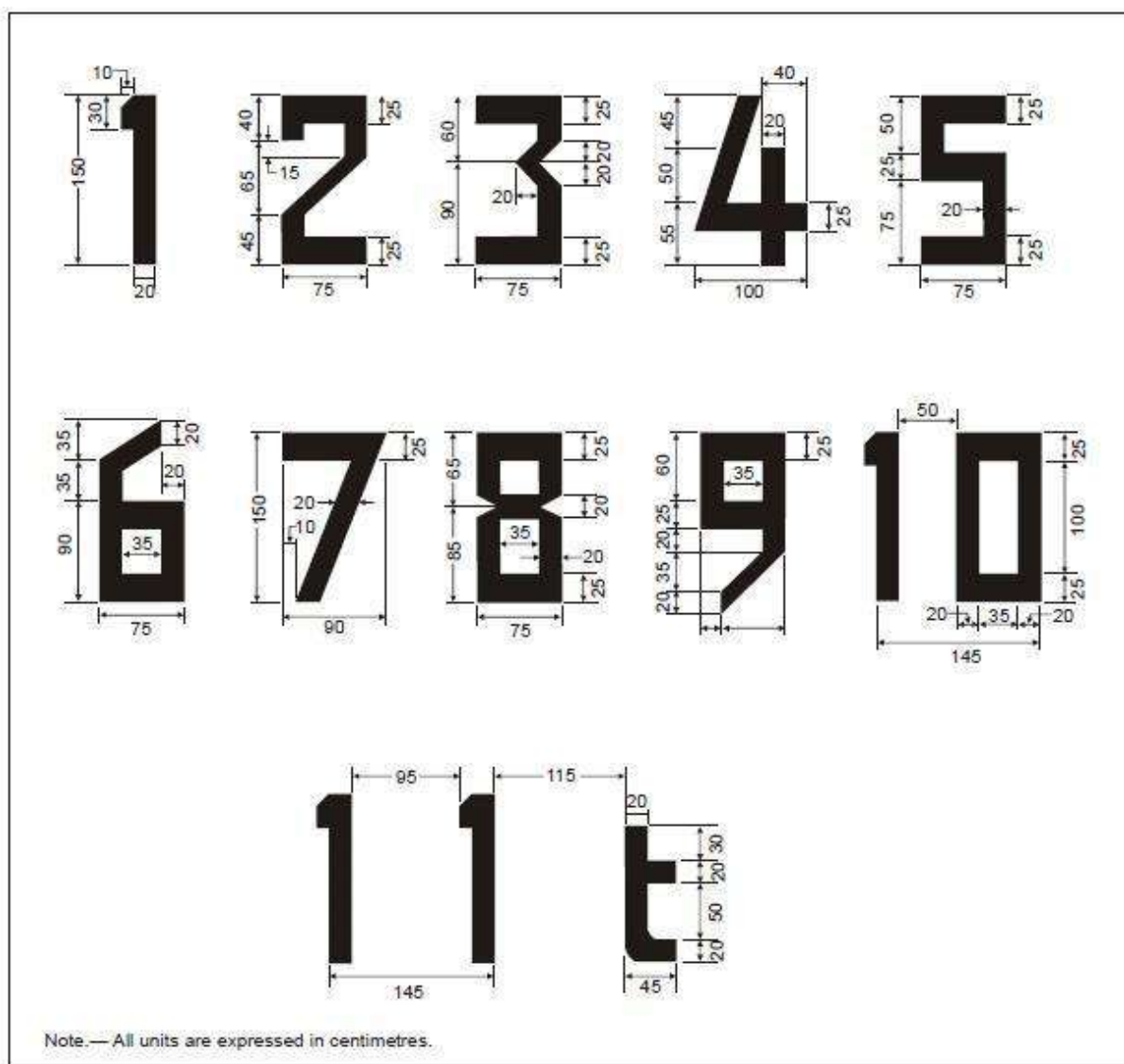


Figure 15-23 Form and proportions of numbers and letters

15.13.6 Final approach and take-off area perimeter marking or markers for surface level heliports

Note: - The objective of final approach and take-off area perimeter marking, or markers, is to provide to the pilot, where the perimeter of the FATO is not self-evident, an indication of the area that is free of obstacles and in which intended procedures, or permitted manoeuvring, may take place.

15.13.6.1 FATO perimeter marking or markers shall:

- (a) be provided at a surface level heliport on ground where the extent of a final approach and take-off area with a solid surface is not self-evident.
- (b) be located on the edge of the final approach and take-off area.

15.13.6.2 Runway-type FATOs

- (a) The perimeter of the FATO shall:
 - (i) be defined with marking or markers spaced at equal intervals of not more than 50 m with at least three markings or markers on each side including a marking or marker at each corner.
 - (ii) be a rectangular stripe with a length of 9 m, or one-fifth of the side of the final approach and take-off area which it defines, and a width of 1 m.
 - (iii) FATO perimeter marking shall be white in color.
- (b) FATO perimeter markers shall:
 - (i) shall have dimensional characteristics as shown in MOS Figure 15-24.
 - (ii) shall be of color(s) that contrast effectively against the operating background.
 - (iii) should be a single color, orange or red, or two contrasting colors, orange and white or alternatively red and white shall be used except where such colors would merge with the background.

15.13.6.3 All FATOs except runway-type FATOs

- (a) For an unpaved FATO the perimeter shall be defined with flush in-ground markers. The FATO perimeter markers shall be 30 cm in width, 1.5 m in length, and with end-to-end spacing of not less than 1.5 m and not more than 2 m. The corners of a square or rectangular FATO shall be defined.
- (b) For a paved FATO the perimeter shall be defined with a dashed line. The FATO perimeter marking segments shall be 30 cm in width, 1.5 m in length, and with end-to-end spacing of not less than 1.5 m and not more than 2 m. The corners of the square or rectangular FATO shall be defined.
- (c) FATO perimeter markings and flush in-ground markers shall be white.

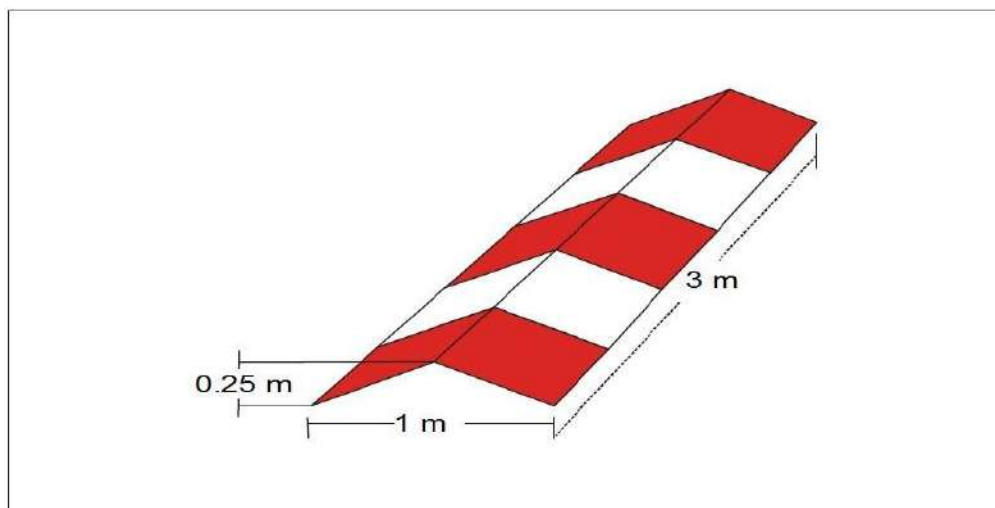


Figure 15-24. Runway-type FATO edge marker

15.13.7 Final approach and take-off area designation markings for runway –type FATOs

Note: - The objective of final approach and take-off area designation markings for runway-type FATOs is to provide to the pilot an indication of the magnetic heading of the runway.

15.13.7.1 A FATO designation marking shall be provided at a heliport where it is necessary to designate the FATO to the pilot.

15.13.7.2 A FATO designation marking shall be located at the beginning of the FATO as shown in MOS Figure 15-21.

15.13.7.3 A FATO designation marking shall consist of a two-digit number. The two-digit number shall be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach. When the above rule would give a single digit number, it shall be a zero. The marking shown in MOS Figure 15-21 shall be supplemented by the heliport identification marking.

15.13.8 Aiming point marking

Note: - The objective of the aiming point marking is to provide a visual cue indicating to the pilot the preferred approach/departure direction; the point to which the helicopter approaches to the hover before positioning to a stand where a touchdown can be made; and that the surface of the FATO is not intended for touchdown.

15.13.8.1 An aiming point marking should be provided at a heliport where it is necessary for a pilot to make an approach to a particular point above a FATO before proceeding to a TLOF.

15.13.8.2 Runway-type FATOs

(a) The aiming point marking shall be located within the final approach and take-off area.

15.13.8.3 All FATOs except runway-type FATOs

(a) The aiming point marking shall be located at the center of the FATO as shown in MOS Figure 15-20.

(b) The aiming point marking shall be an equilateral triangle with the bisector of one of the angles aligned with the preferred approach direction. The marking shall consist of continuous lines, providing a contrast with the background colour, and the dimensions of the marking shall conform to those shown in Figure 15-25.

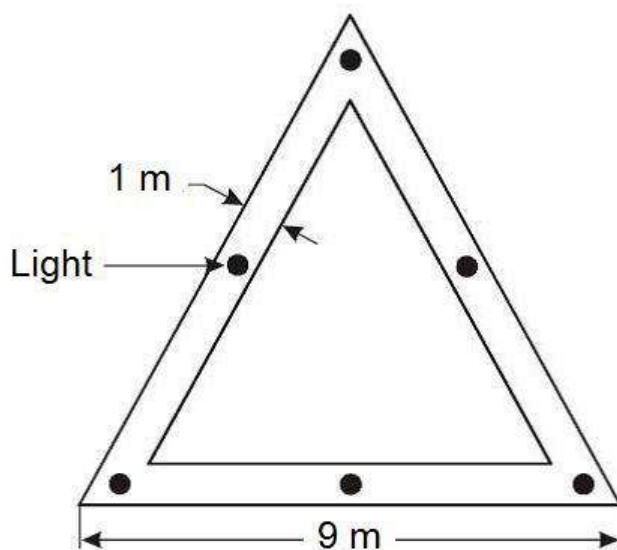


Figure 15-25 Aiming point marking

15.13.9 Touchdown and lift-off area perimeter marking

Note: - The objective of the touchdown and lift-off area perimeter marking is to provide to the pilot an indication of an area that is free of obstacles; has dynamic load bearing; and in which, when positioned in accordance with the TDPM, undercarriage containment is assured.

15.13.9.1 A TLOF perimeter marking shall:

- (a) be displayed on a TLOF located in a FATO at a surface level heliport if the perimeter of the TLOF is not self-evident.
- (b) be displayed on an elevated heliport, a helideck and a shipboard heliport.
- (c) be located along the perimeter edge of the TLOF.
- (d) consist of a continuous white line with a width of at least 30 cm.

15.13.10 Touchdown/positioning marking

Note: - The objective of a touchdown/positioning marking (TDPM) is to provide visual cues which permit a helicopter to be placed in a specific position such that, when the pilot's seat is above the marking, the undercarriage is within the load-bearing area and all parts of the helicopter will be clear of any obstacles by a safe margin.

15.13.10.1 A touchdown/positioning marking shall be provided for a helicopter to touch down or be accurately placed in a specific position.

15.13.10.2 The touchdown/positioning marking shall be:

- (a) when there is no limitation on the direction of touchdown/positioning, a touchdown/positioning circle (TDPC) marking; and
- (b) when there is a limitation on the direction of touchdown/positioning:

- (i) for unidirectional applications, a shoulder line with an associated centerline; or
 - (ii) for multidirectional applications, a TDPC marking with prohibited landing sector(s) marked.
- 15.13.10.3 The inner edge/inner circumference of the touchdown/positioning marking shall be at a distance of $0.25 D$ from the center of the area in which the helicopter is to be positioned.
- 15.13.10.4 On a helideck, the center of the TDPC marking shall be located at the center of the FATO, except that the marking may be offset away from the origin of the obstacle-free sector by no more than $0.1 D$ where an aeronautical study indicates such offsetting is necessary and would not impair safety.
- 15.13.10.5 Prohibited landing sector markings, when provided, shall be located on the touchdown/positioning marking, within the relevant headings, and extend to the inner edge of the TLOF perimeter marking.
- 15.13.10.6 The inner diameter of the TDPC shall be $0.5 D$ of the largest helicopter the area is intended to serve.
- 15.13.10.7 A touchdown/positioning marking shall have a line width of at least 0.5 m. For a helideck and a purpose-built shipboard heliport, the line width shall be at least 1 m.
- 15.13.10.8 The length of a shoulder line shall be $0.5D$ of the largest helicopter the area is intended to serve.
- 15.13.10.9 The prohibited landing sector markings, when provided, shall be indicated by white and red hatched markings as shown in Figure 15-26.
- 15.13.10.10 The TDPM shall take precedent when used in conjunction with other markings on the TLOF except for the prohibited landing sector marking.

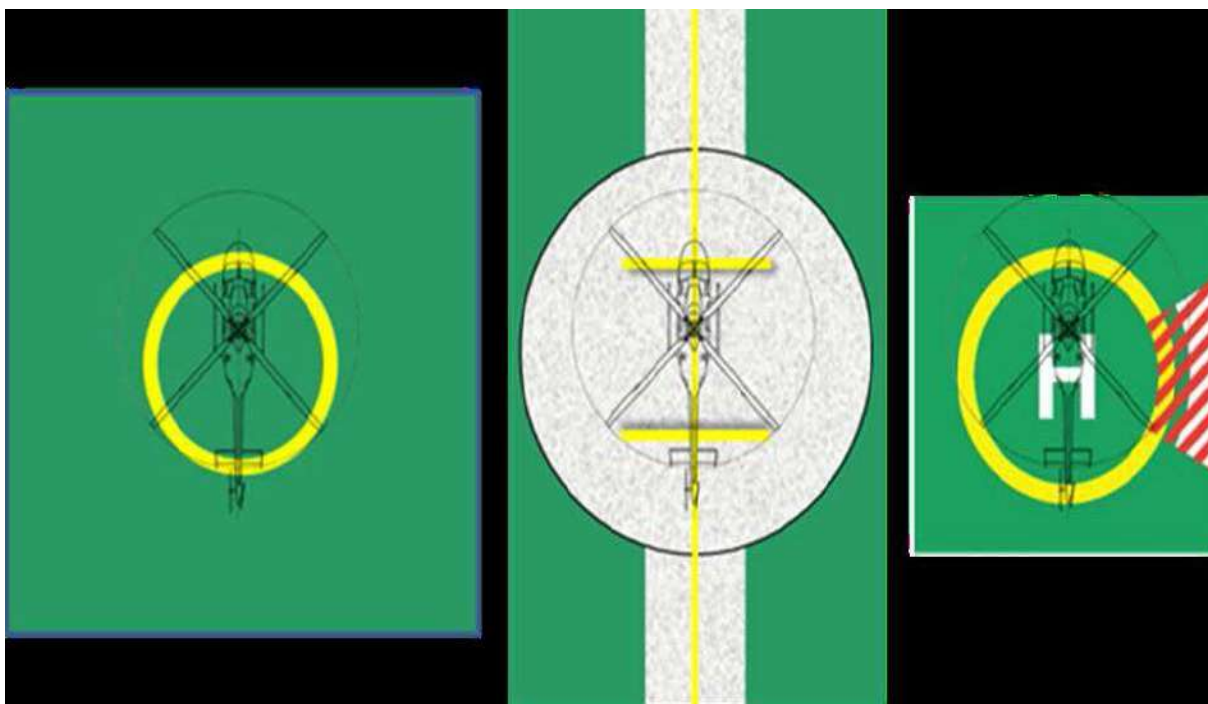


Figure 15-26 (Left) multidirectional TDPC with no limitations. (Center) unidirectional marking shoulder line with associated centerline. (Right) multidirectional TDPC with prohibited landing sector marking

Note: - The prohibited landing sector (PLS) marking, when provided, is not intended to move the helicopter away from objects around the FATO, but to ensure that the tail is not placed in an orientation that might constitute a hazard. This is achieved by having the helicopter nose clear of the hatched markings during the touchdown.

15.13.11 Heliport name marking

Note: - The objective of a heliport name marking is to provide to the pilot a means of identifying a heliport which can be seen, and read, from all directions of approach.

15.13.11.1 A heliport name marking:

- (a) shall be provided at a heliport and helideck where there is insufficient alternative means of visual identification.
- (b) Where a *limited* obstacle sector (LOS) exists on a helideck the marking should be located on the obstacle side of the "heliport identification marking". For a non-purpose built heliport located on a ship's side the marking shall be located on the inboard side of the heliport identification marking in the area between the TLOF perimeter marking and the boundary of the LOS.
- (c) shall consist of the name or the alphanumeric designator of the heliport as used in the radio (R/T) communications.
- (d) should be illuminated, either internally or externally when intended for use at night or during conditions of poor visibility.

15.13.11.2 Runway-type FATOs

- (a) The characters of the marking shall be not less than 3 m in height.

- 15.13.11.3 All FATOs except runway-type FATOs
- (a) The characters of the marking shall be not less than 1.5 m in height at surface level heliports and not less than 1.2 m on elevated heliports, helidecks and shipboard heliports. The color of the marking should contrast with the background and preferably be white.
- 15.13.12 Helideck obstacle-free sector (chevron) marking**
- Note: - The objective of the helideck obstacle-free sector (chevron) marking is to indicate the direction and limits of a sector that is free of obstacles above the level of the helideck for the preferred approach and departure directions.*
- 15.13.12.1 A helideck with adjacent obstacles that penetrate above the level of the helideck shall have an obstacle free sector marking.
- 15.13.12.2 A helideck obstacle-free sector marking shall:
- (a) be located where practicable, at a distance from the center of the TLOF equal to the radius of the largest circle that can be drawn in the TLOF or 0.5D, whichever is greater.
- Note: - Where the Point of Origin is outside the TLOF, and it is not practicable to physically paint the chevron, the chevron is relocated to the TLOF perimeter on the bisector of the OFS. In this case the distance and direction of displacement, along with the attention getting "WARNING DISPLACED CHEVRON", with the distance and direction of displacement, is marked in a box beneath the chevron in black characters not less than 10cm high – an example Figure is given in the Heliport Manual.*
- (b) indicate the location of the obstacle free sector and the directions of the limits of the sector.
- Note: - Example figures are given in the Heliport Manual (Doc 9261).*
- 15.13.12.3 The height of the chevron shall not be less than 30 cm.
- 15.13.12.4 The chevron shall be marked in a conspicuous color.
- 15.13.12.5 The color of the chevron shall be black.
- 15.13.13 Helideck and shipboard heliport surface marking**
- Note: - The objective of the helideck and shipboard heliport surface marking is to provide, by colour and conspicuity, the location of the TLOF on a helideck or shipboard heliport.*
- 15.13.13.1 A surface marking shall be provided to assist the pilot to identify the location of the helideck or shipboard heliport during an approach by day.
- 15.13.13.2 A surface marking shall be applied to the dynamic load bearing area bounded by the TLOF perimeter marking.
- 15.13.13.3 The helideck or shipboard heliport surface bounded by the TLOF perimeter

marking shall be of dark green using a high friction coating.

Note: - Where the application of a surface coating may have a degrading effect on friction qualities the surface might not be painted. In such cases the best operating practice to enhance the conspicuity of markings is to outline deck markings with a contrasting color.

15.13.14 Helicopter ground taxiway markings and markers

Note - 1. The objective of helicopter taxiway markings and markers is, without being a hazard to the helicopter, to provide to the pilot by day and, if necessary, by night, visual cues to guide movement along the taxiway.

Note: - 2. The specifications for taxi-holding position markings in MOS Section 8.4.3, Runway Holding Position Marking are equally applicable to taxiways intended for ground taxiing of helicopters.

Note: - 3. Ground taxi-routes are not required to be marked.

Note - 4. Unless otherwise indicated it may be assumed that a helicopter taxiway is suitable for both ground taxiing and air taxiing of helicopters.

Note - 5. Signage may be required on an aerodrome where it is necessary to indicate that a helicopter taxiway is suitable only for the use of helicopters.

- 15.13.14.1 The centerline of a helicopter taxiway shall be identified with a marking.
- 15.13.14.2 The edges of a helicopter taxiway, if not self-evident, should be identified with markers or markings.
- 15.13.14.3 Helicopter taxiway markings shall be along the centerline and, if required, along the edges of a helicopter taxiway.
- 15.13.14.4 Helicopter taxiway edge markers shall be located at a distance of 1 m to 3 m beyond the edge of the helicopter taxiway.
- 15.13.14.5 Helicopter taxiway edge markers, shall be spaced at intervals of not more than 15 m on each side of straight sections and 7.5 m on each side of curved sections with a minimum of four equally spaced markers per section.
- 15.13.14.6 On a paved taxiway, a helicopter taxiway center line marking shall be a continuous yellow line 15 cm in width.
- 15.13.14.7 On an unpaved taxiway that will not accommodate painted markings, a helicopter taxiway centerline shall be marked with flush in-ground 15 cm wide and approximately 1.5 m in length yellow markers, spaced at intervals of not more than 30 m on straight sections and not more than 15 m on curves, with a minimum of four equally spaced markers per section.
- 15.13.14.8 Helicopter taxiway edge markings shall be a continuous double yellow line, each 15 cm in width, and spaced 15 cm apart (nearest edge to nearest edge).
- 15.13.14.9 A helicopter taxiway edge marker shall be frangible to the wheeled undercarriage of a helicopter.

15.13.14.10 A helicopter taxiway edge marker shall not exceed a plane originating at a height of 25 cm above the plane of the helicopter taxiway, at a distance of 0.5 m from the edge of the helicopter taxiway and sloping upwards and outwards at a gradient of 5 percent to a distance of 3 m beyond the edge of the helicopter taxiway.

15.13.14.11 A helicopter taxiway edge marker shall be blue.

Note: - 1. Guidance on suitable edge markers is given in the Heliport Manual (Doc 9261).

Note: - 2. If blue markers are used on an aerodrome, signage may be required to indicate that the helicopter taxiway is suitable only for helicopters.

15.13.14.12 If the helicopter taxiway is to be used at night, the edge markers, shall be internally illuminated or retro-reflective.

15.13.15 Helicopter air taxi-route markings and markers

Note: - The objective of helicopter air taxi-route markings and markers is to provide to the pilot by day and, if necessary, by night, visual cues to guide movement along the air taxi-route.

15.13.15.1 The centerline of a helicopter air taxi-route shall be identified with markers or markings.

15.13.15.2 A helicopter air taxi-route centerline marking or flush in-ground centerline marker shall be located along the center line of the helicopter air taxiway.

15.13.15.3 A helicopter air taxi-route centerline, when on a paved surface, shall be marked with a continuous yellow line 15 cm in width.

15.13.15.4 A helicopter air taxi-route centerline, when on an unpaved surface that will not accommodate painted markings, shall be marked with flush in-ground 15 cm wide and approximately 1.5 m in length yellow markers, spaced at intervals of not more than 30 m on straight sections and not more than 15 m on curves, with a minimum of four equally spaced markers per section.

15.13.15.5 If the helicopter air taxi-route is to be used at night, edge markers shall be either internally illuminated or retro-reflective.

15.13.16 Helicopter stand markings

Note: - The objective of the helicopter stand markings is to provide to the pilot a visual indication of an area that is free of obstacles and in which permitted manoeuvring, and all necessary ground functions, may take place; identification, mass and D-value limitations, when required; and, guidance for manoeuvring and positioning of the helicopter within the stand.

15.13.16.1 A helicopter stand perimeter marking shall be provided.

15.13.16.2 A helicopter stand shall be provided with the appropriate TDPM. See Figure 15- 26 in Section 15.13.10.

- 15.13.16.3 Alignment lines and lead-in/lead-out lines should be provided on a helicopter stand.
Note: - 1. See Figures 15-5,15-6, 15-6A,15-6B, 15-6C, 15-6D of MOS 15.5 - 15.8.
Note: - 2. Helicopter stand identification markings may be provided where there is a need to identify individual stands.
Note: - 3. Additional markings relating to stand size may be provided. See the Heliport Manual (Doc 9261).
- 15.13.16.4 The TDPM, alignment lines and lead-in/lead-out lines shall be located such that every part of the helicopter can be contained within the helicopter stand during positioning and permitted manoeuvring.
- 15.13.16.5 Alignment lines and lead-in/lead-out lines shall be located as shown in Figures 15-27.
- 15.13.16.6 A helicopter stand perimeter marking shall consist of a continuous yellow line and have a line width of 15 cm.
- 15.13.16.7 The TDPM shall have the characteristics described in MOS Section 15.13.10 above.
- 15.13.16.8 Alignment lines and lead-in/lead-out lines shall be continuous yellow lines and have a width of 15 cm.
- 15.13.16.9 Curved portions of alignment lines and lead-in/lead-out lines shall have radii appropriate to the most demanding helicopter type the helicopter stand is intended to serve.
- 15.13.16.10 Stand identification markings shall be marked in a contrasting colour so as to be easily readable.
- 15.13.17 Flight path alignment guidance marking**
Note: - The objective of a flight path alignment guidance marking is to provide the pilot with a visual indication of the available approach and/or departure path direction(s).
- 15.13.17.1 Flight path alignment guidance marking(s):
- (a) should be provided at a heliport where it is desirable and practicable to indicate available approach and/or departure path direction(s).
Note: - The flight path alignment guidance marking can be combined with a flight path alignment guidance lighting system described in MOS Section 15.14.3.
 - (b) shall be located in a straight line along the direction of approach and/or departure path on one or more of the TLOF, FATO, safety area or any suitable surface in the immediate vicinity of the FATO or safety area.
 - (c) shall consist of one or more arrows marked on the TLOF, FATO and/or

safety area surface as shown in MOS Figure 15-28. The stroke of the arrow(s) shall be 50 cm in width and at least 3 m in length. When combined with a flight path alignment guidance lighting system it shall take the form shown in MOS Figure 15-28 which includes scheme for marking 'heads of the arrows' which are constant regardless of stroke length.

Note: - In the case of a flight path limited to a single approach direction or single departure direction, the arrow marking may be unidirectional. In the case of a heliport with only a single approach/departure path available, one bidirectional arrow is marked.

- 15.13.17.2 The markings should be in a color which provides good contrast against the background color of the surface on which they are marked, preferably white.

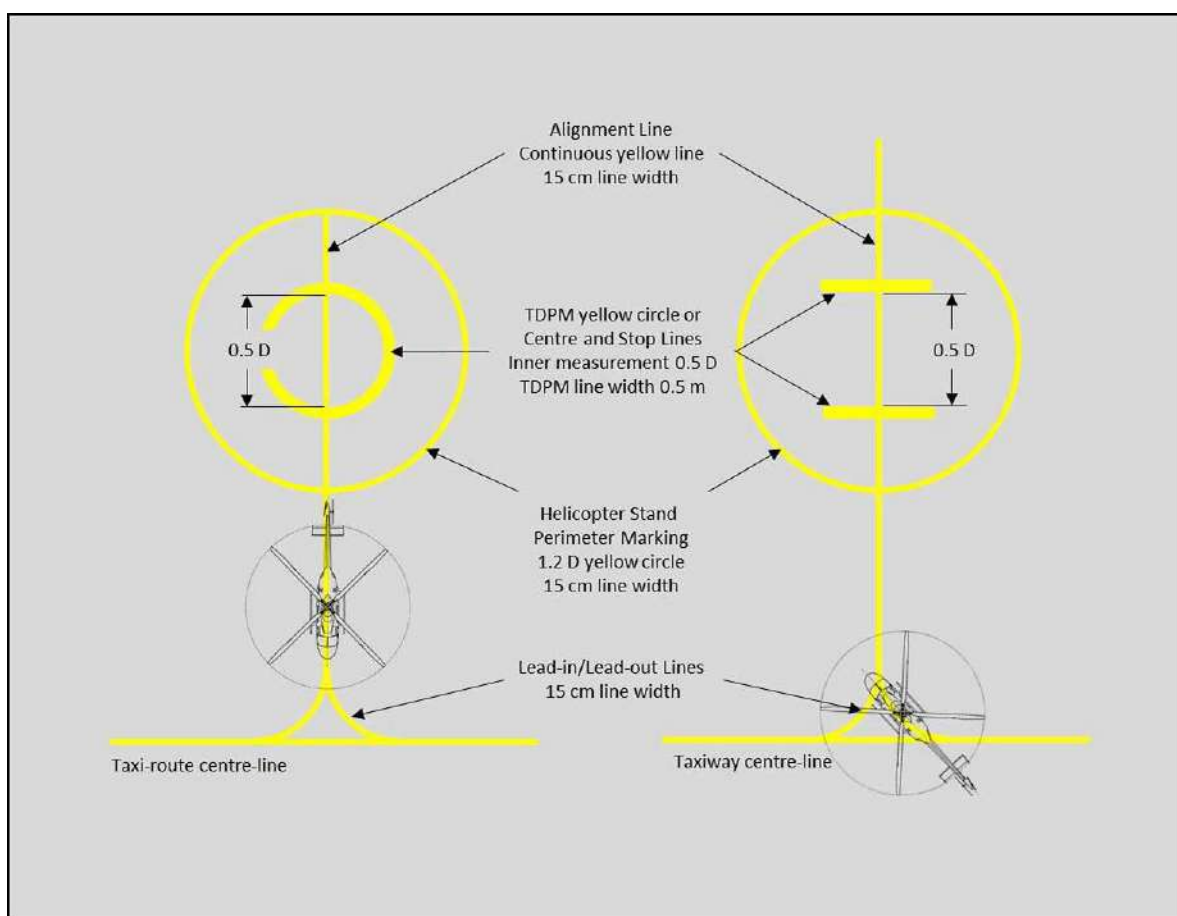


Figure 15-27 Helicopter stand markings

Note: - 1. Where it is intended that helicopters proceed in one direction only, arrows indicating the direction to be followed may be added as part of the alignment lines.

Note: - 2. The characteristics of markings related to the stand size and alignment and lead-in/lead-out lines are illustrated in Figure 15-27 – examples of stands and their markings can be seen in Figures 15-5, 15-6, 15-6A, 15-6B, 15-6C of MOS 15.5 -15.8.

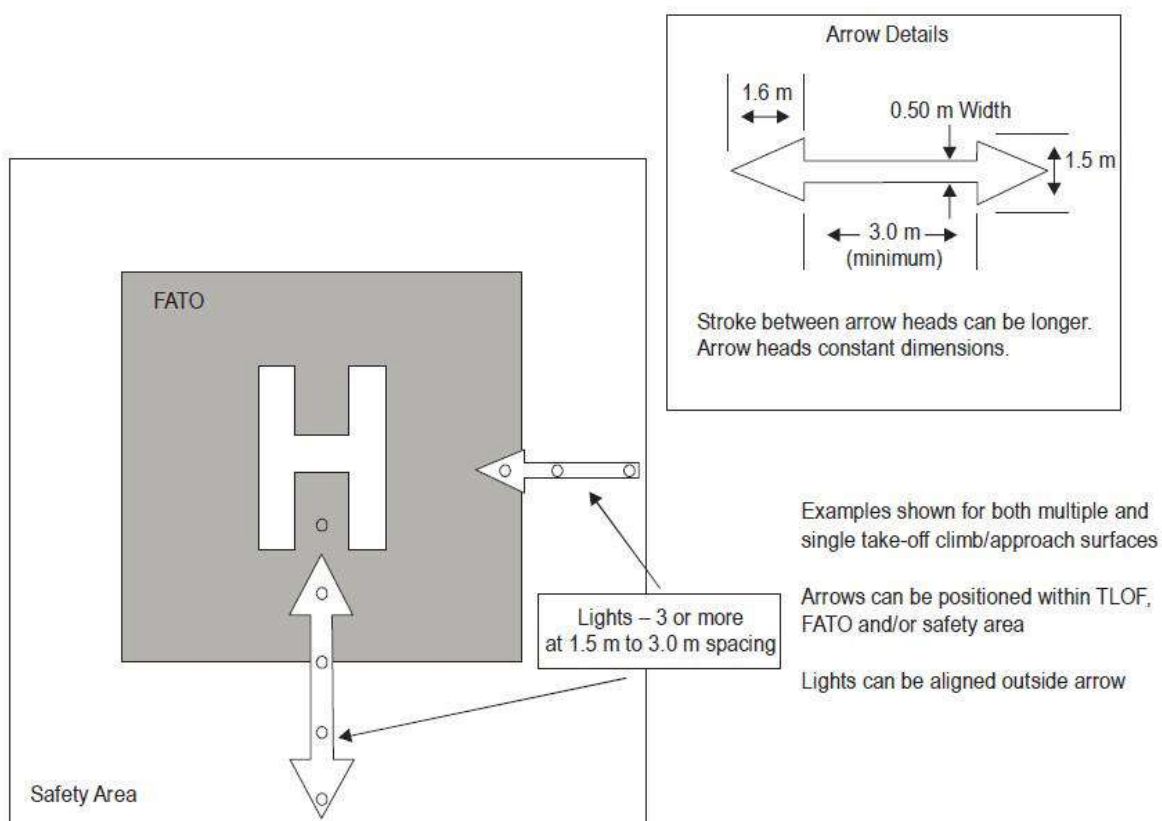


Figure 15-28 Flight Path alignment marking and light

Section 15.14 Visual aids – lights

Note: - 1. See MOS Section 9.18.4.1 and MOS Section 9.1.12, concerning specifications on screening of non-aeronautical ground lights, and design of elevated and inset lights.

Note: 2. - In the case of helidecks and heliports located near navigable waters, consideration needs to be given to ensuring that aeronautical ground lights do not cause confusion to mariners.

Note: 3. - As helicopters will generally come very close to extraneous light sources, it is particularly important to ensure that, unless such lights are navigation lights exhibited in accordance with international regulations, they are screened or located so as to avoid direct and reflected glare.

Note: - 4. Systems addressed in MOS Sections 15.14.3, 15.14.5, 15.14.6 and 15.14.7 are designed to provide effective lighting cues based on night conditions. Where lights are to be used in conditions other than night (i.e. day or twilight) it may be necessary to increase the intensity of the lighting to maintain effective visual cues by use of a suitable brilliancy control. Guidance is provided in the Aerodrome Design Manual (Doc 9157), Part4 - Visual Aids.

Note: - 5. The specifications for marking and lighting of obstacles included in MOS 8.10 and 9.3, are equally applicable to heliports and winching areas.

Note: - 6. In cases where operations into a heliport are to be conducted at night with

Night Vision Imaging Systems (NVIS), it is important to establish the compatibility of the NVIS system with all heliport lighting through an assessment by the helicopter operator prior to use.

15.14.1 Heliport beacon

15.14.1.1 A heliport beacon should be provided at a heliport where:

- (a) long-range visual guidance is considered necessary and is not provided by other visual means; or
- (b) identification of the heliport is difficult due to surrounding lights.

15.14.1.2 The heliport beacon shall be located on or adjacent to the heliport preferably at an elevated position and so that it does not dazzle a pilot at short range.

Note: - Where a heliport beacon is likely to dazzle pilots at short range, it may be switched off during the final stages of the approach and landing.

15.14.1.3 The heliport beacon shall emit repeated series of equispaced short duration white flashes in the format in Figure 15-29.

15.14.1.4 The light from the beacon shall show at all angles of azimuth.

15.14.1.5 The effective light intensity distribution of each flash should be as shown in Figure 15-30, Illustration 1 unless otherwise approved by CAAP.

Note: - Where brilliancy control is desired, settings of 10 percent and 3 percent have been found to be satisfactory. In addition, shielding may be necessary to ensure that pilots are not dazzled during the final stages of the approach and landing.

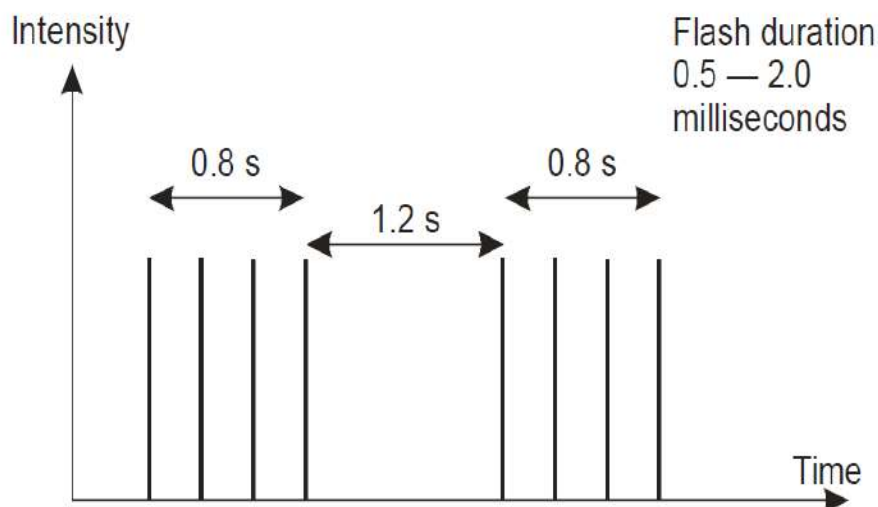


Figure 15-29 Heliport beacon flash characteristics

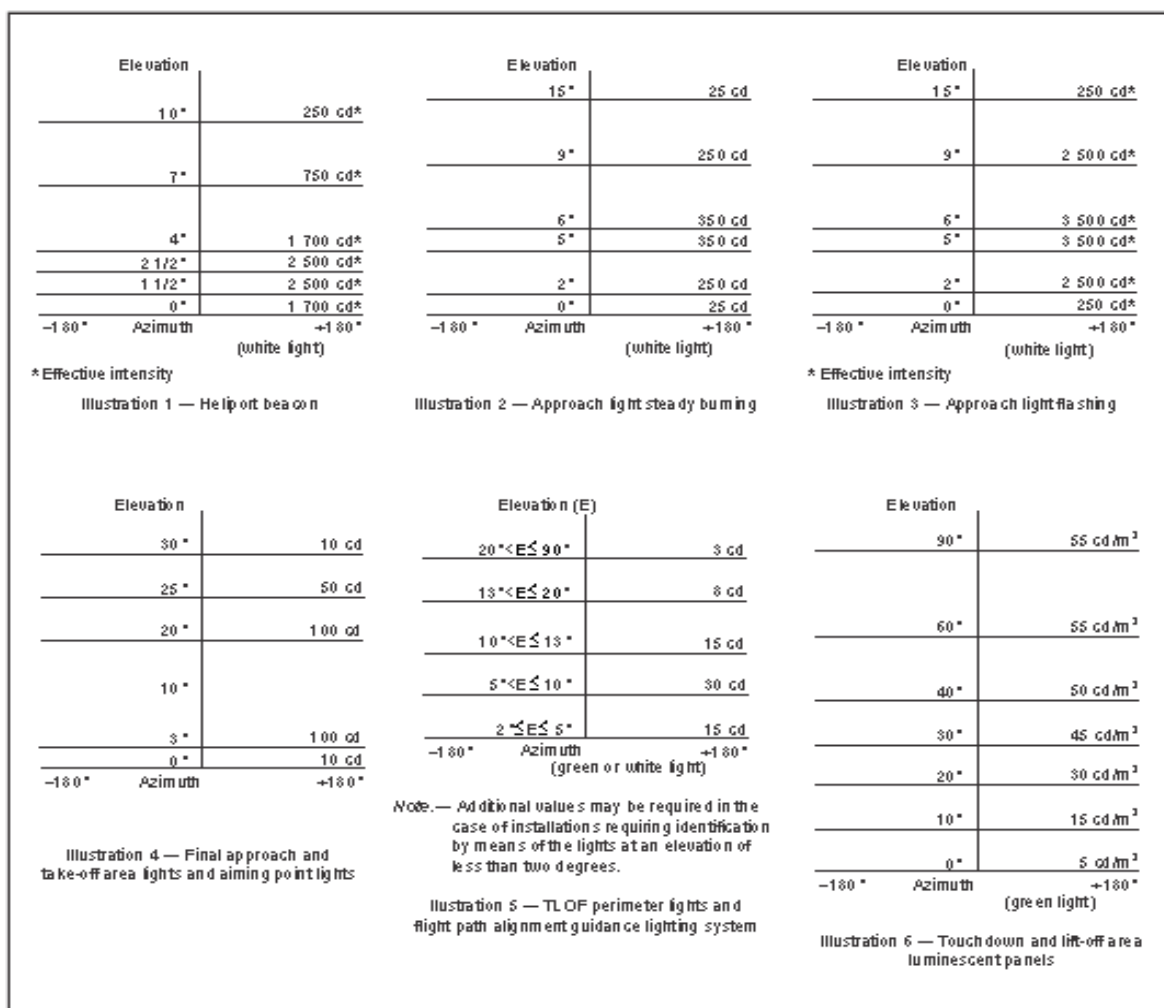


Figure 15-30 Isocandela Diagrams

15.14.2 Approach lighting system

- 15.14.2.1 An approach lighting system should be provided at a heliport where it is desirable and practicable to indicate a preferred approach direction.
- 15.14.2.2 The approach lighting system shall be located in a straight line along the preferred direction of approach.
- 15.14.2.3 An approach lighting system should consist of a row of three lights spaced uniformly at 30 m intervals and of a crossbar 18 m in length at a distance of 90 m from the perimeter of the FATO as shown in Figure 15-31. The lights forming the crossbar should be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the center line lights and spaced at 4.5 m intervals. Where there is the need to make the final approach course more conspicuous, additional lights spaced uniformly at 30 m intervals should be added beyond the crossbar. The lights beyond the crossbar may be steady or sequenced flashing, depending upon the environment.

Note: - Sequenced flashing lights may be useful where identification of the approach lighting system is difficult due to surrounding lights.

- 15.14.2.4 The steady lights shall be omnidirectional white lights.
- 15.14.2.5 Sequenced flashing lights shall be omnidirectional white lights.
- 15.14.2.6 The flashing lights should have a flash frequency of one per second and their light distribution should be as shown in Figure 15-30, Illustration 3. The flash sequence should commence from the outermost light and progress towards the crossbar.
- 15.14.2.7 A suitable brilliancy control should be incorporated to allow for adjustment of light intensity to meet the prevailing conditions.

Note: - The following intensity settings have been found suitable: a) steady lights — 100 percent, 30 percent and 10 percent; and b) flashing lights — 100 percent, 10 percent and 3 percent.

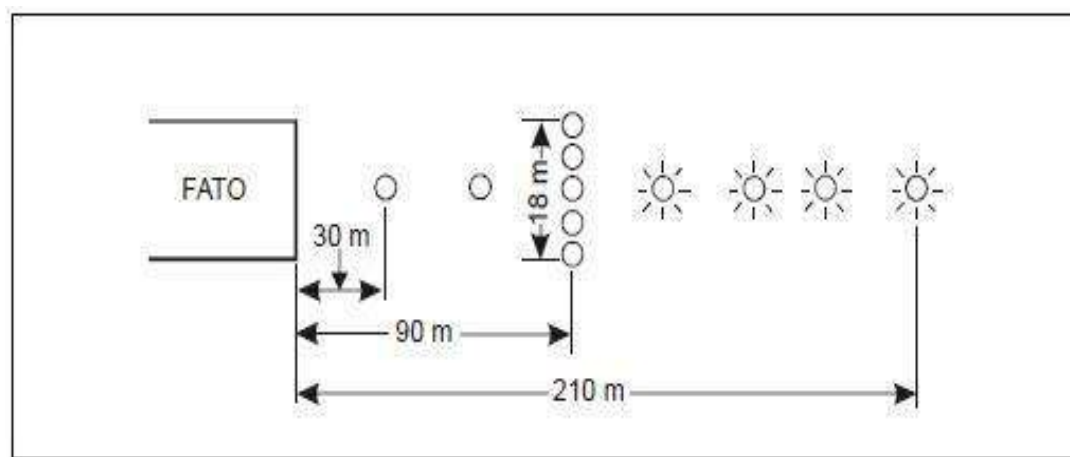


Figure 15 – 31 Approach lighting system

15.14.3 Flight path alignment guidance lighting system

- 15.14.3.1 Flight path alignment guidance lighting system(s) should be provided at a heliport where it is desirable and practicable to indicate available approach and/or departure path direction(s).

Note: - The flight path alignment guidance lighting can be combined with the flight path alignment guidance marking described in MOS Section 15.13.17.

- 15.14.3.2 The flight path alignment guidance lighting system shall be in a straight line along the direction(s) of approach and/or departure path on one or more of the TLOF, FATO, safety area or any suitable surface in the immediate vicinity of the FATO, TLOF or safety area.
- 15.14.3.3 If combined with a flight path alignment guidance marking, as far as is practicable the lights should be located inside the “arrow” markings.

- 15.14.3.4 A flight path alignment guidance lighting system should consist of a row of three or more lights spaced uniformly with a total minimum distance of 6 m. Intervals between lights should not be less than 1.5 m and should not exceed 3 m. Where space permits, there should be 5 lights. (See Figure 15-28.)

Note: - The number of lights and spacing between these lights may be adjusted to reflect the space available. If more than one flight path alignment system is used to indicate available approach and/or departure path direction(s), the characteristics for each system are typically kept the same. (See Figure 15-28).

- 15.14.3.5 The lights shall be steady omnidirectional inset white lights.

- 15.14.3.6 The distribution of the lights should be as indicated in Figure 15-30, Illustration 5.

- 15.14.3.7 A suitable control should be incorporated to allow for adjustment of light intensity to meet the prevailing conditions and to balance the flight path alignment guidance lighting system with other heliport lights and general lighting that may be present around the heliport.

15.14.4 Visual alignment guidance system

Note: - The objective of a visual alignment guidance system is to provide conspicuous and discrete cues to assist the pilot to attain, and maintain, a specified approach track to a heliport. Guidance on suitable visual alignment guidance systems is given in the Heliport Manual (Doc 9261).

- 15.14.4.1 A visual alignment guidance system should be provided to serve the approach to a heliport where one or more of the following conditions exist especially at night:

- (a) obstacle clearance, noise abatement or traffic control procedures require a particular direction to be flown;
- (b) the environment of the heliport provides few visual surface cues; and
- (c) it is physically impracticable to install an approach lighting system.

15.14.5 Visual approach slope indicator

Note: - The objective of a visual approach slope indicator is to provide conspicuous and discrete colour cues within a specified elevation and azimuth, to assist the pilot to attain and maintain the approach slope to a desired position within a FATO. Guidance on suitable visual approach slope indicators is given in the Heliport Manual (Doc 9261).

- 15.14.5.1 A visual approach slope indicator should be provided to serve the approach to a heliport, whether or not the heliport is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist especially at night:

- (i) obstacle clearance, noise abatement or traffic control procedures require a particular slope to be flown;
- (ii) the environment of the heliport provides few visual surface cues; and
- (iii) the characteristics of the helicopter require a stabilized approach.

15.14.6 Final approach and take-off area lighting systems for onshore surface – level heliports

Note: - The objective of a final approach and take-off area lighting system for onshore surface-level heliports is to provide to the pilot operating at night an indication of the shape, location and extent of the FATO.

15.14.6.1 Where a FATO with a solid surface is established at a surface level heliport intended for use at night, FATO lights shall be provided except that they may be omitted where the FATO and the TLOF are nearly coincidental or the extent of the FATO is self-evident.

15.14.6.2 FATO lights shall:

- (a) be placed along the edges of the final approach and take-off area. The lights shall be uniformly spaced as follows:
 - (i) for an area in the form of a square or rectangle, at intervals of not more than 50 m with a minimum of four lights on each side including a light at each corner; and
 - (ii) for any other shaped area, including a circular area, at intervals of not more than 5 m with a minimum of ten lights.
- (b) be fixed omnidirectional lights showing white. Where the intensity of the lights is to be varied the lights shall show variable white.

15.14.6.3 The light distribution of final approach and take-off area lights shall be as shown in MOS Figure 15-30, Illustration 4.

15.14.6.4 The lights shall not exceed a height of 25 cm and should be inset when a light extending above the surface would endanger helicopter operations. Where a FATO is not meant for lift-off or touchdown, the lights should not exceed a height of 25 cm above ground level.

15.14.7 Aiming point lights

Note: - The objective of aiming point lights is to provide a visual cue indicating to the pilot by night the preferred approach/departure direction; the point to which the helicopter approaches to a hover before positioning to a TLOF, where a touchdown can be made; and that the surface of the FATO is not intended for touchdown.

15.14.7.1 Where an aiming point marking is provided at a heliport intended for use at night, aiming point lights shall be provided.

15.14.7.2 Aiming point lights shall be collocated with the aiming point marking.

15.14.7.3 Aiming point lights shall form a pattern of at least six omnidirectional white lights as shown in MOS Figure 15-25. The lights shall be inset when a light extending above the surface could endanger helicopter operations.

15.14.7.4 The light distribution of aiming point lights shall be as shown in MOS Figure 15- 30,

Illustration 4.

15.14.8 Touchdown and lift-off area lighting system

Note: - The objective of a touchdown and lift-off area lighting system is to provide illumination of the TLOF and required elements within. For a TLOF located in a FATO, the objective is to provide discernibility, to the pilot on a final approach, of the TLOF and required elements within; while for a TLOF located on an elevated heliport, shipboard heliport or helideck, the objective is visual acquisition from a defined range and to provide sufficient shape cues to permit an appropriate approach angle to be established.

15.14.8.1 A TLOF lighting system shall be provided at a heliport intended for use at night.

Note: - Where a TLOF is located in a stand, the objective may be met with the use of ambient lighting or stand floodlighting.

15.14.8.2 For a surface level heliport, lighting for the TLOF in a FATO shall consist of one or more of the following:

- (a) perimeter lights.;
- (b) floodlighting;
- (c) arrays of segmented point source lighting (ASPSL) or luminescent panel (LP) lighting to identify the touchdown and lift-off area when (a) and (b) are not practicable and final approach and take-off area lights are available.

15.14.8.3 For an elevated heliport shipboard heliport or helideck, lighting of the TLOF in a FATO shall consist of:

- (a) perimeter lights; and
- (b) ASPSL, and/or LPs to identify the TDPM and/or floodlighting to illuminate the TLOF.

Note: - At elevated heliports, shipboard heliports and helidecks, surface texture cues within the touchdown and lift-off (TLOF) area are essential for helicopter positioning during the final approach and landing. Such cues can be provided using various forms of lighting (ASPSL, LP, floodlights or a combination of these lights, etc.) in addition to perimeter lights. Best results have been demonstrated by the combination of perimeter lights and ASPSL in the form of encapsulated strips of light emitting diodes (LEDs) and inset lights to identify the TDPM and heliport identification markings.

15.14.8.4 TLOF ASPSL and/or LPs to identify the TDPM and/or floodlighting shall be provided at a surface-level heliport intended for use at night when enhanced surface texture cues are required.

15.14.8.5 Touchdown and lift-off area perimeter lights shall:

- (a) be placed along the edge of the area designated for use as the TLOF or within a distance of 1.5 m from the edge. Where the TLOF is a circle the lights shall be:

- (i) located on straight lines in a pattern which will provide information to pilots on drift displacement; and
- (ii) where (a)(i) is not practicable, evenly spaced around the perimeter of the TLOF at the appropriate interval except that over a sector of 45° the lights shall be spaced at half spacing.
- (b) be uniformly spaced at intervals of not more than 3 in for elevated heliports and helidecks and not more than 5 m for surface level heliports. There shall be a minimum number of four lights on each side including a light at each corner. For a circular touchdown and lift-off area, where lights are installed in accordance with 15.14.8.5(a)(ii), there shall be a minimum of fourteen lights.
- (c) be installed at an elevated heliport or fixed helideck such that the pattern cannot be seen by the pilot from below the elevation of the touchdown and lift-off area.
- (d) be installed on a moving helideck or shipboard heliport, such that the pattern cannot be seen by the pilot from below the elevation of the TLOF when the helideck or shipboard heliport is level.
- (e) be fixed omnidirectional lights showing green.

15.14.8.6

On surface level heliports:

- (a) ASPSL or LPs, if provided to identify the touchdown and lift-off area, shall be placed along the marking designating the edge of the touchdown and lift-off area. Where the touchdown and lift-off area is a circle, they shall be located on straight lines circumscribing the area.
- (b) The minimum number of LPs on a touchdown and lift-off area shall be nine. The total length of LPs in a pattern shall not be less than 50% of the length of the pattern. There shall be an odd number with a minimum number of three (3) panels on each side of the touchdown and lift-off area including a panel at each corner. LPs shall be uniformly spaced with a distance between adjacent panel ends of not more than 5 inches on each side of the touchdown and lift-off area.

15.14.8.7

When LPs are used on an elevated heliport or helideck to enhance surface texture cues, the panels shall not be placed adjacent to the perimeter lights. They shall be placed around a touchdown marking or coincident with heliport identification marking.

15.14.8.8

TLOF floodlights shall be located so as to avoid glare to pilots in flight or to personnel working on the area. The arrangement and aiming of flood-lights shall be such that shadows are kept to a minimum.

Note: - ASPSL and LPs used to designate the TDPM and/or heliport identification marking have been shown to provide enhanced surface texture cues when compared to low-level floodlight. Due to the risk of misalignment, if floodlights are used, there is a need for them to be checked periodically to ensure they remain within the specifications contained within MOS 15.14.8.

15.14.8.9

At a surface level heliport, ASPSL or LP shall emit green light when used to define the perimeter of the touchdown and lift-off area.

- 15.14.8.10 The chromaticity and luminance of colors of LPs shall conform to MOS 9.2.6.
- 15.14.8.11 An LP shall have a minimum width of 6 cm. The panel housing shall be the same color as the marking it defines.
- 15.14.8.12 For a surface level or elevated heliport, the TLOF perimeter lights located in a FATO shall not exceed a height of 25 cm and shall be inset when a light extending above the surface could endanger helicopter operations.
- 15.14.8.13 For a helideck or shipboard heliport, the TLOF perimeter lights shall not exceed a height of 5 cm, or for a FATO/TLOF, 15 cm.
- 15.14.8.14 When located within the safety area of a surface level or elevated heliport the TLOF floodlights shall not exceed a height of 25 cm.
- 15.14.8.15 For a helideck or shipboard heliport, the TLOF floodlights shall not exceed a height of 5 cm, or for a FATO/TLOF, 15 cm.
- 15.14.8.16 The LPs shall not extend above the surface by more than 2.5 cm.
- 15.14.8.17 The light distribution of the perimeter lights shall be as shown in MOS Figure 15- 30, Illustration 5.
- 15.14.8.18 The light distribution of the LPs shall be as shown in MOS Figure 15-30, Illustration 6.
- 15.14.8.19 The spectral distribution of TLOF floodlights shall be such that the surface and obstacle marking can be correctly identified.
- 15.14.8.20 The average horizontal illuminance of the floodlighting shall be at least 10 lux, with a uniformity ratio (average to minimum) of not more than 8:1 measured on the surface of the TLOF.
- 15.14.8.21 Lighting used to identify the TDPC should comprise a segmented circle of omnidirectional ASPSL strips showing yellow. The segments shall consist of ASPSL strips, and the total length of the ASPSL strips being not less than 50% of the circumference of the circle.
- 15.14.8.22 If utilized, the heliport identification marking lighting shall be omnidirectional showing green.

15.14.9 Helicopter stand floodlighting

Note: - The objective of helicopter stand floodlighting is to provide illumination of the stand surface and associated markings to assist the manoeuvring and positioning of a helicopter and facilitation of essential operations around the helicopter.

- 15.14.9.1 Floodlighting shall be provided on a helicopter stand intended to be used at night.

Note: - Guidance on stand floodlighting is given in the apron floodlighting section in

the Aerodrome Design Manual (Doc 9157), Part 4.

- 15.14.9.2 Helicopter stand floodlights should be located so as to provide adequate illumination, with a minimum of glare to the pilot of a helicopter in flight and on the ground, and to personnel on the stand. The arrangement and aiming of floodlights should be such that a helicopter stand receives light from two or more directions to minimize shadows.
- 15.14.9.3 The spectral distribution of stand floodlights shall be such that the colours used for surface and obstacle marking can be correctly identified.
- 15.14.9.4 Horizontal and vertical illuminance shall be sufficient to ensure that visual cues are discernible for required manoeuvring and positioning, and essential operations around the helicopter can be performed expeditiously without endangering personnel or equipment.

15.14.10 Winching area floodlighting

Note: - The objective of winching area floodlighting is to provide illumination of the surface, obstacles and visual cues to assist a helicopter to be positioned over, and retained within, an area from which a passenger or equipment can be lowered or raised.

- 15.14.10.1 Winching area floodlighting shall be provided at a winching area intended for use at night.
- 15.14.10.2 Winching area floodlights shall be located so as to avoid glare to pilots in flight or to personnel working on the area. The arrangement and aiming of floodlights shall be such that shadows are kept to a minimum.
- 15.14.10.3 The spectral distribution of winching area floodlights shall be such that the surface and obstacle markings can be correctly identified.
- 15.14.10.4 The average horizontal illuminance shall be at least 10 lux, measured on the surface of the winching area.

15.14.11 Taxiway lights

Note: - The specifications for taxiway centerline lights and taxiway edge lights in MOS Section 9.1.12.1 and MOS Section 9.1.12.4 respectively are equally applicable to taxiways intended for ground taxiing of helicopters.

15.14.12 Visual aids for denoting obstacles outside and below the obstacle limitation surfaces

Note: - Arrangements for an aeronautical study of objects outside the obstacle limitation surface (OLS) and for other objects are addressed in MOS Chapter 7.

- 15.14.12.1 Where an aeronautical study indicates that obstacles in areas outside and below the boundaries of the OLS, established for a heliport, constitute a hazard to helicopters, they should be marked and lit, except that the marking may be omitted when the obstacle is lighted with high-intensity obstacle lights by day.

- 15.14.12.2 Where an aeronautical study indicates that overhead wires or cables crossing a river, waterway, valley or highway constitute a hazard to helicopters, they shall be marked, and their supporting towers marked and lit.

15.14.13 Floodlighting of obstacles

- 15.14.13.1 At a heliport intended for use at night obstacles shall be floodlighted if it is not possible to display obstacle lights on them.
- 15.14.13.2 Obstacle floodlights shall be arranged so as to illuminate the entire obstacle and as far as practicable in a manner so as not to dazzle the helicopter pilots.
- 15.14.13.3 Obstacle floodlighting shall be such as to produce a luminance of at least 10 cd/m².

Section 15.15 Rescue and firefighting

General — Introductory Notes

The content of this section has been extensively revised and updated for Amendment 9. With new concepts and terms now to consider, it is important that MOS 15.15 be read in conjunction with the appropriate detailed guidance on rescue and firefighting options given in the Heliport Manual (Doc 9261).

Provisions described in this section are intended to address incidents or accidents within the heliport response area only. No dedicated firefighting provisions are included for helicopter accidents or incidents that may occur outside the response area, such as on an adjacent roof near an elevated heliport.

Complementary agents are ideally dispensed from one or two extinguishers (although more extinguishers may be permitted where high volumes of an agent are specified, e.g. H3 operations). The discharge rate of complementary agents needs to be selected for optimum effectiveness of the agent used. When selecting dry chemical powders for use with foam, care needs to be exercised to ensure compatibility. Complementary agents need to comply with the appropriate specifications of the International Organization for Standardization (ISO).

Where a fixed monitor system (FMS) is installed, trained monitor operators, where provided, be positioned on at least the upwind location to ensure primary media is directed to the seat of the fire. For a ring-main system (RMS) practical testing has indicated that these solutions are only guaranteed to be fully effective for TLOFs up to 20 m diameter. If the TLOF is greater than 20 m an RMS should not be considered unless supplemented by other means to distribute primary media (e.g. additional pop-up nozzles are installed in the center of the TLOF).

The International Convention for the Safety of Life at Sea (SOLAS) sets forth provisions on rescue and firefighting (RFF) arrangements for purpose-built and non-purpose-built shipboard heliports, in SOLAS regulations II-2/18, II-2- Helicopter Facilities, and the SOLAS Fire Safety Systems Code.

It may therefore be assumed that this chapter does not include RFF arrangements for purpose-built or non-purpose-built shipboard heliports or for winching areas.

15.15.1 Applicability

15.15.1.1 The following specifications shall apply to new builds or replacement of existing systems or part thereof from 1 January 2023:

MOS Section 15.15.2.1, MOS Section 15.15.3.3, MOS Section 15.15.3.4, MOS Section 15.15.3.6, MOS Section 15.15.3.7, MOS Section 15.15.3.9, MOS Section 15.15.3.10, MOS Section 15.15.3.12, MOS Section 15.15.3.13 and MOS Section 15.15.4.2.

Note: - For areas for the exclusive use of helicopters at aerodromes primarily for the use of aeroplanes, distribution of extinguishing agents, response time, rescue equipment and personnel have not been considered in this section; see MOS Chapter 14.

15.15.1.2 Rescue and firefighting equipment and services shall be provided at helidecks and at elevated heliports located above occupied structures.

15.15.1.3 Rescue and firefighting equipment and services shall be provided at surface level heliports and elevated heliports located above unoccupied structures.

15.15.2 Level of protection provided

15.15.2.1 For the application of primary media the discharge rate (in liters/minute) applied over the assumed practical critical area (in m²) shall be predicated on a requirement to bring any fire which may occur on the heliport under control within one minute, measured from activation of the system at the appropriate discharge rate. (Applicable on 1 January 2023).

Practical critical area calculation where primary media is applied as a solid stream

Note: - This section is not applicable to helidecks regardless of how primary media is being delivered.

15.15.2.2 The practical critical area shall be calculated by multiplying the helicopter fuselage length (m) by the helicopter fuselage width (m) plus an additional width factor (W1) of 4 m. Categorization from H0 to H3 should be determined on the basis of the fuselage dimensions in Table 6-1 below.

Table 15-5 Heliport firefighting category

Category (1)	Manximum fuselage length (2)	Manximum fuselage width (3)
H0	up to but not including 8 m	1.5 m
H1	from 8 m up to but not including 12 m	2 m
H2	from 12 m up to but not including 16 m	2.5 m
H3	from 16 m up to 20 m	3 m

Note: - 1. For helicopters which exceed one or both of the dimensions for a category H3 heliport, it will be necessary to recalculate the level of protection using practical critical area assumptions based on the actual fuselage length and the actual fuselage width of the helicopter plus an additional width factor (W1) of 6 m.

Note: - 2. The practical critical area may be considered on a helicopter type-specific basis by using the formula in MOS 15.15.2.2. Guidance on practical critical area in relation to the heliport firefighting category is given in the Heliport Manual (Doc 9261) where a discretionary 10 percent tolerance on fuselage dimension “upper limits” is applied.

Practical critical area calculation where primary media is applied in a dispersed pattern

15.15.2.3 For heliports, except helidecks, the practical critical area shall be based on an area contained within the heliport perimeter, which always includes the TLOF, and to the extent that it is load-bearing, the FATO.

15.15.2.4 For helidecks the practical critical area shall be based on the largest circle capable of being accommodated within the TLOF perimeter.

Note: - MOS Section 15.15.2.4 is applied for the practical critical area calculation for helidecks regardless of how primary media is being delivered.

15.15.3 Extinguishing agents

Note: - 1. Throughout MOS Section 15.15.3 the discharge rate of a performance level B foam is assumed to be based on an application rate of 5.5 L/min/m², and for a performance level C foam and for water, is assumed to be based on an application rate of 3.75 L/min/m². These rates may be reduced if, through practical testing, CAAP demonstrates that the objectives of MOS Section 15.15.2.1 can be achieved for a specific foam use at a lower discharge rate (l/min).

Note: - 2. Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance level B or C rating is given in the Airport Services Manual (Doc 9137), Part 1.

Surface level heliports with primary media applied as a solid stream using a portable foam application system (PFAS)

Note: - Except for a limited-sized surface level heliport, the assumption is made that foam dispensing equipment will be transported to the incident or accident location on an appropriate vehicle (a PFAS).

15.15.3.1 Where an RFFS is provided at a surface level heliport, the amount of primary media and complementary agents shall be in accordance with Table 15-6.

Note: - The minimum discharge duration in Table 15-6 is assumed to be two minutes. However, if the availability of back-up specialist fire services is remote from the heliport, consideration may need to be given to increasing the discharge duration from two minutes to three minutes.

Table 15-6 Minimum usable amounts of extinguishing agents for surface-level heliports

Category	Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate foam solution/minute	Dry chemical powder (kg) and	Gaseous media (kg)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
H O	500	250	330	165	23	9
H 1	800	400	540	270	23	9
H 2	1200	600	800	400	45	18
H 3	1600	800	1100	550	90	36

Elevated heliports with primary media applied as a solid stream using a fixed foam application system (FFAS)

- 15.15.3.2 Where an RFFS is provided at an elevated heliport, the amount of foam media and complementary agents shall be in accordance with Table 15-7.

Note: - The minimum discharge duration in Table 15-7 is assumed to be five minutes.

Table 15-7 Minimum usable amounts of extinguishing agents for elevated heliports

Category	Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate foam solution/minute	Dry chemical powder (kg) and	Gaseous media (kg)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
H O	1250	250	825	165	23	9
H 1	2000	400	1350	270	45	18
H 2	3000	600	2000	400	45	18
H 3	4000	800	2750	550	90	36

Note: - For guidance on the provision of additional hand-controlled foam branches for the application of aspirated foam, see the Heliport Manual (ICAO Doc 9261).

Elevated heliports/ limited-sized surface level heliports with primary media applied in a dispersed pattern through a fixed foam application system (FFAS) – a solid plate heliport

- 15.15.3.3 The amount of water required for foam production should be predicated on the practical critical area (m²) multiplied by the appropriate application rate (L/min/m²), giving a discharge rate for foam solution (in L/min). The discharge rate should be multiplied by the discharge duration to calculate the amount of water needed for foam production. (Applicable on 1 January 2023).
- 15.15.3.4 The discharge duration should be at least three minutes. (Applicable on 1 January 2023).
- 15.15.3.5 Complementary media shall be in accordance with Table 15-7, for H2 operations.
- Note: - For helicopters with a fuselage length greater than 16 m and/or a fuselage width greater than 2.5 m, complementary media in Table 15-7 for H3 operations may be considered.*

Purpose-built elevated heliports/limited-sized surface level heliport with primary media applied in a dispersed pattern through a fixed application system (FAS) – a passive fire retarding surface with water-only DIFFS

- 15.15.3.6 The amount of water required should be predicated on the practical critical area (m²) multiplied by the appropriate application rate (3.75 L/min/m²) giving a discharge rate for water (in L/min). The discharge rate should be multiplied by the discharge duration to determine the total amount of water needed. (Applicable on 1 January 2023)
- 15.15.3.7 The discharge duration should be at least two minutes. (Applicable on 1 January 2023).
- 15.15.3.8 Complementary media shall be in accordance with Table 15-7, for H2 operations.
- Note: - For helicopters with a fuselage length greater than 16 m and/or a fuselage width greater than 2.5 m, complementary media for H3 operations may be considered.*

Purpose-built helidecks with primary media applied in a solid stream or a dispersed pattern through a fixed foam application system (FFAS) – a solid plate heliport

- 15.15.3.9 The amount of water required for foam media production should be predicated on the practical critical area (m²) multiplied by the application rate (L/min/m²) giving a discharge rate for foam solution (in L/min). The discharge rate should be multiplied by the discharge duration to calculate the amount of water needed for foam production. (Applicable on 1 January 2023)
- 15.15.3.10 The discharge duration should be at least five minutes. (Applicable on 1 January 2023).

- 15.15.3.11 Complementary media shall be in accordance with Table 15-7, H0 levels for helidecks up to and including 16.0 m and to H1/H2 levels for helidecks greater than 16.0 m. Helidecks greater than 24 m should adopt H3 levels.

Note: - For guidance on the provision of additional hand-controlled foam branches for the application of aspirated foam, see the Heliport Manual (Doc 9261).

Purpose-built helidecks with primary media applied in a dispersed pattern through a fixed application system (FAS) – a passive fire-retarding surface with water-only DIFFS

- 15.15.3.12 The amount of water required should be predicated on the practical critical area (m²) multiplied by the application rate (3.75 L/min/m²) giving a discharge rate for water (in L/min). The discharge rate should be multiplied by the discharge duration to calculate the amount of water needed. (Applicable on 1 January 2023).

Note: - Sea-water may be used.

- 15.15.3.13 The discharge duration should be at least three minutes. (Applicable on 1 January 2023)

- 15.15.3.14 Complementary media shall be in accordance with Table 15-7, to H0 levels for helidecks up to and including 16.0 m and to H1/H2 levels for helidecks greater than 16.0 m. Helidecks greater than 24 m should adopt H3 levels.

15.15.4 Response time

- 15.15.4.1 At surface level heliports, the operational objective of the rescue and firefighting response shall be to achieve response times not exceeding two minutes in optimum conditions of visibility and surface conditions.

Note: - Response time is considered to be the time between the initial call to the rescue and firefighting service and the time when the first responding vehicle(s) (the service) is (are) in position to apply foam at a rate of at least 50 percent of the discharge rate specified in Table 15-6.

- 15.15.4.2 At elevated heliports, limited-sized surface level heliports and helidecks, the response time for the discharge of primary media at the required application rate should be 15 seconds measured from system activation. If rescue and firefighting personnel are needed, they should be immediately available on or in the vicinity of the heliport while helicopter movements are taking place. (Applicable on 1 January 2023).

15.15.5 Rescue arrangements

- 15.15.5.1 Rescue arrangements commensurate with the overall risk of the helicopter operation shall be provided at the heliport.

Note: - Guidance on the rescue arrangements, e.g. options for rescue and for personal protective equipment to be provided at a heliport, is given in the Heliport Manual (Doc 9261).

15.15.6 Communication and alerting system

- 15.15.6.1 A suitable alerting and/or communication system shall be provided in accordance with the emergency response plan.

15.15.7 Personnel

Note: - The provision of rescue and firefighting personnel may be determined by use of a task/resource analysis. Guidance is given in the Heliport Manual (Doc 9261).

- 15.15.7.1 Where provided, the number of rescue and firefighting personnel shall be sufficient for the required task.
- 15.15.7.2 Where provided, rescue and firefighting personnel shall be trained to perform their duties, and maintain their competence.
- 15.15.7.3 Rescue and firefighting personnel shall be provided with protective equipment.

15.15.8 Means of escape

- 15.15.8.1 Elevated heliports and helidecks shall be provided with a main access and at least one additional means of escape.
- 15.15.8.2 Access points should be located as far apart from each other as is practicable.

Note: - The provision of an alternative means of escape is necessary for evacuation and for access by rescue and firefighting personnel. The size of an emergency access/egress route may require consideration of the number of passengers and of special operations like Helicopter Emergency Medical Services (HEMS) that require passengers to be carried on stretchers or trolleys.

Section 15.16 Heliport Emergency Response**15.16.1 Heliport Emergency Planning**

Introductory Note: - Heliport emergency planning is the process of preparing a heliport to cope with an emergency that takes place at the heliport or in its vicinity. Examples of emergencies include crashes on or off the heliport, medical emergencies, dangerous goods occurrences, fires and natural disasters.

The purpose of heliport emergency planning is to minimize the impact of an emergency by saving lives and maintaining helicopter operations.

The heliport emergency plan sets out the procedures for coordinating the response of heliport agencies or services (air traffic services unit, firefighting services, heliport administration, medical and ambulance services, aircraft operators, security services and police) and the response of agencies in the surrounding community (fire departments, police, medical, and ambulance services, hospitals, military, and harbor patrol or coast guard) that could be of assistance in responding to the emergency.

- 15.16.1.1 A heliport emergency plan shall:
- (a) shall be established commensurate with the helicopter operations and other activities conducted at the heliport.
 - (b) shall identify agencies which could be of assistance in responding to an emergency at the heliport or in its vicinity; and
 - (c) should provide for the coordination of the actions to be taken in the event of an emergency occurring at a heliport or in its vicinity.
- 15.16.1.2 Where an approach/departure path at a heliport is located over water, the plan should identify which agency is responsible for coordinating rescue in the event of a helicopter ditching and indicate how to contact that agency.
- 15.16.1.3 The heliport emergency plan as a minimum shall include the information:
- (a) the types of emergencies planned for;
 - (b) how to initiate the plan for each emergency specified;
 - (c) a grid map of the heliport and its immediate vicinity.
- 15.16.1.4 Other information that should be included in the Heliport Emergency Plan are the following:
- (a) the name of agencies on and off the heliport to contact for each type of emergency with telephone numbers or other contact information;
 - (b) the role of each agency for each type of emergency;
 - (c) a list of pertinent on-heliport services available with telephone numbers or other contact information;
 - (d) copies of any written agreements with other agencies for mutual aid and the provision of emergency services; and
- 15.16.1.5 All agencies identified in the plan should be consulted about their role in the plan.
- 15.16.1.6 The plan should be reviewed and the information in it updated at least yearly or, if deemed necessary, after an actual emergency, so as to correct any deficiency found during an actual emergency.
- 15.16.1.7 A test of the emergency plan should be carried out at least once every three years.

Section 15.17 Heliport operating procedures

15.17.1 Heliport Safety/Reporting Officer

- 15.17.1.1 The operator of a heliport must have in place experienced or appropriately trained persons, known as reporting officers, to carry out the aerodrome safety functions. Attributes required include:
- (a) Knowledge of the standards that the aerodrome has to be maintained to;
 - (b) Maturity and responsibility to ensure reliance on the conduct of regular

serviceability inspections of the safety elements of the aerodrome; and

- (c) Having the written and oral communication skills to initiate NOTAM or to communicate aerodrome condition status to ATC, pilots and other aerodrome users.

15.17.1.2 Reporting officers are normally directly employed by the heliport operator. However, at an aerodrome where heliport operator's employees may not be available at all times, other persons may be nominated as reporting officers. Before entrusting the reporting function to a person, the heliport operator must ensure that the person is trained and has the appropriate attributes.

15.17.1.3 Reporting officers must be provided with appropriate radios so they can maintain a listening watch of aircraft /helicopter activities in the vicinity of the heliport during operational hours.

15.17.2 Heliport serviceability inspections

15.17.2.1 Serviceability inspections are visual checks of elements of the heliport which may impact on helicopter safety. A checklist of contents of the inspection must be developed, commensurate with the size and complexity of the heliport.

15.17.2.2 The checklist must encompass at least the following items:

- (a) Surface condition of the helipad area, including cleanliness;
- (b) Surface condition of the helipad, particularly the usability of unsealed pavements in wet conditions;
- (c) Markings, markers, wind direction indicators and aerodrome lighting systems;
- (d) Any obstacle which may infringe the approach, take-off, transitional surfaces (as appropriate);

Note:- New obstructions can arise during construction / maintenance activities.

- (e) Animal or bird activities on and in the vicinity of the heliport;
- (f) Helipad drainage;
- (g) presence Foreign object debris (FOD);
- (h) Checking of fences or other devices that prevent persons and vehicles getting on the movement area (surface level heliport); and
- (i) Checking the currency of any outstanding NOTAM initiated.

Note:- Elements of matters to be checked for, are similar to those detailed in MOS 10.

15.17.3 Frequency of serviceability inspection

15.17.3.1 The heliport must be inspected on a regular basis to ensure that unsafe conditions are identified and action is promptly taken. Regular heliport inspection will also serve as program maintenance activities both responsive and preventive.

15.17.3.2 At heliports where daily air transport operations occur, serviceability inspections must be carried out daily, and prior to any scheduled operation.

- 15.17.3.3 At heliports where night operations are conducted, the lighting systems shall be inspected for serviceability at least once during hours of darkness.
- 15.17.3.4 Additional serviceability inspections must be conducted after significant weather phenomena such as strong wind, earthquake, or heavy rain.
- 15.17.3.5 At heliports without daily regular public transport operations, serviceability inspections must be conducted before each air transport operation or not less than twice per week, whichever is more.

15.17.4 Safety Inspection Report

- 15.17.4.1 The report must provide a true picture of the state of the heliport in its compliance with applicable standards. Where corrective action or necessary improvements are identified, the aerodrome operator must provide a statement of how the corrective action or improvements are to be addressed.
- 15.17.4.2 For heliports used by aeroplanes with less than 10 passenger seats, the approach and take-off area would still need to be checked on a regular basis for vegetation growth or new tall objects. Where another obstacle may become the critical obstacle and affect the published take-off gradient or the threshold location, the checking shall be conducted by a person with appropriate technical expertise.

15.17.5 Record of inspections and remedial actions

- 15.17.5.1 The operator of a heliport must maintain an inspection logbook to demonstrate that inspections have been carried out. Besides recording the inspections, the logbook shall also record significant heliport upgrading or remedial works.
- 15.17.5.2 The logbook must be kept for at least two (2) years and must be made available to any CAAP authorized person conducting inspection of the aerodrome and to any person who conducts the annual or periodic safety inspection.

15.17.6 Training for Safety Personnel

- 15.17.6.1 The initial and refresher training aimed at providing the safety personnel with the knowledge and skills necessary to deal effectively with an emergency at a heliport, shall comprise of the following subjects:
- (a) familiarization with the operation of the heliport;
 - (b) aircraft familiarization;
 - (c) safety procedures around helicopters during ground operations;
 - (d) the use and functioning of the communication systems at the heliport;
 - (e) familiarization with the heliport emergency plan; and
 - (f) the use of any equipment, among the following, which is provided at the heliport:
 - (i) portable fire extinguishers;
 - (ii) fire hoses, nozzles and other similar appliances; and
 - (iii) extinguishing agents.

APPENDIX

Appendix 1: Schedule of particulars to be included in an Aerodrome Manual

Signature. The aerodrome manual must be signed by the most senior officer who is responsible and directly accountable for general management of the aerodrome

Foreword. A general statement indicating the importance of the manual and that the contents are binding to the staff. The foreword also provides a convenient mechanism for the manual to be signed by the most senior officer responsible for the general management of the aerodrome.

Part 1 - General Information, including:

1.1 Conditions of Use

{Name} Airport operates twenty-four (24) hours per day for take-off and landing of aircraft and when it is so available it shall be so under equal terms and conditions to all persons and operators.

1.2 Aeronautical Information

All data relating to the aeronautical aspect of this aerodrome are published in the Republic of the Philippines Aeronautical Information Publication. The *Airside Safety Manager* is responsible for complete and correct promulgation of data to AIS section of the CAAP in accordance with the procedures described in this Manual.

1.3 Recording Aircraft Movements

All data relating to the recording of aircraft movements is collected and recorded by Air Traffic Control. The *Tower Team Leader* is responsible for complete and correct collection recording and reporting to the *Airport General Manager* in accordance with procedures described in this Manual.

1.4 Obligation of the Aerodrome Operator

Under the civil aviation regulations the operator of a certificated aerodrome is to:

- Comply with the mandatory standards and practices;
- Employ an adequate number of qualified and skilled staff;
- Operate the aerodrome in accordance with the procedures set out in the Aerodrome Manual;
- Have an acceptable aerodrome Safety Management System (SMS);
- Arrange for audit of the SMS and the management of airport organizations;
- Permit access to authorized CAAP officers for inspection and testing purposes related to ensuring safety at the aerodrome;
- Make required notifications to the CAAP, ATC or pilots;
- Conduct special inspections as necessary;
- Remove obstructions on the aerodrome that are likely to be a hazard; and
- Erect warning signs if low flying or taxiing aircraft are likely to be hazardous to people or vehicles.

Part 2 Aerodrome Site Information

Aerodrome Plan
Aerodrome Land Titles

Part 3 AIS Information

Aerodrome dimensions
AIP Data

Part 4 Aerodrome Operating Procedures

Section 1 - Aerodrome Reporting
Section 2 - Access to Aerodrome movement area
Section 3 - Aerodrome Emergency Plan (AEP)
Section 4 - Aerodrome Rescue and Firefighting Services (ARFFS)
Section 5 - Aerodrome Inspection by the aerodrome operator
Section 6 - Visual Aids, Electrical systems and Lighting
Section 7 - Movement Area maintenance
Section 8 - Aerodrome Works Safety
Section 9 - Aircraft Parking Control
Section 10 - Apron Safety management
Section 11 - Airside Vehicle Control
Section 12 - Wildlife Hazard Management
Section 13 - Obstacle Control
Section 14 - Disabled Aircraft Removal
Section 15 - Handling of Hazardous Materials
Section 16 - Low Visibility Operations
Section 17 - Protection of Radar And Navigation Aids

Part 5 Aerodrome Administration

Section 1 - Organization contacts and structure
Section 2 - Exemptions, Directions, Approvals
Section 3 - Aerodrome Safety Management System

Appendix 2: List of Effective Pages

Part	Page nos.	No. of pages	Edition/ Amendment	Date of Issue
Cover and version	<i>i - ii</i>	2	2 nd Edition Amendment 4	February 2017
Introduction	<i>iii - iv</i>	2	2 nd Edition Amendment 4	February 2017
Foreword	<i>v - vi</i>	2	2 nd Edition Amendment 4	February 2017
Amendment record	<i>vii - viii</i>	2	2 nd Edition Amendment 7	29 January 2021
Table of Contents	<i>ix - xxx</i>	22	2 nd Edition Amendment 7	29 January 2021
Chapter 1: Introduction	1-1 - 1-26	26	2 nd Edition Amendment 8	13 August 2021
Chapter 2: Application of Standards to Aerodromes	2-1 - 2-10	10	2 nd Edition Amendment 7	29 January 2021
Chapter 3: Applying for an Aerodrome Certificate	3-1 - 3-12	12	2 nd Edition Amendment 7	29 January 2021
Chapter 4: Applying for an Aerodrome Registration Type 1, Aerodrome Registration Type 2 and Permit to Operate (PTO)	4-1 - 4-10	10	2 nd Edition Amendment 7	29 January 2021
Chapter 5: Aerodrome Information for AIP	5-1 - 5-22	22	2 nd Edition Amendment 8	13 August 2021
Chapter 6: Aerodrome Physical Characteristics	6-1 - 6-38	38	2 nd Edition Amendment 7	29 January 2021
Chapter 7: Obstacle Restriction and Limitation	7-1 - 7-20	20	2 nd Edition Amendment 5	30 July 2019
Chapter 8: Aerodrome visual aids: markers, markings, signals and signs	8-1 - 8-110	110	2 nd Edition Amendment 7	29 January 2021
Chapter 9: Aerodrome visual aids – aerodrome lighting	9-1 - 9-162	162	2 nd Edition Amendment 8	13 August 2021
Chapter 10: Operating standards for certified aerodromes and Aerodrome Registration Type 1	10-1 - 10-62	62	2 nd Edition Amendment 8	13 August 2021
Chapter 11: Standards for other aerodrome facilities	11-1 - 11-12	12	2 nd Edition Amendment 7	29 January 2021
Chapter 12: Operating Standards for Aerodrome Registration Type 2	12-1 - 12-4	4	2 nd Edition Amendment 6	06 February 2020
Chapter 13: Standards for small aerodromes used for light aircraft operations	13-1 - 13-10	10	2 nd Edition Amendment 6	06 February 2020
Chapter 14: Aerodrome Rescue and Fire Fighting Service	14-1 - 14-8	8	2 nd Edition Amendment 8	13 August 2021



Chapter 15: Standards for heliports	15-1 - 15-84	84	2 nd Edition Amendment 7	05 January 2021
Appendix 1 Aerodrome Manual requirements	APP -1 - APP - 2	2	2 nd Edition Amendment 4	February 2017
Appendix 2 List of effective pages	APP -3 - APP - 4	2	2 nd Edition Amendment 7	29 January 2021
Appendix 3 Application form for aerodrome certification	APP -5 - APP - 6	2	2 nd Edition Amendment 4	February 2017
Appendix 4 Application Forms for Aerodrome Registration and Permit to Operate	APP -7 - APP - 14	8	2 nd Edition Amendment 4	February 2017
Appendix 5: Aeronautical data accuracy and integrity requirements	APP -15 - APP - 18	4	2 nd Edition Amendment 4	February 2017
Appendix 6: Specifications and location of obstacle lights	APP -19 - APP - 28	10	2 nd Edition Amendment 4	February 2017
Appendix 7: For instrument heliports with non-precision and/or precision approaches and instrument departures	APP -29 - APP -38	10	2 nd Edition Amendment 5	19 June 2019
ATTACHMENT A: SUPPLEMENTARY GUIDANCE MATERIAL TO MOS	ATT-1 - ATT-36	36	2 nd Edition Amendment 8	13 August 2021
ATTACHMENT B: CRITICAL DATA RELATED TO SAFETY OCCURRENCES REPORTED AT AERODROMES FOR THE MONITORING OF SAFETY	ATT-37 - ATT-42	6	2 nd Edition Amendment 4	February 2017

Appendix 3: Application Form for Aerodrome Certification

AANSOO Form A3: AGA-C-2013



Republic of the Philippines
CIVIL AVIATION AUTHORITY OF THE PHILIPPINES
Aerodrome and Air Navigation Safety Oversight Office
www.caap.gov.ph

AANSOO APPLICATION FORM – AERODROME CERTIFICATION**1. Particulars of the Applicant**

<i>Full Name:</i>	
<i>Address:</i>	
<i>Position:</i>	<i>Signature:</i>
<i>Telephone Number:</i>	<i>Fax No.:</i>
<i>Mobile No.:</i>	<i>Date:</i>

2. Particulars of the Aerodrome/ Heliport Site

<i>Name of Aerodrome/ Heliport</i>	
<i>Real Property Description:</i>	
<i>Aerodrome Reference Point (ARP)</i>	<i>Latitude:</i>
	<i>Longitude:</i>
<i>Distance and direction with respect to nearest Aerodrome/ Heliport:</i>	

3. Is the Applicant the Owner of the Aerodrome/Heliport Site?

YES <input type="checkbox"/>	NO <input type="checkbox"/>
<i>If No, provide:</i> a) <i>Details of rights held in relation to the site; and</i> b) <i>Name and address of the owner of the site and written evidence to show that permission has been obtained for the site to be used by the applicant as an aerodrome/heliport.</i> <i>NOTE: (For existing Aerodrome) The application must be accompanied by a report prepared by an approved safety inspector confirming that the information provided on this page is accurate and that the aerodrome meets the applicable safety standards.</i>	

4. Indicate the largest type of aircraft expected to use the aerodrome:

5. *Is the aerodrome to be used for air transport operations?*

Yes

☐

No

☐6. *Details to be shown on the aerodrome certificate*

Aerodrome Name:
Aerodrome Operator:

[On behalf of the Aerodrome Operator shown above*], I hereby apply for a certificate to operate the aerodrome.

**Delete if not applicable.*

Signed: _____

My authority to act on behalf of the applicant is:

Printed name of Person: _____

Signing this application: _____

Date: ____ / ____ / ____

For information:

1. A copy of the Aerodrome Manual, prepared in accordance with the regulations and commensurate with the aircraft activities expected at the aerodrome, is required as part of the application.
2. The application should be submitted to the Chief, AANSOO, CAAP.
3. Documentary evidence in support of all matters in this application may be requested.

Appendix 4: Application Forms for Aerodrome Registration and Permit to Operate

4.1 Aerodrome Registration

AANSOO Form A3: AGA-R-2013



Republic of the Philippines
CIVIL AVIATION AUTHORITY OF THE PHILIPPINES
Aerodrome and Air Navigation Safety Oversight Office
www.caap.gov.ph

AANSOO APPLICATION FORM – AERODROME REGISTRATION
1. Particulars of the Applicant

<i>Full Name:</i>	
<i>Address:</i>	
<i>Position:</i>	<i>Signature:</i>
<i>Telephone Number:</i>	<i>Fax No.:</i>
<i>Mobile No.</i>	<i>Date</i>

2. Particulars of the Aerodrome/ Heliport Site

<i>Name of Aerodrome/ Heliport</i>	
<i>Real Property Description:</i>	
<i>Aerodrome Reference Point (ARP)</i>	<i>Latitude:</i>
	<i>Longitude:</i>
<i>Distance and direction with respect to nearest Aerodrome/ Heliport:</i>	

3. Is the Applicant the Owner of the Aerodrome/Heliport Site?

YES <input type="checkbox"/>	NO <input type="checkbox"/>
<i>If No, provide:</i> c) <i>Details of rights held in relation to the site; and</i> d) <i>Name and address of the owner of the site and written evidence to show that permission has been obtained for the site to be used by the applicant as an aerodrome/heliport.</i> NOTE: (For existing Aerodrome) The application must be accompanied by a report prepared by an approved safety inspector confirming that the information provided on this page is accurate and that the aerodrome meets the applicable safety standards.	

4. Aerodrome Data. *If not applicable, insert N/A. (Heliport data must be derived in accordance with Chapter 5 of the MOS for Aerodromes).*

a) Aerodrome Diagram – Provide a diagram to depict the following:

- i) Runway lay-out, their magnetic bearing and length in meters;
- ii) Taxiways and aprons;
- iii) Aerodrome reference point;
- iv) Wind direction indicators, both lit and unlit;
- v) Elevation of the aerodrome (the highest point on the landing surface);
- vi) Magnetic bearing and distance to the nearest city, town or population center.

b) Aerodrome Administration

<i>Name of Aerodrome Operator:</i>		
<i>Address:</i>		
<i>Tel No.</i>	<i>(O/H):</i>	<i>(A/H):</i>
<i>Is the aerodrome open to public?</i>	<i>Yes</i>	<i>No</i>
<i>Landing Charges:</i>	<i>Yes</i>	<i>No</i>
<i>If yes, Please specify:</i>		
<i>Aerodrome Reporting Officer:</i>	<i>Name:</i>	<i>Contact details:</i>

c) Runway details. For each runway provide the following:

<i>Runway Designation:</i>	<i>Runway Reference Code</i>
	<i>TORA</i>
	<i>TODA</i>
	<i>ASDA</i>
	<i>LDA</i>
<i>Runway width</i>	
<i>Runway slope</i>	
<i>Runway strip width</i>	<i>(graded)</i>
<i>Pavement (surface type)</i>	
<i>Rating</i>	<i>(CAN/PCN) or</i>
	<i>(Max aircraft weight and tire pressure)</i>

d) Aerodrome Lighting. For each runway equipped with lighting, provide the following:

<i>Runway designation:</i>	
<i>Runway edge lights:</i>	
<i>Standby power? Yes</i> <input type="checkbox"/> <i>No</i> <input type="checkbox"/>	<i>Portable Lights? Yes</i> <input type="checkbox"/> <i>No</i> <input type="checkbox"/> <i>If yes, PAL frequency:</i>
<i>Any other lighting, specify</i>	

e) Ground Services. Information of services available to visiting pilots:

<i>Fuel type:</i>	<i>Supplier</i>	<i>Tel No.</i>
<i>If more than one fuel supplier, detail:</i>		

f) Special procedures:**e) Notices:**

4.2 Permit to Operate

AANSOO Form A3:AGA-P-2013



Republic of the Philippines
CIVIL AVIATION AUTHORITY OF THE PHILIPPINES
Aerodrome and Air Navigation Safety Oversight Office
www.caap.gov.ph

AANSOO APPLICATION FORM – PERMIT TO OPERATE
1. Particulars of the Applicant

<i>Full Name:</i>	
<i>Address:</i>	
<i>Position:</i>	<i>Signature:</i>
<i>Telephone Number:</i>	<i>Fax No.:</i>
<i>Mobile No.</i>	<i>Date</i>

2. Particulars of the Aerodrome/ Heliport Site

<i>Name of Aerodrome/ Heliport</i>	
<i>Real Property Description:</i>	
<i>Aerodrome Reference Point (ARP)</i>	<i>Latitude:</i>
	<i>Longitude:</i>
<i>Distance and direction with respect to nearest Aerodrome/ Heliport:</i>	

3. Is the Applicant the Owner of the Aerodrome/Heliport Site?

YES <input type="checkbox"/>	NO <input type="checkbox"/>
<i>If No, provide:</i> <ul style="list-style-type: none"> a) <i>Details of rights held in relation to the site; and</i> b) <i>Name and address of the owner of the site and written evidence to show that permission has been obtained for the site to be used by the applicant as an aerodrome/heliport.</i> <p>NOTE: (For existing Aerodrome) The application must be accompanied by a report prepared by an approved safety inspector confirming that the information provided on this page is accurate and that the aerodrome meets the applicable safety standards.</p>	

4. Heliport Data. *If not applicable, insert N/A. (Heliport data must be derived in accordance with Chapter 15 of the MOS for Aerodromes)*

a) Ground Site Heliport

<i>Dimension:</i>
<i>Elevation (AMSL):</i>
<i>Strength of contact surface:</i>
<i>Surfacing:</i>
<i>Thickness of Pavement:</i>
<i>Type of sub-grade soil:</i>
<i>Dimension of Touchdown Pad(s):</i>
<i>Nearest distance of fence from edge of safety area:</i>
<i>Nearest distance and direction of building(s) from edge of safety area:</i>
<i>Height, distance, direction of highest obstruction(s) near the heliport:</i>

b) Roof Site Heliport

<i>Dimension:</i>
<i>Elevation (AMSL):</i>
<i>Height of Roof above ground:</i>
<i>Dimension of Touchdown Pad(s):</i>
<i>Dimensions of safety area(s):</i>
<i>Strength of contact surface:</i>
<i>Height and nearest distance of parapet/guard rail with respect to center of touchdown pad:</i>
<i>Possible directions of approach and Departure Paths with respect to the Magnetic North:</i>
<i>Height, distance, direction of highest obstruction(s) near the heliport:</i>

5. Airstrip Data**a) Runway Strip**

<i>Dimension:</i>
<i>Type of Fencing:</i>

b) Runway

<i>Dimension:</i>		
<i>Magnetic Bearing:</i>		
<i>Elevation (AMSL):</i>		
<i>Type of Surfacing:</i>		
<i>Thickness of Pavement</i>	<i>Sub-base</i>	
	<i>Base:</i>	
	<i>Wearing Surface:</i>	
<i>Type of Sub-grade soil:</i>		<i>BR:</i>
<i>Strength (lbs. AUW):</i>	<i>SW:</i>	
	<i>DW:</i>	
	<i>DTW:</i>	
<i>Gradient:</i>		
<i>Stopways:</i>		
<i>Clearways:</i>		

c) Apron

<i>Dimension:</i>	
	<i>SW:</i>
<i>Strength (lbs. AUW)</i>	<i>DW:</i>
	<i>DTW:</i>
<i>Type of Surfacing:</i>	
<i>Parking Capacity</i>	
<i>Location</i>	

6. Facilities

<i>Day Facilities:</i>	<i>Day Markers:</i>	
	<i>Prevailing Wind Direction(s):</i>	
	<i>Wind Direction Indicator (kind and location)</i>	
<i>Night Facilities</i>		
<i>Communication (Radio, Telegraph, Telephone, etc.)</i>		
<i>Weather Instrument (Barometer, Thermometer, etc.)</i>		
<i>Transportation (Land, Water, etc.)</i>		
<i>Emergency (First Aid, Hospital, Firefighting, Repair Shop, etc.)</i>		
<i>Others (Fuel, Oil, Water, etc.)</i>		
<i>Are subject to flood:</i>		
<i>Brief description of artificial drainage system:</i>		
<i>Attach detailed plans of aerodrome/heliport showing landing area, surrounding area and obstructions duly signed and sealed by a licensed Civil Engineer:</i>		
<i>Rating desired:</i>		
<i>Type of operations: (check one or more as applicable)</i>	<i>Commercial</i>	
	<i>General Aviation</i>	
	<i>Commercial</i>	
	<i>Private use of general aviation owner only</i>	



CONSENT OF LAND AND/OR BUILDING OWNER(S)

Name of Building Owner: _____

Name of Land Owner: _____

Signature of Building Owner

Signature of Land Owner

Signature of Civil Engineer _____

PTR No. _____

Expiration date _____

Issued _____

TO BE FILLED UP BY CAAP AANSOO INSPECTOR

Inspection Fee (Php): _____

Official Receipt No.: _____

Date: _____

1. Name of Inspector: _____

2. Position : _____

3. Date Inspected: _____

4. Findings: _____

5. Recommendations: _____

Signature of Inspector

Appendix 5: Aeronautical data accuracy and integrity requirements**Table A5.1-1 - Latitude and longitude**

Latitude and longitude	Accuracy Data type	Integrity Classification
Aerodrome reference point.....	30 m surveyed/calculated	routine
Nav aids located at the aerodrome.....	3 m surveyed	essential
Obstacle in Area 3.....	0.5 m surveyed	essential
Obstacles in Area 2 (the part within the aerodrome boundary).....	5 m surveyed	essential
Runway thresholds.....	1 m surveyed	critical
Runway end (flight path alignment point).....	1 m surveyed	critical
Runway centre line points.....	1 m surveyed	critical
Runway-holding position.....	0.5 m surveyed	critical
Taxiway centre line/parking guidance line points.....	0.5 m surveyed	essential
Intermediate holding position marking line.....	0.5 m surveyed	essential
Exit guidance line.....	0.5 m surveyed	essential
Apron boundaries (polygon).....	1 m surveyed	routine
Aircraft stand points/INS checkpoints.....	0.5 m surveyed	routine

Note: - 1. See CAR-ANS Part 15, Appendix 15G for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

Note: - 2. Implementation of CAR-ANS Part 15, provisions 15.10.1.4 and 15.10.1.8, concerning the availability, as of 12 November 2015, of obstacle data according to Area 2 and Area 3 specifications would be facilitated by appropriate planning for the collection and processing of such data.

Table A5 – 2 Elevation/Altitude/Height

Elevation/altitude/height	Accuracy Data type	Integrity Classification
Aerodrome elevation.....	0.5 m surveyed	essential
WGS-84 geoid undulation at aerodrome elevation position.....	0.5 m surveyed	essential
Runway threshold, non-precision approaches	0.5 m surveyed	essential
WGS-84 geoid undulation at runway threshold, non-precision approaches.....	0.5 m surveyed	essential
Runway thresholds, precision approaches	0.25 m surveyed	critical
WGS-84 geoid undulation at runway threshold, precision approaches.....	0.25 m surveyed	critical
Runway centre line points.....	0.25 m surveyed	critical
Taxiway centre line/parking guidance line points.....	1 m surveyed	essential
Obstacles in Area 2 (the part within the aerodrome boundary).....	3 m surveyed	essential
Obstacles in Area 3.....	0.5 m surveyed	essential
Distance Measuring equipment/precision (DME/P).....	3 m surveyed	essential

Note: - 1. See CAR-ANS Part 15, Appendix 15G for graphical illustrations of obstacle data collection surfaces and criteria to identify obstacles in the defined areas

Note:- 2. Implementing of CAR-ANS Part 15, provisions 15.10.1.4 & 15.10.1.8, concerning the availability, as of 12 November 2015, of obstacle data according to Area 2 and Area 3 specifications would be facilitated by appropriate planning for the collection and processing of such data.

Table A5 – 3 Declination and magnetic variation

Declination/variation	Accuracy Data type	Integrity Classification
Aerodrome magnetic variation.....	1 degree surveyed	essential
ILS Localizer antenna magnetic variation.....	1 degree surveyed	essential
MLS azimuth antenna magnetic variation.....	1 degree surveyed	essential

Table A5 – 4 Bearing

Bearing	Accuracy Data type	Integrity Classification
ILS localizer alignment.....	1/100 degree surveyed	essential
MLS zero azimuth alignment.....	1/100 degree surveyed	essential
Runway bearing (True).....	1/100 degree surveyed	routine

Table A5 – 5 Length/distance/dimension

Length/distance/dimension	Accuracy Data type	Integrity Classification
Runway length.....	1 m surveyed	critical
Runway width.....	1 m surveyed	essential
Displaced threshold distance.....	1 m surveyed	routine
Stopway length and width.....	1 m surveyed	critical
Clearway length and width.....	1 m surveyed	essential
Landing distance available.....	1 m surveyed	critical
Take-off run available.....	1 m surveyed	critical
Take-off distance available.....	1 m surveyed	critical
Accelerate-stop distance available.....	1 m surveyed	critical
Runway shoulder width.....	1 m surveyed	essential
Taxiway width.....	1 m surveyed	essential
Taxiway shoulder width.....	1 m surveyed	essential
ILS localizer antenna-runway end, distance.....	3 m calculated	routine
ILS glide slope antenna-threshold, distance along centre line.....	3 m calculated	routine
ILS marker-threshold distance.....	3 m calculated	essential
ILS DME antenna-threshold, distance along centre line.....	3 m calculated	essential
MLS azimuth antenna-runwayend, distance.....	3 m calculated	routine
MLS elevation antenna-threshold, distance along centre line.....	3 m calculated	routine
MLS DME/P antenna-threshold, distance along centre line.....	3 m calculated	essential

Appendix 6: Specifications and location of obstacle lights**6.1 Specifications for obstacle lights****Table 6.1-1. Characteristics of obstacle lights**

1	2	3	4	5	6	7
Light Type	Color	Signal type/ (flash rate)	Peak intensity (cd) at given Background Luminance (b)			Light Distribution Table
			Day (Above 500 cd/m ²)	Twilight (50-500 cd/m ²)	Night (Below 50 cd/m ²)	
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 6.1-2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 6.1-2
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 6.1-2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60-90 fpm)	N/A	200	200	Table 6.1-2
Low-intensity, Type E	Red	Flashing (c)	N/A	N/A	32	Table 6.1-2 (Type B)
Medium-intensity, Type A	White	Flashing (20-60 fpm)	20000	20000	2000	Table 6.1-3
Medium-intensity, Type B	Red	Flashing (20-60 fpm)	N/A	N/A	2000	Table 6.1-3
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2000	Table 6.1-3
High-intensity, Type A	White	Flashing (40-60 fpm)	200000	20000	2000	Table 6.1-3
High-intensity, Type B	White	Flashing (40-60 fpm)	100000	20000	2000	Table 6.1-3

- (a) Low intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security shall be flashing-blue and those displayed on other vehicles shall be flashing-yellow.
- (b) For flashing lights, effective intensity as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.
- (c) For wind turbine application, to flash at the same rate as the lighting on the nacelle.

Table 6.1-2. Light distribution for low-intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

Note.— This table does not include recommended horizontal beam spreads. MOS 8.10.3.1(c) requires 360° coverage around an obstacle.

Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

- (a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.
- (b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.
- (c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.
- (d) Peak intensity should be located at approximately 2.5° vertical.
- (e) Peak intensity should be located at approximately 17° vertical.
- (f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Table 6.1-3. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table 6.1-1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

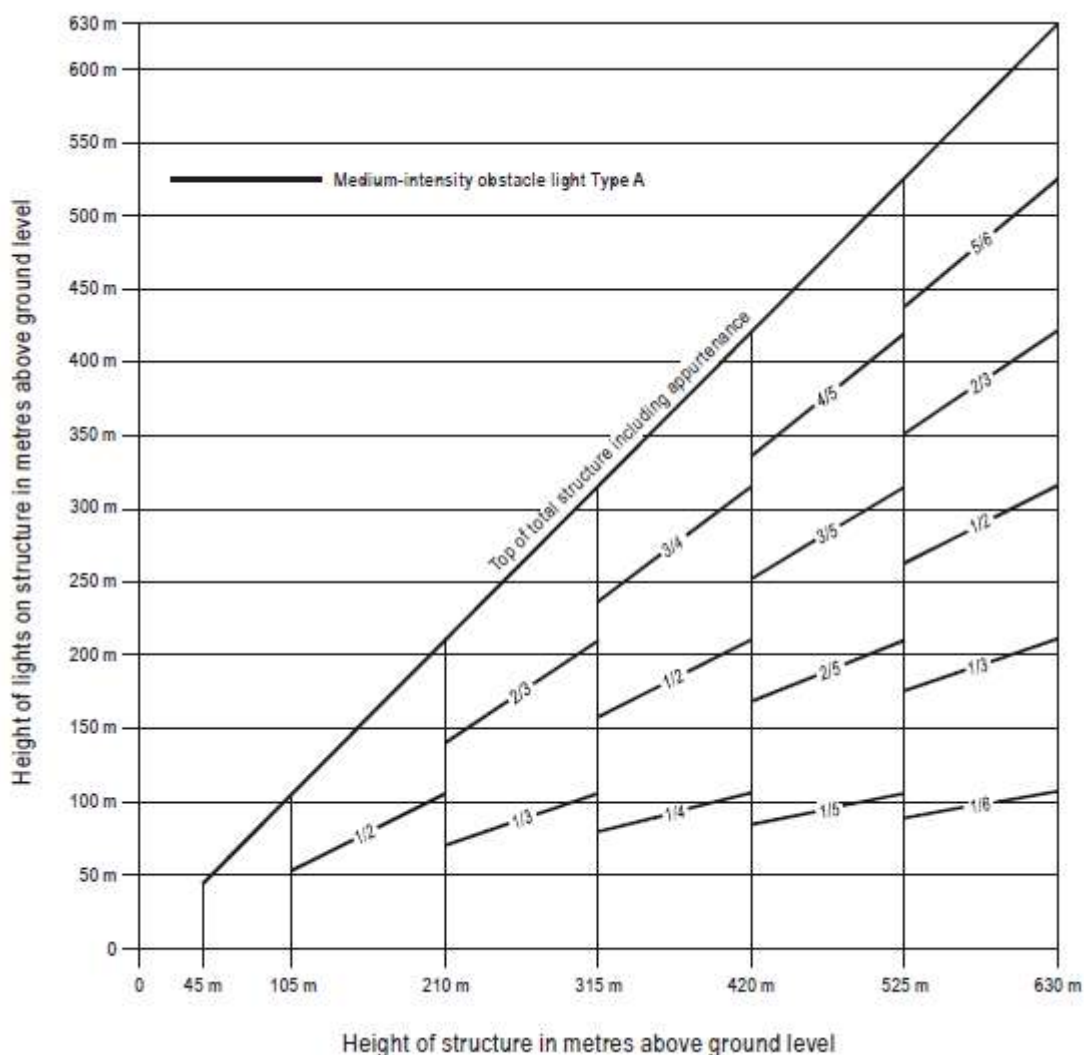
Note.— This table does not include recommended horizontal beam spreads. MOS 8.10.3.1 (c) requires 360° coverage around an obstacle.

Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

- (a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.
- (b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.
- (c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Note: - An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

6.2 Location of lights on obstacles



Note.— High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A6.2-1. Medium-intensity flashing-white obstacle lighting system, Type A

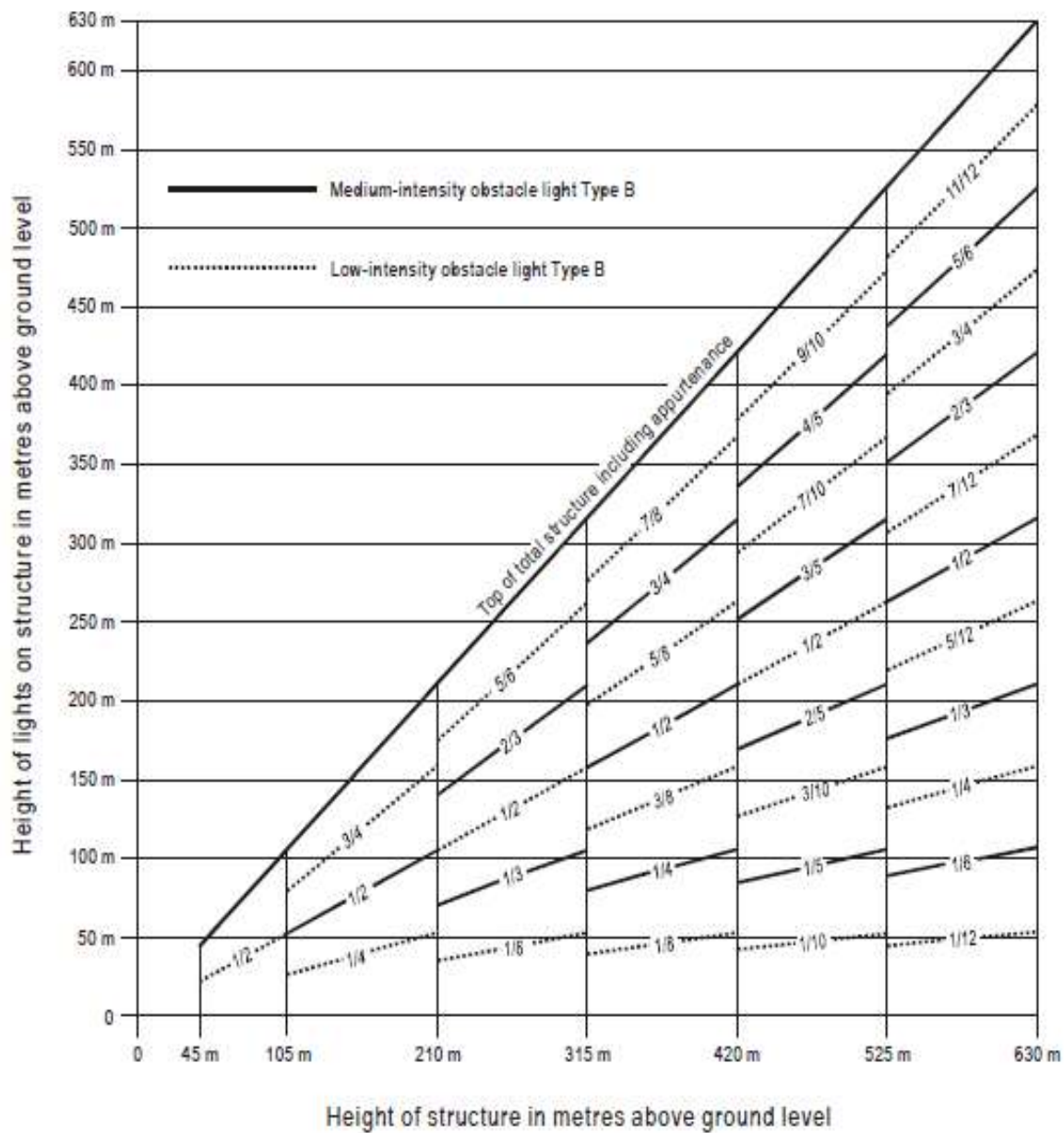
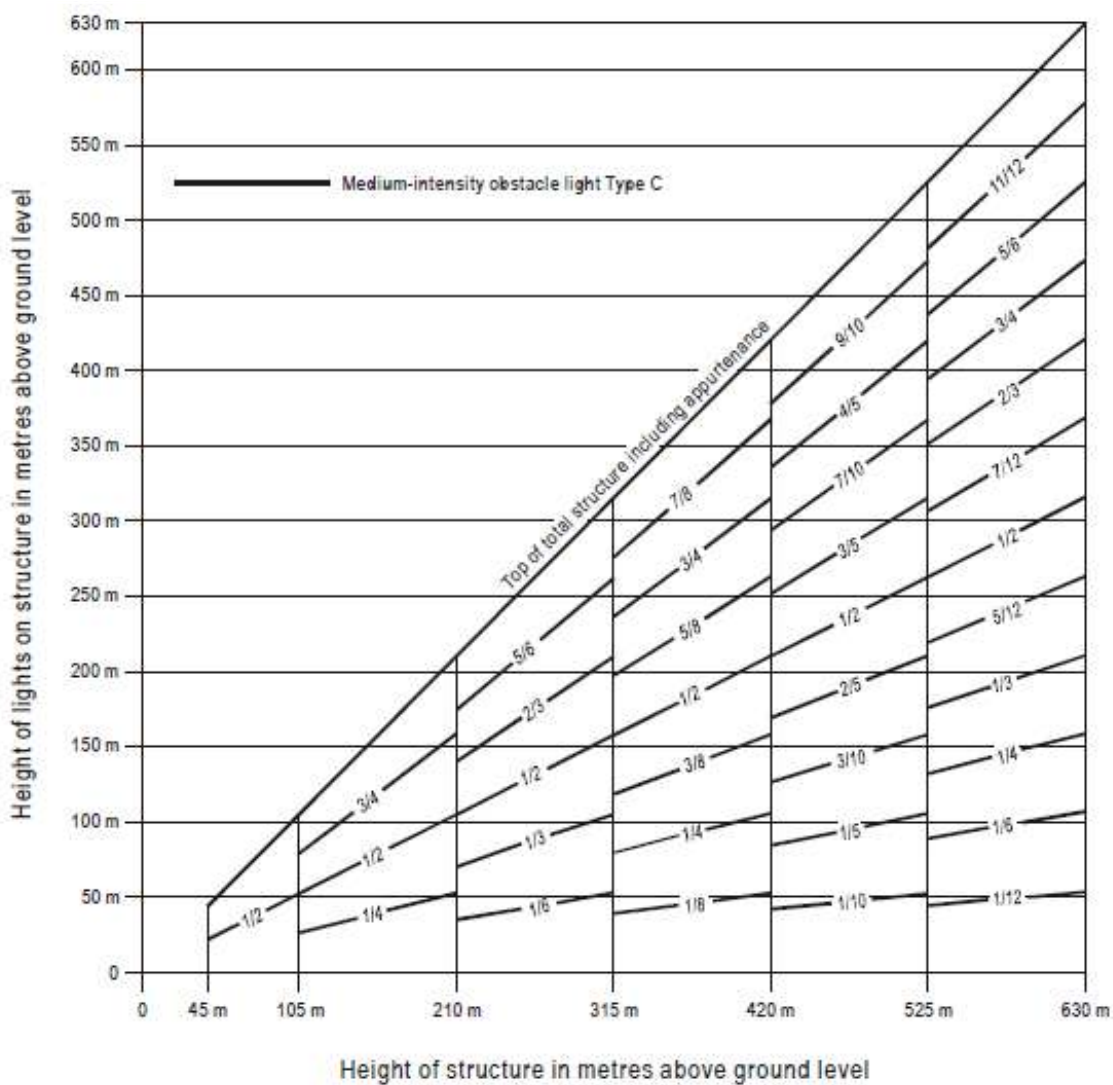
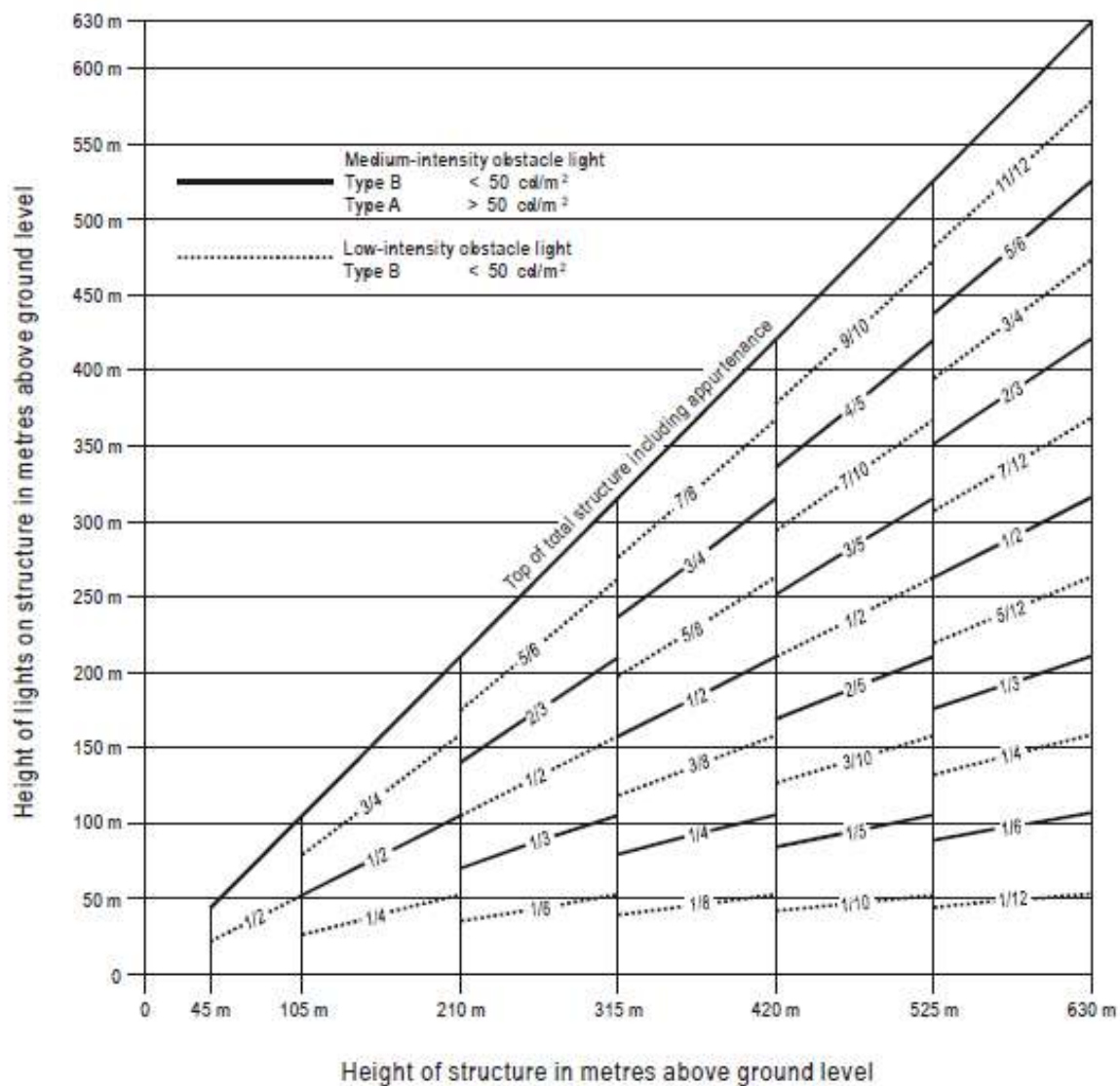


Figure A6.2-2. Medium-intensity flashing-red obstacle lighting system, Type B



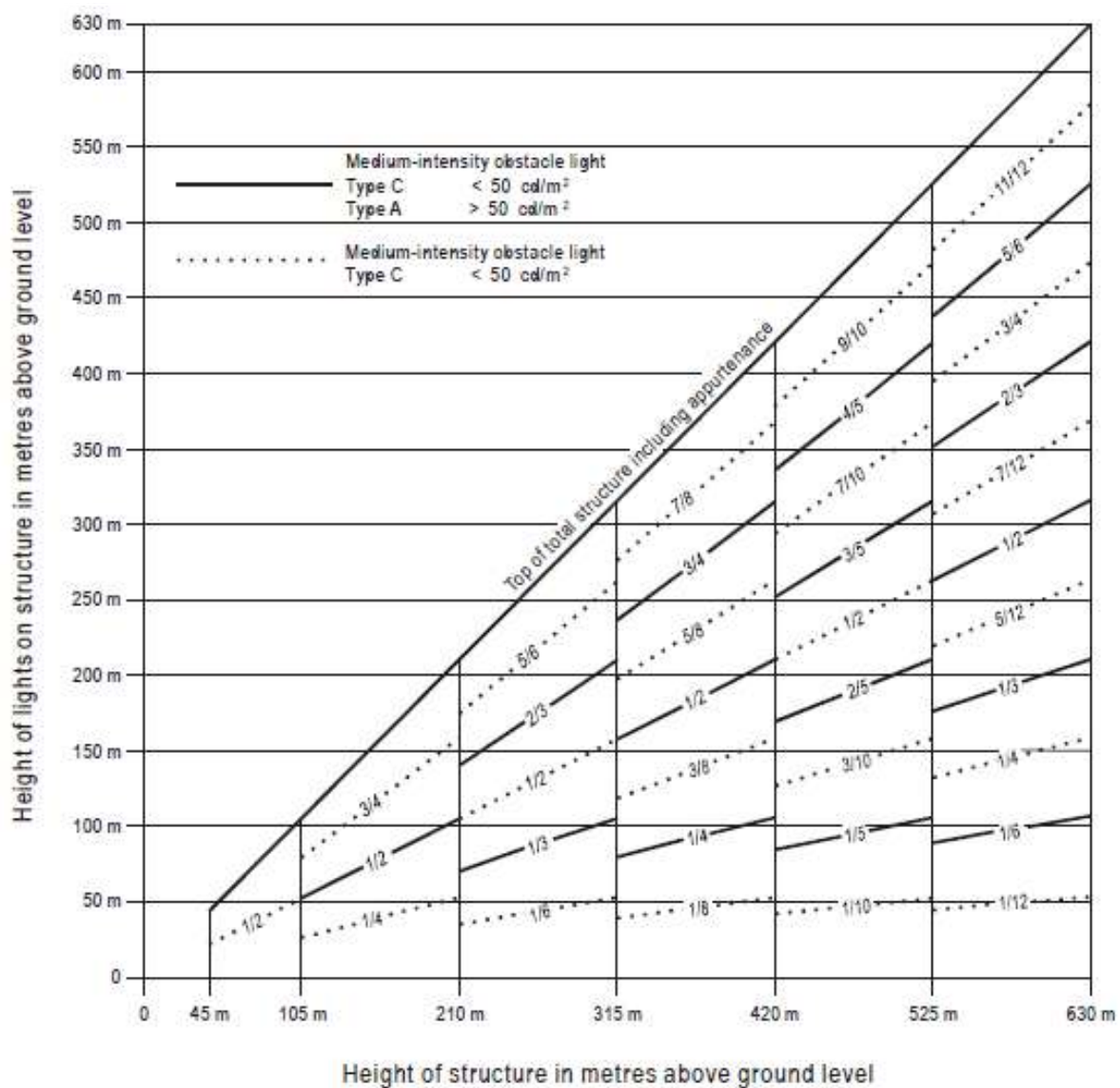
Note.— For night-time use only.

Figure A6.2-3. Medium-intensity fixed-red obstacle lighting system, Type C



Note.— High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A6.2-4. Medium-intensity dual obstacle lighting system, Type A/Type B



Note: - High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A6.2-5. Medium-intensity dual obstacle lighting system, Type A/Type C

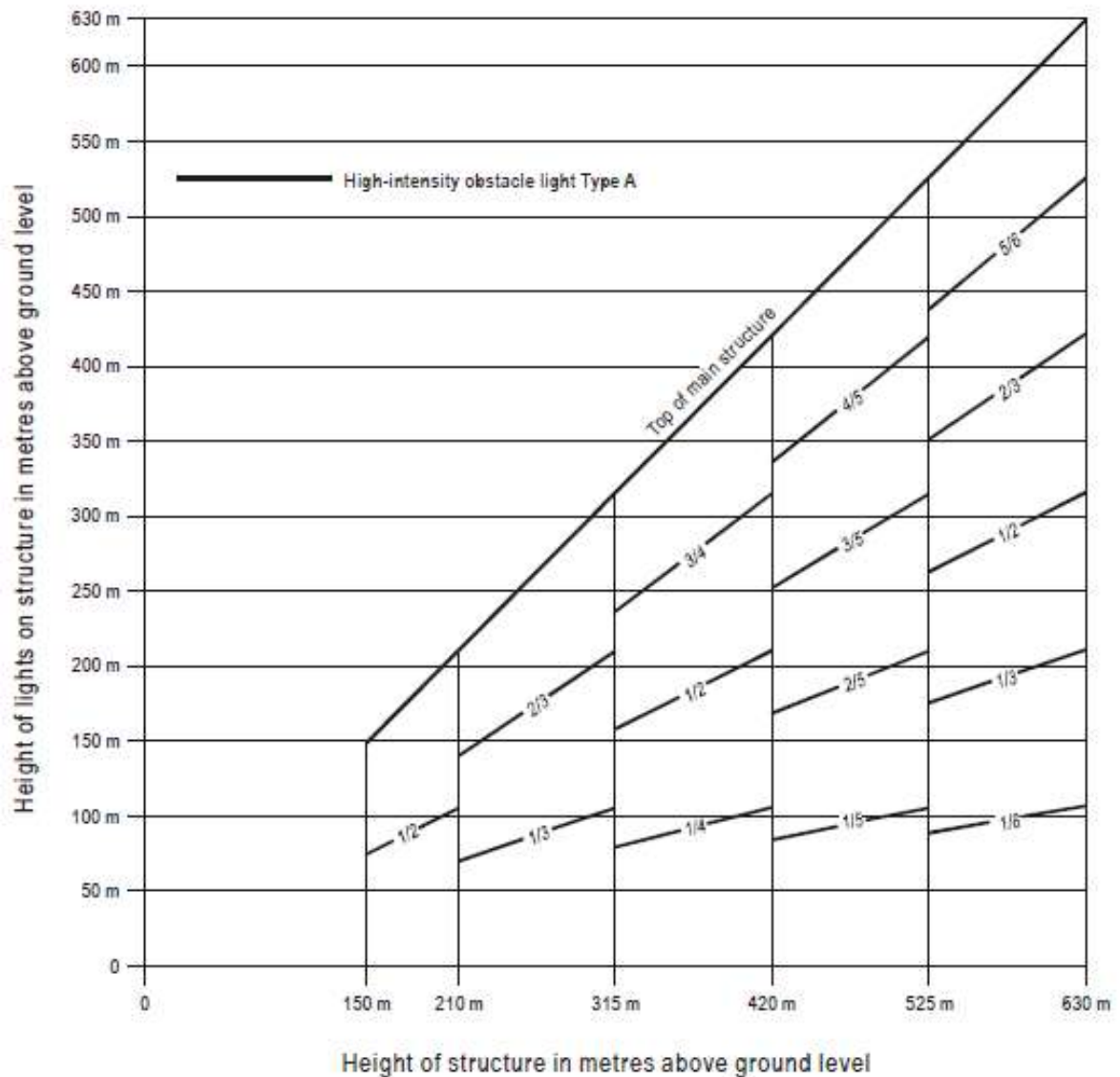


Figure A6.2-6. High-intensity flashing-white obstacle lighting system, Type A

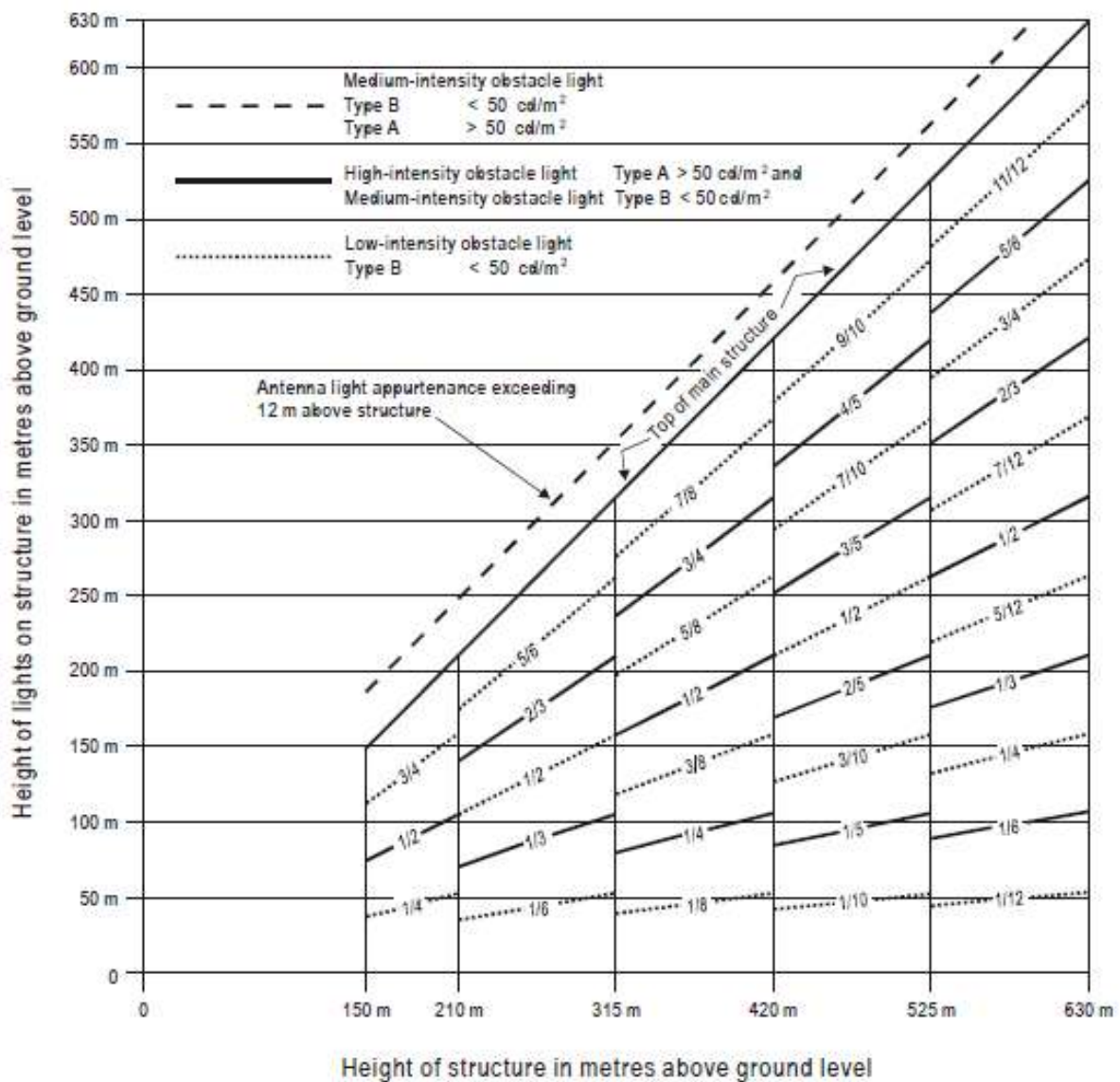


Figure A6.2-7. High-/medium-intensity dual obstacle lighting system, Type A/Type B

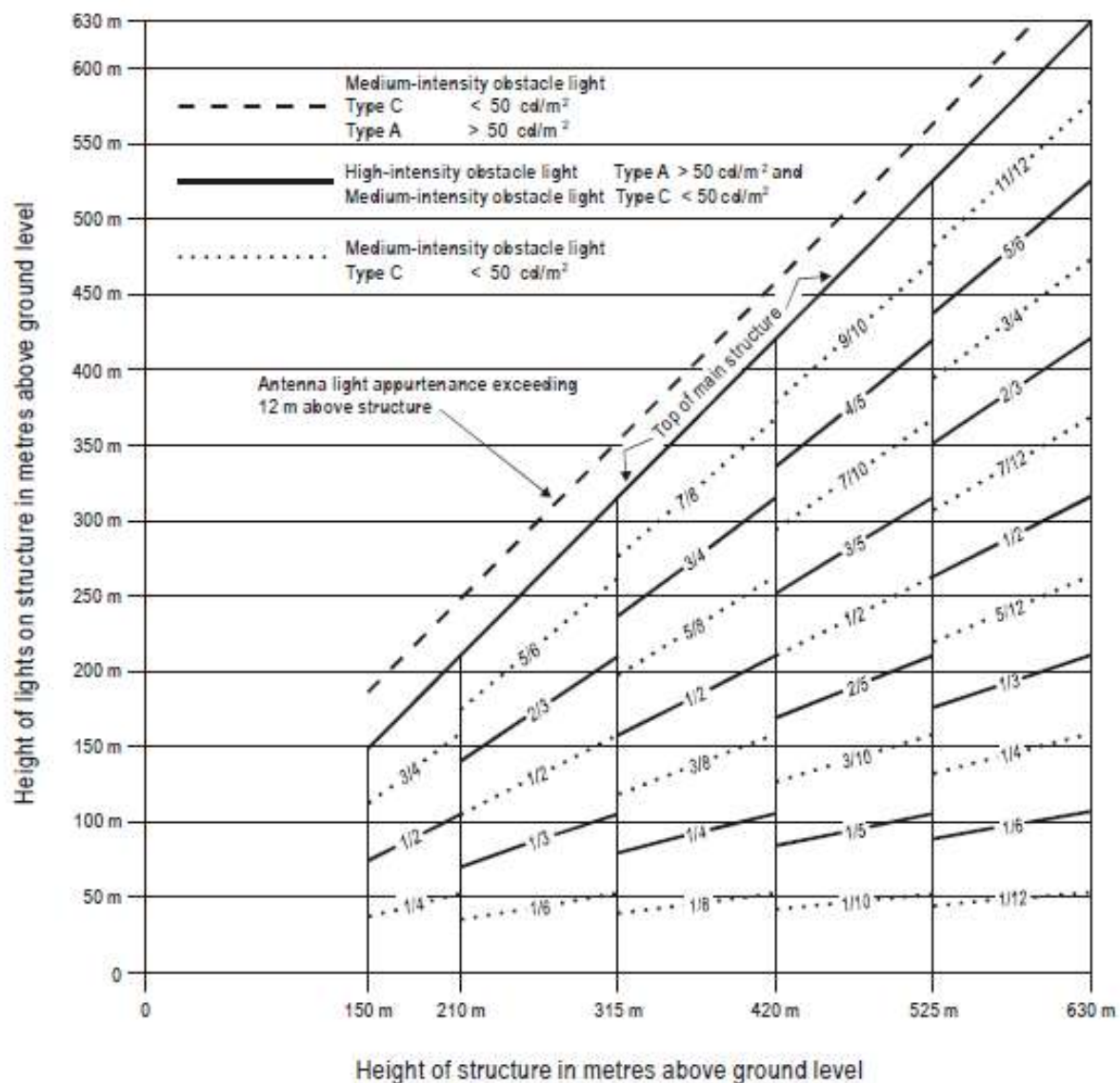


Figure A6.2-8. High-/medium-intensity dual obstacle lighting system, Type A/Type C

Appendix 7: For instrument heliports with non-precision and/or precision approaches and instrument departures

7.1 GENERAL

Introductory Note 1 -MOS 15 contains specification that prescribe the physical characteristics and obstacle limitation surfaces to be provided for at heliports, and certain facilities and technical services normally provided at a heliport. It is not intended that these specifications limit or regulate the operation of an aircraft.

Introductory Note 2.- The specifications in this appendix describe additional conditions beyond those found in the main sections of MOS 15 that apply to instrument heliports with non-precision and/or precision approaches. All specifications contained within MOS 15 are equally applicable to instrument heliports, but with reference to further provisions.

7.2 HELIPORT DATA

7.2.1 Heliport elevation

The elevation of the TLOF and/or the elevation and geoid undulation of each threshold of the FATO (where appropriate) shall be measured and reported to the aeronautical information services authority to the accuracy of:

- (a) one-half meter or foot for non-precision approaches; and
- (b) one-quarter meter or foot for precision approaches.

Note: - Geoid undulation must be measured in accordance with the appropriate system of coordinates.

7.2.2 Heliport dimensions and related information

The following additional data shall be measured or described, as appropriate, for each facility provided on an instrument heliport:

- (a) distances to the nearest meter or foot of localizer and glide path elements comprising an instrument landing system (ILS) in relation to the associated TLOF or FATO extremities.

7.3 PHYSICAL CHARACTERISTICS

7.3.1 Surface-level and elevated heliports

7.3.1.1 Safety areas

A safety area surrounding an instrument FATO shall extend:

- (a) laterally to a distance of at least 45 m on each side of the centerline; and
- (b) longitudinally to a distance of at least 60 m beyond the ends of the FATO.

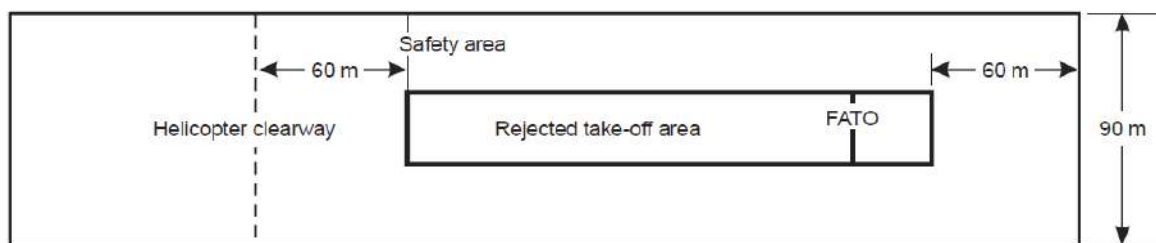


Figure A7-1 Safety area for Instrument FATO

7.4 OBSTACLE ENVIRONMENT

7.4.1 Obstacle limitation surfaces and sectors

7.4.1.1 Approach surface

Characteristics. The limits of an approach surface shall comprise:

- (a) an inner edge horizontal and equal in length to the minimum specified width of the FATO plus the safety area, perpendicular to the centerline of the approach surface and located at the outer edge of the safety area;
- (b) two side edges originating at the ends of the inner edge;
 - (i) for an instrument FATO with a non-precision approach, diverging uniformly at a specified rate from the vertical plane containing the centerlines of the FATO;
 - (ii) for an instrument FATO with a precision approach, diverging uniformly at a specified rate from the vertical plane containing the centerline of the FATO, to a specified height above FATO, and then diverging uniformly at a specified rate to a specified final width and continuing thereafter at that width for the remaining length of the approach surface; and
- (c) an outer edge horizontal and perpendicular to the centerline of the approach surface and at a specified height above the elevation of the FATO.

7.4.2 Obstacle limitation requirements

7.4.2.1 The following obstacle limitation surfaces shall be established for an instrument FATO with a non-precision and/or precision approach:

- (a) take-off climb surface;
- (b) approach surface; and
- (c) transitional surfaces.

Note: - See MOS Figures A7-2 to A7-5.

7.4.2.2 The slopes of the obstacle limitation surfaces shall not be greater than, and their other dimensions not less than, those specified in MOS Tables A7-1 to A7-3.

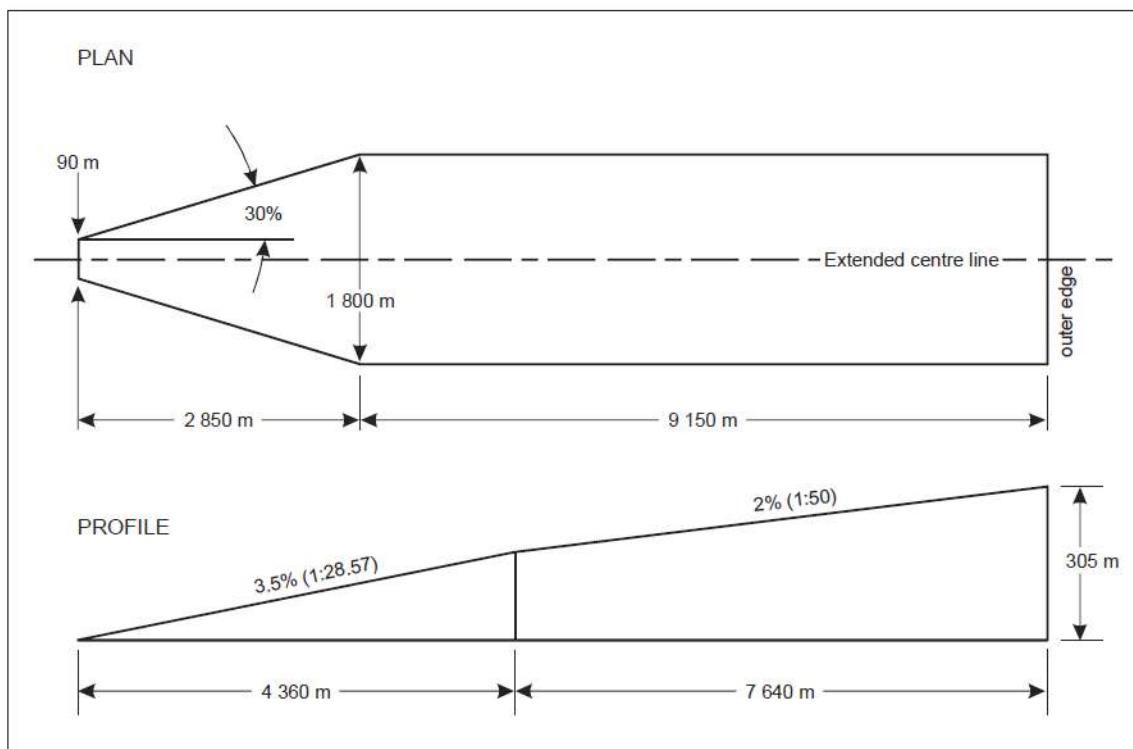


Figure A7-2. Take-off climb surface for instrument FATO

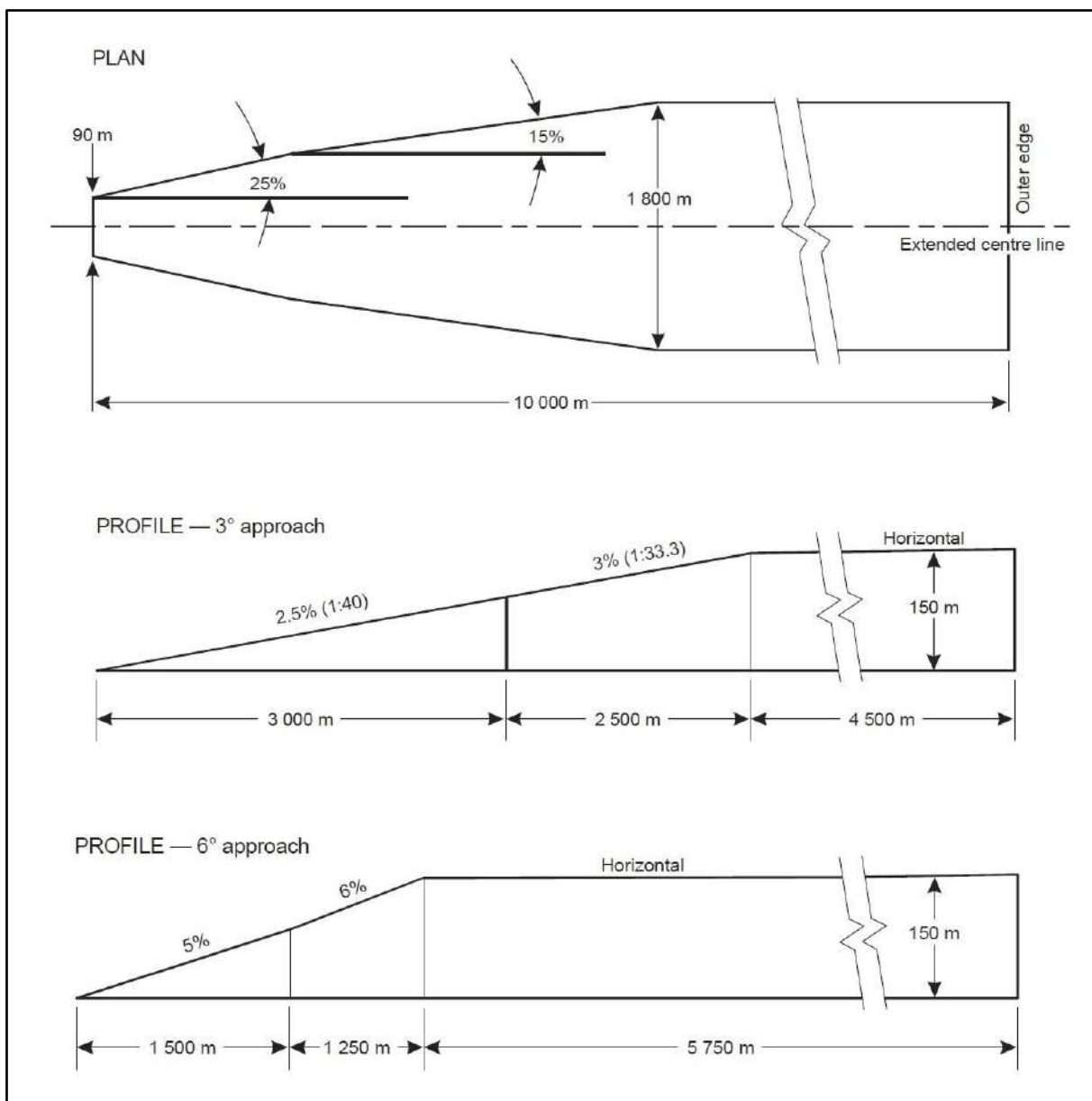


Figure A7-3. Approach surface for precision approach FATO

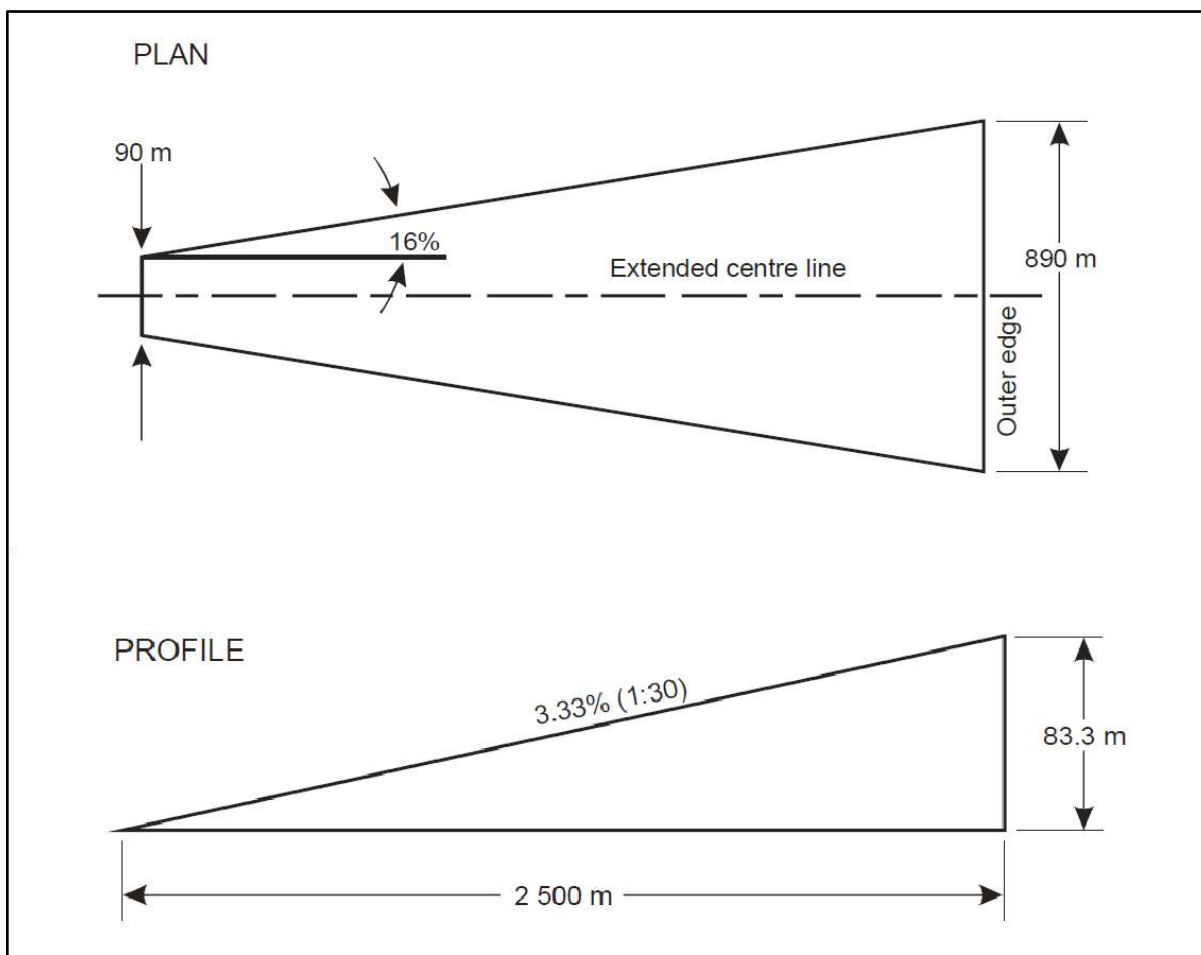
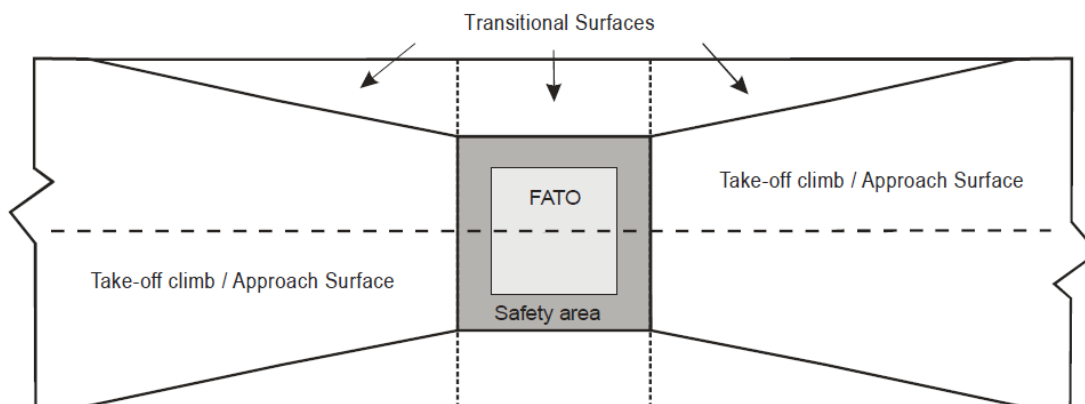


Figure A7-4. Approach surface for non-precision approach FATO



Note 1. – For single take-off climb / Approach Surface. Transition surface extends perpendicular to far side of Safety Area.

Note 2. – Doc.8168, Vol II, Part IV, Helicopters, details further obstacle limitation surface requirements associated with a VSS.

Figure A7-5. Transitional surfaces for an instrument FATO with a non-precision and/or precision approach

<i>SURFACE and DIMENSIONS</i>		
APPROACH SURFACE		
Width of inner edge		Width of safety area
Location of inner edge		boundary
First Section		
Divergence	— day	16%
	— night	
Length	— day	500 m
	— night	
Outer width	— day	800 m
	— night	
Slope (maximum)		3.33%
Second Section		
Divergence	— day	—
	— night	
Length	— day	—
	— night	
Outer width	— day	—
	— night	
Slope (maximum)		—
Third Section		
Divergence		—
Length	— day	—
	— night	
Outer width	— day	—
	— night	
Slope (maximum)		—
TRANSITIONAL		
Slope		20%
Height		45 m

Table A7-1. Dimensions and slopes of obstacle limitation surfaces Instrument (Non-precision) FATO

Surface and dimensions	3° approach				6° approach			
	Height above FATO				Height above FATO			
	90 m (300 ft)	60 m (200 ft)	45 m (150 ft)	30 m (100 ft)	90 m (300 ft)	60 m (200 ft)	45 m (150 ft)	30 m (100 ft)
APPROACH SURFACE								
Length of inner edge	90 m	90 m	90 m	90 m	90 m	90 m	90 m	90 m
Distance from end of FATO	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence each side to height above FATO	25%	25%	25%	25%	25%	25%	25%	25%
Distance to height above FATO	1 745 m	1 163 m	872 m	581 m	870 m	580 m	435 m	290 m
Width at height above FATO	962 m	671 m	526 m	380 m	521 m	380 m	307.5 m	235 m
Divergence to parallel section	15%	15%	15%	15%	15%	15%	15%	15%
Distance to parallel section	2 793 m	3 763 m	4 246 m	4 733 m	4 250 m	4 733 m	4 975 m	5 217 m
Width of parallel section	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m
Distance to outer edge	5 462 m	5 074 m	4 882 m	4 686 m	3 380 m	3 187 m	3 090 m	2 993 m
Width at outer edge	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m
Slope of first section	2.5% (1:40)	2.5% (1:40)	2.5% (1:40)	2.5% (1:40)	5% (1:20)	5% (1:20)	5% (1:20)	5% (1:20)
Length of first section	3 000 m	3 000 m	3 000 m	3 000 m	1 500 m	1 500 m	1 500 m	1 500 m
Slope of second section	3% (1:33.3)	3% (1:33.3)	3% (1:33.3)	3% (1:33.3)	6% (1:16.66)	6% (1:16.66)	6% (1:16.66)	6% (1:16.66)
Length of second section	2 500 m	2 500 m	2 500 m	2 500 m	1 250 m	1 250 m	1 250 m	1 250 m
Total length of surface	10 000 m	10 000 m	10 000 m	10 000 m	8 500 m	8 500 m	8 500 m	8 500 m
TRANSITIONAL								
Slope	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m

**Table A7-2. Dimensions and slopes of obstacle limitation surfaces
Instrument (Precision) FATO**

<i>SURFACE and DIMENSIONS</i>		<i>Instrument</i>
TAKE-OFF CLIMB		
Width of inner edge		90 m
Location of inner edge		Boundary of end of clearway
First Section		
Divergence	– day	30%
	– night	
Length	– day	2 850 m
	– night	
Outer width	– day	1 800 m
	– night	
Slope (maximum)		3.5%
Second Section		
Divergence	– day	parallel
	– night	
Length	– day	1 510 m
	– night	
Outer width	– day	1 800 m
	– night	
Slope (maximum)		3.5%*
Third Section		
Divergence		parallel
Length	– day	7 640 m
	– night	
Outer width	– day	1 800 m
	– night	
Slope (maximum)		2%
* This slope exceeds the maximum mass one-engine-inoperative climb gradient of many helicopters which are currently operating.		

STRAIGHT TAKE-OFF

Table A7-3. Dimensions and slopes of obstacle limitation surfaces

7.5 VISUAL AIDS**7.5.1 Lights****7.5.1.1 Approach Lighting Systems**

- (a) Where an approach lighting system is provided for a non-precision FATO, the system should not be less than 210 m in length.
- (b) The light distribution of steady lights should be as indicated in MOS Figure 15-30, Illustration 2 except that the intensity shall be increased by a factor of three for a non-precision FATO.

SURFACE AND DIMENSIONS	NON-PRECISION FATO	
Length of inner edge	Width of safety area	
Distance from end of FATO	60 m	
Divergence	15%	
Total length	2 500m	
Slope	PAPI	$A^a - 0.57^\circ$
	HAPI	$A^b - 0.65^\circ$
	APAPI	$A^a - 0.9^\circ$

- a. As indicated in MOS Figures 9.8-3.
- b. The length of the upper boundary of the “below slope” signal.

Table A7-4. Dimensions and slopes of the obstacle protection surface



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ATTACHMENT A: SUPPLEMENTARY GUIDANCE MATERIAL TO MOS**1. Runway end safety areas**

- 1.1 Where a runway end safety area is provided in accordance with MOS 6.4, consideration should be given to providing an area long enough to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localizer is normally the first upstanding obstacle, and the runway end safety area should extend up to this facility. In other circumstances the first upstanding obstacle may be a road, a railroad or other constructed or natural feature. The provision of a runway end safety area should take such obstacles into consideration.
- 1.2 Where provision of a runway end safety area will be particularly prohibitive to implement, consideration will have to be given to reducing some of the declared distances of the runway for the provision of a runway end safety area and installation of an arresting system.
- 1.3 Research programmes, as well as evaluation of actual aircraft overruns into arresting systems, have demonstrated that the performance of some arresting systems can be predictable and effective in arresting aircraft overruns.
- 1.4 Demonstrated performance of an arresting system can be achieved by a validated design method, which can predict the performance of the system. The design and performance should be based on the type of aircraft anticipated to use the associated runway that imposes the greatest demand upon the arresting system.
- 1.5 The design of an arresting system should consider multiple aircraft parameters, including but not limited to, allowable aircraft gear loads, gear configuration, tire contact pressure, aircraft center of gravity and aircraft speed. Accommodating undershoots should also be addressed. Additionally, the design should allow the safe operation of fully loaded rescue and fire fighting vehicles, including their ingress and egress.
- 1.6 The information relating to the provision of a runway end safety area and the presence of an arresting system should be published in the AIP.
- 1.7 Additional information is contained in the Aerodrome Design Manual (Doc 9157), Part 1.

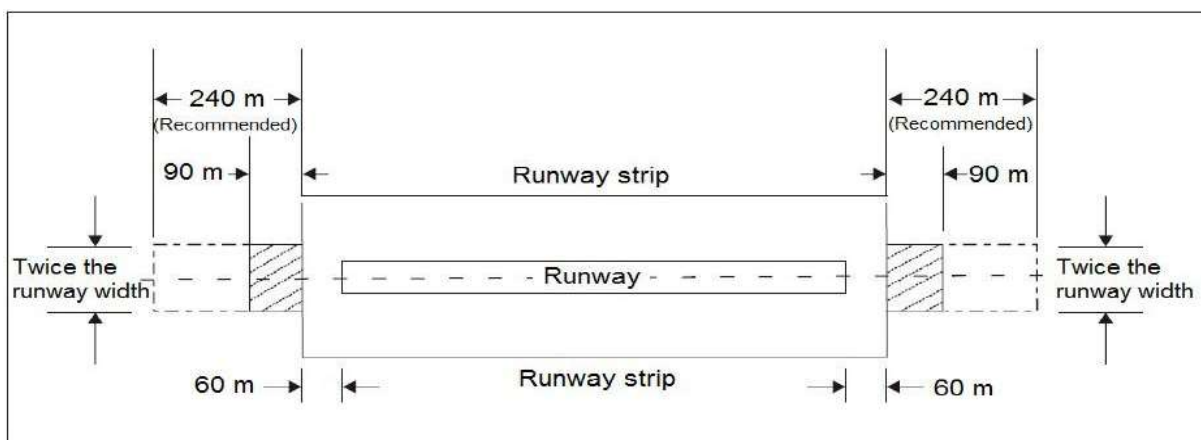


Fig. A-1 Runway end safety area for a runway where the code number is 3 or 4

2. Drainage characteristics of the movement area and adjacent areas

2.1 General

2.1.1 Rapid drainage of surface water is a primary safety consideration in the design, construction and maintenance of movement area and adjacent areas. The objective is to minimize water depth on the surface by draining water off the runway in the shortest path possible and particularly out of the area of the wheel path. There are two distinct drainage processes taking place:

- (a) natural drainage of the surface water from the top of the pavement surface until it reaches the final recipient such as rivers or other water bodies; and
- (b) dynamic drainage of the surface water trapped under a moving tire until it reaches outside the tire-to-ground contact area.

2.1.2 Both processes can be controlled through:

- (a) design;
- (b) construction; and
- (c) maintenance.

of the pavements in order to prevent accumulation of water on the pavement surface.

2.2 Design of pavement

2.2.1 Surface drainage is a basic requirement and serves to minimize water depth on the surface. The objective is to drain water off the runway in the shortest path. Adequate surface drainage is provided primarily by an appropriately sloped surface (in both the longitudinal and transverse directions). The resulting combined longitudinal and transverse slope is the path for the drainage run-off. This path can be shortened by adding transverse grooves.

2.2.2 Dynamic drainage is achieved through built-in texture in the pavement surface. The rolling tire builds up water pressure and squeezes the water out the escape channels provided by the texture. The dynamic drainage of the tire-to-ground contact area should be

improved by adding transverse grooves provided that they are subject to rigorous maintenance.

2.3 Construction of pavement

2.3.1 Through construction, the drainage characteristics of the surface are built into the pavement. These surface characteristics are:

- (a) slopes;
- (b) texture:
 - 1) microtexture;
 - 2) macrotexture.

2.3.2 Slopes for the various parts of the movement area and adjacent parts are described in MOS 6 and figures are given as per cent. Further guidance is given in the Aerodrome Design Manual (Doc 9157), Part 1, Chapter 5.

2.3.3 Texture in the literature is described as microtexture or macrotexture. These terms are understood differently in various parts of the aviation industry.

2.3.4 Microtexture is the texture of the individual stones and is hardly detectable by the eye. Microtexture is considered a primary component in skid resistance at slow speeds. On a wet surface at higher speeds a water film should prevent direct contact between the surface asperities and the tire due to insufficient drainage from the tire-to-ground contact area.

2.3.5 Microtexture is a built-in quality of the pavement surface. By specifying crushed material that will withstand polishing microtexture, drainage of thin water films are ensured for a longer period of time. Resistance against polishing is expressed in terms of the Polished Stone Values (PSV) which is in principle a value obtained from a friction measurement in accordance with international standards. These standards define the PSV minima that will enable a material with a good microtexture to be selected.

2.3.6 A major problem with microtexture is that it can change within short time periods without being easily detected. A typical example of this is the accumulation of rubber deposits in the touchdown area which will largely mask microtexture without necessarily reducing macrotexture.

2.3.7 Macrotexture is the texture among the individual stones. This scale of texture should be judged approximately by the eye. Macrotexture is primarily created by the size of aggregate used or by surface treatment of the pavement and is the major factor influencing drainage capacity at high speeds. Materials should be selected so as to achieve good macrotexture.

2.3.8 The primary purpose of grooving a runway surface is to enhance surface drainage. Natural drainage can be slowed down by surface texture, but grooving can speed up the drainage by providing a shorter drainage path and increasing the drainage rate.

2.3.9 For measurement of macrotexture, simple methods such as the "sand and grease patch" methods described in the Airport Services Manual (Doc 9137), Part 2 were developed. These methods were used for the early research on which current airworthiness

requirements are based, which refer to a classification categorizing macrotexture from A to E. This classification was developed, using sand or grease patch measuring techniques, and issued in 1971 by the Engineering Sciences Data Unit (ESDU).

Runway classification based on texture information from ESDU 71026:

Classification Texture depths (mm)

- A 0.10 – 0.14
- B 0.15 – 0.24
- C 0.25 – 0.50
- D 0.51 – 1.00
- E 1.01 – 2.54

- 2.3.10 Using this classification, the threshold value between microtexture and macrotexture is 0.1 mm mean texture depth (MTD). Related to this scale, the normal wet runway aircraft performance is based upon texture giving drainage and friction qualities midway between classification B and C (0.25 mm). Improved drainage through better texture might qualify for a better aircraft performance class. However, such credit should be in accordance with aeroplane manufacturers' documentation and agreed by CAAP. Presently credit is given to grooved or porous friction course runways following design, construction and maintenance criteria acceptable to CAAP. The harmonized certification standards referred to texture giving drainage and friction qualities midway between classification D and E (1.0 mm).
- 2.3.11 For construction, design and maintenance, CAAP use various international standards. Currently ISO 13473-1: Characterization of pavement texture by use of surface profiles - Part 1: Determination of Mean Profile Depth links the volumetric measuring technique with non-contact profile measuring techniques giving comparable texture values. These standards describe the threshold value between microtexture and macrotexture as 0.5 mm. The volumetric method has a validity range from 0.25 to 5 mm MTD. The profilometry method has a validity range from 0 to 5 mm mean profile depth (MPD). The values of MPD and MTD differ due to the finite size of the glass spheres used in the volumetric technique and because the MPD is derived from a two-dimensional profile rather than a three-dimensional surface. Therefore, a transformation equation should be established for the measuring equipment used to relate MPD to MTD.
- 2.3.12 The ESDU scale groups runway surfaces based on macrotexture from A through E, where E represents the surface with best dynamic drainage capacity. The ESDU scale thus reflects the dynamic drainage characteristics of the pavement. Grooving any of these surfaces enhances the dynamic drainage capacity. The resulting drainage capacity of the surface is thus a function of the texture (A through E) and grooving. The contribution from grooving is a function of the size of the grooves and the spacing between the grooves. Aerodromes exposed to heavy or torrential rainfall should ensure that the pavement and adjacent areas have drainage capability to withstand these rainfalls or put limitations on the use of the pavements under such extreme situations. These airports should seek to have the maximum allowable slopes and the use of aggregates providing good drainage characteristics. They should also consider grooved pavements in the E classification to ensure that safety is not impaired.

- 2.4 Maintenance of drainage characteristics of pavement
- 2.4.1 Macrottexture does not change within a short timespan but accumulation of rubber can fill up the texture and as such reduce the drainage capacity, which can result in impaired safety. Furthermore, the runway structure may change over time and give unevenness which results in ponding after rainfall. Guidance on rubber removal and unevenness can be found in the Airport Services Manual (Doc 9137), Part 2. Guidance on methods for improving surface texture can be found in the Aerodrome Design Manual (Doc 9157), Part 3.
- 2.4.2 When groovings are used, the condition of the grooves should be regularly inspected to ensure that no deterioration has occurred and that the grooves are in good condition. Guidance on maintenance of pavements is available in the Airport Services Manual (Doc 9137), Part 2 — Pavement Surface Conditions and Part 9 — Airport Maintenance Practices and the Aerodrome Design Manual (Doc 9157), Part 2.
- 2.4.3 The pavement should be shot blasted in order to enhance the pavement macrottexture.

3. Runway condition report for reporting runway surface condition

Applicable as of 4 November 2021

- 3.1 On a global level, movement areas are exposed to a multitude of climatic conditions and consequently a significant difference in the condition to be reported. The runway condition report (RCR) describes a basic methodology applicable for all these climatic variations and is structured in such a way that CAAP can adjust them to the climatic conditions applicable for CAAP region.
- 3.2 The concept of the RCR is premised on:
- (a) an agreed set of criteria used in a consistent manner for runway surface condition assessment, aeroplane (performance) certification and operational performance calculation;
 - (b) a unique runway condition code (RWYCC) linking the agreed set of criteria with the aircraft landing and take-off performance table, and related to the braking action experienced and eventually reported by flight crews;
 - (c) reporting of contaminant type and depth that is relevant to take-off performance;
 - (d) a standardized common terminology and phraseology for the description of runway surface conditions that can be used by aerodrome operator inspection personnel, air traffic controllers, aircraft operators and flight crew; and
 - (e) globally-harmonized procedures for the establishment of the RWYCC with a built-in flexibility to allow for local variations to match the specific weather, infrastructure and other particular conditions.
- 3.3 These harmonized procedures are reflected in a runway condition assessment matrix (RCAM) which correlates the RWYCC, the agreed set of criteria and the aircraft braking action which the flight crew should expect for each value of the RWYCC.

- 3.4 Procedures which relate to the use of the RCAM are provided in the PANS-Aerodromes (Doc 9981).
- 3.5 It is recognized that information provided by the aerodrome's personnel assessing and reporting runway surface condition is crucial to the effectiveness of the runway condition report. A misreported runway condition alone should not lead to an accident or incident. Operational margins should cover for a reasonable error in the assessment, including unreported changes in the runway condition. But a misreported runway condition can mean that the margins are no longer available to cover for other operational variance (such as unexpected tailwind, high and fast approach above threshold or long flare).
- 3.6 This is further amplified by the need for providing the assessed information in the proper format for dissemination, which requires insight into the limitations set by the syntax for dissemination. This in turn restricts the wording of plain text remarks that can be provided.
- 3.7 It is important to follow standard procedures when providing assessed information on the runway surface conditions to ensure that safety is not compromised when aeroplanes use wet or contaminated runways. Personnel should be trained in the relevant fields of competence and their competence verified in a manner required by CAAP to ensure confidence in their assessments.
- 3.8 The training syllabus may include initial and periodic recurrent training in the following areas:
- (a) aerodrome familiarization, including aerodrome markings, signs and lighting;
 - (b) aerodrome procedures as described in the aerodrome manual;
 - (c) aerodrome emergency plan;
 - (d) Notice to Airmen (NOTAM) initiation procedures;
 - (e) completion of/ initiation procedures for RCR;
 - (f) aerodrome driving rules;
 - (g) air traffic control procedures on the movement area;
 - (h) radiotelephone operating procedures;
 - (i) phraseology used in aerodrome control, including the ICAO spelling alphabet;
 - (j) aerodrome inspection procedures and techniques;
 - (k) type of runway contaminants and reporting;
 - (l) assessment and reporting of runway surface friction characteristics;
 - (m) use of runway friction measurement device;
 - (n) calibration and maintenance of runway friction measurement device;
 - (o) awareness of uncertainties related to l) and m); and
 - (p) low visibility procedures.

4. Runway surface evenness

- 4.1 In adopting tolerances for runway surface irregularities, the following standard of construction is achievable for short distances of 3 m and conforms to good engineering practice:

Except across the crown of a camber or across drainage channels, the finished surface of the wearing course is to be of such regularity that, when tested with a 3 m straight-edge placed anywhere in any direction on the surface, there is no deviation greater than 3 mm between the bottom of the straight-edge and the surface of the pavement anywhere along the straight-edge.

- 4.2 Caution should also be exercised when inserting runway lights or drainage grilles in runway surfaces to ensure that adequate smoothness of the surface is maintained.

- 4.3 The operation of aircraft and differential settlement of surface foundations will eventually lead to increases in surface irregularities. Small deviations in the above tolerances will not seriously hamper aircraft operations. In general, isolated irregularities of the order of 2.5 cm to 3 cm over a 45 m distance are acceptable, as shown in MOS Figure A-2. Although maximum acceptable deviations vary with the type and speed of an aircraft, the limits of acceptable surface irregularities can be estimated to a reasonable extent. The following table describes acceptable, tolerable and excessive limits:

- (a) if the surface irregularities exceed the heights defined by the acceptable limit curve but are less than the heights defined by the tolerable limit curve, at the specified minimum acceptable length, herein noted by the tolerable region, then maintenance action should be planned. The runway should remain in service. This region is the start of possible passenger and pilot discomfort;
- (b) if the surface irregularities exceed the heights defined by the tolerable limit curve, but are less than the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the excessive region, then maintenance corrective action is mandatory to restore the condition to the acceptable region. The runway may remain in service but be repaired within a reasonable period. This region can lead to the risk of possible aircraft structural damage due to a single event or fatigue failure over time; and
- (c) if the surface irregularities exceed the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the unacceptable region, then the area of the runway where the roughness has been identified warrants closure. Repairs must be made to restore the condition to within the acceptable limit region and the aircraft operators may be advised accordingly. This region runs the extreme risk of a structural failure and must be addressed immediately.

Note that "surface irregularity" is defined herein to mean isolated surface elevation deviations that do not lie along a uniform slope through any given section of a runway. For the purposes of this concern, a "section of a runway" is defined herein to mean a segment of a runway throughout which a continuing general uphill, downhill or flat slope is prevalent. The length of this section is generally between 30 and 60 meters, and can be greater, depending on the longitudinal profile and the condition of the pavement.

The maximum tolerable step type bump, such as that which could exist between adjacent slabs, is simply the bump height corresponding to zero bump length at the upper end of the tolerable region of the roughness criteria of Table 10.15-3. The bump height at this location is 1.75 cm.

Surface Irregularity	Length of irregularity (m)								
	3	6	9	12	15	20	30	45	60
Acceptable surface irregularity height (cm)	2.9	3.8	4.5	5	5.4	5.9	6.5	8.5	10
Tolerable surface irregularity height (cm)	3.9	5.5	6.8	7.8	8.6	9.6	11	13.6	16
Excessive surface irregularity height (cm)	5.8	7.6	9.1	10	10.8	11.9	13.9	17	20

Table A-1: Length of irregularity (m)

- 4.4 MOS Figure A-2 illustrates a comparison of the surface roughness criteria with those developed by the United States Federal Aviation Administration. Further guidance regarding temporary slopes for overlay works on operational runways can be found in *Aerodrome Design Manual, Part 3 — Pavements* (Doc 9157).

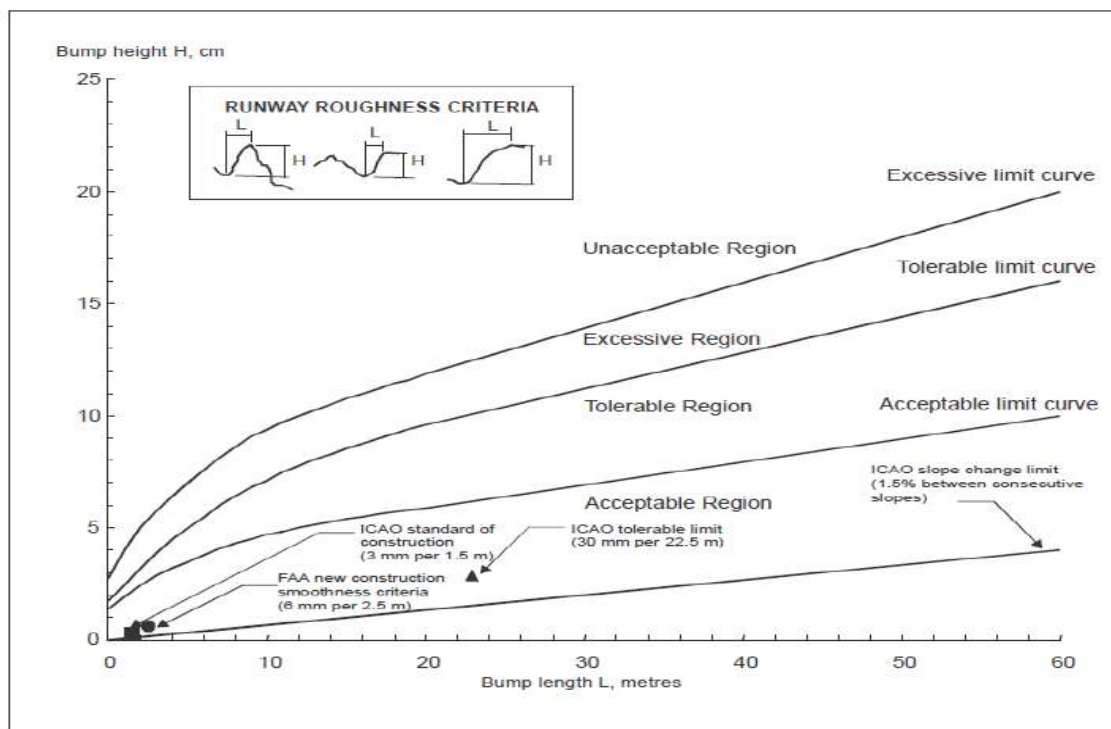


Figure A-2. Comparison of roughness criteria

Note.— These criteria address single event roughness, not long wavelength harmonic effects nor the effect of repetitive surface undulations.

- 4.5 Deformation of the runway with time may also increase the possibility of the formation of water pools. Pools as shallow as approximately 3 mm in depth, particularly if they are located where they are likely to be encountered at high speed by landing aeroplanes, can induce aquaplaning, which can then be sustained on a wet runway by a much shallower depth of water. Improved guidance regarding the significant length and depth of pools relative to aquaplaning is the subject of further research.

5. Rescue and Firefighting Services

5.1 Administration

- 5.1.1 The rescue and firefighting service at an aerodrome should be under the administrative control of the aerodrome management, which should also be responsible for ensuring that the service provided is organized, equipped, staffed, trained and operated in such a manner as to fulfil its proper functions.

- 5.1.2 In drawing up the detailed plan for the conduct of search and rescue operations in accordance with CAR-ANS 12.4.2.1, the aerodrome management should coordinate its plans with the relevant rescue coordination centers to ensure that the respective limits of their responsibilities for an aircraft accident within the vicinity of an aerodrome are clearly delineated.

- 5.1.3 Coordination between the rescue and firefighting service at an aerodrome and public protective agencies, such as local fire brigade, police force, coast guard and hospitals, should be achieved by prior agreement for assistance in dealing with an aircraft accident.

- 5.1.4 A grid map of the aerodrome and its immediate vicinity should be provided for the use of the aerodrome services concerned. Information concerning topography, access roads and location of water supplies should be indicated. This map should be conspicuously posted in the control tower and fire station, and available on the rescue and fire fighting vehicles and such other supporting vehicles required to respond to an aircraft accident or incident. Copies should also be distributed to public protective agencies as desirable.

- 5.1.5 Coordinated instructions should be drawn up detailing the responsibilities of all concerned and the action to be taken in dealing with emergencies. The appropriate authority should ensure that such instructions are promulgated and observed.

5.2 Training

- (a) fire dynamics, toxicity and basic first aid;
- (b) extinguishing agents and firefighting techniques;
- (c) handling of vehicles, vessels and equipment;
- (d) airfield layout and aircraft construction;

- (e) operational tactics and manoeuvres;
- (f) emergency communication;
- (g) leadership performance;
- (h) physical fitness; and
- (i) auxiliary modules (e.g. rescue in difficult terrain, response to biological/chemical threats, etc.).

Note: Guidance for the development of an RFFS Training Programme for Aerodromes is contained in AC 139-RFFS - 02 and Doc 9137, Airport Services Manual137 Part 1 — Rescue and Firefighting, Fourth Edition, 2015.

5.3 Level of protection to be provided

5.3.1 In accordance with MOS 14, aerodromes should be categorized for rescue and firefighting purposes and the level of protection provided should be appropriate to the aerodrome category.

5.3.2 However, MOS 14.2 permits a lower level of protection to be provided for a limited period where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three (3) months. It is important to note that the concession included in MOS 14.2 is applicable only where there is a wide range of difference between the dimensions of the aeroplanes included in reaching 700 movements.

5.4 Rescue equipment for difficult environments

5.4.1 Suitable rescue equipment and services should be available at an aerodrome where the area to be covered by the service includes water, swampy areas or other difficult environment that cannot be fully served by conventional wheeled vehicles. This is particularly important where a significant portion of approach/departure operations takes place over these areas.

5.4.2 The rescue equipment should be carried on boats or other vehicles such as helicopters and amphibious or air cushion vehicles, capable of operating in the area concerned. The vehicles should be so located that they can be brought into action quickly to respond to the areas covered by the service.

5.4.3 At an aerodrome bordering the water, the boats or other vehicles should preferably be located on the aerodrome, and convenient launching or docking sites provided. If these vehicles are located off the aerodrome, they should preferably be under the control of the aerodrome rescue and firefighting service or, if this is not practicable, under the control of another competent public or private organization working in close coordination with the aerodrome rescue and firefighting service (such as police, military services, harbor patrol or coast guard).

5.4.4 Boats or other vehicles should have as high a speed as practicable so as to reach an accident site in minimum time. To reduce the possibility of injury during rescue operations, water jet-driven boats are preferred to water propeller driven boats unless the propellers of the latter boats are ducted. Vehicles used in this service should be

equipped with life rafts and life preservers related to the requirements of the larger aircraft normally using the aerodrome, with two-way radio communication, and with floodlights for night operations. If aircraft operations during periods of low visibility are expected, it is necessary to provide guidance for the responding emergency vehicles.

- 5.4.5 The personnel designated to operate the equipment should be adequately trained and drilled for rescue services in the appropriate environment.

5.5 Facilities

- 5.5.1 The provision of special telephone, two-way radio communication and general alarm systems for the rescue and firefighting service is desirable to ensure the dependable transmission of essential emergency and routine information.

Consistent with the individual requirements of each aerodrome, these facilities serve the following purposes:

- (a) direct communication between the activating authority and the aerodrome fire station in order to ensure the prompt alerting and dispatch of rescue and fire fighting vehicles and personnel in the event of an aircraft accident or incident;
- (b) direct communication between the rescue and firefighting service and the flight crew of an aircraft in emergency;
- (c) emergency signals to ensure the immediate summoning of designated personnel not on standby duty;
- (d) as necessary, summoning essential related services on or off the aerodrome; and
- (e) The availability of ambulance and medical facilities for the removal and after-care of casualties arising from an aircraft accident should receive the careful consideration of the appropriate authority and should form part of the overall emergency plan established to deal with such emergencies.

6. Operators and vehicles

- 6.1 The authorities responsible for the operation of vehicles on the movement area should ensure that the operators are properly qualified. This includes, as appropriate to the driver's function, knowledge of:
- (a) the geography of the aerodrome;
 - (b) aerodrome signs, markings and lights;
 - (c) radiotelephone operating procedures;
 - (d) terms and phrases used in aerodrome control including the ICAO spelling alphabet;
 - (e) rules of air traffic services as they relate to ground operations;
 - (f) airport rules and procedures; and
 - (g) specialist functions as required, for example, in rescue and firefighting.

- 6.2 The operator should be able to demonstrate competency, as appropriate, in:
- (a) the operation or use of vehicle transmit/receive equipment;
 - (b) understanding and complying with air traffic control and local procedures;
 - (c) vehicle navigation on the aerodrome; and
 - (d) special skills required for the particular function.

In addition, as required for any specialist function, the operator shall be the holder of a Land Transportation Office (LTO) driver's license, a National Telecommunication Commission (NTC) radio operator's license or other licenses.

- 6.3 The above should be applied as is appropriate to the function to be performed by the operator, and it is not necessary that all operators be trained to the same level, for example, operators whose functions are restricted to the apron.
- 6.4 If special procedures apply for operations in low visibility conditions, it is desirable to verify an operator's knowledge of the procedures through periodic checks.

7. Intensity control of approach and runway lights

- 7.1 The conspicuity of a light depends on the impression received of contrast between the light and its background. If a light is to be useful to a pilot by day when on approach, it should have an intensity of at least 2000 or 3000 cd, and in the case of approach lights an intensity of the order of 20,000 cd is desirable. In conditions of very bright daylight fog it may not be possible to provide lights of sufficient intensity to be effective. On the other hand, in clear weather on a dark night, an intensity of the order of 100 cd for approach lights and 50 cd for the runway edge lights may be found suitable. Even then, owing to the closer range at which they are viewed, pilots have sometimes complained that the runway edge lights seemed unduly bright.
- 7.2 In fog the amount of light scattered is high. At night this scattered light increases the brightness of the fog over the approach area and runway to the extent that little increase in the visual range of the lights can be obtained by increasing their intensity beyond 2000 or 3000 cd. In an endeavor to increase the range at which lights will first be sighted at night, their intensity should not be raised to an extent that a pilot might find excessively dazzling at diminished range.
- 7.3 From the foregoing will be evident the importance of adjusting the intensity of the lights of an aerodrome lighting system according to the prevailing conditions, so as to obtain the best results without excessive dazzle that will disconcert the pilot. The appropriate intensity setting on any particular occasion will depend both on the conditions of background brightness and the visibility. Detailed guidance material on selecting intensity setting for different conditions is given in the Aerodrome Design Manual (Doc 9157), Part 4.

8. Autonomous runway incursion warning system (ARIWS)

These autonomous systems are generally quite complex in design and operation and, as such deserve careful consideration by all levels of the industry, from the regulating

authority to the end user. This guidance is offered to provide a more clear description of the system(s) and offer some suggested actions required in order to properly implement these system(s) at an aerodrome in any province in the Philippines.

The Manual on the Prevention of Runway Incursion (Doc 9870) presents different approaches for the prevention of runway incursion.

8.1 General Description

8.1.1 The operation of an ARIWS is based upon a surveillance system which monitors the actual situation on a runway and automatically returns this information to warning lights at the runway (take-off) thresholds and entrances. When an aircraft is departing from a runway (rolling) or arriving at a runway (short final), red warning lights at the entrances will illuminate, indicating that it is unsafe to enter or cross the runway. When an aircraft is aligned on the runway for take-off and another aircraft or vehicle enters or crosses the runway, red warning lights will illuminate at the threshold area, indicating that it is unsafe to start the take-off roll.

8.1.2 In general, an ARIWS consists of an independent surveillance system (primary radar, multi-lateration, specialized cameras, dedicated radar, etc.) and a warning system in the form of extra airfield lighting systems connected through a processor which generates alerts independent from ATC directly to the flight crews and vehicle operators.

8.1.3 An ARIWS does not require circuit interleaving, secondary power supply or operational connection to other visual aid systems.

8.1.4 In practice, not every entrance or threshold needs to be equipped with warning lights. Each aerodrome will have to assess its needs individually depending on the characteristics of the aerodrome. There are several systems developed offering the same or similar functionality.

8.2 Flight crew actions

8.2.1 It is of critical importance that flight crews understand the warning being transmitted by the ARIWS system. Warnings are provided in near real-time, directly to the flight crew because there is no time for “relay” types of communications. In other words, a conflict warning generated to ATS which should then interpret the warning, evaluate the situation and communicate to the aircraft in question, will result in several seconds being taken up where each second is critical in the ability to stop the aircraft safely, and prevent a potential collision. Pilots are presented with a globally consistent signal which means “STOP IMMEDIATELY” and should be taught to react accordingly. Likewise, pilots receiving an ATS clearance to take-off or cross a runway, and seeing the red light array, should STOP and advise ATS that they aborted/stopped because of the red lights. Again, the criticality of the timeline involved is so tight that there is no room for misinterpretation of the signal. It is of utmost importance that the visual signal be consistent around the world.

8.2.2 It should also be stressed that the extinguishing of the red lights does not, in itself, indicate a clearance to proceed. That clearance is still required from air traffic control.

The absence of red warning lights only means that potential conflicts have not been detected.

8.2.3 In the event that a system becomes unserviceable, one of two things will occur. If the system fails in the extinguished condition, then no procedural changes need to be accomplished. The only thing that will happen is the loss of the automatic, independent warning system. Both ATS operations and flight crew procedures (in response to ATS clearances) will remain unchanged.

8.2.4 Procedures should be developed to address the circumstance where the system fails in the illuminated condition. It will be up to the ATS and/or aerodrome operator to establish those procedures depending on their own circumstances. It should be remembered that flight crews are instructed to "STOP" at all red lights. If the affected portion of the system, or the entire system is shut off, the situation is reverted to the extinguished scenario described in 8.2.3 above.

8.3 Aerodromes

8.3.1 An ARIWS does not have to be provided at all aerodromes. An aerodrome considering the installation of such a system may wish to assess its needs individually, depending on traffic levels, aerodrome geometry, ground taxi patterns, etc. Local user groups such as the Local Runway Safety Team (LRST) can be of assistance in this process. Also, not every runway or taxiway needs to be equipped with the lighting array(s), and not every installation requires a comprehensive ground surveillance system to feed information to the conflict detection computer.

8.3.2 Although there might be local specific requirements, some basic system requirements are applicable to all ARIWS:

- (a) the control system and energy power supply of the system should be independent from any other system in use at the aerodrome, especially the other parts of the lighting system;
- (b) the system should operate independently from ATS communications;
- (c) the system should provide a globally accepted visual signal that is consistent and instantly understood by crews; and
- (d) local procedures should be developed in the case of malfunction or failure of a portion of, or the entire system.

8.4 Air traffic services

8.4.1 The ARIWS is designed to be complementary to normal ATS functions, providing warnings to flight crews and vehicle operators when some conflict has been unintentionally created or missed during normal aerodrome operations. The ARIWS will provide a direct warning when, for example, ground control or tower (local) control has provided a clearance to hold short of a runway but the flight crew or vehicle operator has "missed" the hold short portion of their clearance and tower has issued a take-off or landing clearance to that same runway, and the non-read back by the flight crew or vehicle operator was missed by air traffic control.

8.4.2 In the case where a clearance has been issued and a crew reports a non-

compliance due to “red lights”, or aborting because of “red lights”, then it is imperative that the controller assess the situation and provide additional instructions as necessary. It may well be that the system has generated a false warning or that the potential incursion no longer exists; however, it may also be a valid warning. In any case, additional instructions and/or a new clearance need to be provided. In a case where the system has failed, then procedures will need to be put into place as described in 8.2.3 and 8.2.4 above. In no case should the illumination of the ARIWS be dismissed without confirmation that, in fact, there is no conflict. It is worth noting that there have been numerous incidents avoided at aerodromes with such systems installed. It is also worth noting that there have been false warnings as well, usually as a result of the calibration of the warning software, but in any case, a confirmation of the potential conflict existence or non-existence should be done.

- 8.4.3 While many installations may have a visual or audio warning available to ATS personnel, it is in no way intended that ATS personnel be required to actively monitor the system. Such warnings may assist ATS personnel in quickly assessing the conflict in the event of a warning and help them to provide appropriate further instructions, but the ARIWS should not play an active part in the normal functioning of any ATS facility.
- 8.4.4 Each aerodrome where the system is installed will develop procedures depending upon their unique situation. Again, it should be stressed that under no circumstances should pilots or operators be instructed to “cross the red lights”. As indicated previously, the use of local runway safety teams can greatly assist in this development process.
- 8.5 Promulgation of information
- 8.5.1 Information on the characteristics and status of an ARIWS at an aerodrome are promulgated in the Philippine AIP, Section AD 2.9, in PANS-AIM (Doc 10066) and its status updated as necessary through NOTAM or ATIS in compliance with MOS 5.1.5.1.
- 8.5.2 Aircraft operators are to ensure that flight crews documentation include procedures regarding ARIWS and appropriate guidance information, in compliance with Annex 6, Part I.
- 8.5.3 Aerodromes should provide additional sources of guidance on operations and procedures for their personnel, aircraft operators, ATS and third parties personnel who will deal with an ARIWS.
- 9. Taxiway design guidance for minimizing the potential for runway incursions**
- 9.1 Good aerodrome design practices can reduce the potential for runway incursions while maintaining operating efficiency and capacity. The following taxiway design guidance should be considered to be part of a runway incursion prevention programme as a means to ensure that runway incursion aspects are addressed during the design phase for new runways and taxiways. Within this focused guidance, the prime considerations are to limit the number of aircraft or vehicles entering or crossing a runway, provide pilots with enhanced unobstructed views of the entire runway, and correct taxiways identified as hot spots as far as possible.

- 9.2 The centerline of an entrance taxiway should be perpendicular to the runway centerline, where possible. This design principle provides pilots with an unobstructed view of the entire runway, in both directions, to confirm that the runway and approach are clear of conflicting traffic before proceeding towards the runway. Where the taxiway angle is such that a clear unobstructed view, in both directions, is not possible, consideration should be given to providing a perpendicular portion of the taxiway immediately adjacent to the runway to allow for a full visual scan by the pilots prior to entering or crossing a runway.
- 9.3 For taxiways intersecting with runways, avoid designing taxiways wider than recommended in the MOS. This design principle offers improved recognition of the location of the runway holding position and the accompanying sign, marking, and lighting visual cues.
- 9.4 Existing taxiways wider than recommended in the MOS, can be rectified by painting taxi side stripe markings to the recommended width. As far as practicable, it is preferable to redesign such locations properly rather than to repaint such locations
- 9.5 Multi-taxiway entrances to a runway should be parallel to each other and should be distinctly separated by an unpaved area. This design principle allows each runway holding location an earthen area for the proper placement of accompanying sign, marking, and lighting visual cues at each runway holding position. Moreover, the design principle eliminates the needless costs of building unusable pavement and as well as the costs for painting taxiway edge markings to indicate such unusable pavement. In general, excess paved areas at runway holding positions reduce the effectiveness of sign, marking, and lighting visual cues.
- 9.6 Build taxiways that cross a runway as a single straight taxiway. Avoid dividing the taxiway into two after crossing the runway. This design principle avoids constructing “Y-shaped” taxiways known to present risk of runway incursions.
- 9.7 If possible, avoid building taxiways that enter at the mid-runway location. This design principle helps to reduce the collision risks at the most hazardous locations (high energy location) because normally departing aircraft have too much energy to stop, but not enough speed to take-off, before colliding with another errant aircraft or vehicle.
- 9.8 Provide clear separation of pavement between a rapid exit taxiway and other non-rapid taxiways entering or crossing a runway. This design principle avoids two taxiways from overlapping each other to create an excessive paved area that will confuse pilots entering a runway.
- 9.9 Avoid the placement of different pavement materials (asphalt and cement concrete) at or near the vicinity of the runway holding position, as far as practicable. This design principle avoids creating visual confusion as to the actual location of the runway holding position.
- 9.10 Perimeter taxiways. Many aerodromes have more than one runway, notably paired parallel runways (two runways on one side of the terminal), which creates a difficult problem in that either on arrival or departure an aircraft is required to cross a runway. Under such a configuration, the safety objective here is to avoid or at least keep to a minimum the number of runway crossings. This safety objective may be achieved by

constructing a “perimeter taxiway”. A perimeter taxiway is a taxi route that goes around the end of a runway, enabling arrival aircraft (when landings are on outer runway of a pair) to get to the terminal or departure aircraft (when departures are on outer runway of a pair) to get to the runway without either crossing a runway, or conflicting with a departing or approaching aircraft.

- 9.11 A perimeter taxiway will be designed according to the following criteria:
- 9.11.1 Sufficient space is required between the landing threshold and the taxiway centerline where it crosses under the approach path, to enable the critical taxiing aircraft to pass under the approach without penetrating any approach surface.
- 9.11.2 The jet blast impact of aircraft taking off should be considered in consultation with aircraft manufacturers; the extent of take-off thrust should be evaluated when determining the location of a perimeter taxiway.
- 9.11.3 The requirement for a runway end safety area, as well as possible interference with landing systems and other navigation aids should also be taken into account. For example, in the case of an Instrument Landing System, the perimeter taxiway should be located behind the localizer antenna, not between the localizer antenna and the runway, due to the potential for severe Instrument Landing System disturbance, noting that this is harder to achieve as the distance between the localizer and the runway increases.
- 9.11.4 Human factors issues should also be taken into account. Appropriate measures should be put in place to assist pilots to distinguish between aircraft that are crossing the runway and those that are safely on a perimeter taxiway.

10. Aerodrome mapping data

10.1 Introduction

MOS 5.1.2.2 and 5.1.2.3, contain provisions related to the provision of aerodrome mapping data. The aerodrome mapping data features are collected and made available to the aeronautical information services for aerodromes designated by CAAP with consideration of the intended applications. These applications are closely tied to an identified need and operational use where the application of the data will provide a safety benefit or can be used as mitigation to a safety concern.

10.2 Applications

- 10.2.1 Aerodrome mapping data include aerodrome geographic information that support applications which improve the user's situational awareness or supplement surface navigation, thereby increasing safety margins and operational efficiency. With appropriate data element accuracy, these data sets support collaborative decision making, common situational awareness, and aerodrome guidance applications. The data sets are intended to be used in the following air navigation applications:

- (a) on-board positioning and route awareness including moving maps with own aircraft position, surface guidance and navigation;

- (b) traffic awareness including surveillance and runway incursion detection and alerting (such as respectively in A-SMGCS levels 1 and 2);
 - (c) ground positioning and route awareness including situational displays with aircraft and vehicles position and taxi route, surface guidance and navigation (such as A-SMGCS levels 3 and 4);
 - (d) Facilitation of aerodrome-related aeronautical information, including NOTAMs;
 - (e) resource and aerodrome facility management; and
 - (f) aeronautical chart production.
- 10.2.2 The data may also be used in other applications such as training / flight simulators and on-board or ground enhanced vision systems (EVS), synthetic vision systems (SVS) and combined vision systems (CVS).
- 10.3 Determination of aerodromes to be considered for collection of aerodrome mapping data features.
- 10.3.1 In order to determine which aerodromes should make use of applications requiring the collection of aerodrome mapping data features, the following aerodrome characteristics should be considered:
- safety risks at the aerodrome;
 - visibility conditions;
 - aerodrome layout; and
 - traffic density.
- Note: - Further guidance on aerodrome mapping data can be found in Doc 9137, Airport Services Manual, Part 8 — Airport Operational Service.*
- 11. Location of threshold**
- 11.1 General
- 11.1.1 The threshold is normally located at the extremity of a runway, if there are no obstacles penetrating above the approach surface. In some cases, however, due to local conditions it may be desirable to displace the threshold permanently (see 11.2). When studying the location of a threshold, consideration should also be given to the height of the ILS reference datum and the determination of the obstacle clearance limits. (Specifications concerning the height of the ILS reference datum is given in CAR-ANS 6.3.1).
- 11.1.2 In determining that no obstacles penetrate above the approach surface, account should be taken of mobile objects (vehicles on roads, trains, etc.) at least within that portion of the approach area within 1200 m longitudinally from the threshold and of an overall width of not less than 150 m.
- 11.2 Displaced threshold
- 11.2.1 If an object extends above the approach surface and the object cannot be removed, consideration should be given to displacing the threshold permanently.

- 11.2.2 To meet the obstacle limitation objectives of MOS 7, the threshold should ideally be displaced down the runway for the distance necessary to provide that the approach surface is cleared of obstacles.
- 11.2.3 However, displacement of the threshold from the runway extremity will inevitably cause reduction of the landing distance available, and this may be of greater operational significance than penetration of the approach surface by marked and lighted obstacles. A decision to displace the threshold, and the extent of such displacement should, therefore, have regard to an optimum balance between the considerations of clear approach surfaces and adequate landing distance. In deciding this question, account will need to be taken of the types of aeroplanes which the runway is intended to serve, the limiting visibility and cloud base conditions under which the runway will be used, the position of the obstacles in relation to the threshold and extended centerline and, in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.
- 11.2.4 Notwithstanding the consideration of landing distance available, the selected position for the threshold should not be such that the obstacle free surface to the threshold is steeper than 3.3% where the code number is 4 or steeper than 5% where the code number is 3.
- 11.2.5 In the event of a threshold being located according to the criteria for obstacle free surfaces in the preceding paragraph, the obstacle marking requirements of MOS 8.10 should continue to be met in relation to the displaced threshold.
- 11.2.6 Depending on the length of the displacement, the RVR at the threshold can differ from that at the beginning of the runway for take-offs. The use of red runway edge lights with photometric intensities lower than the nominal value of 10,000 cd for white lights increases that phenomenon. The impact of a displaced threshold on take-off minima should be assessed by the appropriate authority.
- 11.2.7 Provisions in the MOS regarding marking and lighting of displaced thresholds and some operational recommendations can be found in MOS 8.3.12.5, 9.8.1.8, 9.9.15.6, 9.9.7.3, 9.9.10.1, 9.9.11.1 and 9.9.19.7.

12. Signal area

A signal area need be provided only when it is intended to use visual ground signals to communicate with aircraft in flight. Such signals may be needed when the aerodrome does not have an aerodrome control tower or an aerodrome flight information service unit, or when the aerodrome is used by aeroplanes not equipped with radio. Visual ground signals may also be useful in the case of failure of two-way radio communication with aircraft. It should be recognized, however, that the type of information which should be conveyed by visual ground signals should normally be available in AIPs or NOTAM. The potential need for visual ground signals should therefore be evaluated before deciding to provide a signal area.

13. Lighting of unserviceable areas

Where a temporarily unserviceable area exists, it should be marked with fixed- red lights. These lights should mark the most potentially dangerous extremities of the area. A minimum of four (4) such lights should be used, except where the area is triangular in shape where a minimum of three (3) lights should be employed. The number of lights should be increased when the area is large or of unusual configuration. At least one light should be installed for each 7.5 m of peripheral distance of the area. If the lights are directional, they should be orientated so that as far as possible their beams are aligned in the direction from which aircraft or vehicles will approach. Where aircraft or vehicles will normally approach from several directions, consideration should be given to adding extra lights or using omnidirectional lights to show the area from these directions. Unserviceable area lights should be frangible. Their height should be sufficiently low to preserve clearance for propellers and for engine pods of jet aircraft.

14. Rapid exit taxiway indicator lights

- 14.1 Rapid exit taxiway indicator lights (RETILs) comprise a set of yellow unidirectional lights installed in the runway adjacent to the centerline. The lights are positioned in a 3-2-1 sequence at 100 m intervals prior to the point of tangency of the rapid exit taxiway centerline. They are intended to give an indication to pilots of the location of the next available rapid exit taxiway.
- 14.2 In low visibility conditions, RETILs provide useful situational awareness cues while allowing the pilot to concentrate on keeping the aircraft on the runway centerline.
- 14.3 Following a landing, runway occupancy time has a significant effect on achievable runway capacity. RETILs allow pilots to maintain a good roll-out speed until it is necessary to decelerate to an appropriate speed for the turn into a rapid exit turn-off. A roll-out speed of 60 knots until the first RETIL (three-light barrette) is reached is seen as the optimum.

15. The ACN-PCN ACR-PCR method of reporting pavement strength

PART A: The ACN-PCN method of reporting pavement strength [†]
(Applicable until 27 November 2024)

- 15.1 Overload operations
 - 15.1.1 Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behavior are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behavior is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

- (a) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10% above the reported PCN should not adversely affect the pavement;
- (b) for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5% above the reported PCN should not adversely affect the pavement;
- (c) if the pavement structure is unknown, the 5% limitation should apply; and
- (d) the annual number of overload movements should not exceed approximately 5% of the total annual aircraft movements.

15.1.2 Such overload movements should not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading should be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade can be weakened by water. Where overload operations are conducted, the appropriate authority should review the relevant pavement condition regularly, and should also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

15.2 ACNs for several aircraft types

15.2.1 For convenience, several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade strength categories in MOS 5.1.4.1(c)(ii), and the results tabulated in the Aerodrome Design Manual (Doc 9157), Part 3.

PART B: The ACN-PCN ACR-PCR method of reporting pavement strength ^{††} *(Applicable as of 28 November 2024)*

15.1 Overload operations

15.1.1 Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behavior are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behavior is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

- (a) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10% above the reported PCN shall not adversely affect the pavement;
- (b) the annual number of overload movements shall not exceed approximately 5% of the total annual aircraft movements excluding light aircraft.

15.1.2 Such overload movements shall not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading shall be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade can be weakened by water. Where overload operations are conducted, the appropriate authority shall review the relevant pavement condition regularly, and shall also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

15.2 ACRs for several aircraft types

15.2.1 For convenience, a dedicated software is available on the ICAO website, for computing any aircraft ACRs at any mass on rigid and flexible pavements for the four standard subgrade strength categories detailed in MOS 5.1.4.10 (d)(ii).

16. Approach lighting systems

16.1 Types and characteristics

16.1.1 The specifications in this volume provide for the basic characteristics for simple and precision approach lighting systems. For certain aspects of these systems, some latitude is permitted, for example, in the spacing between centerline lights and crossbars. The approach lighting patterns that have been generally adopted are shown in MOS Figures A-4 and A-5. A diagram of the inner 300 m of the precision approach category II and III lighting system is shown in MOS Figure 9.6-2.

16.1.2 The approach lighting configuration is to be provided irrespective of the location of the threshold, i.e. whether the threshold is at the extremity of the runway or displaced from the runway extremity. In both cases, the approach lighting system should extend up to the threshold. However, in the case of a displaced threshold, inset lights are used from the runway extremity up to the threshold to obtain the specified configuration. These inset lights are designed to satisfy the structural requirements specified in MOS 9.1.14.11, and the photometric requirements specified in MOS Figures 9.7-1 or 9.7-2.

16.1.3 Flight path envelopes to be used in designing the lighting are shown in MOS Figure A-3.

16.2 Installation tolerances

Horizontal

16.2.1 The dimensional tolerances are shown in MOS Figure A-5.

16.2.2 The centerline of an approach lighting system should be as coincident as possible with the extended centerline of the runway with a maximum tolerance of $\pm 15'$.

16.2.3 The longitudinal spacing of the centerline lights should be such that one light (or group of lights) is located in the center of each crossbar, and the intervening centerline lights are spaced as evenly as practicable between two crossbars or a crossbar and a

threshold.

- 16.2.4 The crossbars and barrettes should be at right angles to the centerline of the approach lighting system with a tolerance of $\pm 30'$, if the pattern in MOS Figure A- 5 (A) is adopted, or $\pm 20'$, if MOS Figure A-5 (B) is adopted.
- 16.2.5 When a crossbar has to be displaced from its standard position, any adjacent crossbar should, where possible, be displaced by appropriate amounts in order to reduce the differences in the crossbar spacing.
- 16.2.6 When a crossbar in the system shown in MOS Figure A-5 (A) is displaced from its standard position, its overall length should be adjusted so that it remains one- twentieth of the actual distance of the crossbar from the point of origin. It is not necessary, however, to adjust the standard 2.7 m spacing between the crossbar lights, but the crossbars should be kept symmetrical about the centerline of the approach lighting.

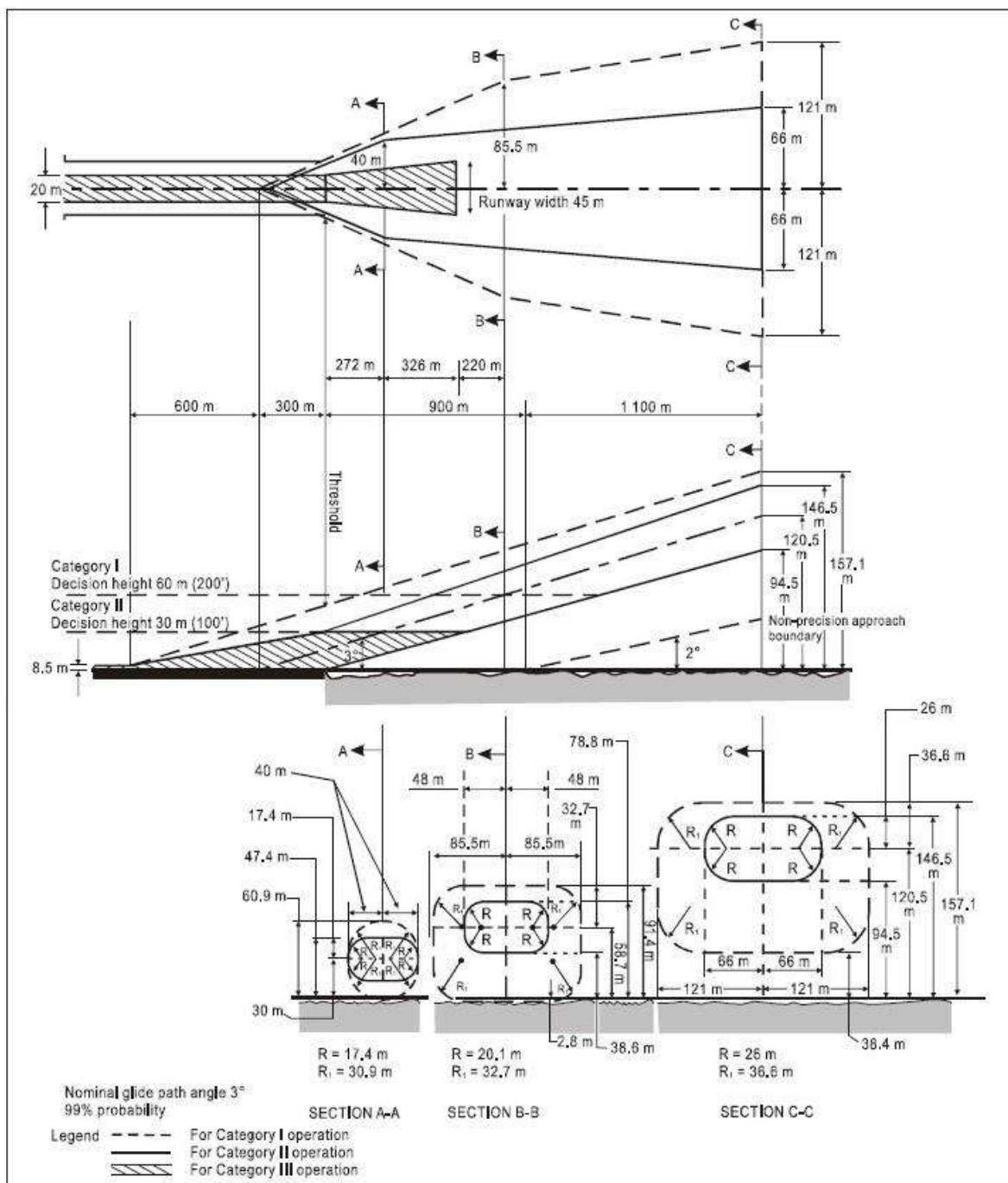


Figure A-3. Flight path envelopes to be used for lighting design for category I, II and III operations

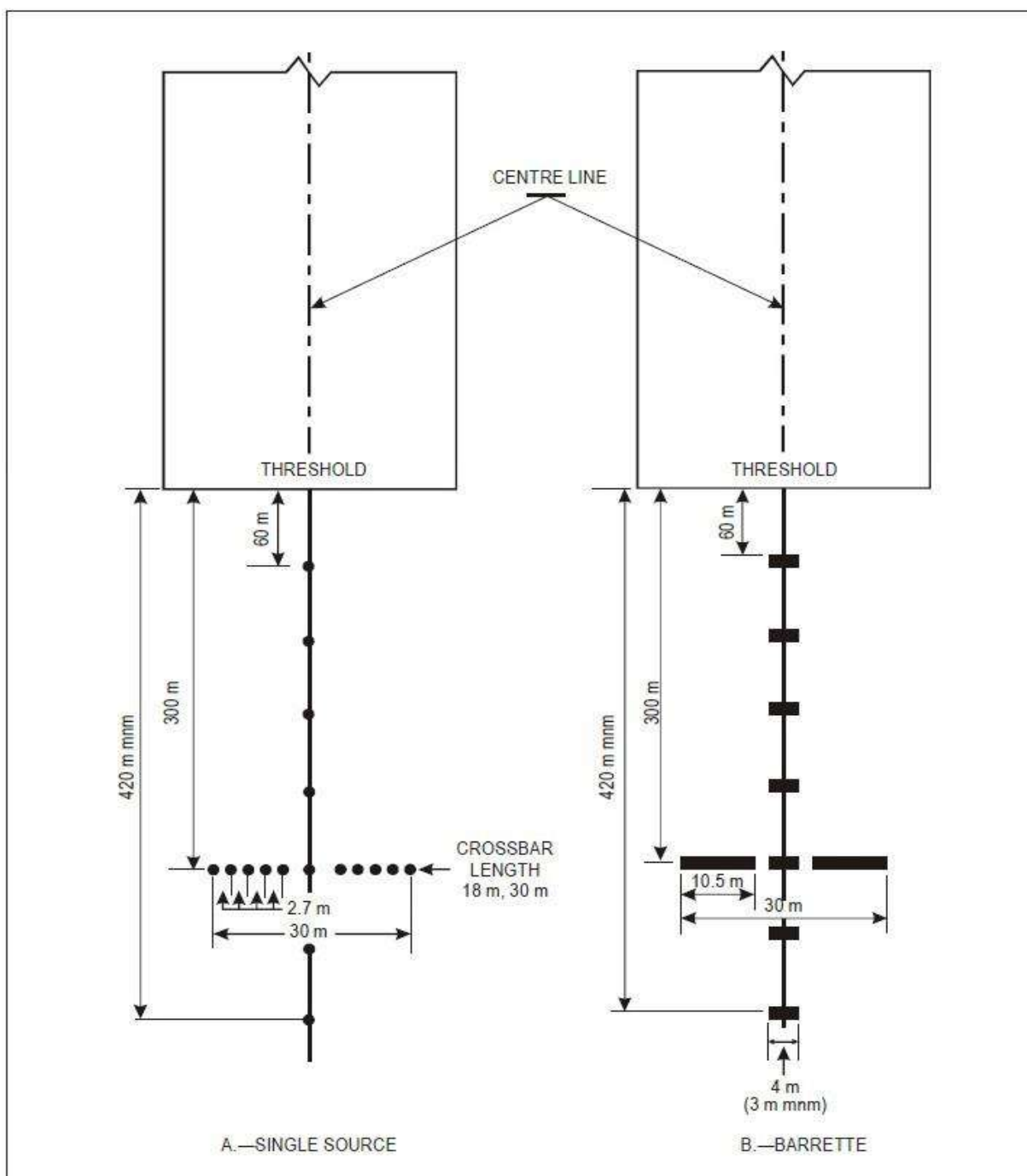


Figure A-4. Simple approach lighting systems

Vertical

- 16.2.7 The ideal arrangement is to mount all the approach lights in the horizontal plane passing through the threshold (See MOS Figure A-6), and this should be the general aim as far as local conditions permit. However, buildings, trees, etc., should not obscure the lights from the view of a pilot who is assumed to be 1° below the electronic glide path in the vicinity of the outer marker.

- 16.2.8 Within a stopway or clearway, and within 150 m of the end of a runway, the lights should be mounted as near to the ground as local conditions permit in order to minimize risk of damage to aeroplanes in the event of an overrun or undershoot. Beyond the stopway and clearway, it is not so necessary for the lights to be mounted close to the ground, and therefore, undulations in the ground contours can be compensated for by mounting the lights on poles of appropriate height.
- 16.2.9 It is desirable that the lights be mounted so that, as far as possible, no object within a distance of 60 m on each side of the centerline protrudes through the plane of the approach lighting system. Where a tall object exists within 60 m of the centerline and within 1,350 m from the threshold for a precision approach lighting system, or 900 m for a simple approach lighting system, it may be advisable to install the lights so that the plane of the outer half of the pattern clears the top of the object.
- 16.2.10 In order to avoid giving a misleading impression of the plane of the ground, the lights should not be mounted below a gradient of 1 in 66 downwards from the threshold to a point 300 m out, and below a gradient of 1 in 40 beyond the 300 m point. For a precision approach category II and III lighting system, more stringent criteria may be necessary, e.g. negative slopes not permitted within 450 m of the threshold.
- 16.2.11 Centerline. The gradients of the centerline in any section (including a stopway or clearway) should be as small as practicable, and the changes in gradients should be as few and small as can be arranged and should not exceed 1 in 60. Experience has shown that as one proceeds outwards from the runway, rising gradients in any section of up to 1 in 66, and falling gradients of down to 1 in 40, are acceptable.
- 16.2.12 Crossbars. The crossbar lights should be so arranged as to lie on a straight line passing through the associated centerline lights, and wherever possible this line should be horizontal. It is permissible, however, to mount the lights on a transverse gradient not more than 1 in 80, if this enables crossbar lights within a stopway or clearway to be mounted nearer to the ground on sites where there is a cross-fall.
- 16.3 Clearance of obstacles
- 16.3.1 An area, hereinafter referred to as the light plane, has been established for obstacle clearance purposes, and all lights of the system are in this plane. This plane is rectangular in shape and symmetrically located about the approach lighting system's centerline. It starts at the threshold and extends 60 m beyond the approach end of the system, and is 120 m wide.
- 16.3.2 No objects are permitted to exist within the boundaries of the light plane which are higher than the light plane except as designated herein. All roads and highways are considered as obstacles extending 4.8 m above the crown of the road, except aerodrome service roads where all vehicular traffic is under control of the aerodrome authorities and coordinated with the aerodrome traffic control tower. Railroads, regardless of the amount of traffic, are considered as obstacles extending 5.4 m above the top of the rails.
- 16.3.3 It is recognized that some components of electronic landing aids systems, such as reflectors, antennas, monitors, etc., should be installed above the light plane. Every effort should be made to relocate such components outside the boundaries of the light

plane. In the case of reflectors and monitors, this can be done in many instances.

- 16.3.4 Where an ILS localizer is installed within the light plane boundaries, it is recognized that the localizer, or screen if used, should extend above the light plane. In such cases the height of these structures should be held to a minimum and they should be located as far from the threshold as possible. In general the rule regarding permissible heights is 15 cm for each 30 m the structure is located from the threshold. As an example, if the localizer is located 300 m from the threshold, the screen will be permitted to extend above the plane of the approach lighting system by $10 \times 15 = 150$ cm maximum, but preferably should be kept as low as possible consistent with proper operation of the ILS.
- 16.3.5 Objects existing within the boundaries of the light plane, requiring the light plane to be raised in order to meet the criteria contained herein, should be removed, lowered or relocated where this can be accomplished more economically than raising the light plane.
- 16.3.6 In some instances objects may exist which cannot be removed, lowered or relocated economically. These objects may be located so close to the threshold that they cannot be cleared by the 2 per cent slope. Where such conditions exist and no alternative is possible, the 2 per cent slope may be exceeded or a “stair step” resorted to in order to keep the approach lights above the objects. Such “step” or increased gradients should be resorted to only when it is impracticable to follow standard slope criteria, and they should be held to the absolute minimum. Under this criterion no negative slope is permitted in the outermost portion of the system.
- 16.4 Consideration of the effects of reduced lengths
- 16.4.1 The need for an adequate approach lighting system to support precision approaches where the pilot is required to acquire visual references prior to landing cannot be stressed too strongly. The safety and regularity of such operations is dependent on this visual acquisition. The height above runway threshold at which the pilot decides there are sufficient visual cues to continue the precision approach and land will vary, depending on the type of approach being conducted and other factors such as meteorological conditions, ground and airborne equipment, etc. The required length of approach lighting system which will support all the variations of such approaches is 900 m, and this should always be provided whenever possible.
- 16.4.2 However, there are some runway locations where it is impossible to provide the 900 m length of approach lighting system to support precision approaches.
- 16.4.3 In such cases, every effort should be made to provide as much approach lighting system as possible. The appropriate authority may impose restrictions on operations to runways equipped with reduced lengths of lighting. There are many factors which determine at what height the pilot should have decided to continue the approach to land or execute a missed approach. It should be understood that the pilot does not make an instantaneous judgment upon reaching a specified height. The actual decision to continue the approach and landing sequence is an accumulative process which is only concluded at the specified height. Unless lights are available prior to reaching the decision point, the visual assessment process is impaired and the likelihood of missed approaches will increase substantially. There are many operational considerations which should be taken

into account by the appropriate authorities in deciding if any restrictions are necessary to any precision approach and these are detailed in PCARs, Part 8.

17. Clearways and stopways

- 17.1 The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway will depend on the physical characteristics of the area beyond the runway end, and on the operating performance requirements of the prospective aeroplanes. The runway, stopway and clearway lengths to be provided are determined by the aeroplane take-off performance, but a check should also be made of the landing distance required by the aeroplanes using the runway to ensure that adequate runway length is provided for landing. The length of a clearway, however, cannot exceed half the length of take-off run available.
- 17.2 The aeroplane performance operating limitations require a length which is enough to ensure that the aeroplane can, after starting a take-off, either be brought safely to a stop or complete the take-off safely. For the purpose of discussion it is supposed that the runway, stopway and clearway lengths provided at the aerodrome are only just adequate for the aeroplane requiring the longest take-off and accelerate-stop distances, taking into account its take-off mass, runway characteristics and ambient atmospheric conditions. Under these circumstances there is, for each take-off, a speed, called the decision speed; below this speed, the take-off should be abandoned if an engine fails, while above it the take-off should be completed. A very long take-off run and take-off distance will be required to complete a take-off when an engine fails before the decision speed is reached, because of the insufficient speed and the reduced power available. There will be no difficulty in stopping in the remaining accelerate-stop distance available provided action is taken immediately. In these circumstances the correct course of action will be to abandon the take-off.
- 17.3 On the other hand, if an engine fails after the decision speed is reached, the aeroplane will have sufficient speed and power available to complete the take-off safely in the remaining take-off distance available. However, because of the high speed, there will be difficulty in stopping the aeroplane in the remaining accelerate-stop distance available.
- 17.4 The decision speed is not a fixed speed for any aeroplane, but can be selected by the pilot within limits to suit the accelerate-stop and take-off distance available, aeroplane take-off mass, runway characteristics and ambient atmospheric conditions at the aerodrome. Normally, a higher decision speed is selected as the accelerate-stop distance available increases.
- 17.5 A variety of combinations of accelerate-stop distances required and take-off distances required can be obtained to accommodate a particular aeroplane, taking into account the aeroplane take-off mass, runway characteristics, and ambient atmospheric conditions. Each combination requires its particular length of take-off run.

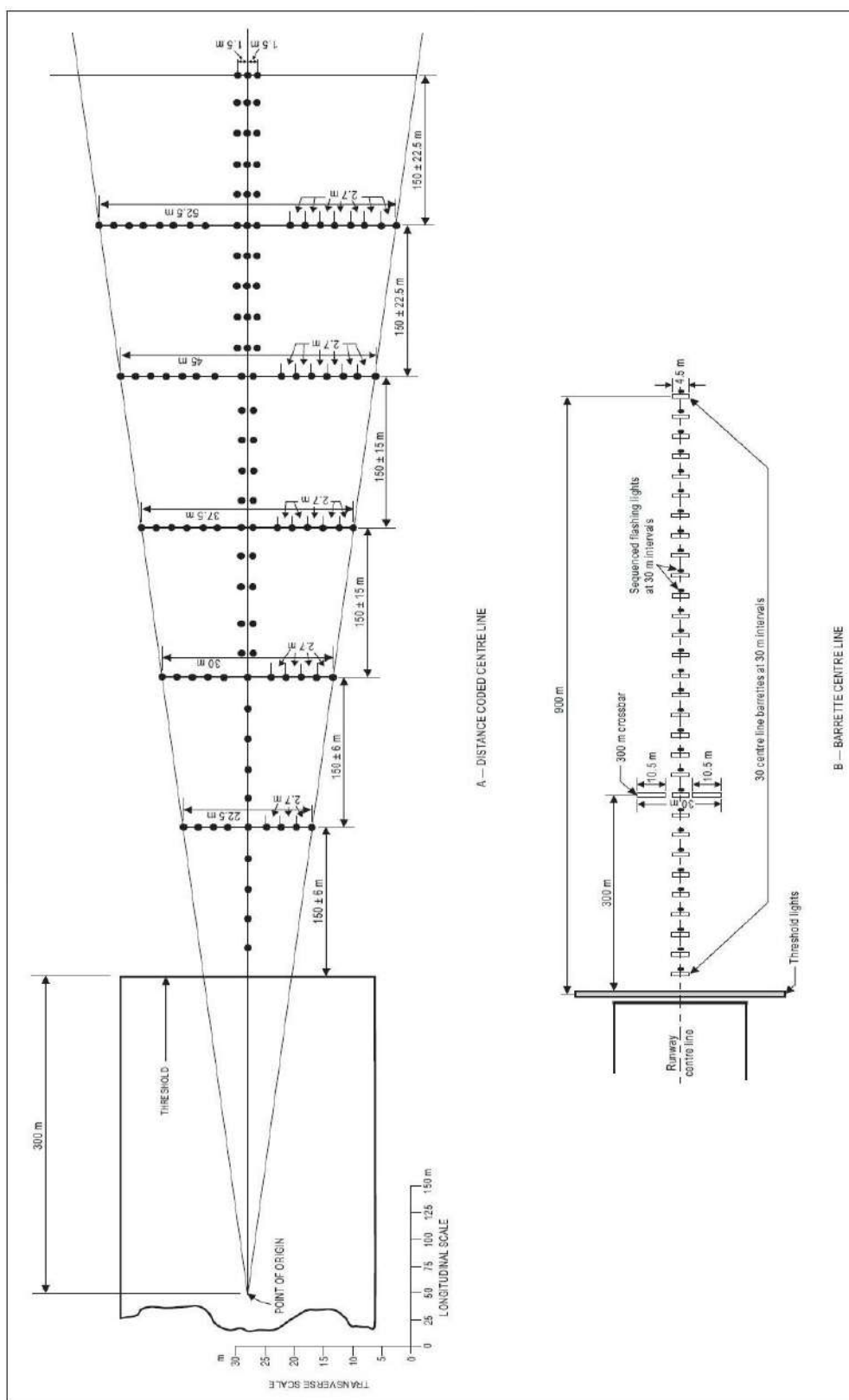


Figure A-5. Precision approach category I lighting systems

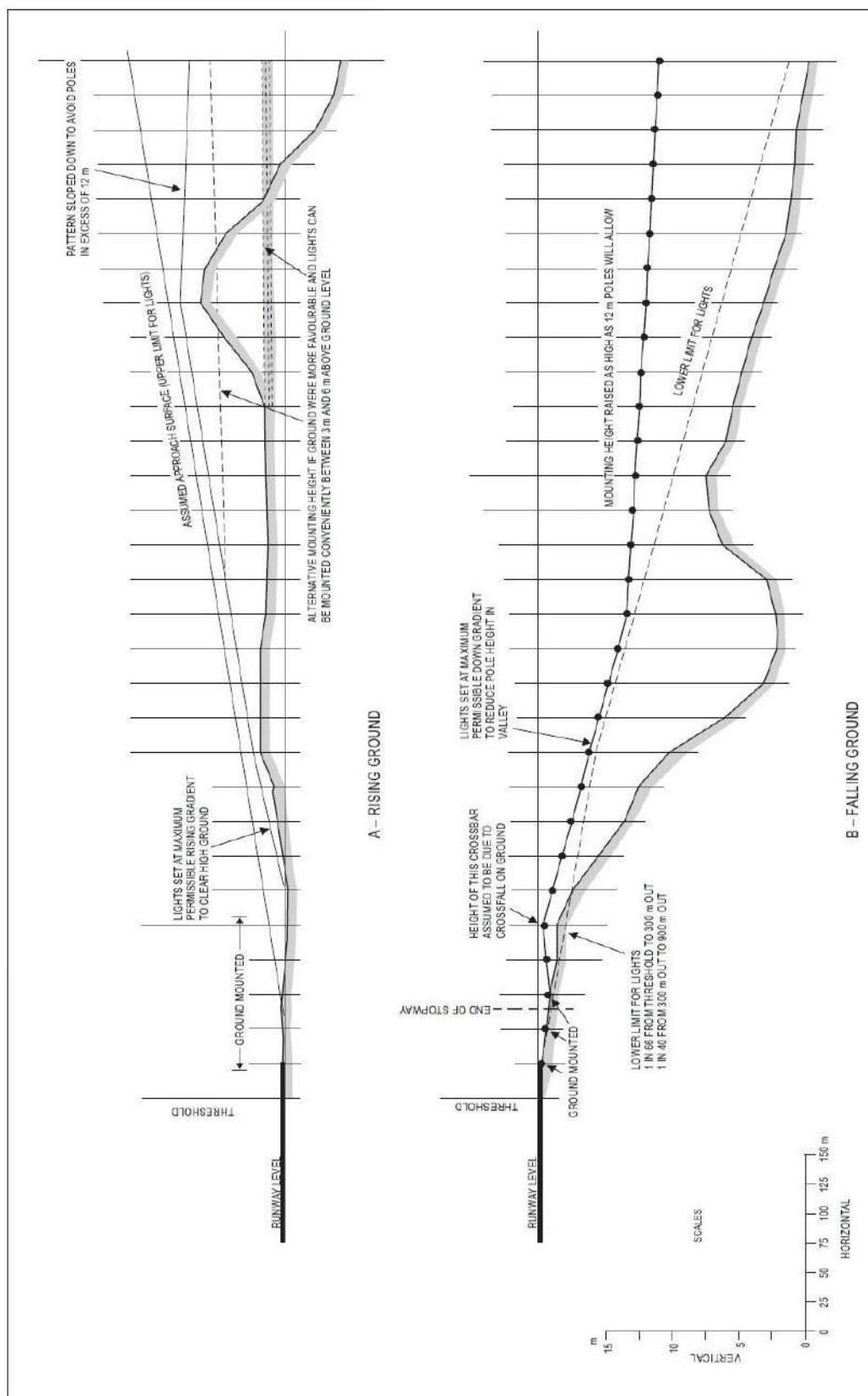


Figure A-6. Vertical installation tolerance

- 17.6 The most familiar case is where the decision speed is such that the take-off distance required is equal to the accelerate-stop distance required; this value is known as the balanced field length. Where stopway and clearway are not provided, these distances are both equal to the runway length. However, if landing distance is for the moment ignored, runway is not essential for the whole of the balanced field length, as the take-off run required is, of course, less than the balanced field length. The balanced field length can, therefore, be provided by a runway supplemented by an equal length of clearway and stopway, instead of wholly as a runway. If the runway is used for take-off in both directions, an equal length of clearway and stopway has to be provided at each runway end. The saving in runway length is, therefore, bought at the cost of a greater overall length.
- 17.7 In case economic considerations preclude the provision of stopway and, as a result, only runway and clearway are to be provided, the runway length (neglecting landing requirements) should be equal to the accelerate-stop distance required or the take-off run required, whichever is the greater. The take-off distance available will be the length of the runway plus the length of clearway.
- 17.8 The minimum runway length and the maximum stopway or clearway length to be provided may be determined as follows, from the data in the aeroplane flight manual for the aeroplane considered to be critical from the viewpoint of runway length requirements:
- 17.8.1 If a stopway is economically possible, the lengths to be provided are those for the balanced field length. The runway length is the take-off run required or the landing distance required, whichever is the greater. If the accelerate-stop distance required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway. In addition, a clearway of the same length as the stopway should also be provided;
- 17.8.2 If a stopway is not to be provided, the runway length is the landing distance required, or if it is greater, the accelerate-stop distance required, which corresponds to the lowest practical value of the decision speed. The excess of the take-off distance required over the runway length should be provided as clearway, usually at each end of the runway.
- 17.9 In addition to the above consideration, the concept of clearways in certain circumstances can be applied to a situation where the take-off distance required for all engines operating exceeds that required for the engine failure case.
- 17.10 The economy of a stopway can be entirely lost if, after each usage, it should be regraded and compacted. Therefore, it should be designed to withstand at least a certain number of loadings of the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.

18. Number, siting and orientation of runways

Note: - Siting and orientation of runways

- 18.1 Many factors should be taken into account in the determination of the siting and orientation of runways. Without attempting to provide an exhaustive list of these factors nor an analysis of their effects, it appears useful to indicate those which most

frequently require study. These factors may be classified under four headings:

- 18.1.1 Type of operation. Attention should be made in particular to whether the aerodrome is to be used in all meteorological conditions or only in visual meteorological conditions, and whether it is intended for use by day and night, or only by day.
- 18.1.2 Climatological conditions. A study of the wind distribution should be made to determine the usability factor. In this regard, the following comments should be taken into account:
- (a) Wind statistics used for the calculation of the usability factor are normally available in ranges of speed and direction, and the accuracy of the results obtained depends, to a large extent, on the assumed distribution of observations within these ranges. In the absence of any sure information as to the true distribution, it is usual to assume a uniform distribution since, in relation to the most favourable runway orientations, this generally results in a slightly conservative usability factor.
 - (b) The maximum mean crosswind components given in MOS 6.2.1.3, refer to normal circumstances. There are some factors which may require that a reduction of those maximum values be taken into account at a particular aerodrome. These include:
 - (i) the wide variations which may exist, in handling characteristics and maximum permissible crosswind components, among diverse types of aeroplanes (including future types) within each of the three groups given in MOS 6.2.1.3;
 - (ii) prevalence and nature of gusts;
 - (iii) prevalence and nature of turbulence;
 - (iv) the availability of a secondary runway;
 - (v) the width of runways;
 - (vi) the runway surface conditions - water on the runway materially reduce the allowable crosswind component; and
 - (vii) the strength of the wind associated with the limiting crosswind component.
- A study should also be made of the occurrence of poor visibility and/or low cloud base. Account should be taken of their frequency as well as the accompanying wind direction and speed.
- 18.1.3 Topography of the aerodrome site, its approaches, and surroundings, particularly:
- (a) compliance with the obstacle limitation surfaces;
 - (b) current and future land use. The orientation and layout should be selected so as to protect as far as possible the particularly sensitive areas such as residential, school and hospital zones from the discomfort caused by aircraft noise. Detailed information on this topic is provided in the Airport Planning Manual (Doc 9184), Part 2, and in Guidance on the Balanced Approach to Aircraft Noise Management (ICAO Doc 9829);
 - (c) current and future runway lengths to be provided;

- (d) construction costs; and
- (e) possibility of installing suitable non-visual and visual aids for approach- to-land.

18.1.4 Air traffic in the vicinity of the aerodrome, particularly:

- (a) proximity of other aerodromes or ATS routes;
- (b) traffic density; and
- (c) air traffic control and missed approach procedures.

18.2 The number of runways to be provided in each direction depends on the number of aircraft movements to be catered to.

19. Slopes on a runway

19.1 Distance between slope changes

The following example illustrates how the distance between slope changes is to be determined (See MOS Figure 6.2-1):

D for a runway where the code number is 3 should be at least:

$$15\,000 (|x - y| + |y - z|) \text{ m}$$

$|x - y|$ being the absolute numerical value of $x - y$

$|y - z|$ being the absolute numerical value of $y - z$

Assuming $x = +0.01$

$$y = -0.005$$

$$z = +0.005$$

then $|x - y| = 0.015$

then $|y - z| = 0.01$

To comply with the specifications, D should be not less than:

$$15\,000 (0.015 + 0.01) \text{ m},$$

that is, $15\,000 \times 0.025 = 375 \text{ m}$

19.2 Consideration of longitudinal and transverse slopes

When a runway is planned that will combine the extreme values for the slopes and changes in slope permitted under MOS 6.2.7.1 to 6.2.7.7 and MOS 6.2.9, a study should be made to ensure that the resulting surface profile will not hamper the operation of aeroplanes.

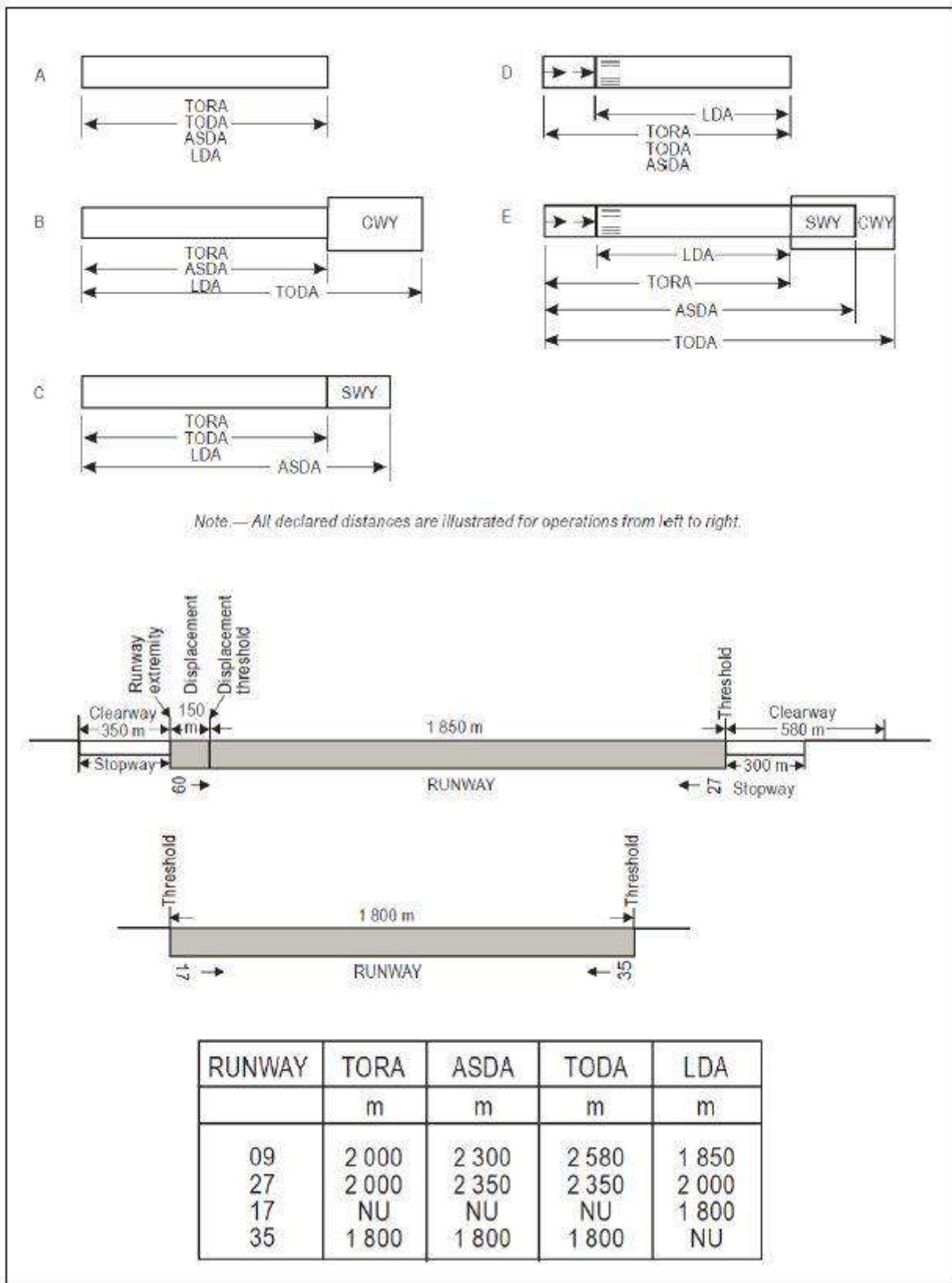


Figure A-7. Illustration of declared distances

19.3 Radio altimeter operating area

In order to accommodate aeroplanes making auto-coupled approaches and automatic landings (irrespective of weather conditions) it is desirable that slope changes be avoided or kept to a minimum, on a rectangular area at least 300 m long before the threshold of a precision approach runway. The area should be symmetrical about the extended centerline, 120 m wide. When special circumstances so warrant, the width should be reduced to no less than 60 m, if an aeronautical study indicates that such reduction will not affect the safety of operations of aircraft. This is desirable because these aeroplanes are equipped with a radio altimeter for final height and flare guidance, and when the aeroplane is above the terrain immediately prior to the threshold, the radio altimeter will begin to provide information to the automatic pilot for auto- flare. Where slope changes cannot be avoided, the rate of change between two consecutive slopes should not exceed 2% per 30 m.

20. **Determination of surface friction characteristics for construction and maintenance purposes**

Applicable until 3 November 2021

Note. - The guidance in this section involves the functional measurement of friction-related aspects related to runway construction and maintenance. Excluded from this section is the operational, as opposed to functional, measurement of friction for contaminated runways. However, the devices used for functional measurement could also be used for operational measurement, but in the latter case, the figures given in MOS Table 10.15-1 are not relevant.

- 20.1 The surface friction characteristics of a paved runway should be:
- (a) assessed to verify the surface friction characteristics of new or resurfaced paved runways (MOS 6.2.10.5); and
 - (b) assessed periodically in order to determine the slipperiness of paved runways (MOS 10.15.2.4).
- 20.2 The condition of a runway pavement is generally assessed under dry conditions using a self-wetting continuous friction measuring device. Evaluation tests of runway surface friction characteristics are made on clean surfaces of the runway when first constructed or after resurfacing.
- 20.3 Friction tests of existing surface conditions are taken periodically in order to avoid falling below the minimum friction level specified by CAAP. When the friction of any portion of a runway is found to be below this value, then such information is promulgated in a NOTAM specifying which portion of the runway is below the minimum friction level and its location on the runway. A corrective maintenance action should be initiated without delay. Friction measurements are taken at time intervals that will ensure the identification of runways in need of maintenance or of special surface treatment before their condition becomes serious. The time intervals and mean frequency of measurements depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and pavement service and maintenance requirements.

- 20.4 Friction measurements of existing, new or resurfaced runways are made with a continuous friction measuring device provided with a smooth tread tire. The device should use self-wetting features to allow measurements of the surface friction characteristics to be made at a water depth of 1 mm.
- 20.5 When it is suspected that the surface friction characteristics of a runway may be reduced because of poor drainage, owing to inadequate slopes or depressions, then an additional measurement is made, but this time under natural conditions representative of a local rain. This measurement differs from the previous one in that water depths in the poorly cleared areas are normally greater in a local rain condition. The measurement results are thus more apt to identify problem areas having low friction values that could induce aquaplaning than the previous test. If circumstances do not permit measurements to be conducted during natural conditions representative of a rain, then this condition may be simulated. (See MOS Attachment A, Section 2.)
- 20.6 When conducting friction tests using a self-wetting continuous friction measuring device, a wet runway produces a drop in friction with an increase in speed. However, as the speed increases, the rate at which the friction is reduced becomes less. Among the factors affecting the friction coefficient between the tire and the runway surface, texture is particularly important. If the runway has a good macrotexture allowing the water to escape beneath the tire, then the friction value will be less affected by speed. Conversely, a low macrotexture surface will produce a larger drop in friction with increase in speed.
- 20.7 CAAP should specify a minimum friction level below which corrective maintenance action should be taken. As criteria for surface friction characteristics of new or resurfaced runway surfaces and its maintenance planning, CAAP should establish a maintenance planning level below which appropriate corrective maintenance action should be initiated to improve the friction. The Airport Services Manual (Doc 9137), Part 2, provides guidance on establishing maintenance planning and minimum friction levels for runway surfaces in use.

21. Priority of installation of visual approach slope indicator systems

- 21.1 It has been found impracticable to develop guidance material that will permit a completely objective analysis to be made of which runway on an aerodrome should receive first priority for the installation of a visual approach slope indicator system. However, factors that should be considered when making such a decision are:
- (a) frequency of use;
 - (b) seriousness of the hazard;
 - (c) presence of other visual and non-visual aids;
 - (d) type of aeroplanes using the runway; and
 - (e) frequency and type of adverse weather conditions under which the runway will be used.
- 21.2 With respect to the seriousness of the hazard, the order given in the application specifications for a visual approach slope indicator system, MOS 9.8.1.2 b) to e), may

be used as a general guide. These may be summarized as:

- (a) inadequate visual guidance because of:
 - (i) approaches over water or featureless terrain, or absence of sufficient extraneous light in the approach area by night;
 - (ii) deceptive surrounding terrain;
- (b) serious hazard in approach;
- (c) serious hazard if aeroplanes undershoot or overrun; and
- (d) unusual turbulence.

21.3 The presence of other visual or non-visual aids is a very important factor. Runways equipped with ILS will generally receive the lowest priority for a visual approach slope indicator system installation. It should be remembered, though, that visual approach slope indicator systems are visual approach aids in their own right and can supplement electronic aids. When serious hazards exist and/or a substantial number of aeroplanes not equipped for ILS use a runway, priority should be given to installing a visual approach slope indicator on this runway.

21.4 Priority should be given to runways used by turbojet aeroplanes.



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ATTACHMENT B: CRITICAL DATA RELATED TO SAFETY OCCURRENCES REPORTED AT AERODROMES FOR THE MONITORING OF SAFETY

Note: - The provisions in this appendix do not override the requirements in Annex 13 — Aircraft Accident and Incident Investigation, concerning the mandatory reporting of certain types of accidents/serious incidents and the responsibilities of the various parties involved.

When safety occurrences of the following types are reported, the following critical data should be collected when relevant and feasible. This may require a collaborative effort from the aerodrome operator, ANSP or other involved parties commensurate with the severity of the potential risk attached to each occurrence.

1. Runway excursions

- a) type of event (lateral veer-off, overrun);
- b) landing/take-off;
- c) type of approach if it is a landing event (local time or UTC);
- d) date and time (local time or UTC);
- e) aeroplane type;
- f) Runway;
 - 1) dimensions (width/length);
 - 2) slopes
 - 3) displaced threshold (yes/no, and if so, distance between the runway threshold and the runway edge);
 - 4) runway end safety area (RESA) (yes/no, and if so, orientation, dimensions and structure);
 - 5) contaminated runway (yes/no, and if so, contaminant type (water, other (to be specified), contaminant depth);
- g) wind (direction and speed);
- h) visibility;
- i) Details of the exit:
 - 1) exit speed or estimation;
 - 2) aeroplane angle with the runway edge;
 - 3) distance between the touchdown and the exit;
 - 4) description of the trajectory of the aeroplane once on the runway strip and/or RESA;
- j) details of the location of the aeroplane once stopped.

Note:- 1. For overruns, information to be reported includes longitudinal position in relation to the threshold location and/or end of runway surface and lateral position in relation to runway lateral edge or runway centerline.

Note: - 2. Runway excursions are serious incidents, if not accidents, according to Annex 13, Attachment C. This would normally imply that the State's accident/incident investigation authority needs to become involved, and coordination with the relevant authorities is therefore required.

2. Undershoot (land short of runway)

- a) type of event (land short, undershoot);
- b) type of approach;
- c) ground-based vertical guidance available and operational (instrument landing system (ILS), precision approach path indicator (PAPI), abbreviated precision approach path indicator (APAPI));
- d) date and time (local time or UTC);
- e) wind speed (including gusts), description (calm/variable) and direction;
- f) visibility;
- g) aeroplane type;
- h) runway;
 - 1) dimensions (width/length);
 - 2) slopes
 - 3) displaced threshold (yes/no, and if so, distance between the runway threshold and the runway edge);
 - 4) RESA (yes/no, and if so, magnetic orientation of runway (QFU), dimensions and structure);
 - 5) contaminated runway (yes/no, and if so, contaminant type (slush, snow, ice, water, other (to be specified), contaminant depth);
- i) details of the undershoot (aeroplane speed at touchdown, distance between the touchdown and the runway edge, causes of the event):
 - 1) description of the trajectory of the aeroplane after touchdown.

Note: - Undershoots are serious incidents, if not accidents, according to Annex 13, Attachment C. This would normally imply that the State's accident/incident investigation authority needs to become involved, and coordination with the relevant authorities is therefore required.

3. Runway incursion

- a) entities involved (aeroplane/vehicle; aeroplane/aeroplane; aeroplane/ person);
- b) date and time (local time or UTC);
- c) aeroplane type, landing/take-off, type of approach;
- d) vehicle type, location;
- e) runway:
 - 1) dimensions (width/length);

- 2) slopes/line of sight;
- 3) displaced threshold (yes/no, and if so, distance between the runway threshold and the runway edge);
- 4) rapid exits
- 5) wind;
- 6) visibility;
- f) details of the incursion:
 - 1) description of the trajectories and speeds of both vehicles/aeroplanes;
 - 2) estimated distances (horizontal and vertical) between the entities involved;
 - 3) contaminated operational surfaces in the incursion area (yes/no, and if so, contaminant type (slush, snow, ice, water, other (to be specified), contaminant depth).

Note: - 1. Runway incursions classified with severity A are serious incidents according to Annex 13, Attachment C. This would normally imply that the State's accident/incident investigation authority needs to become involved, and coordination with the relevant authorities is therefore required.

Note:- 2. Guidance on prevention of runway incursions, including severity classification, is available in Doc 9870 - Manual on the Prevention of Runway Incursions).

4. Landing or take-off on a taxiway

- a) landing/take-off;
- b) type of approach when relevant;
- c) date and time (local time or UTC);
- d) wind;
- e) visibility;
- f) aeroplane type;
- g) taxiway:
 - 1) dimensions (width/length);
 - 2) slopes;
- h) details of the event:
 - 1) possible contributing factors (e.g. inadequate lighting, procedure not applied, works, inadequate or misleading marking).

Note: - Landing and take-off on taxiways are serious incidents according to Annex 13, Attachment C. This would normally imply that the State's accident/incident investigation authority needs to become involved, and coordination with the relevant authorities is therefore required.

5. FOD-related events

- a) type of event;
- b) location (runway, orientation, or taxiway, stand), location of FOD, including where possible lateral and longitudinal positions;
- c) date and time (local time or UTC);
- d) FOD description:
 - 1) name (if possible);
 - 2) shape and dimensions;
 - 3) material;
 - 4) color;
 - 5) origin (if known: lighting, infrastructure, works, animals, aeroplane, environment (wind, etc.)).

6. Other excursions (i.e. from the taxiway or apron)

- a) type of event;
- b) location;
- c) date and time (local time or UTC);
- d) aeroplane type;
- e) taxiway:
 - 1) dimensions (width/length);
 - 2) slopes;
 - 3) if in a curved section: fillets (yes/no, and characteristics);
 - 4) contaminated taxiway (yes/no, and if so, contaminant type (slush, snow, ice, water, other (to be specified) and contaminant depth);
- f) wind (direction and speed);
- g) details of the exit (exit speed or estimation, aeroplane angle with the taxiway edge, in a straight or a curved section, causes of the event);
- h) details of the location of the aeroplane once stopped.

7. Other incursions (i.e. on taxiway or apron)

Same data as for Item 2 (**Undershoot**).

8. Birds/wildlife strike-related events

To be conducted in accordance with ICAO bird strike information system (IBIS) data (ingestion, collision). If there has been no collision, and the animal was avoided, it is important to know the location of the animal at the time the avoided collision occurred.

9. Ground collisions

- a) type of event (ground collision);
- b) location:
 - 1) apron;
 - 2) maneuvering area;
 - 3) runway, taxiway;
 - 4) contaminant (if relevant: type and depth);
 - 5) wind (if relevant);
- c) date and time (local time or UTC);
- d) phase of flight (e.g. taxi out, departure roll, engine start/pushback);
- e) aeroplane(s) involved;
 - 1) type of aeroplane and trajectory;
- f) vehicle(s) involved;
 - 1) type of vehicle and trajectory;
- g) material damages (to both aeroplane(s) and/or vehicle(s))/human damages and location of the damages;
- h) phase of operation, if ground handling is involved;
- i) description of the collision:
 - 1) estimated speed of both vehicle(s) and/or aeroplane(s);
 - 2) description of the trajectories of the aeroplane(s) and/or the vehicle(s).

Note: - 1. Ground collisions involving aeroplanes can be incidents, serious incidents or accidents. If classified as an incident, they are normally investigated as part of the aerodrome's SMS. If classified as a serious incident or accident, this would normally imply that the State's accident/incident investigation authority needs to become involved, and coordination with the relevant authorities is therefore required.

Note: - 2. Ground collisions not involving aeroplanes can be an incident and investigated as part of the aerodrome's SMS.



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