AUTORITATEA AERONAUTICĂ CIVILĂ
A REPUBLICII MOLDOVA

GM-ADR-DSN

MATERIAL de ÎNDRUMARE (GM)

la

SPECIFICAŢIILE de CERTIFICARE (CS)

pentru proiectarea aerodromurilor

Ediţia 01 / April 2019

REPUBLICA MOLDOVA
MINISTERUL ECONOMIEI
ŞI INFRASTRUCTURII

РЕСПУБЛИКА МОЛДОВА
МИНИСТЕРСТВО ЭКОНОМИКИ
И ИНФРАСТРУКТУРЫ

O R D I N
cu privire la aprobarea amendamentului nr.01 la „Materiale de îndrumare la Specificaţii de certificare (GM-ADR-DSN) la Regulamentul privind procedurile administrative referitoare la aerodromuri”, ediţia 01

nr. 45/GEN din 21.10.2020

Monitorul Oficial nr.286-292/1102 din 06.11.2020

* * *

În temeiul articolului 7 alineatul (3) punctul 1) litera d) şi art.35 alineatul (10) din Codul aerian al Republicii Moldova nr.301/2017, precum şi al punctului 10 alineatul 1) litera d) din Regulamentul cu privire la organizarea şi funcţionarea Autorităţii Aeronautice Civile, aprobat prin Hotărârea Guvernului Republicii Moldova nr.133/2019, întru executarea atribuţiilor ce revin Autorităţii Aeronautice Civile în calitate de autoritate administrativă de certificare, supraveghere continuă şi control în domeniul aviaţiei civile, pentru asigurarea concordanţei cu Standardele şi Practicile Recomandate (SARPs) ale Organizaţiei Aviaţiei Civile Internaţionale urmare a aprobări Amendamentului 15 la Anexa 14, volumul I „Aerodromuri. Proiectarea şi exploatarea aerodromurilor” la Convenţia privind aviaţia civilă internaţională, în scopul asigurării implementării Regulamentului privind procedurile administrative referitoare la aerodromuri, aprobat prin Hotărârea Guvernului nr.653/2018,

ORDON:

1. Se aprobă amendamentul nr.01 la „Materiale de îndrumare la Specificaţii de certificare (GM-ADR-DSN) la Regulamentul privind procedurile administrative referitoare la aerodromuri”, ediţia 01, conform Anexei la prezentul ordin.

2. Autoritatea Aeronautică Civilă va pune la dispoziţia tuturor persoanelor interesate Anexa la prezentul ordin prin publicarea pe pagina web oficială www.caa.md, la rubrica „Cadrul normativ – Materiale de îndrumare (GM)”.

3. Amendamentul nr.01 la „Materiale de îndrumare la Specificaţii de certificare (GM-ADR-DSN) la Regulamentul privind procedurile administrative referitoare la aerodromuri”, ediţia 01, se aplică din data publicării prezentului ordin în Monitorul Oficial al Republicii Moldova.

4. Prezentul ordin intră în vigoare la data publicării în Monitorul Oficial al Republicii Moldova.

DIRECTOR **Eugeniu COŞTEI**

Nr.45/GEN. Chişinău, 21 octombrie 2020.

O R D I N
cu privire la aprobarea materialelor de îndrumare la specificaţiile de certificare (GM-ADR-DSN) la Regulamentul privind procedurile administrative referitoare la aerodromuri

nr. 18/GEN din 15.04.2019

Monitorul Oficial nr.148-158/724 din 26.04.2019

* * *

În temeiul art.7 alin.(3) punctul 1) lit.d) şi art.35 alin.(10) din Codul aerian al Republicii Moldova nr.301/2017, întru executarea atribuţiilor ce îi revin Autorităţii Aeronautice Civile în calitate de autoritate administrativă de certificare, supraveghere continuă şi control în domeniul aviaţiei civile, în scopul asigurării implementării Regulamentului privind procedurile administrative referitoare la aerodromuri, aprobat prin Hotărârea Guvernului nr.653/2018,

ORDON:

1. Se aprobă materialele de îndrumare la specificaţiile de certificare (GM-ADR-DSN) ediţia 01 la Regulamentul privind procedurile administrative referitoare la aerodromuri, conform anexei la prezentul ordin.

2. Autoritatea Aeronautică Civilă va pune la dispoziţia tuturor persoanelor interesate anexa la prezentul ordin prin publicarea pe pagina web oficială www.caa.md, la compartimentul Cadrul normativ – Materiale de îndrumare (GM).

3. Operatorii de aerodromuri/aeroporturi care cad sub incidenţa prevederilor Regulamentului privind procedurile administrative referitoare la aerodromuri vor utiliza materialele de îndrumare la specificaţiile de certificare (GM-ADR-DSN) în scopul certificării aerodromurilor.

4. Prezentul ordin intră în vigoare la data publicării în Monitorul Oficial al Republicii Moldova.

DIRECTORUL
AUTORITĂŢII AERONAUTICE CIVILE Octavian NICOLAESCU

Nr.18/GEN. Chişinău, 15 aprilie 2019.

CONTENT

LIST OF ABBREVIATIONS ... 1
CHAPTER A — GENERAL ... 3
GM1 ADR-DSN.A.001 Applicability ... 3
GM1 ADR-DSN.A.002 Definitions ... 3
GM1 ADR-DSN.A.005 Aerodrome Reference Code ... 3
GM1 ADR-DSN.A.010 ... 4
CHAPTER B — RUNWAYS ... 5
GM1 ADR-DSN.B.015 Number, siting, and orientation of runways ... 5
GM1 ADR-DSN.B.020 Choice of maximum permissible crosswind components ... 6
GM1 ADR-DSN.B.025 Data to be used ... 6
GM1 ADR-DSN.B.030 Runway threshold ... 6
GM1 ADR-DSN.B.035 Length of the runway and declared distances ... 7
GM1 ADR-DSN.B.040 Runways with stopways, or clearways ... 9
GM1 ADR-DSN.B.045 Width of runways ... 10
GM1 ADR-DSN.B.050 Minimum distance between parallel non-instrument runways ... 10
GM1 ADR-DSN.B.055 Minimum distance between parallel instrument runways ... 10
GM1 ADR-DSN.B.060 Longitudinal slopes on runways ... 10
GM1 ADR-DSN.B.065 Longitudinal slopes changes on runways ... 10
GM1 ADR-DSN.B.070 Sight distance for slopes of runways ... 10
GM1 ADR-DSN.B.075 Distance between slope changes on runways ... 10
GM1 ADR-DSN.B.080 Transverse slopes on runways ... 11
GM1 ADR-DSN.B.085 Runway strength ... 11
GM1 ADR-DSN.B.090 Surface of runways ... 12
SECTION 1 — RUNWAY TURN PADS ... 12
GM1 ADR-DSN.B.095 Runway turn pads ... 12
GM1 ADR-DSN.B.100 Slopes on runway turn pads ... 13
GM1 ADR-DSN.B.105 Strength of runway turn pads ... 13
GM1 ADR-DSN.B.110 Surface of runway turn pads ... 13
GM1 ADR-DSN.B.115 Width of shoulders for runway turn pads ... 13
GM1 ADR-DSN.B.120 Strength of shoulders for runway turn pads ... 13
SECTION 2 — RUNWAY SHOULDERS ... 13
GM1 ADR-DSN.B.125 Runway shoulders ... 13
GM1 ADR-DSN.B.130 Slopes on runway shoulders ... 13
GM1 ADR-DSN.B.135 Width of runway shoulders ... 13
GM1 ADR-DSN.B.140 Strength of runway shoulders ... 14

GM1 ADR-DSN.B.145 Surface of runway shoulders 14
SECTION 3 — RUNWAY STRIP 15
GM1 ADR-DSN.B.150 Runway strip to be provided 15
GM1 ADR-DSN.B.155 Length of runway strip 15
GM1 ADR-DSN.B.160 Width of runway strip 15
GM1 ADR-DSN.B.165 Objects on runway strips 15
GM1 ADR-DSN.B.170 16
GM1 ADR-DSN.B.175 Grading of runway strips 16
GM1 ADR-DSN.B.180 Longitudinal Slopes on runway strips 16
GM1 ADR-DSN.B.185 Transverse slopes on runway strips 16
GM1 ADR-DSN.B.190 Strength of runway strips 17
GM1 ADR-DSN.B.191 Drainage characteristics of the movement area and adjacent areas 17
SECTION 4 — CLEARWAYS, STOPWAYS AND RADIO ALTIMETER OPERATING AREA 19
GM1 ADR-DSN.B.195 Clearways 19
GM1 ADR-DSN.B.200 Stopways 21
GM1 ADR-DSN.B.205 Radio altimeter operating area 21
CHAPTER C — RUNWAY END SAFETY AREA (RESA) 22
GM1 ADR-DSN.C.210 Runway end safety areas 22
GM1 ADR-DSN.C.215 Dimensions of runway end safety areas 25
GM1 ADR-DSN.C.220 Objects on runway end safety areas 25
GM1 ADR-DSN.C.225 Clearing and grading of runway end safety areas 26
GM1 ADR-DSN.C.230 Slopes on runway end safety areas 26
GM1 ADR-DSN.C.235 Strength of runway end safety areas 26
CHAPTER D — TAXIWAYS 27
GM1 ADR-DSN.D.240 Taxiways general 27
GM1 ADR-DSN.D.245 Width of taxiways 29
GM1 ADR-DSN.D.250 Taxiways curves 29
GM1 ADR-DSN.D.255 Junction and intersection of taxiways 30
GM1 ADR-DSN.D.260 Taxiway minimum separation distance 30
GM1 ADR-DSN.D.265 Longitudinal slopes on taxiways 31
GM1 ADR-DSN.D.270 Longitudinal slope changes on taxiways 31
GM1 ADR-DSN.D.275 Sight distance of taxiways 31
GM1 ADR-DSN.D.280 Transverse slopes on taxiways 31
GM1 ADR-DSN.D.285 Strength of taxiways 31
GM1 ADR-DSN.D.290 Surface of taxiways 31
GM1 ADR-DSN.D.295 Rapid exit taxiways 31
GM1 ADR-DSN.D.300 Taxiways on bridges 31
GM1 ADR-DSN.D.305 Taxiway shoulders 31
GM1 ADR-DSN.D.310 Taxiway Strip 31
GM1 ADR-DSN.D.315 Width of taxiway strips 32

GM1 ADR-DSN.D.320 Objects on taxiway strips 32
GM1 ADR-DSN.D.325 Grading of taxiway strips 32
GM1 ADR-DSN.D.330 Slopes on taxiway strips 32
GM1 ADR-DSN.D.335 Holding bays, runway-holding positions, intermediate holding positions, and road-holding positions ... 32
GM1 ADR-DSN.D.340 Location of holding bays, runway-holding positions, intermediate holding positions, and road-holding positions 33
CHAPTER E — APRONS 35
GM1 ADR-DSN.E.345 General 35
GM1 ADR-DSN.E.350 Size of aprons 35
GM1 ADR-DSN.E.355 Strength of aprons 35
GM1 ADR-DSN.E.360 Slopes on aprons 36
GM1 ADR-DSN.E.365 Clearance distances on aircraft stands 36
CHAPTER F — ISOLATED AIRCRAFT PARKING POSITION 37
GM1 ADR-DSN.F.370 Isolated aircraft parking position 37
CHAPTER G — DE-ICING/ANTI-ICING FACILITIES 38
GM1 ADR-DSN.G.375 General 38
GM1 ADR-DSN.G.380 Location 38
GM1 ADR-DSN.G.385 Size of de-icing/anti-icing pads 38
GM1 -ADR-DSN.G.390 Slopes on de-icing/anti-icing pads 39
GM1 ADR-DSN.G.395 Strength of de-icing/anti-icing pads 39
GM1 ADR-DSN.G.400 Clearance distances on a de-icing/anti-icing pad 39
CHAPTER H — OBSTACLE LIMITATION SURFACES 40
GM1 ADR-DSN.H.405 Applicability 40
GM1 ADR-DSN.H.410 Outer horizontal surface 40
GM1 ADR-DSN.H.415 Conical surface 42
GM1 ADR-DSN.H.420 Inner horizontal surface 42
GM1 ADR-DSN.H.425 Approach surface 43
GM1 ADR-DSN.H.430 Transitional surface 43
GM1 ADR-DSN.H.435 Take-off climb surface 43
GM1 ADR-DSN.H.440 Slewed Take-off climb surface 43
GM1 ADR-DSN.H.445 Obstacle-free zone (OFZ) 43
GM1 ADR-DSN.H.450 Inner approach surface 44
GM1 ADR-DSN.H.455 Inner transitional surface 44
GM1 ADR-DSN.H.460 Balked landing surface 44
CHAPTER J — OBSTACLE LIMITATION REQUIREMENTS 45
GM1 ADR-DSN.J.465 General 45
GM1 ADR-DSN.J.470 Non-instrument runways 45
GM1 ADR-DSN.J.475 Non-precision approach runways 45
GM1 ADR-DSN.J.480 Precision approach runways 45
GM1 ADR-DSN.J.485 Runways meant for take-off 46
GM1 ADR-DSN.J.486 Other objects 46

GM1 ADR-DSN.J.487 Objects outside the obstacle limitation surfaces 46
CHAPTER K — VISUAL AIDS FOR NAVIGATION (INDICATORS AND SIGNALLING DEVICES) 47
GM1 ADR-DSN.K.490 Wind direction indicator 47
GM1 ADR-DSN.K.495 Landing direction indicator 47
GM1 ADR-DSN.K.500 Signalling lamp 48
GM1 ADR-DSN.K.505 Signal panels and signal area 48
GM1 ADR-DSN.K.510 Location of signal panels and signal area 48
GM1 ADR-DSN.K.515 Characteristics of signal panels and signal area 48
CHAPTER L — VISUAL AIDS FOR NAVIGATION (MARKINGS) 49
GM1 ADR-DSN.L.520 General – Colour and conspicuity 49
GM1 ADR-DSN.L.525 Runway designation marking 49
GM1 ADR-DSN.L.530 Runway centre line marking 49
GM1 ADR-DSN.L.535 Threshold marking 49
GM1 ADR-DSN.L.540 Aiming point marking 49
GM1 ADR-DSN.L.545 Touchdown zone marking 49
GM1 ADR-DSN.L.550 Runway side stripe marking 49
GM1 ADR-DSN.L.555 Taxiway centre line marking 49
GM1 ADR-DSN.L.560 Interruption of runway markings 50
GM1 ADR-DSN.L.565 Runway turn pad marking 51
GM1 ADR-DSN.L.570 Enhanced taxiway centre line marking 51
GM1 ADR-DSN.L.575 Runway-holding position marking 51
GM1 ADR-DSN.L.580 Intermediate holding position marking 52
GM1 ADR-DSN.L.585 VOR aerodrome checkpoint marking 52
GM1 ADR-DSN.L.590 Aircraft stand marking 52
GM1 ADR-DSN.L.595 Apron safety lines 52
GM1 ADR-DSN.L.597 Apron service road marking 52
GM1 ADR-DSN.L.600 Road-holding position marking 53
GM1 ADR-DSN.L.605 Mandatory instruction marking 53
GM1 ADR-DSN.L.610 Information marking 53
CHAPTER M — VISUAL AIDS FOR NAVIGATION (LIGHTS) 55
GM1 ADR-DSN.M.615 General 55
GM1 ADR-DSN.M.620 Aeronautical beacons 56
SECTION 1 — APPROACH LIGHTING SYSTEMS 56
GM1 ADR-DSN.M.625 Approach lighting systems 56
GM1 ADR-DSN.M.626 Simple approach lighting systems 61
GM1 ADR-DSN.M.630 Precision approach category I lighting system 61
GM1 ADR-DSN.M.635 Precision approach category II and III lighting system 62
SECTION 2 — VISUAL APPROACH SLOPE INDICATOR SYSTEMS 62
GM1 ADR-DSN.M.640 Visual approach slope indicator systems 62

GM1 ADR-DSN.M.645 Precision approach path indicator and Abbreviated precision approach path indicator (PAPI and APAPI) 63
GM1 ADR-DSN.M.650 Approach slope and elevation setting of light units for PAPI and APAPI 63
GM1 ADR-DSN.M.655 Obstacle protection surface for PAPI and APAPI 63
GM1 ADR-DSN.M.660 Circling guidance lights 63
GM1 ADR-DSN.M.665 Runway lead-in lighting systems 63
GM1 ADR-DSN.M.670 Runway threshold identification lights 63
GM1 ADR-DSN.M.675 Runway edge lights 63
GM1 ADR-DSN.M.680 Runway threshold and wing bar lights 63
GM1 ADR-DSN.M.685 Runway end lights 63
GM1 ADR-DSN.M.690 Runway centre line lights 63
GM1 ADR-DSN.M.695 Runway touchdown zone lights 64
GM1 ADR-DSN.M.696 Simple touchdown zone lights 64
GM1 ADR-DSN.M.700 Rapid exit taxiway indicator lights (RETILs) 64
GM1 ADR-DSN.M.705 Stopway lights 64
GM1 ADR-DSN.M.706 Runway status lights (RWSLs) 64
GM1 ADR-DSN.M.710 Taxiway centre line lights 65
GM1 ADR-DSN.M.715 Taxiway centre line lights on taxiways, runways, rapid exit taxiways, or on other exit taxiways 65
GM1 ADR-DSN.M.720 Taxiway edge lights 65
GM1 ADR-DSN.M.725 Runway turn pad lights 65
GM1 ADR-DSN.M.730 Stop bar 65
GM1 ADR-DSN.M.735 Intermediate holding position lights 66
GM1 ADR-DSN.M.740 De-icing/anti-icing facility exit lights 66
GM1 ADR-DSN.M.745 Runway guard lights 66
SECTION 4 — APRON LIGHTING 66
GM1 ADR-DSN.M.750 Apron floodlighting 66
GM1 ADR-DSN.M.755 Visual docking guidance system 66
GM1 ADR-DSN.M.760 Advanced visual docking guidance system 66
GM1 ADR-DSN.M.765 Aircraft stand manoeuvring guidance lights 67
GM1 ADR-DSN.M.770 Road-holding position light 67
GM1 ADR-DSN.M.771 No-entry bar 67
CHAPTER N — VISUAL AIDS FOR NAVIGATION (SIGNS) 69
GM1 ADR-DSN.N.775 General 69
GM1 ADR-DSN.N.780 Mandatory instruction signs 69
GM1 ADR-DSN.N.785 Information signs 69
GM1 ADR-DSN.N.790 VOR aerodrome checkpoint sign 69
GM1 ADR-DSN.N.795 Aircraft stand identification signs 69

GM1 ADR-DSN.N.800 Road-holding position sign 69
CHAPTER P — VISUAL AIDS FOR NAVIGATION (MARKERS) 70
GM1 ADR-DSN.P.805 General 70
GM1 ADR-DSN.P.810 Unpaved runway edge markers 70
GM1 ADR-DSN.P.815 Stopway edge markers 70
GM1 ADR-DSN.P.820 Edge markers for snow-covered runways . 70
GM1 ADR-DSN.P.825 Taxiway edge markers 70
GM1 ADR-DSN.P.830 Taxiway centre line markers 71
GM1 ADR-DSN.P.835 Unpaved taxiway edge markers 71
CHAPTER Q — VISUAL AIDS FOR DENOTING OBSTACLES 72
GM1 ADR-DSN.Q.840 Objects to be marked and/or lighted within the lateral boundaries of the obstacle limitation surfaces 72
GM1 ADR-DSN.Q.841 Objects to be marked and/or lighted outside the lateral boundaries of the obstacle limitation surfaces 72
GM1 ADR-DSN.Q.845 Marking of objects 72
GM1 ADR-DSN.Q.846 Lighting of fixed objects 72
GM1 ADR-DSN.Q.847 Lighting of fixed objects with a height less than 45 m above ground level 80
GM1 ADR-DSN.Q.848 Lighting of fixed objects with a height 45 m to a height less than 150 m above ground level 80
GM1 ADR-DSN.Q.849 Lighting of fixed objects with a height 150 m or more above ground level 81
GM1 ADR-DSN.Q.850 Lighting of other objects 81
GM1 ADR-DSN.Q.851 Marking and lighting of wind turbines 81
GM1 ADR-DSN.Q.852 Marking and lighting of overhead wires, cables, supporting towers, etc. 81
CHAPTER R — VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS 82
GM1 ADR-DSN.R.855 Closed runways and taxiways, or parts thereof 82
GM1 ADR-DSN.R.860 Non-load-bearing surfaces 82
GM1 ADR-DSN.R.865 Pre-threshold area 83
GM1 ADR-DSN.R.870 Unserviceable areas 83
CHAPTER S — ELECTRICAL SYSTEMS 84
GM1 ADR-DSN.S.875 Electrical power supply systems for air navigation facilities 84
GM1 ADR-DSN.S.880 Electrical power supply 84
GM1 ADR-DSN.S.885 System design 85
GM1 ADR-DSN.S.890 Monitoring 85
GM1 ADR-DSN.S.895 Serviceability levels 85
CHAPTER T — AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATION 86
GM1 ADR-DSN.T.900 Emergency and service access roads 86
GM1 ADR-DSN.T.905 Fire stations 87

GM1 ADR-DSN.T.910 Equipment frangibility requirements 87
GM1 ADR-DSN.T.915 Siting of equipment and installations on operational areas.. 87
GM1 ADR-DSN.T.920 Fencing.. 87
GM1 ADR-DSN.T.921 Autonomous runway incursion warning system (ARIWS).. 88
CHAPTER U — COLOURS FOR AERONAUTICAL GROUND LIGHTS, MARKINGS, SIGNS AND PANELS 91
GM1 ADR-DSN.U.925 General 91
GM1 ADR-DSN.U.930 Colours for aeronautical ground lights....... 91
GM1 ADR-DSN.U.935 Colours for markings, signs and panels 91
GM1 ADR-DSN.U.940 Aeronautical ground light characteristics... 91

PAGES CONTROL LIST

Page Number	Edition / Amendment	Date
Content	01 / 00	April 2019
Pages control list	01 / 00	April 2019
1	01 / 00	April 2019
2	01 / 00	April 2019
3	01 / 00	April 2019
4	01 / 00	April 2019
5	01 / 00	April 2019
6	01 / 00	April 2019
7	01 / 00	April 2019
8	01 / 00	April 2019
9	01 / 00	April 2019
10	01 / 00	April 2019
11	01 / 00	April 2019
12	01 / 00	April 2019
13	01 / 00	April 2019
14	01 / 00	April 2019
15	01 / 00	April 2019
16	01 / 00	April 2019
17	01 / 00	April 2019
18	01 / 00	April 2019
19	01 / 00	April 2019
20	01 / 00	April 2019
21	01 / 00	April 2019
22	01 / 00	April 2019
23	01 / 00	April 2019
24	01 / 00	April 2019
25	01 / 00	April 2019
26	01 / 00	April 2019
27	01 / 01	October 2020
28	01 / 00	April 2019
29	01 / 00	April 2019
30	01 / 00	April 2019
31	01 / 00	April 2019
32	01 / 00	April 2019
33	01 / 01	October 2020
34	01 / 00	April 2019
35	01 / 00	April 2019
36	01 / 00	April 2019
37	01 / 00	April 2019
38	01 / 00	April 2019
39	01 / 00	April 2019
40	01 / 00	April 2019
41	01 / 00	April 2019
42	01 / 00	April 2019

Page Number	Edition / Amendment	Date
43	01 / 00	April 2019
44	01 / 00	April 2019
45	01 / 00	April 2019
46	01 / 00	April 2019
47	01 / 00	April 2019
48	01 / 00	April 2019
49	01 / 00	April 2019
50	01 / 00	April 2019
51	01 / 00	April 2019
52	01 / 00	April 2019
53	01 / 00	April 2019
54	01 / 00	April 2019
55	01 / 00	April 2019
56	01 / 00	April 2019
57	01 / 00	April 2019
58	01 / 00	April 2019
59	01 / 00	April 2019
60	01 / 00	April 2019
61	01 / 00	April 2019
62	01 / 00	April 2019
63	01 / 00	April 2019
64	01 / 00	April 2019
65	01 / 00	April 2019
66	01 / 00	April 2019
67	01 / 00	April 2019
68	01 / 00	April 2019
69	01 / 00	April 2019
70	01 / 00	April 2019
71	01 / 00	April 2019
72	01 / 00	April 2019
73	01 / 00	April 2019
74	01 / 00	April 2019
75	01 / 00	April 2019
76	01 / 00	April 2019
77	01 / 00	April 2019
78	01 / 00	April 2019
79	01 / 00	April 2019
80	01 / 00	April 2019
81	01 / 00	April 2019
82	01 / 00	April 2019
83	01 / 00	April 2019
84	01 / 00	April 2019
85	01 / 00	April 2019
86	01 / 00	April 2019
87	01 / 00	April 2019

LIST OF ABBREVIATIONS

ACN	Aircraft classification number
AGL	Above ground level
AGL	Aeronautical ground light
AIP	Aeronautical information publication
AIS	Aeronautical information cervices
APAPI	Abbreviated precision approach path indicator
ARC	Aerodrome reference code
ARIWS	Autonomous runway incursion warning systems
ASDA	Accelerate-stop distance available
A-SMGCS	Advanced surface movement guidance and control system
ATC	Air traffic contro
ATIS	Automatic terminal information service
ATM	Air traffic management
ATS	Air traffic services
A-VDGS	Advanced visual docking guidance system
CBR	California bearing ratio
CCR	Constant current regulators
CIE	International Commission on Illumination (Commission Internationale de l'Éclairage)
CWY	Clearway
DH	Decision height
DME	Distance measuring equipment
ESDU	Engineering sciences data unit
FOD	Foreign object debris
FOV	Field of view
Hes	Height of equivalent elevated sign character
Hps	Height of pavement sign character
ICAO	International Civil Aviation Organization
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ISO	International Organisation for Standardisation
LDA	Landing distance available
LED	Light-emitting diodes
LRST	Local runway safety team
MLS	Microwave landing system
MPD	Mean profile depth
MTD	Mean texture depth
NOTAM	Notice to airman
NU	Not usable

OCA/H	Obstacle clearance altitude/ height
OFZ	Obstacle-free zone
OLS	Obstacle limitation surface
OMGWS	Outer main gear wheel span
OPS	Obstacle protection surface
PAPI	Precision approach path indicator
PCN	Pavement classification number
PBN	Performance based navigation
PSV	Polished stone values
RELs	Runway entrance lights
RESA	Runway end safety area
RET	Rapid exit taxiway
RETILs	Rapid exit taxiway indicator lights
RFF	Rescue and firefighting
RFFS	Rescue and firefighting services
RP	Reference point
RVR	Runway visual range
RWSL	Runway status lights
RWY	Runway
SMGCS	Surface movement guidance and control system
SWY	Stopway
TDZ	Runway touchdown zone
THLs	Take-off hold lights
TODA	Take-off distance available
TORA	Take-off run available
UPS	Uninterruptible power supply
VMC	Visual meteorological conditions
VOR	VHF Omnidirectional radio range
WGS-84	World geodetic system – 1984

CHAPTER A — GENERAL

GM1 ADR-DSN.A.001 Applicability

(a) The certification specifications ”CS-ADR-DSN” and the related guidance material contained in this document” GM-ADR-DSN” are applicable to the aerodromes that fall in the scope of the Aviation Code.

(b) At an aerodrome, which falls in the scope of the Aviation Code and Government Decision (further on GD) no.653 of 11.07.2018 on approval of the Regulation regarding administrative procedures related to aerodromes and has more than one runway, at least one runway should meet the criteria contained in the GD no.653. However, for other ‘types’ of runways at aerodrome, it is not compulsory that those runways meet the criteria of the GD no.653. Such runways may be Non instrument runways, unpaved runways, shorten than 800 m runways, runways which are not open to public use or for commercial air transport. The certification specifications and guidance material are applicable also to those runways.

GM1 ADR-DSN.A.002 Definitions

For the purpose of this document ”GM-ADR-DSN” the definitions from Certification Specifications for Aerodrome design ”CS-ADR-DSN” should apply.

GM1 ADR-DSN.A.005 Aerodrome Reference Code

(a) 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.

(b) 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 the critical aeroplane characteristics for which the facility is provided. When applying CS-ADR-DSN text, the aeroplanes which the aerodrome is intended to serve, are first identified and then the two elements of the code.

(c) In addition to the reference code, other aircraft characteristics, such as aircraft length and tail height, may also have an impact on the design of an aerodrome. Additionally, some characteristics of a piece of infrastructure are directly related to one element of the code (wingspan or wheel span) but are not impacted by other. The aerodrome designer should consider all the relationships between aircraft characteristics and aerodromes and piece of infrastructures characteristics.

(d) It is not intended that the specifications deriving from the aerodrome reference code limit or regulate the operation of an aircraft.

(e) It is recognized that not all areas of the aerodrome should need to correspond to the critical aeroplane that determines the Aerodrome Reference Code. Elements of the aerodrome infrastructure that do not meet the requirements of the Aerodrome Reference Code for the design aeroplane should be designated with an appropriate code letter for its dimensions. Limitations should be identified to aircraft size permitted or operating limitations.

(f) Further guidance on aerodrome reference code and on planning for aeroplanes with wingspans greater than 80 m is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways, and Part 2, Taxiways, Aprons and Holding Bays.

Additional guidance on determining the runway length is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

Note: References to the ICAO documents provided in CS-ADR-DSN are made for additional guidance. Changes in the CS-ADR-DSN regarding the aerodrome reference code are not yet fully reflected in these documents.

GM1 ADR-DSN.A.010

Intentionally left blank.

CHAPTER B — RUNWAYS

GM1 ADR-DSN.B.015 Number, siting, and orientation of runways

(a) In practice the number and orientation of runways at an aerodrome should normally be such that the usability factor of the aerodrome would normally be not less than 95% for the aeroplanes that the aerodrome is intended to serve.

(b) Many factors affect the determination of the orientation, siting, and number of runways:

(1) The wind distribution (to minimise crosswinds liable to affect runways);

(i) 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.

(ii) The maximum mean crosswind components given in GM1 ADR-DSN.B.020, 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:

A. 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 GM1 ADR-DSN.B.020;

B. prevalence and nature of gusts;

C. prevalence and nature of turbulence;

D. the availability of a secondary runway;

E. the width of runways;

F. the runway surface conditions — water, snow, and ice on the runway materially reduce the allowable crosswind component; and

G. the strength of the wind associated with the limiting crosswind component.

(2) The need to facilitate the provision of approaches conforming to the approach surface specifications, ensuring that obstacles in these areas or other factors should not restrict the operation of the aeroplanes for which the runway is intended. This may relate to individual obstacles or local geography (e.g. high ground).

(3) The need to minimize interference with areas approved for residential use and other noise-sensitive areas close to the aerodrome.

(4) The need to avoid the turbulence impacts of buildings on or close to the aerodrome.

(5) Type of operation. Attention should be paid 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.

(6) Topography of the aerodrome site, its approaches, and surroundings, particularly:

(i) compliance with the obstacle limitation surfaces;

(ii) 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 ICAO Doc 9184, Airport Planning Manual, Part 2, Land Use and Environmental Control and in ICAO Doc 9829, Guidance on the Balanced Approach to Aircraft Noise Management;

(iii) current and future runway lengths to be provided;

(iv) construction costs; and

(v) possibility of installing suitable non-visual and visual aids for approach-to-land.

(7) Air traffic in the vicinity of the aerodrome, particularly:

(i) proximity of other aerodromes or ATS routes;

(ii) traffic density; and (iii) air traffic control and missed approach procedures.

(c) The number of runways to be provided in each direction depends on the number of aircraft movements to be catered for.

(d) Whatever the factors that determine the runway orientation, the siting, and orientation of runways at an aerodrome should where possible, be such that safety is optimised.

(e) 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 in CS ADR-DSN.H.425. Further guidance on these and other factors is given in ICAO Annex 14, Attachment A, Section 1. When a new instrument runway is being located, particular attention needs to be given to areas over which aeroplanes should be required to fly when following instrument approach and missed approach procedures so as to ensure that obstacles in these areas or other factors should not restrict the operation of the aeroplanes for which the runway is intended.

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

GM1 ADR-DSN.B.020 Choice of maximum permissible crosswind components

In the application of GM1 ADR-DSN.B.015 (a) it should be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:

(1) 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 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) should be assumed;

(2) 24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m; and

(3) 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.

GM1 ADR-DSN.B.025 Data to be used

Intentionally left blank.

GM1 ADR-DSN.B.030 Runway threshold

(a) Additional distance should be provided to meet the requirements of the runway end safety area as appropriate.

(b) Where this displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 m in length should be available between the unserviceable area and the displaced threshold.

(c) Guidance Material on the survey requirements for aerodromes is provided in the ICAO World Geodetic system – 1984 (WGS-84) Manual, notably in Section 5.3. However, this guidance does not accurately define the survey locations for the runway edge or the runway threshold because, in both cases, the measurement point is not the centre of the relevant paint marking.

(d) Location of threshold:

(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 below). When studying the location of a threshold, consideration should also be given to the height of the ILS reference datum, and/or MLS approach reference datum, and the determination of the obstacle clearance limits. Specifications concerning the height of the ILS reference datum and MLS approach reference datum are given in ICAO Annex 10, Volume I.

(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 1 200 m longitudinally from the threshold and of an overall width of not less than 150 m.

(e) Displaced threshold:

(1) If an object extends above the approach surface and the object cannot be removed, consideration should be given to displacing the threshold permanently.

(2) To meet the obstacle limitation objectives of certification specifications, prescribed in Chapter H, the threshold should ideally be displaced down the runway for the distance necessary to provide that the approach surface is cleared of obstacles.

(3) However, displacement of the threshold from the runway extremity should 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 should 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 should be used, the position of the obstacles in relation to the threshold and extended centre line, and, in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.

(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.

(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 Chapter Q should continue to be met in relation to the displaced threshold.

(6) Depending on the length of the displacement, the RVR at the threshold could 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.

GM1 ADR-DSN.B.035 Length of the runway and declared distances

(a) Length of the runway:

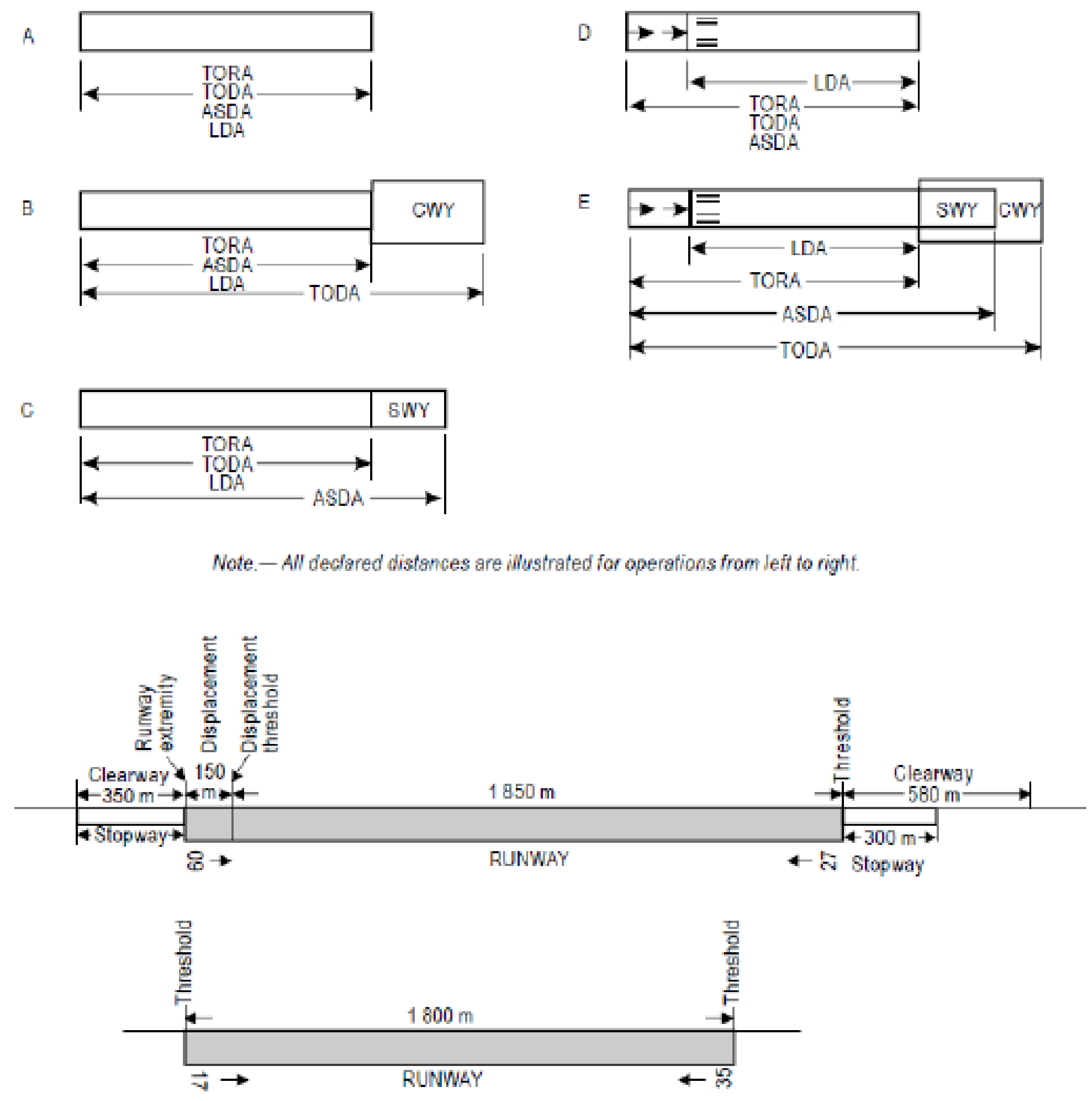
(1) This specification does not necessarily mean providing for operations by the critical aeroplane at its maximum mass.

(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.

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

(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 ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

(5) Except as provided in GM1 ADR-DSN.B.040, the actual runway length to be provided for a runway should be adequate to meet the operational requirements of the aeroplanes for which the runway is intended, and should be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant aeroplanes.



F

RUNWAY	TORA	ASDA	TODA	LDA
	m	m	m	m
09	2 000	2 300	2 580	1 850
27	2 000	2 350	2 350	2 000
17	NU	NU	NU	1 800
35	1 800	1 800	1 800	NU

Figure GM-B-1. Illustration of declared distances

GM1 ADR-DSN.B.040 Runways with stopways, or clearways

Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of GM1 ADR-DSN.B.035 as appropriate, may be considered satisfactory but, in such a case, any combination of runway, stopway, and clearway provided should permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.

GM1 ADR-DSN.B.045 Width of runways

(a) The combinations of code numbers and OMGWSs for which widths are specified have been developed for typical aeroplane characteristics.

(b) Factors affecting runway width are given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

(c) See CS ADR-DSN.B.125 to CS ADR-DSN.B.145 concerning the provision of runway shoulders, in particular for code F aeroplanes with four (or more) engines.

GM1 ADR-DSN.B.050 Minimum distance between parallel non-instrument runways

(a) Except that for independent parallel approaches, combinations of minimum distances and associated conditions other than those specified in the PANS-ATM (Doc 4444) may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

(b) Procedures for wake turbulence categorization of aircraft and wake turbulence separation minima are contained in the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM), Doc 4444, Chapter 4, 4.9 and Chapter 5, 5.8, respectively.

GM1 ADR-DSN.B.055 Minimum distance between parallel instrument runways

Guidance on procedures and facilities requirements for simultaneous operations on parallel or nearparallel instrument runways are contained in ICAO, PANS-ATM, Doc 4444, Chapter 6 and ICAO, 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 is contained in ICAO Doc, 9643, Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR).

GM1 ADR-DSN.B.060 Longitudinal slopes on runways

Slopes should be so designed as to minimise impact on aircraft and so not to hamper the operation of aircraft. For precision approach runways, slopes in a specified area from the runway end, and including the touchdown area, should be designed so that they should correspond to the characteristics needed for such type of approach.

GM1 ADR-DSN.B.065 Longitudinal slopes changes on runways

(a) Slope changes are so designed as to reduce dynamic loads on the undercarriage system of the aeroplane. Minimizing slope changes is especially important on runways where aircraft move at high speeds.

(b) For precision approach runways, slopes in a specified area from the runway end, and including the touchdown area, are so designed that they should correspond to the characteristics needed for such type of approach.

GM1 ADR-DSN.B.070 Sight distance for slopes of runways

Runway longitudinal slopes and slopes changes are so designed that the pilot in the aircraft has an unobstructed line of sight over all or as much of the runway as possible, thereby enabling him to see aircraft or vehicles on the runway, and to be able to manoeuvre and take avoiding action.

GM1 ADR-DSN.B.075 Distance between slope changes on runways

The following example illustrates how the distance between slope changes is to be determined (see Figure GM-B-2):

D for a runway where the code number is 3 should be at least:

$15\,000\,(|x - y| + |y - z|)$ 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 $|x - y| = 0.015$

$|y - z| = 0.01$

To comply with the specifications, D should be not less than:

15 000 (0.015 + 0.01) m,

that is, 15 000 × 0.025 = 375 m

When a runway is planned that should combine the extreme values for the slopes and changes in slope permitted, as prescribed in CS ADR-DSN.B.060 to CS ADR-DSN.B.080, a study should be made to ensure that the resulting surface profile should not hamper the operation of aeroplanes.

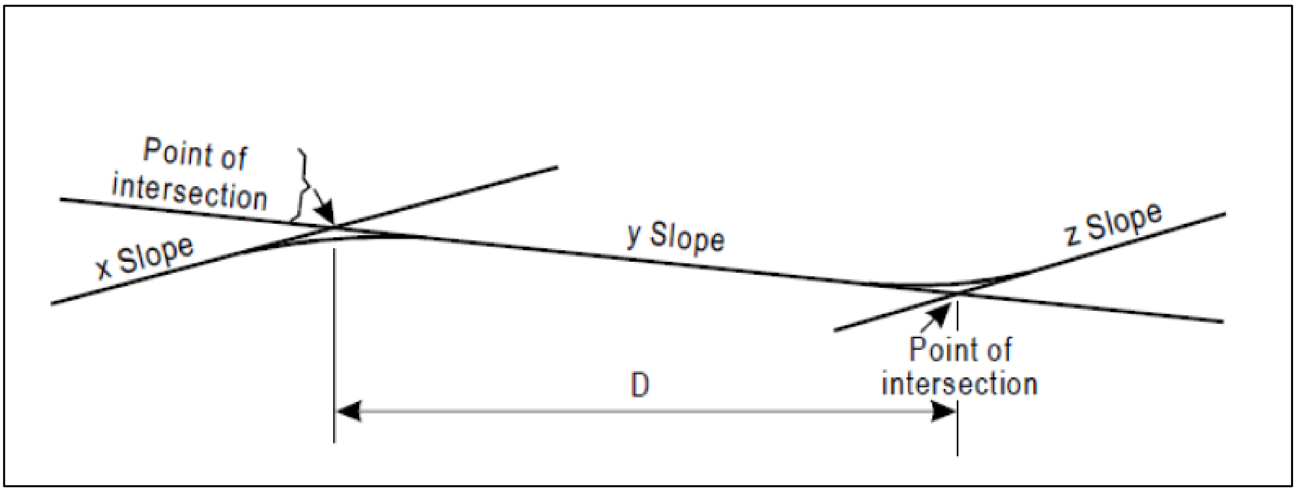


Figure GM-B-2. Profile on centre line of runway

GM1 ADR-DSN.B.080 Transverse slopes on runways

The slopes on a runway are intended to prevent the accumulation of water (or possible fluid contaminant) on the surface and to facilitate rapid drainage of surface water (or possible fluid contaminant). The water (or possible fluid contaminant) evacuation is facilitated by an adequate combination of longitudinal and transverse slopes, and may also be assisted by grooving the runway surface.

GM1 ADR-DSN.B.085 Runway strength

(a) Pavement forming part of the movement area needs to be of sufficient strength to allow aircraft to operate without risk of damage either to the pavement or to the aircraft. Pavements subject to overload conditions should deteriorate at an increasing rate depending upon the degree of overload. To control this, it is necessary to classify both pavement and aircraft under a system whereby the load-bearing capacity of the pavement and the loads imposed by the aircraft can be compared. The method used is the Aircraft Classification Number - Pavement Classification Number (ACN/PCN) method. The ACN/PCN method has been developed by ICAO as an international method of reporting the bearing strength of pavements.

(b) All pavements forming part of the movement area should be of adequate bearing strength for the types of aircraft expected to use the aerodrome. All pavements should be regularly examined by a suitably qualified person. Any pavements which have been subjected to overload conditions should be closely monitored by suitably qualified staff for a period of several weeks or until it is clear that no rapid deterioration of the pavement has been triggered.

(c) Reporting pavement bearing strength:

(1) The ACN/PCN method of classifying the bearing strength of pavements considers the load imposed on the pavement by the aircraft. In this respect, the load rating of the aircraft is most significantly affected by the subgrade support strength of the pavement. ACNs are, therefore, numbers giving a relative load rating of the aircraft on pavements for certain specified subgrade strengths. ACN values for most aeroplanes have been calculated by ICAO and are published in Aeronautical Information Publications. The PCN is also a number which represents the load-bearing strength of the pavement in terms of the highest ACN which can be accepted on the pavement for unrestricted use.

(2) A PCN can also be identified and reported without a technical evaluation of the pavement by means of an assessment of the results of aircraft using the pavement. Providing the type and subgrade support strength of the pavement are known, the ACN of the most demanding aircraft successfully using the pavement can be reported as the PCN.

(3) A PCN is reported in a five-part format. Apart from the numerical value, notification is also required of the pavement type (rigid or flexible) and the subgrade support category. Additionally, provision is made for the aerodrome operator to limit the maximum allowable tire pressure. A final indication is whether the assessment has been made by a technical evaluation or from past experience of aircraft using the pavement.

GM1 ADR-DSN.B.090 Surface of runways

(a) In adopting tolerances for runway surface irregularities, the following standard of construction is achievable for short distances of 3 m and conform 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.

(b) 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.

(c) Additional guidance on surface of runways is given in ICAO Doc 9157, Aerodrome Design Manual, Part 3, Pavements.

(d) Macrotexture and microtexture should be taken into consideration in order to provide the required surface friction characteristics. Additional guidance is given in GM1 ADR-DSN.B.191. Additional guidance on design and methods for improving runway surface texture is given in ICAO Doc 9157, Aerodrome Design Manual, Part 3, Pavements.

(e) The surface of a paved runway should be evaluated when constructed or resurfaced to determine that the surface friction characteristics achieve the design objectives.

SECTION 1 — RUNWAY TURN PADS

GM1 ADR-DSN.B.095 Runway turn pads

Where severe weather conditions and resultant lowering of surface friction characteristics prevail, a larger wheel-to-edge clearance should be provided.

(a) A typical runway turn pad layout is presented in Figure GM-B-3 below:

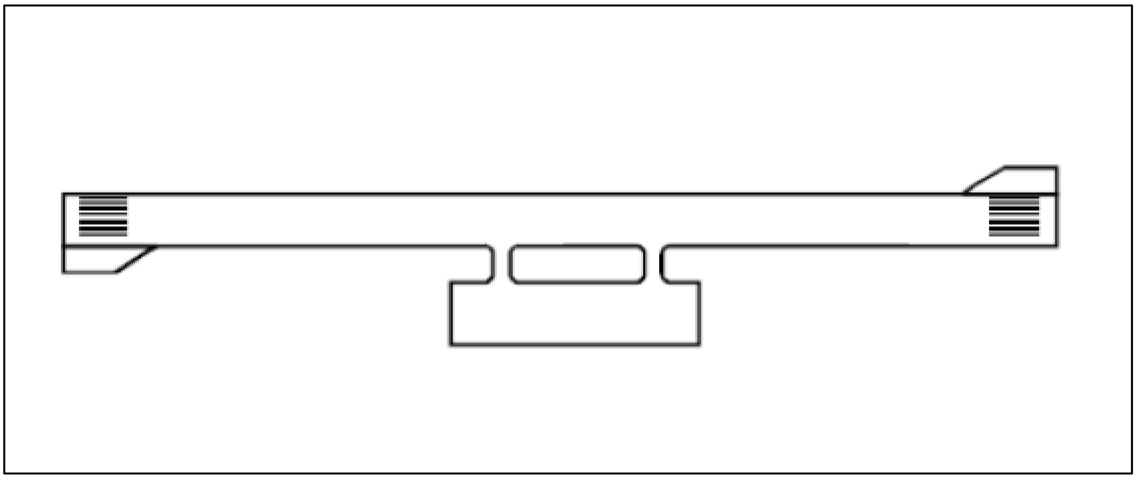


Figure GM B-3. Typical turn pad layout

(b) Additional guidance on the design of runway turn pads is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

GM1 ADR-DSN.B.100 Slopes on runway turn pads

Slopes should be so designed as to minimize impact on aircraft and so not to hamper the operation of aircraft.

GM1 ADR-DSN.B.105 Strength of runway turn pads

Intentionally left blank

GM1 ADR-DSN.B.110 Surface of runway turn pads

Intentionally left blank

GM1 ADR-DSN.B.115 Width of shoulders for runway turn pads

As a minimum, the width of the shoulders would need to cover the outer engine of the most demanding aircraft and thus may be wider than the associated runway shoulders.

GM1 ADR-DSN.B.120 Strength of shoulders for runway turn pads

Intentionally left blank

SECTION 2 — RUNWAY SHOULDERS

GM1 ADR-DSN.B.125 Runway shoulders

(a) Runway shoulders should be considered because strong crosswinds may result in significant deviation from the runway centre line. In the case of some large aircraft, the wing-mounted engines may overhang the runway edge and there is a risk of jet blast eroding the surface adjacent to the runway. This can cause dust and the possible ingestion of debris by the engines.

(b) Further guidance on runway shoulders is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

(c) Mitigation measures that can be considered are to provide the runway with inset runway edge lights (in lieu of elevated lights, to protect aeroplane from ingestion) and additional runway centre line guidance.

GM1 ADR-DSN.B.130 Slopes on runway shoulders

Intentionally left blank

GM1 ADR-DSN.B.135 Width of runway shoulders

Intentionally left blank

GM1 ADR-DSN.B.140 Strength of runway shoulders

(a) Runway shoulders should be so prepared as to be capable of supporting the aeroplanes using the runway without causing structural damage to those aeroplanes. They should also be capable of supporting vehicles such as firefighting appliances. In some cases, whilst the bearing strength of the natural ground may be sufficient, special preparation may be necessary to avoid erosion and the possible ingestion of debris by engines.

(b) Guidance on characteristics and treatment of runway shoulders:

(1) The shoulder of a runway or stopway should be prepared or constructed so as to support an aeroplane and 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 further measures to avoid the ingestion of loose stones or other objects by turbine engines.

(2) 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 should depend on local soil conditions and on the mass of the aeroplanes the runway is intended to serve. Soil tests should help in determining the best method of improvement (e.g. drainage, stabilization, surfacing and light paving).

(c) Attention should also be paid when designing shoulders to prevent the ingestion of stones or other objects by turbine engines. Similar considerations apply here to those discussed for the margins of taxiways both as to the special measures that may be necessary and as to the distance over which such special measures, if required, should be taken. Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1 Runways, and Part 2, Taxiways, Aprons and Holding Bays.

(d) 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. Such difficulties can be overcome either by providing a good visual contrast between the surfacing of the runway and of the strip, or by providing a runway side stripe marking.

(e) Additional guidance on strength of runway shoulders is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

GM1 ADR-DSN.B.145 Surface of runway shoulders

(a) Where a runway shoulder is not paved, additional surface treatment or inspections may be necessary, especially for runways that accept operations by 4-engined aircraft with a code letter D or larger.

(b) Shoulders for runways where the code letter is E normally should be paved.

(c) If movements of 4-engined aircraft with a code letter D take place, the need for fully paved width shoulders should be assessed by local hazard analysis. Where the runway shoulder is not paved, it may be possible to contain the risk from erosion or from the ingestion of debris. In such cases:

(1) The runway shoulder should be stabilized and the ground is prepared so that there is full grass coverage with no loose gravel or other material. This may include additional materials if the bearing strength and surface of the ground are not sufficient.

(2) A programme of inspections of the shoulders and runway may be implemented to confirm their continuing serviceability, and ensure that there is no deterioration that could create a risk of foreign object debris (FOD), or otherwise hazard aircraft operations.

(3) A programme of sweeping may be required before and after movements, should debris be drawn onto the runway surface.

(d) Additional guidance on surface of runway shoulders is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

SECTION 3 — RUNWAY STRIP

GM1 ADR-DSN.B.150 Runway strip to be provided

(a) A runway strip extends laterally to a specified distance from the runway centre line, longitudinally before the threshold, and beyond the runway end. It provides an area clear of objects that may endanger aeroplanes. Any equipment or installation required for air navigation or for aircraft safety purposes and is located in this object-free area should be frangible and mounted as low as possible.

(b) When the threshold or end of the landing distance do not coincide with the ends of a runway, the runway strip enclosing the runway and any associated stopway should extend to the lengths specified in CS ADR-DSN.B.155 at the widths specified in CS ADR-DSN.B.160, based on the threshold, end of landing distance or end of stopway, as appropriate.

GM1 ADR-DSN.B.155 Length of runway strip

Intentionally left blank

GM1 ADR-DSN.B.160 Width of runway strip

Intentionally left blank

GM1 ADR-DSN.B.165 Objects on runway strips

(a) Within the graded portion of the runway strip, measures should 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 constructions within the graded portion of the runway strip, such as intersecting runways or taxiways, where the surface should also be flush with the strip surface, they should be delethalised, that is, so constructed as to avoid presenting a buried vertical face to aircraft wheels in soft ground conditions in any direction from which an aircraft is likely to approach. A vertical face can be eliminated by chamfering from the top of those constructions to not less than 30 cm below the strip surface level. Other objects situated within the graded portion of the runway strip, the functions of which do not require them to be at surface level, should be buried to a depth of not less than 30 cm. Where this is not feasible, to eliminate a buried vertical surface, a slope should be provided which extends from the top of the construction to not less than 30 cm below ground level. The slope can be created by using a mixture of compacted gravel or asphalt or crushed aggregates and soil.

(b) Consideration should 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.

(c) Guidance on the design of drain covers is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

(d) Where open-air or covered storm water conveyances are installed, consideration should be given in order to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle.

(e) Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, in particular birds. The open-air storm water conveyance may be covered by a net, if required. Further guidance is given in ICAO Doc 9137, Airport Services Manual, Part 3, Wildlife Control and Reduction.

GM1 ADR-DSN.B.170

Intentionally left blank

GM1 ADR-DSN.B.175 Grading of runway strips

(a) For a precision approach runway, where the code number is 3 or 4, it may be desirable a greater width of that portion of a strip to be graded should be considered. Figure GM-B-4 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 centre line, except that the distance is gradually reduced to 75 m from the centre line at both ends of the strip, for a length of 150 m from the runway end.

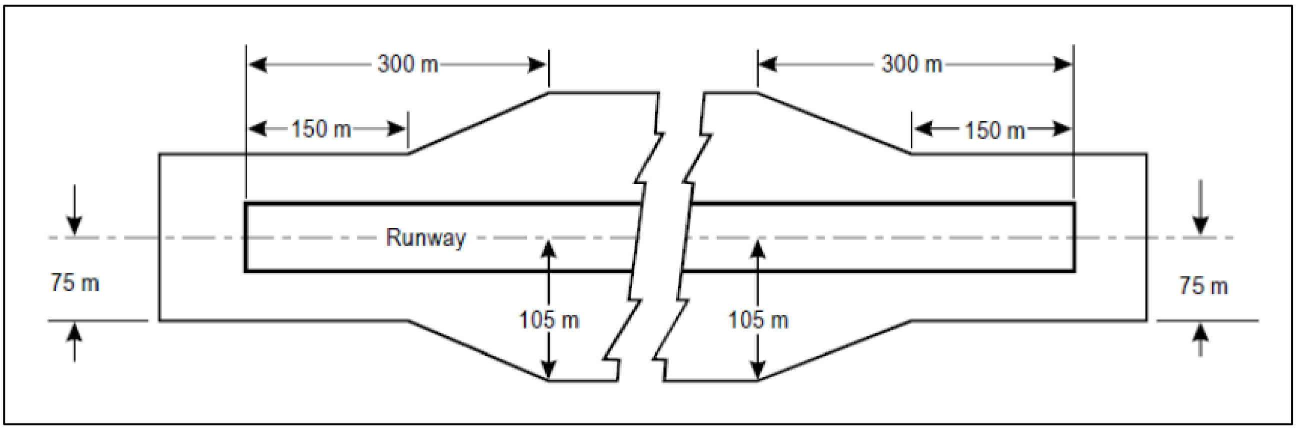


Figure GM B-4. Graded portion of a strip including a precision approach runway where the code number is 3 or 4

(b) Where the areas in paragraph (a) above have paved surface, they should be able to withstand the occasional passage of the critical aeroplane for runway pavement design.

(c) The area adjacent to the end of a runway may be referred to as a blast pad.

(d) Additional guidance on grading is given in ICAO Doc 9157, Aerodrome Design Manual Part 1, Runways.

(e) The area provided to reduce the erosive effects of jet blast and propeller wash may be referred to as a blast pad.

(f) Guidance on protection against aeroplane engine blast is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2.

GM1 ADR-DSN.B.180 Longitudinal Slopes on runway strips

(a) Where required for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a runway strip and should be placed as far as practicable from the runway.

(b) The aerodrome RFF procedure should take into account the location of open-air storm water conveyances within the non-graded portion of a runway strip.

GM1 ADR-DSN.B.185 Transverse slopes on runway strips

(a) Where required for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a runway strip and should be placed as far as practicable from the runway.

(b) The aerodrome RFF procedure should take into account the location of open-air storm water conveyances within the non-graded portion of a runway strip.

GM1 ADR-DSN.B.190 Strength of runway strips

Since the graded portion of a strip is provided to minimise the hazard to an aircraft running off the runway, it should grant sufficient strength in such a manner as to prevent the collapse of the nose landing gear of the aircraft. The surface should be prepared in such a manner as to provide drag to an aircraft and below the surface, it should have sufficient bearing strength to avoid damage to the aircraft. To meet these divergent needs, the following guidelines are provided for preparing the strip. It is noted, that a depth of 15 cm is a depth to which the nose gear may sink without collapsing. Therefore, it is recommended that the soil at a depth of 15 cm below the finished strip surface should be prepared to have a sufficient stability, demonstrated by bearing strength of California Bearing Ratio (CBR) value of 15 to 20. The intention of this is to prevent the nose gear from damage. The top 15 cm may be of lesser strength which would facilitate deceleration of aircraft. There are also other methods for soil investigation. In case of a deeper sinking than 15 cm, the maximum wheel sinking without collapsing should be examined by using different methods of soil investigation.

GM1 ADR-DSN.B.191 Drainage characteristics of the movement area and adjacent areas

(a) Rapid drainage of surface water is a primary safety consideration in the design, construction and maintenance of movement area and adjacent areas.

(b) There are two distinct drainage processes:

(1) 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

(2) dynamic drainage of the surface water trapped under a moving tire until it reaches outside the tire-to-ground contact area.

Both drainage processes can be controlled through design, construction and maintenance of the pavements in order to prevent accumulation of water on the pavement surface.

(c) Surface drainage is a basic requirement and serves to minimise water depth on the surface. 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 runoff. This path can be shortened by adding transverse grooves.

(d) 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 may be improved by adding transverse grooves provided that they are subject to rigorous maintenance.

(e) Through construction, the drainage characteristics of the surface are built into the pavement. These surface characteristics are:

(1) Slopes;

(2) Texture:

(i) Microtexture;

(ii) Macrotexture.

(f) Slopes for the various parts of the movement area and adjacent parts are described in Chapters B to G and figures are given as per cent. Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways, Chapter 5.

(g) Texture in the literature is described as microtexture or macrotexture. These terms are understood differently in various part of the aviation industry.

(h) 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 may prevent direct contact between the surface asperities and the tire due to insufficient drainage from the tire-to-ground contact area. 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. 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.

(k) Macrotexture is the texture among the individual stones. This scale of texture may 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.

(l) 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.

(m) For measurement of macrotexture, simple methods such as the 'sand and grease patch' methods described in ICAO Doc 9137, Airport Services Manual, Part 2, Pavement Surface Conditions were developed. These methods were used for the early research on which current airworthiness requirements are based and 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).

(n) 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 must be in accordance with aeroplane manufacturers' documentation. Presently credit is given to grooved or porous friction course runways following design, construction and maintenance criteria. The harmonized certification standards of some States refer to texture giving drainage and friction qualities midway between classification D and E (1.0 mm).

Runway classification based on texture information from ESDU 71026:	
Classification	**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

(o) For construction, design and maintenance, various international standards are used. 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 must be established for the measuring equipment used to relate MPD to MTD.

(p) 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 must 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.

SECTION 4 — CLEARWAYS, STOPWAYS AND RADIO ALTIMETER OPERATING AREA

GM1 ADR-DSN.B.195 Clearways

(a) 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 that they may endanger aeroplanes.

(b) Abrupt upward changes in slope should be avoided when the slope on the ground in a clearway is relatively small or when the mean slope is upward. In such situations, in that portion of the clearway within a distance of 22.5 m or half the runway width whichever is greater, on each side of the extended centre line, the slopes, slope changes, and the transition from runway to clearway should generally conform with those of the runway with which the clearway is associated.

(c) The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway should 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.

(d) 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 would 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 would 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 would be to abandon the take-off.

(e) On the other hand if an engine fails after the decision speed is reached, the aeroplane should 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 would be difficulty in stopping the aeroplane in the remaining accelerate-stop distance available.

(f) 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.

(g) 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.

(h) 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.

(i) 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 greater. The take-off distance available should be the length of the runway plus the length of clearway.

(j) 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:

(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 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;

(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 may be provided as clearway, usually at each end of the runway.

(k) 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.

GM1 ADR-DSN.B.200 Stopways

(a) The transition from one slope to another should be accomplished by a curved surface with a rate of change not exceeding:

(1) 0.3 % per 30 m (minimum radius of curvature of 10 000 m) where the code number is 3 or 4; and

(2) 0.4 % per 30 m (minimum radius of curvature of 7 500 m) where the code number is 1 or 2.

(b) The friction characteristics of an unpaved stopway should not be substantially less than that of the runway with which the stopway is associated.

(c) 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. Notwithstanding that a stopway may have a paved surface, it is not intended that PCN Figures need to be developed for a stopway. Further guidance is given in ICAO Doc 4444, PANS-OPS.

GM1 ADR-DSN.B.205 Radio altimeter operating area

(a) 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 centre line, 120 m wide. When special circumstances so warrant, the width may be reduced to no less than 60 m if a safety assessment indicates that such reduction would 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 should 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.

(b) With a radio altimeter operating area in the pre-threshold area of a precision approach runway the margin to calculate the decision altitude should be smaller and the usability of the adjacent runway may be enhanced.

(c) Further guidance on radio altimeter operating area is given in ICAO Doc 9365, Manual of All-Weather Operations, Section 5.2. Guidance on the use of radio altimeter is given in the ICAO, PANS-OPS, Volume II, Part II, Section 1.

CHAPTER C — RUNWAY END SAFETY AREA (RESA)

GM1 ADR-DSN.C.210 Runway end safety areas

(a) General

(1) A runway end safety area should provide an area long and wide enough, and suitable to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localiser 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 provisions of a runway end safety area should take such obstacle into consideration.

(2) Whatever length of RESA is provided, it is important to ensure that likelihood of, and potential impacts arising from an overrun are minimised as far as reasonably practicable.

(3) It is recognised that achieving the recommended distance could present challenges. Therefore, the aim of this guidance is to identify the types of aerodrome activities that can be undertaken to reduce the likelihood and consequences of an overrun occurring, and to decide on appropriate actions and it is suggested that aerodrome operators assess their RESA provisions.

(4) The overrun is a complex risk to assess because there are a number of variables, such as prevailing weather, type of aeroplane, the landing aids available, runway characteristics and available distances, the surrounding environment, and human factors. Each of these can have a significant contribution to the overall hazard; furthermore, the nature of the hazard and level of risk should be different for each aerodrome and even for each runway direction at any one aerodrome. The aerodrome may address some, and these are included below. Additionally, aircraft operating procedures may impact but the aerodrome may have little ability to influence these. This should not prevent aerodromes from working with aircraft operators so that the operations are conducted so as to minimise the likelihood of an overrun occurring.

(5) Noting the requirement for a runway end safety area (RESA) 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. Therefore, aerodromes should try to maximise the length of RESA available on all applicable runways. When considering the RESA distance required for individual circumstances, aerodromes operators should take into account factors, such as:

(i) the runway length and slope, in particular the general operating lengths required for take-off and landing versus the runway distances available, including the excess of available length over that required;

(ii) current RESA provision (length & width – how much the RESA complies with the recommended distance) and options to increase or improve this;

(iii) the nature and location of any hazard beyond the runway end, including the topography and obstruction environment in and beyond the RESA and outside the runway strip;

(iv) the type of aeroplane and level of traffic at the aerodrome, and actual or proposed changes to either;

(v) aircraft performance limitations arising from runway and RESA length – high performance aircraft, operating at high loads and speeds have greater length requirements than smaller, low-performance aircraft, the relationship between required balanced field length and available distances;

(vi) navigation aids available (PBN, instrument or visual - if an ILS is only available on one runway direction, a downwind approach and landing may be necessary in poor weather) and the availability of vertical guidance ;

(vii) friction and drainage characteristics of the runway, which impact on runway susceptibility to surface contamination and aeroplane braking action;

(viii) traffic density, which may lead to increased pressure to vacate so increased speed;

(ix) aerodrome weather patterns, including wind shear;

(x) aerodrome overrun history; and

(xi) overrun/undershoot causal factors.

(b) Assessment of runway end safety areas

(1) The RESA assessment should help the aerodrome operator identify the hazards and appropriate actions to reduce the risk. A range of measures may be available, singly or in combination, to reduce the risks of an overrun occurring or becoming an accident. Measures aimed at reducing the likelihood of an overrun/undershoot include:

(i) improving runway surfaces and friction measurement, particularly when the runway is contaminated — know your runways and their condition and characteristics in precipitation;

(ii) ensuring that accurate and up-to-date information on weather, the runway state and characteristics, is notified and passed to flight crews in a timely way, particularly when flight crews need to make operational adjustments;

(iii) improving an aerodrome management’s knowledge, recording, prediction and dissemination of wind data, including wind shear, and any other relevant weather information, particularly when it is a significant feature of an aerodrome’s weather pattern;

(iv) upgrading visual and instrument landing aids to improve the accuracy of aeroplane delivery at the correct landing position on runways (including the provision of Instrument Landing PBN approach systems, location of aiming point and harmonisation with PAPIs);

(v) formulating, in consultation with aeroplane operators, adverse weather and any other relevant aerodrome operating procedures or restrictions, and promulgating such information appropriately; and

(vi) working with aircraft operators to optimise the operation.

(2) Combined with this, measures may be considered that would reduce the severity of the consequences should an event occur. Wherever practicable, aerodrome operators should seek to optimise the RESA. This may be achieved through a combination of:

(i) relocation, shifting or realignment of the runway — it may be possible to construct additional pavement at the start of take-off end to make more pavement available to retain the declared distances. The start and end of declared distances can be moved towards the downwind (start of take-off) end, thereby retaining the declared distance and creating space for a longer RESA, as shown in GM1 ADR-DSN.B.035;

(ii) in the case where undershoot RESA is limited and the runway has a displaced landing threshold, examine whether the threshold can be moved (downwind) to increase the RESA and/or runway length;

(iii) reducing runway declared distances in order to provide the necessary RESA may be a viable option where the existing runway length exceeds that required for the existing or projected design aircraft. If the take-off distance required for the critical aircraft operating at the aerodrome is less than the take-off distance available, there may be an opportunity to reduce the relevant runway declared distances. Where provision of a runway end safety area would be particularly prohibitive to implement consideration would have to be given to reducing some of the declared distances of the runway for the provision of a runway end safety area and/or installation of an arresting system;

(iv) increasing the length of a RESA, and/or minimising the obstruction environment in the area beyond the RESA. Means to increase the RESA provision include land acquisition, improvements to the grading, realigning fences or roads to provide additional area;

(v) installing suitably positioned and designed arresting systems, to supplement or as an alternative to a RESA where an equivalent level of safety is demonstrated;

(vi) improving the slopes in the RESA to minimise or remove downward slopes; and

(vii) providing paved RESA with known friction characteristics.

(3) A runway meant for take-off and landing in both directions should have 2 RESAs extending for the required distance beyond the end of the strip extending from the runway end. Depending of the position of the threshold on a runway, the RESA related to the reverse runway should protect aircraft undershooting the threshold. Assessments of overruns and undershoots have shown that the likelihood of an undershoot is approximately four times less than for an overrun. Additionally, the undershoot rate shows that the likelihood of an event is further reduced by the availability of precision approach aids, especially those with vertical guidance. Therefore, on a precision approach runway consideration may include whether to reduce the minimum length of RESA towards the length of the runway strip before the runway.

(4) It is recognised that improving RESAs is often difficult. However, it is important to note that incremental gains should be obtained wherever possible, as any gain is valuable. Therefore, whenever a runway project involves construction, consideration should also be given to improving the RESA.

(5) The above lists are not in any particular order, are not exhaustive, and should complement action by aeroplane operators, designers and aviation regulators.

(6) RESA provision should be considered by the Local Runway Safety Team.

(c) Arresting systems on runway end safety areas

(1) In recent years, recognising the difficulties associated with achieving a standard runway end safety area (RESA) at all aerodromes, research programmes have been undertaken on the use of various materials for arresting systems. Furthermore, research programmes have been undertaken to evaluate and develop arrestor systems using engineered materials. This research was driven by the recognition that many runways where natural obstacles, local development, and/or environmental constraints inhibit the provision of RESA and lead to limited dimension of RESA. Additionally, there had been accidents at some aerodromes where the ability to stop an overrunning aeroplane within the RESA would have prevented major damage to aeroplane and/or injuries to passengers.

(2) The research programmes, as well as evaluation of actual aeroplane overruns into arresting system, have demonstrated that the performance of some arresting systems can be predictable and effective in arresting aeroplane overruns.

(3) Arresting system designs should be supported by a validated design method that can predict the performance of the system. The design method should be derived

from field or laboratory tests. Testing may be based either on passage of an actual aircraft or an equivalent single wheel load through a test bed. The design should consider multiple aircraft parameters, including but not limited to allowable aircraft gear loads, gear configuration, tire contact pressure, aircraft centre of gravity, and aircraft speed. The model should calculate imposed aircraft gear loads, g-forces on aircraft occupants, deceleration rates, and stopping distances within the arresting system. Any rebound of the crushed material that may lessen its effectiveness, should also be considered.

(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 aeroplane anticipated to use the associated runway that imposes the greatest demand upon the arresting system. The design of an arresting system should be based on a critical (or design) aircraft which is defined as aircraft using the associated runway that imposes the greatest demand upon the arresting system. This is usually but not always, the heaviest/largest aircraft that regularly uses the runway. Arresting system performance is dependent not only on aircraft weight but allowable aeroplane gear loads, gear configuration, tire contact pressure, aeroplane centre of gravity and aeroplane speed. Accommodating undershoots should also be addressed. All configurations should be considered in optimising the arresting system design. The aerodrome operator and arresting system manufacturer should consult regarding the selection of the design aeroplane that should optimise the arresting system for a particular aerodrome. Additionally, the design should allow the safe operation of fully loaded rescue and fire fighting vehicles, including their ingress and egress.

(5) Additional information is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

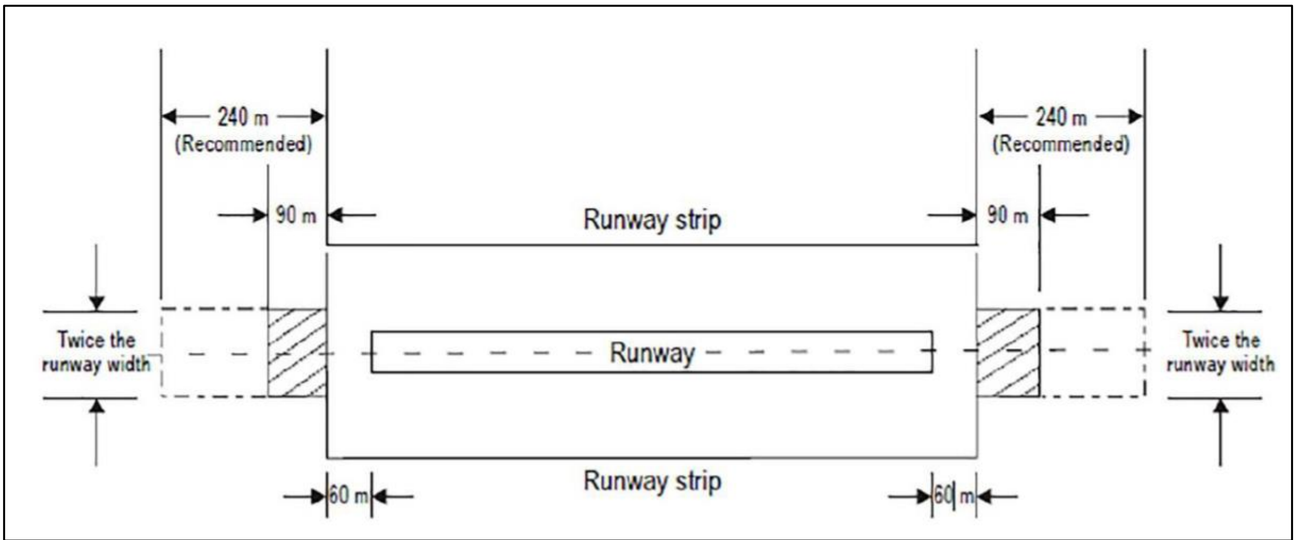


Figure GM-C-1. Runway end safety area for a runway where the code number is 3 or 4

GM1 ADR-DSN.C.215 Dimensions of runway end safety areas

It is accepted that many aerodromes were constructed before requirements for RESAs were introduced. For applicable runways where the RESA does not extend to the recommended distance, as part of their Safety Management System, aerodromes should assess the risk and implement appropriate and suitable mitigation measures as necessary.

GM1 ADR-DSN.C.220 Objects on runway end safety areas

Information regarding siting of equipment and installations on operational areas, including RESA, is detailed in CS ADR-DSN.T.915.

GM1 ADR-DSN.C.225 Clearing and grading of runway end safety areas

(a) The surface of the runway end safety area should be prepared but does not need to be prepared to the same quality as the runway strip.

(b) Guidance on clearing and grading of runway end safety areas is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

GM1 ADR-DSN.C.230 Slopes on runway end safety areas

Where clearway is provided, the slope on the RESA should be amended accordingly.

GM1 ADR-DSN.C.235 Strength of runway end safety areas

(a) A runway end safety area should be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, enhance aeroplane deceleration, and facilitate the movement of rescue and firefighting vehicles.

(b) Guidance on the strength of a runway end safety area is given in the GM1 ADR-DSN.B.190 Strength of runway strips and in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

CHAPTER D — TAXIWAYS

GM1 ADR-DSN.D.240 Taxiways general

Note 1. — Unless otherwise indicated, the requirements in this section are applicable to all types of taxiways.

Note 2. — See CS ADR-DSN.N.785 Information signs 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 National Technical requirements on design and operation of aerodromes (CT-AD) Attachment 23 «Taxiway design guidance for minimizing the potential for runway incursions», for specific taxiway design guidance which may assist in the prevention of runway incursions when developing a new taxiway or improving existing ones with known runway incursion safety risks.

[According to Order no. 45/GEN from 21.10.2020]

(a) Taxiways should be provided to permit the safe and expeditious surface movement of aircraft. Sufficient entrance and exit taxiways for a runway should 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.

Note. — Guidance on layout and standardized nomenclature of taxiways is given in the Aerodrome Design Manual (Doc 9157), Part 2.

[According to Order no. 45/GEN from 21.10.2020]

(b) Design of runway and taxiway infrastructure that either prevents aircraft entering or crossing a runway or mitigates the risk of an aircraft runway incursion collision should be considered both in the development of any new infrastructure and as a retrospective enhancement to existing infrastructure especially in hot-spot areas (areas where risk appraisal or incident data demonstrates a higher risk). This guidance may be considered as part of a runway incursion prevention programme and to help ensure that runway incursion aspects are addressed in any new design proposal.

(c) The initial approach should be to reduce the number of available entrances to the runway, so that the potential for entry to the runway at an unintended location is minimised. Taxiway entry, crossing and runway exit taxiways should be clearly identified and promulgated, using taxiing guidance signs, lighting and pavement markings.

(d) Many aerodromes have more than one runway, notably paired parallel runways (two runways on one side of the terminal apron), which create a difficult problem in that either on arrival or departure an aircraft is required to cross a runway. The potential for runway crossings should be eliminated or at least be as low as reasonably practicable. This may be achieved by constructing a ‘perimeter taxiway’ to enable aircraft to get to the departure runway or to the apron without either crossing a runway or conflicting with an approaching or departing aircraft.

(e) A perimeter taxiway is ideally designed according to the following criteria:

(1) Sufficient space is required between the landing threshold and the taxiway centre line where it crosses under the approach path, to enable the critical aeroplane to pass under the approach without violating the approach surface.

(2) The extent of the jet blast impact of aircraft taking off is considered when determining the location of a perimeter taxiway.

(3) The requirement for RESA, as well as possible interference with the ILS or other navigation aids is also taken into account: the perimeter taxiway is located behind the localiser antenna, not between the localiser antenna and the runway, due to the potential for severe ILS disturbance, noting that this is harder to achieve as

the distance between the localiser and the runway increases. Likewise, perimeter roads are provided where possible.

(4) Appropriate measures should be considered in order to assist pilots to distinguish between aircraft that are crossing the runway and those that are safely on a perimeter taxiway.

(f) Taxiways crossing runways should be provided at low energy locations, preferably at the runway ends. Where runway crossings cannot be eliminated, they should only be done on taxiways at right angles to a runway. This will afford the flight crew an unobstructed view of the runway, in both directions, to confirm that the runway and approach is clear of conflicting traffic before proceeding across.

(g) The runway/taxiway junction configuration should be simple, for example with single taxiway entrances; this is particularly relevant for taxiways crossing runways.

(h) The main design principles for entry and exit taxiways are:

(1) Taxiways should be perpendicular to the runway centre line if possible.

(2) The taxiway angle should be such that the crew of an aircraft at a taxiway holding position (if any) should be able to see an aircraft using or approaching the runway. Where the taxiway angle is such that this clear view, in both directions is not possible, consideration is given to provide a perpendicular portion of the taxiway immediately adjacent to the runway to allow for a full visual scan prior to entering (or crossing).

(3) Rapid exit taxiways are designed to be runway exits. Whilst it may be an operational practice at some airports to allow smaller aircraft the option of departing at a mid-point on the runway from one of these rapid exit taxiways, the geometry of the taxiway/runway intersection does not allow the crew to properly scan the runway in both directions to confirm that there is no conflicting traffic. This practice should thus be eliminated and from the design point of view, all signage and markings should deter any aircraft from using these rapid exit taxiways for any purpose other than what they are designed for (exiting the runway after landing). However, this may be mitigated by the addition of a fillet so that aircraft can manoeuvre to see down the approach. Note that aircraft on an angled taxiway may have a greater likelihood of causing ILS interference.

(4) A clear separation of pavement between a rapid exit taxiway and other non-rapid taxiways entering or crossing a runway should be provided. This design principle prevents two taxiways from overlapping with each other and creating an excessive paved area that would confuse pilots entering a runway.

(5) Limiting the options available to pilots on each entrance or exit helps to avoid confusion. Therefore, avoid dual or multiple taxiway entrances at one location, as Y-shaped connectors present opportunities for runway incursions and for aircraft vacating the runway to enter the wrong taxiway. Limiting the options available to pilots on each entrance or exit helps to avoid confusion.

(6) Runway/taxiway separations should be sufficient to permit space for effective RETs.

(7) Avoid designs which include crossing a runway to access a taxiway.

(8) Provide clear separation between high speed (RET) and taxi speed runway exits; if RETs are provided have a series in a row without other entrances.

(9) Where the aerodrome has more than one runway, ensure that runway ends are not too close together; if this is not possible ensure that they are clearly identified as separated. This may be achieved through visual aids, taxiway design and the taxiway naming convention.

(10) Surface colour should not create confusion:

(i) Have different colours for runway and taxiways.

(ii) Avoid a mix of concrete & asphalt.

(11) Wide taxiway entrances onto runways should be broken up with islands or barriers or painting taxiway edges with continuous edge markings to indicate unusable pavement. Avoid long holding position lines and excess paved areas which reduce the effectiveness of signs and markings. Use standard taxiway widths, suitable for a wide range of aeroplane, including the largest type expected to use the aerodrome.

(12) Avoid multi-taxiway intersections and reduce the number of taxiways at any intersection as far as possible.

(13) As far as practicable, it is preferable to redesign rather than reconfigure or repaint where possible – design errors out and reduce potential for human error.

(14) Consistent design of runway entrances – same visual aids at each, both taxiways and service road accesses.

(15) It is always preferable for safety reasons to have a taxiway parallel to the runway all along the runway, even if capacity constraints do not make it necessary.

(i) Aerodrome infrastructure can also be used to support design, whether by the systems installed or by their operating characteristics. Examples include:

(1) Stopbars and runway guard lights should be provided at all entrances, and preferably illuminated H24 and in all weather conditions. Runway incursions do not happen only under restricted visibilities. In fact, more incursions happen when the weather is good.

(2) Avoid confusion between CAT I and CAT III holding positions. This may be achieved in some circumstances by combining both holding positions.

(j) 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 construction of unusable pavement and as well as the painting of 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.

(k) Guidance on layout of taxiways is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.245 Width of taxiways

(a) The width of the taxiway should be measured at the edge of the paved surface, or where the taxiway edge is marked, at the outside edge of the taxiway edge marking.

(b) Additional guidance on width of taxiways is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.250 Taxiways curves

(a) The location of taxiway centre line markings and lights is specified in CS ADR-DSN.L.555 and CS ADR-DSN.M.710.

(b) Compound curves may reduce or eliminate the need for extra taxiway width.

(c) An example of widening taxiways to achieve the wheel clearance specified is illustrated in Figure GM-D-1. Guidance on the values of suitable dimensions is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

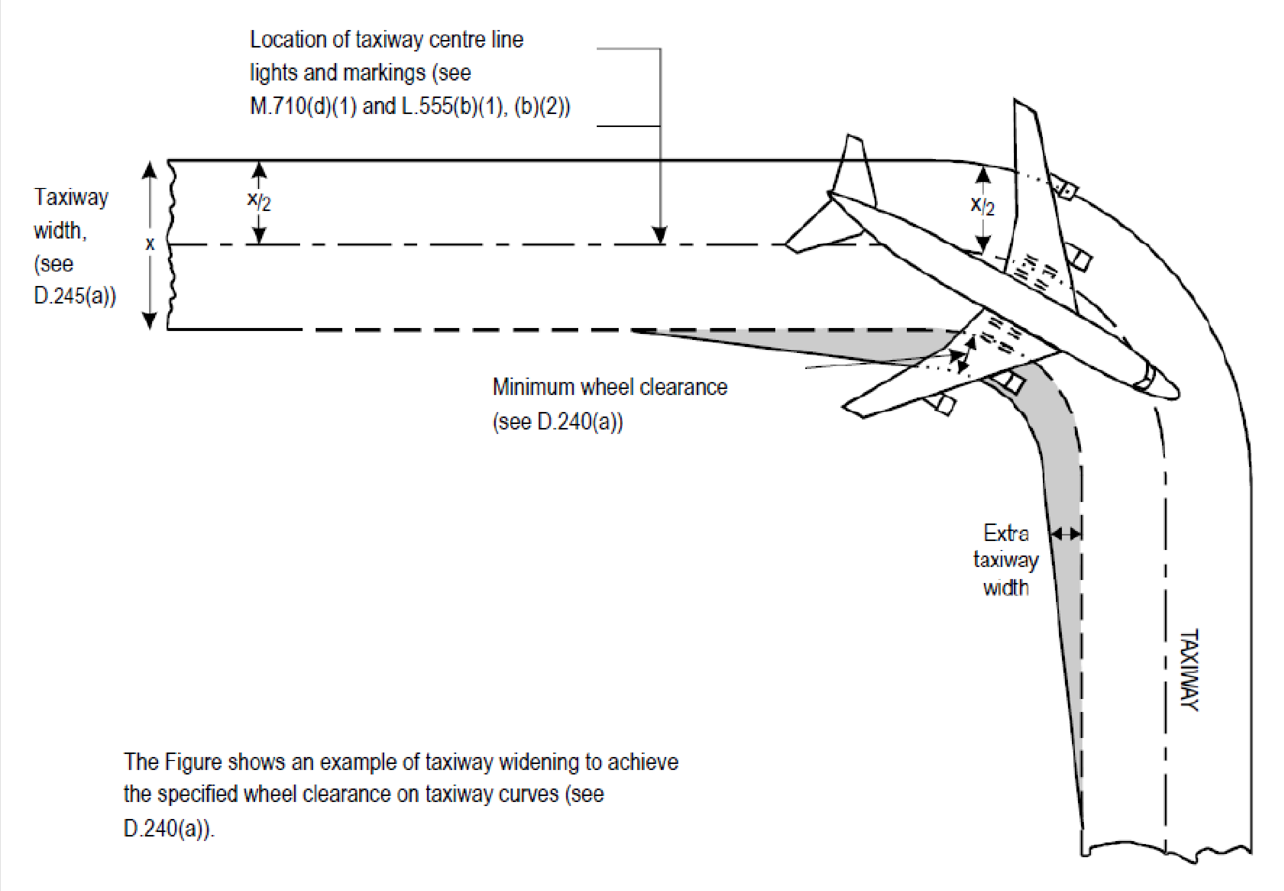


Figure GM-D-1 Taxiway curve

GM1 ADR-DSN.D.255 Junction and intersection of taxiways

Consideration should be given to the aeroplane datum length when designing fillets. Guidance on the design of fillets and the definition of the term aeroplane datum length are given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.260 Taxiway minimum separation distance

(a) Guidance on factors which may be considered in the safety assessment is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

(b) ILS and MLS installations may also influence the location of taxiways due to interferences to ILS and MLS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS and MLS installations is contained in ICAO, Annex 10, Volume I, Attachments C and G (respectively).

(c) The separation distances, as prescribed in Table D-1, 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 ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

(d) The separation distance between the centre line of an aircraft stand taxilane and an object, as prescribed in Table D-1, column (13), may need to be increased when jet exhaust wake velocity may cause hazardous conditions for ground servicing.

(e) It may be permissible to operate with lower separation distances at an existing aerodrome if a safety assessment indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

(f) The separation distances, as prescribed in Table D-1, may have to be increased on taxiway curves to accommodate the wing sweep of the critical aeroplane or on dual parallel taxiways when, as for example, used as bypass taxiways.

(g) The requirements for apron taxiways regarding strip width, separation distances, etc., are the same as for any other type of taxiway.

GM1 ADR-DSN.D.265 Longitudinal slopes on taxiways

Intentionally left blank

GM1 ADR-DSN.D.270 Longitudinal slope changes on taxiways

Intentionally left blank

GM1 ADR-DSN.D.275 Sight distance of taxiways

Intentionally left blank

GM1 ADR-DSN.D.280 Transverse slopes on taxiways

The slopes on a taxiway are intended to prevent the accumulation of water (or possible fluid contaminant) on the surface and to facilitate rapid drainage of surface water (or possible fluid contaminant). Slopes should be so designed as to minimize impact on aircraft and so not to hamper the operation of aircraft.

GM1 ADR-DSN.D.285 Strength of taxiways

Information regarding pavement bearing strength, including the ACN/PCN classification system may be found in GM1 ADR-DSN.B.085.

Due consideration being given to the fact that a taxiway should 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.

GM1 ADR-DSN.D.290 Surface of taxiways

Suitable surface friction characteristics are those surface properties required on taxiways that assure safe operation of aeroplanes.

GM1 ADR-DSN.D.295 Rapid exit taxiways

(a) The following guidance applies particularly to rapid exit taxiways (see Figure D-1). The general requirements for taxiways, as prescribed in CS-ADR-DSN are also applicable to rapid exit taxiways. Guidance on the provision, location and design of rapid exit taxiways is included in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

(b) The locations of rapid exit taxiways along a runway are based on several criteria described in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays, in addition to different speed criteria.

GM1 ADR-DSN.D.300 Taxiways on bridges

If aeroplane engines overhang the bridge structure, protection of adjacent areas below the bridge from engine blast may be required.

GM1 ADR-DSN.D.305 Taxiway shoulders

Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.310 Taxiway Strip

A taxiway strip should be so prepared or constructed as to minimize hazards arising from differences in load bearing capacity to aeroplanes which the taxiway is intended to serve in the event of an aeroplane accidentally running off the taxiway.

Guidance on characteristics of taxiway strips is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.315 Width of taxiway strips

Intentionally left blank.

GM1 ADR-DSN.D.320 Objects on taxiway strips

(a) Consideration should 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.

(b) The detailed requirements for siting objects on taxiway strips are in CS ADR-DSN.T.915.

(c) Where open-air or covered storm water conveyances are installed, consideration should be given in order to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle.

(d) Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, in particular birds. The open-air storm water conveyance may be covered by a net, if required. Further guidance is given in ICAO Doc 9137, Airport Services Manual, Part 3, Wildlife Control and Reduction.

(e) Guidance on the design of drain covers is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.325 Grading of taxiway strips

Further guidance on the width of the graded portion of a taxiway is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

GM1 ADR-DSN.D.330 Slopes on taxiway strips

(a) Where required for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a taxiway strip and should be placed as far as practicable from the taxiway.

(b) The locations of open-air storm water conveyances within the non-graded portion of a taxiway strip should be so designed to permit unobstructed access for rescue and firefighting services (RFFS).

GM1 ADR-DSN.D.335 Holding bays, runway-holding positions, intermediate holding positions, and road-holding positions

(a) At low levels of aerodrome activity (less than approximately 50 000 annual operations), there is normally little need to make deviations in the departure sequence. However, for higher activity levels, aerodromes with single taxiways and no holding bays or other bypasses provide aerodrome control units with no opportunity to change the sequence of departures once the aircraft have left the apron. In particular, at aerodromes with large apron areas, it is often difficult to arrange for aircraft to leave the apron in such a way that they should arrive at the end of the runway in the sequence required by air traffic services units.

(b) The provision of an adequate number of holding bay spaces or other bypasses, based upon an analysis of the current and near-term hourly aircraft departure demand, should allow a large degree of flexibility in generating the departure sequence.

(c) The space required for a holding bay depends on the number of aircraft positions to be provided, the size of the aircraft to be accommodated, and the frequency of their utilization. The dimensions should allow for sufficient space between aircraft to enable them to manoeuvre independently.

(d) Emergency access roads are not intended for use for the functions of aerodrome service roads. However, they should be provided by different access controls which should be clearly visible for all service ground traffic.

(e) Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays and ICAO Doc 4444, Procedures for Air Navigation Services — Air Traffic Management.

GM1 ADR-DSN.D.340 Location of holding bays, runway-holding positions, intermediate holding positions, and road-holding positions

(a) Care should be taken so that propeller wash and jet blast from holding aircraft do not interfere with aircraft operations, cause damage to vehicles, or injure people.

(b) Generally, when used to allow flexible departure sequencing, the most advantageous location for a holding bay is adjacent to the taxiway serving the runway end. Other locations along the taxiway are satisfactory for aircraft performing pre-flight checks or engine run-ups, or as a holding point for aircraft awaiting departure clearance.

(c) An aircraft taxiing could endanger aircraft operations when the aircraft is too close to the runway during take-off and landings. It is so advised to check if the aircraft taking off or landing could be hinder. For this OLS and specially approach surfaces, take-off climb surfaces and OFZ are the first aspects to consider. An aircraft taxiing could also endanger aircraft operations when the aircraft location and orientation are so that the aircraft interfere with navigation aids. It is specific to instrument runways and especially important for precision approach runways. The non-penetration of critical/sensitive areas is the first check. The areas within which this degradable interference of course or path signals are possible need to be defined and recognized. For the purposes of developing protective zoning criteria for ILS, these areas are critical areas and sensitive areas. The ILS critical area is an area of defined dimensions about the localizer and glide path antennas where vehicles, including aircraft, are excluded during all ILS operations. The critical area is protected, since the presence of vehicles and/or aircraft inside the critical area boundaries would cause unacceptable disturbance to the ILS signal. The ILS sensitive area is an area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations.

(d) For all runways, it should be verified that the distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway is so that a holding aircraft or vehicle should not infringe the approach surface and/or take-off climb surface.

(e) If the affected runway is used under precision approach procedures, it should be also verified that the distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway is so that a holding aircraft or vehicle should not infringe the obstacle-free zone and the critical/sensitive areas of precision approach navigation aids (e.g. ILS/MLS).

(f) 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 Table D-2 should be further increased 5 m for every metre the bay or position is higher than the threshold.

[According to Order no. 45/GEN from 21.10.2020]

(g) An aircraft taxiing could also endanger aircraft operation when the aircraft is too close to other taxiing aircraft. For this, separation distances or margins between taxiing aircraft or taxiways should be considered.

(h) In radiotelephony phraseologies, the expression ‘holding point’ is used to designate the runway-holding position.

(i) Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays.

CHAPTER E — APRONS

GM1 ADR-DSN.E.345 General

Intentionally left blank

GM1 ADR-DSN.E.350 Size of aprons

(a) The total apron area should be adequate to permit safe and expeditious handling of aerodrome traffic at its maximum anticipated density.

(b) The amount of area required for a particular apron layout depends upon the following factors:

(1) the size and maneuverability characteristics of the aircraft using the apron;
(2) the volume of traffic using the apron;
(3) clearance requirements;
(4) type of ingress and egress to the aircraft stand;
(5) basic terminal layout or other aerodrome use;
(6) aircraft ground activity requirements; and
(7) taxiways and apron service roads.

(c) Passenger aircraft services that are carried out during the time the aircraft is parked in a stand position include: galley; toilet and potable water service; baggage handling; fuelling; provision of air conditioning, oxygen, electrical power supply and starting air; and aircraft towing. Most of these functions have a vehicle and/or equipment associated with them, or have some type of fixed installation established to conduct these services. Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays, paragraph 3.4.6.

(d) Consideration should be given to providing sufficient area on the starboard side of the aircraft to support the level of activity that take place in the turnaround operation. Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays, paragraph 3.4.6.

GM1 ADR-DSN.E.355 Strength of aprons

(a) Apron pavement protection against fuel: On aircraft stands, pavement surface in bituminous concrete and joints between concrete slabs should be protected from fuel effects.

(b) Fuel on bituminous concrete provokes a disintegration of the concrete which becomes a kind of dark powder. On aircraft stands, it is not rare to have fuel on the pavement surface, due to leakage from aircraft or refuelling devices or due to a wrong move during refuelling. Therefore, if the aircraft stand pavement is in bituminous concrete, a specific protection is considered. Such protection is:

(1) a surface protection consisting in an overlay with a material inert against fuel; or
(2) a product incorporated in the mass of the bituminous concrete during its fabrication, protecting aggregates and binder.

(c) The first solution has the disadvantages to be fragile against stamping effects due to aircraft at the stand but is very useful for existing pavement protection.

(d) Taking into account the stamping due to aircraft at stands and the weakness of bituminous concrete against fuel, the aircraft stand pavements are often in cement concrete, which offers a much better resistance to stamping and to fuel. Nevertheless, joints between cement concrete slabs could be also damaged by fuel. According to the location of such joints regarding aircraft location and refuelling devices location, it is preferable to manufacture such joints in a material resistant to the fuel.

GM1 ADR-DSN.E.360 Slopes on aprons

(a) The design of slopes should direct spilled fuel away from building and apron service areas. Where such slopes are unavoidable, special measures should be taken to reduce the fire hazard resulting from fuel spillage.

(b) Slopes on apron have the same purpose as other pavement slopes, meaning to prevent the accumulation of water (or possible fluid contaminant) on the surface and to facilitate rapid drainage of surface water (or possible fluid contaminant). Nevertheless, the design of the apron, especially for the parts containing airplane stands, should specifically take into account the impact of the slopes on the airplane during its braking at the stand and during its start for departure (with push-back or with its own engines). The aims are, on the one hand, to avoid that an airplane passes its stop point and goes on the apron service road or to the closest building and on the other hand, to save fuel and optimize the maneuverability of the airplane or of the push-back device.

(c) Where the slope limitation of 1 % on the stands cannot be achieved, the slope should be kept as shallow as possible and should be such that the operation of the aircraft and vehicles is not compromised.

GM1 ADR-DSN.E.365 Clearance distances on aircraft stands

(a) Reduced separation at the gate is possible where azimuth guidance by a visual docking guidance system is provided, in combination with additional mitigation measures, such as:

(1) good condition of marking and signage;
(2) maintenance of visual docking systems.

(b) On aircraft stands, where reduced clearance distances are applied:

(1) Guidance by a visual docking guidance system should be provided.
(2) All objects for which reduced clearances apply should be properly marked or lighted (see Chapter Q Visual Aids for Denoting Obstacles).
(3) Aircraft stands where reduced clearance distances apply should be identified and the information published in the AIP.
(4) For code letters D, E or F, an aircraft stand equipped with a visual docking guidance system the minimum clearance of 4.5 metres may be applied between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand or other objects.
(5) For code letter C an aircraft stand equipped with a visual docking guidance system the minimum clearance of 3 metres may be applied between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand or other objects if a safety assessment indicates that such reduction would not affect the safety of operations of aircraft.

(c) Any aircraft passing behind an aircraft parked on an aircraft stand should keep the required clearance distances defined in Table D-1.

CHAPTER F — ISOLATED AIRCRAFT PARKING POSITION

GM1 ADR-DSN.F.370 Isolated aircraft parking position

Care should 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. The aerodrome control tower should be advised of an area or areas suitable for the parking of an aircraft.

CHAPTER G — DE-ICING/ANTI-ICING FACILITIES

GM1 ADR-DSN.G.375 General

Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling, produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, should have a transparent rather than a cloudy appearance and, at the higher specific gravities, should be readily distinguishable from slush.

GM1 ADR-DSN.G.380 Location

(a) The de-icing/anti-icing facilities should be so located as to ensure that the holdover time of the anti-icing treatment is still in effect at the end of taxiing, and when take-off clearance of the treated aeroplane is given.

(b) To further maximize departure flow rates for all aeroplanes, the location and size of de-icing/anti-icing facilities should be such that they allow for bypass taxiing during de-icing/anti-icing operations. Additional guidance is given in ICAO Doc 9640, Manual of aircraft ground de-icing/anti-icing operations, paragraph 8.5(e).

(c) Remote de-icing/anti-icing facilities located near departure runway ends or along taxiways are recommended when taxi times from terminals or off-terminal de-icing/anti-icing locations frequently exceed holdover times.

(d) Remote facilities compensate for changing weather conditions when icing conditions or blowing snow are expected to occur along the taxi-route taken by the aeroplane to the runway meant for take-off.

(e) The de-icing/anti-icing facilities should be so located as to provide for an expeditious traffic flow, perhaps with a bypass configuration, and not require unusual taxiing manoeuvre into and out of the pads.

(f) The jet blast effects caused by a moving aeroplane on other aeroplanes receiving the anti-icing treatment or taxiing behind should have to be taken into account to prevent degradation of the treatment.

GM1 ADR-DSN.G.385 Size of de-icing/anti-icing pads

(a) It is recommended that the aerodrome have facilities with a de-icing/anti-icing capability equivalent to the maximum peak hour departure rate that can be managed by the ATC units during de-icing/anti-icing operations. Additional guidance is given in ICAO Doc 9640, Manual of aircraft ground de-icing/anti-icing operations, paragraph 8.3.

(b) The number of de-icing/anti-icing pads required should be determined based on the meteorological conditions, the type of aeroplanes to be treated, the method of application of de-icing/anti-icing fluid, the type and capacity of the dispensing equipment used, and the volume of traffic and departure flow rates.

(c) An aeroplane de-icing/anti-icing pad consists of:

(1) an inner area for parking of an aeroplane to be treated; and
(2) an outer area for movement of two or more mobile de-icing/anti-icing equipment.

(d) Where more than one de-icing/anti-icing pad is provided, consideration should be given to providing de-icing/anti-icing vehicle movement areas of adjacent pads that do not overlap but are exclusive for each pad. Consideration should also be given to bypassing of the area by other aeroplanes with the clearances specified in CS ADR-DSN.G.400.

GM1 -ADR-DSN.G.390 Slopes on de-icing/anti-icing pads

It is recommended that the drainage arrangements for the collection and safe disposal of excess de-icing/anti-icing fluids prevent ground water contamination.

GM1 ADR-DSN.G.395 Strength of de-icing/anti-icing pads

Consideration should be given to the fact that the de-icing/anti-icing pad (in common with an apron) should be subjected to a higher density of traffic and, as a result of slow-moving or stationary aircraft, to higher stresses than a runway.

GM1 ADR-DSN.G.400 Clearance distances on a de-icing/anti-icing pad

(a) The separation criteria should take into account the need for individual de-icing/anti-icing pads to provide sufficient maneuvering area around the airplane to allow simultaneous treatment by two or more mobile de-icing/anti-icing vehicles and sufficient non-overlapping space for a vehicle safety zone between adjacent de-icing pads and for other de-icing/anti-icing pads.

(b) The minimum clearance distance of 3.8 m is necessary for the movement of de-icing/anti-icing vehicles round the aircraft.

(c) Where the de-icing/anti-icing facility is located in a non-movement area, the minimum clearance distance can be reduced.

CHAPTER H — OBSTACLE LIMITATION SURFACES

GM1 ADR-DSN.H.405 Applicability

(a) The obstacle limitation surfaces define the limits to which objects may project into the airspace. Each surface is related to one or more phases of a flight, and provides protection to aircraft during that phase.

(b) The OLS also help to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes.

(c) The effective utilization of an aerodrome may be considerably influenced by natural features and man-made constructions outside its boundary. These may result in limitations on the distance available for take-off and landing and on the range of meteorological conditions in which take-off and landing can be undertaken. For these reasons, certain areas of the local airspace should be regarded as integral parts of the aerodrome environment.

(d) Objects which penetrate the obstacle limitation surfaces 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 (ICAO, PANS-OPS, Doc 8168).

(e) In ideal circumstances all the surfaces should be free from obstacles but when a surface is infringed, any safety measures required should have regard to:

(1) the nature of the obstacle and its location relative to the surface origin, to the extended centre line of the runway or normal approach and departure paths, and to existing obstructions;
(2) the amount by which the surface is infringed;
(3) the gradient presented by the obstacle to the surface origin;
(4) the type of air traffic at the aerodrome; and
(5) the instrument approach procedures published for the aerodrome.

(f) Safety measures could be as follows:

(1) promulgation in the AIP of appropriate information;
(2) marking and/or lighting of the obstacle;
(3) variation of the runway distances declared as available;
(4) limitation of the use of the runway to visual approaches only;
(5) restrictions on the type of traffic.

(g) In addition to the requirements described in Certification specifications (CS), Chapter H, it may be necessary to call for other restrictions to development and construction on and in the vicinity of the aerodrome in order to protect the performance of visual and electronic aids to navigation and to ensure that such development does not adversely affect instrument approach procedures and the associated obstacle clearance limits.

GM1 ADR-DSN.H.410 Outer horizontal surface

(a) The outer horizontal surface should extend from the periphery of the conical surface as shown in Figure GM-H-1. An outer horizontal surface is a specified portion of a horizontal plane around an aerodrome beyond the limits of the conical surface. It represents the level above which consideration needs to be given to the control of new obstacles in order to facilitate practicable and efficient instrument approach procedures, and together with the conical and inner horizontal surfaces to ensure safe visual manoeuvring in the vicinity of an aerodrome.

(b) The outer horizontal surface is of particular importance for safe operations in areas of high ground or where there are concentrations of obstacles.

(c) In the experience of some States, operational problems can arise from the erection of tall structures in the vicinity of aerodromes beyond the areas currently recognized in the national aerodrome regulations as areas in which restriction of new construction may be necessary. Such problems may be addressed through the provision of an outer horizontal surface, which is a specified portion of a horizontal plane around an aerodrome beyond the limits of the conical surface. It represents the level above which consideration needs to be given to the control of new obstacles in order to facilitate practicable and efficient instrument approach procedures, and together with the conical and inner horizontal surfaces to ensure safe visual manoeuvring in the vicinity of an aerodrome.

(d) As a broad specification for the outer horizontal surface, tall structures can be considered to be of possible significance if they are both higher than 30 m above local ground level, and higher than 150 m above aerodrome elevation within a radius of 15 000 m of the centre of the airport where the runway code number is 3 or 4. The area of concern may need to be extended to coincide with the PANS OPS obstacle areas for the individual approach procedures at the airport under consideration.

(e) Guidance on Outer Horizontal Surface is included in ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

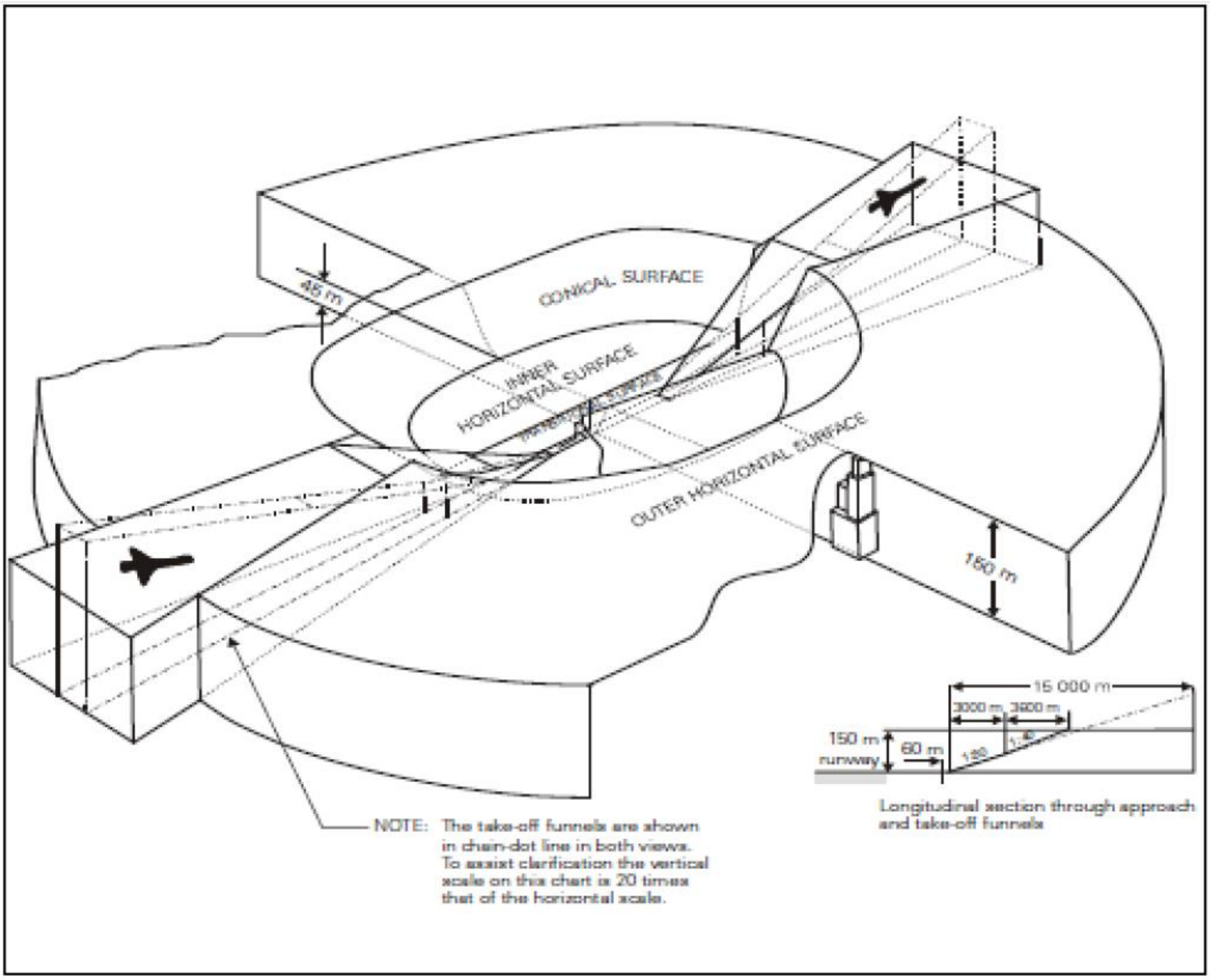


Figure GM-H-1 Disposition of Outer Horizontal Surface

GM1 ADR-DSN.H.415 Conical surface

Intentionally left blank

GM1 ADR-DSN.H.420 Inner horizontal surface

(a) 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 ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

(b) The limits of the inner horizontal surface for longer runways (1 800 m or more in length) are defined as circles of radius 4 000 m centred on the strip ends of the runway. These circles are joined by common tangents parallel to the runway centre line to form a racetrack pattern. The boundary of this pattern is the boundary of the inner horizontal surface.

(c) For runways less than 1 800 m in length, the inner horizontal surface may be defined as a circle centred on the midpoint of the runway.

(d) To protect two or more runways, a more complex pattern could become necessary. In this situation, all the circles are joined tangentially by straight lines: illustrated at the Figure GM-H-2.

(e) For relatively level runways the selection of elevation datum location is not critical, but when the thresholds differ by more than 6 m, the elevation datum should regard to the factors as the elevation of the most frequent used altimeter setting datum points, minimum circling altitudes in use or required and the nature of operations at the aerodrome. For more complex inner horizontal surfaces, with runways on different levels, as shown in Figure GM-H-2, a common elevation is not essential, but where surfaces overlap, the lower surface should be regarded as dominant.

(f) Further guidance is given in ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

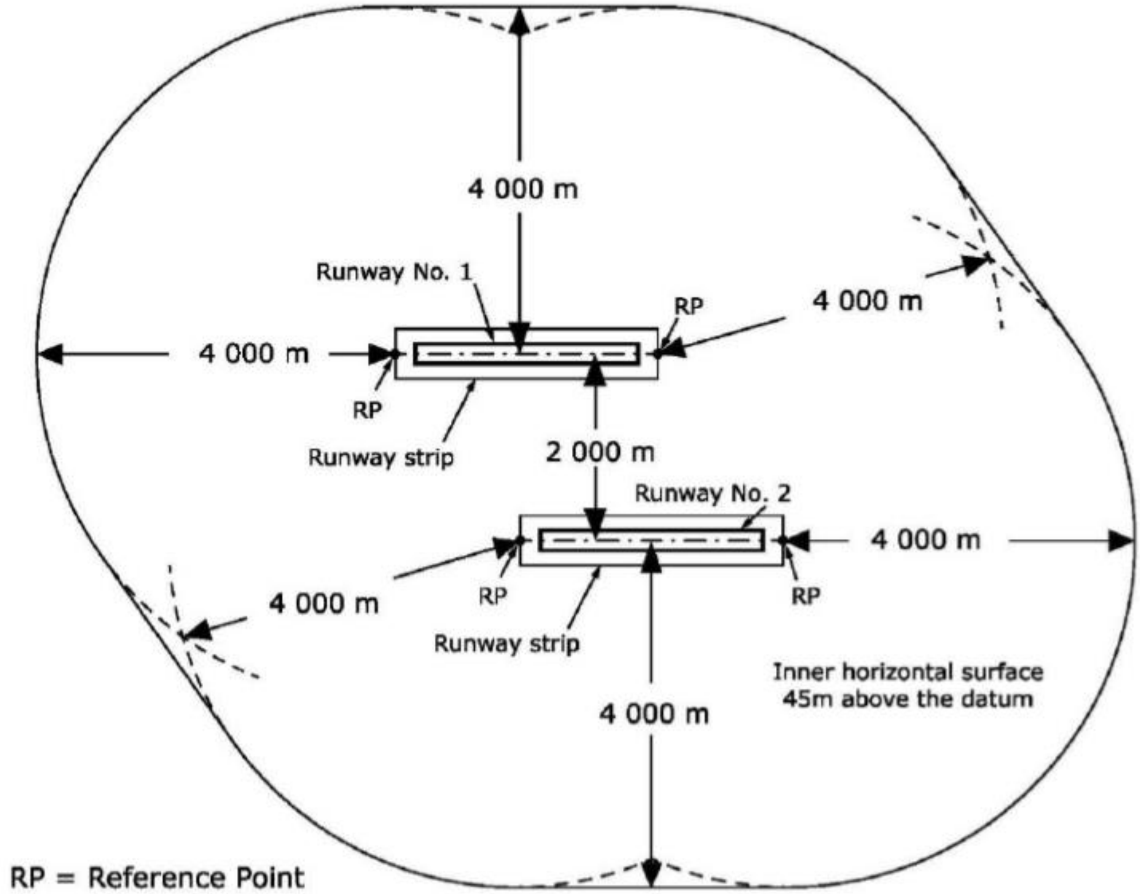


Figure GM-H-2. Composite inner horizontal surface for two parallel runways (where the runway code is 4)

GM1 ADR-DSN.H.425 Approach surface

Intentionally left blank

GM1 ADR-DSN.H.430 Transitional surface

When the elevation of a point on the lower edge is along the strip and equal to the elevation of the nearest point on the centre line of the runway or its extension as a result the transitional surface along the strip should be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The intersection of the transitional surface with the inner horizontal surface should also be a curved or a straight line depending on the runway profile.

GM1 ADR-DSN.H.435 Take-off climb surface

Intentionally left blank

GM1 ADR-DSN.H.440 Slewed Take-off climb surface

The edge of a Take-off climb surface may be slewed in the direction of a turn away from the extended runway centre line up to a maximum of 15° splay. The portion of take-off climb surface encompassing the new departure track should be the same shape and dimensions as the original take-off climb surface measured relative to the new departure track. The opposite edge of the take-off climb surface should remain unchanged unless there is another turning departure towards that side as well, in which case, the edge may be slewed in that direction too.

GM1 ADR-DSN.H.445 Obstacle-free zone (OFZ)

Intentionally left blank

GM1 ADR-DSN.H.450 Inner approach surface

Intentionally left blank

GM1 ADR-DSN.H.455 Inner transitional surface

(a) It is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids, aircraft, and other vehicles that should be near the runway, and which is not to be penetrated except for frangible objects. The transitional surface is intended to remain as the controlling obstacle limitation surface for buildings, etc.

(b) The inner transitional surface along the strip should 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 should also be a curved or straight line depending on the runway profile.

GM1 ADR-DSN.H.460 Balked landing surface

Intentionally left blank

CHAPTER J — OBSTACLE LIMITATION REQUIREMENTS

GM1 ADR-DSN.J.465 General

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 of the runway is made. In cases where operations are conducted to or from both directions of a runway, the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

GM1 ADR-DSN.J.470 Non-instrument runways

(a) Circumstances in which the shielding principle may reasonably be applied are described in the ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

(b) 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 that they may endanger aeroplanes.

GM1 ADR-DSN.J.475 Non-precision approach runways

(a) If it is of particular importance for safe operation on circuits, arrival routes towards the aerodrome or on departure or missed approach climb-paths, an outer horizontal surface for non-precision approach runways should be established.

(b) Circumstances in which the shielding principle may reasonably be applied are described in ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

(c) 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.

GM1 ADR-DSN.J.480 Precision approach runways

(a) The following obstacle limitation surfaces should be established for a precision approach runway Category I:

  (1) inner approach surface;
  (2) inner transitional surfaces; and
  (3) balked landing surface.

(b) See CS ADR-DSN.T.915 for information regarding siting of equipment and installations on operational areas.

(c) Guidance on obstacle limitation surfaces for precision approach runways is given in ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

(d) Circumstances in which the shielding principle may reasonably be applied are described in ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

(e) 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 that they may endanger aeroplanes.

(f) For information on code letter F aeroplanes equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre. Additional guidance is given in ICAO Circular, 301, New Larger Aeroplanes — Infringement of the Obstacle Free Zone.

GM1 ADR-DSN.J.485 Runways meant for take-off

(a) If no object reaches the 2 % (1:50) take-off climb surface, an obstacle-free surface of 1.6 % (1:62.5) should be established.

(b) When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in Table J-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.

(c) Circumstances in which the shielding principle may reasonably be applied are described in ICAO Doc 9137, Airport Services Manual, Part 6, Control of Obstacles.

(d) 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 that they may endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.

(e) The operational characteristics of aeroplanes for which the runway is intended should be examined to see if it is desirable to reduce the slope specified in Table J-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 should be made so as to provide protection to a height of 300 m.

GM1 ADR-DSN.J.486 Other objects

In certain circumstances, objects that do not project above any of the obstacle limitation surfaces may constitute a hazard to aeroplanes as, for example, where there are one or more isolated objects in the vicinity of an aerodrome.

GM1 ADR-DSN.J.487 Objects outside the obstacle limitation surfaces

(a) Beyond the limits of the obstacle limitation surfaces the safety assessment should be conducted for the proposed constructions that extend above the established limits in order to protect safe operation of aircraft.

(b) The safety assessment may have regard to the nature of operations concerned and may distinguish between day and night operations.

CHAPTER K — VISUAL AIDS FOR NAVIGATION (INDICATORS AND SIGNALLING DEVICES)

GM1 ADR-DSN.K.490 Wind direction indicator

(a) Wind direction indicators are important visual aids for all runway ends. Large wind direction indicators are particularly important at aerodromes where landing information is not available through radio communications. On the other hand, landing direction indicators are seldom used due to the necessity and, consequently, responsibility, of changing their direction as wind direction shifts. Visual ground signals for runway and taxiway serviceability are contained in the document «Технические требования. Правила полетов». Additional guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids, Chapter 3.

(b) A fabric wind cone is generally the type preferred by pilots because it provides a general indication of wind speed. Cones that extend fully at wind speeds of about 15 kt are most useful since this is the maximum crosswind landing component for small aircraft.

(c) It may be possible to improve the perception by the pilot of the location of the wind direction indicator by several means notably by circular marking around this indicator. The location of at least one wind direction indicator should be marked by a circular band 15 m in diameter and 1.2 m wide. The band should be centred about the wind direction indicator support, and should be in a colour chosen to give adequate conspicuity, preferably white.

(d) The usefulness of any visual aid is determined largely by its size, conspicuity, and location. Given conditions of good atmospheric visibility, the maximum distance at which the information available from an illuminated wind sleeve can be usefully interpreted is 1 km. Thus, in order that a pilot may make use of this information whilst on approach, the wind sleeve should be sited no farther from the runway threshold than 600 m. Obstacle criteria excluded, the ideal location is 300 m along the runway from the threshold and laterally displaced at 80 m from the runway centre line.

(e) This means, in effect, that only those aerodromes where the thresholds are less than 1 200 m apart can meet the minimum requirement with a single unit. Most code 3 and 4 aerodromes should require two or more units suitably sited in order to provide the best possible coverage.

(f) The final choice of unit numbers and location should depend on a number of factors which should vary from aerodrome to aerodrome. However, when deciding on the most appropriate location, account should be taken to ensure that the wind direction indicator is:

(1) outside the Cleared and Graded Area of the runway and taxiway strips;
(2) clear of the OFZ and ILS critical/sensitive areas where appropriate;
(3) preferably not more than 200 m lateral displacement from the runway edge;
(4) preferably between 300 m and 600 m from the runway threshold measured along the runway;
(5) in an area with low background levels of illumination;
(6) visible from the approach and take-off positions of all runways; and
(7) free from the effects of air disturbance caused by nearby objects.

GM1 ADR-DSN.K.495 Landing direction indicator

The landing ‘T’ may be constructed of wood or other light material and its dimensions may correspond to those shown in Figure K-1. It may be painted white or orange. The landing ‘T’ should be mounted on a cement concrete pedestal adequately reinforced with steel bars to avoid cracks resulting from unequal settlement. The surface of the pedestal should be finished smooth with a steel trowel and coated with paint of appropriate colour. The colour of the pedestal should be chosen to contrast with the colour of the landing ‘T’. Before fastening the landing ‘T’ base to the concrete pedestal, the mounting bolts should be checked for correct spacing. The landing ‘T’ should be assembled and mounted in accordance with the manufacturer’s installation instructions. It should be free to move about a vertical axis so that it can be set in any direction. Where required for use at night, the landing ‘T’ should either be illuminated or outlined by white lights.

GM1 ADR-DSN.K.500 Signalling lamp

When selecting the green light, use should be made of the restricted boundary of green as specified in GM1 ADR-DSN.U.930(a).

GM1 ADR-DSN.K.505 Signal panels and signal area

(a) A signal panels and signal area should be provided when visual ground signals are used to communicate with aircraft in flight.

(b) A signal panel and signal area 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 may be conveyed by visual ground signals should normally be available in AIP or NOTAM. The potential need for visual ground signals should, therefore, be evaluated before deciding to provide a signal area.

(c) the document ”Technical requirements rules of the air” Appendix 1, specifies the shape, colour and use of visual ground signals.

GM1 ADR-DSN.K.510 Location of signal panels and signal area

A signal area should be located so as to be visible for all angles of azimuth above an angle of 10° above the horizontal when viewed from a height of 300 m.

GM1 ADR-DSN.K.515 Characteristics of signal panels and signal area

(a) The signal area should be an even horizontal surface at least 9 m square.

(b) The signal area should be constructed of cement concrete reinforced with an adequate quantity of steel to avoid cracks resulting from unequal settlement. The top surface should be finished smooth with a steel trowel and coated with paint of appropriate colour. The colour of the signal area should be chosen to contrast with the colours of the signal panels to be displayed thereon. More guidance is given in ICAO Doc 9157, Aerodrome Design Manual Part 4, Visual Aids, Chapter 3.

(c) The colour of the signal area should be chosen to contrast with the colours of the signal panels used, and it should be surrounded by a white border not less than 0.3 m wide.

CHAPTER L — VISUAL AIDS FOR NAVIGATION (MARKINGS)

GM1 ADR-DSN.L.520 General – Colour and conspicuity

(a) Where there is insufficient contrast between the marking and the pavement surface, the marking should include an appropriate border.

(1) This border should be white or black;
(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; and
(3) Markings should consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.
(4) Guidance on reflective materials is given in the ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

(b) At aerodromes where operations take place at night, pavement markings should be made with reflective materials designed to enhance the visibility of the markings.

GM1 ADR-DSN.L.525 Runway designation marking

Intentionally left blank

GM1 ADR-DSN.L.530 Runway centre line marking

For the centre line marking the 30 m length of and gap between stripes may be adjusted to take into consideration the runway thresholds locations.

GM1 ADR-DSN.L.535 Threshold marking

Intentionally left blank

GM1 ADR-DSN.L.540 Aiming point marking

For runways with widths of 30 m, the width of the rectangular stripes of the aiming point marking and the lateral spacing between the inner sides of the stripes may be adjusted in proportion to the available runway width to avoid overlapping of the aiming point marking with the runway side stripe marking.

GM1 ADR-DSN.L.545 Touchdown zone marking

(a) In order to give information regarding the overall extension of a distance coding touchdown marking, as specified in CS ADR-DSN.L.545, the last pair of markings after the threshold should consist of two single stripes, and the other pairs should correspond to the patterns shown in Figure L-4.

(b) Such sequential layout gives intuitive information about the extension of the touchdown zone and, as a consequence, of the LDA or of the distance between thresholds.

GM1 ADR-DSN.L.550 Runway side stripe marking

When turn pads are not available at the end of a runway for back-track manoeuvres and threshold is displaced, in order to better identify full-strength bearing surface, it may be useful to display specific dashed markings as showed by Figure GM-L-1 and with dimensions described in Table GM-L-1.

GM1 ADR-DSN.L.555 Taxiway centre line marking

The term ‘continuous guidance’ is not intended to require that taxiway centre line markings are provided onto aircraft stands. Instead, it is intended that the centre line marking be provided on taxiways leading to aircraft stands or other apron areas from which visual cues or other means exist, such as lead-in arrows and stand number indicators, to enable aircrew to manoeuvre the aircraft onto a stand or other parking area.

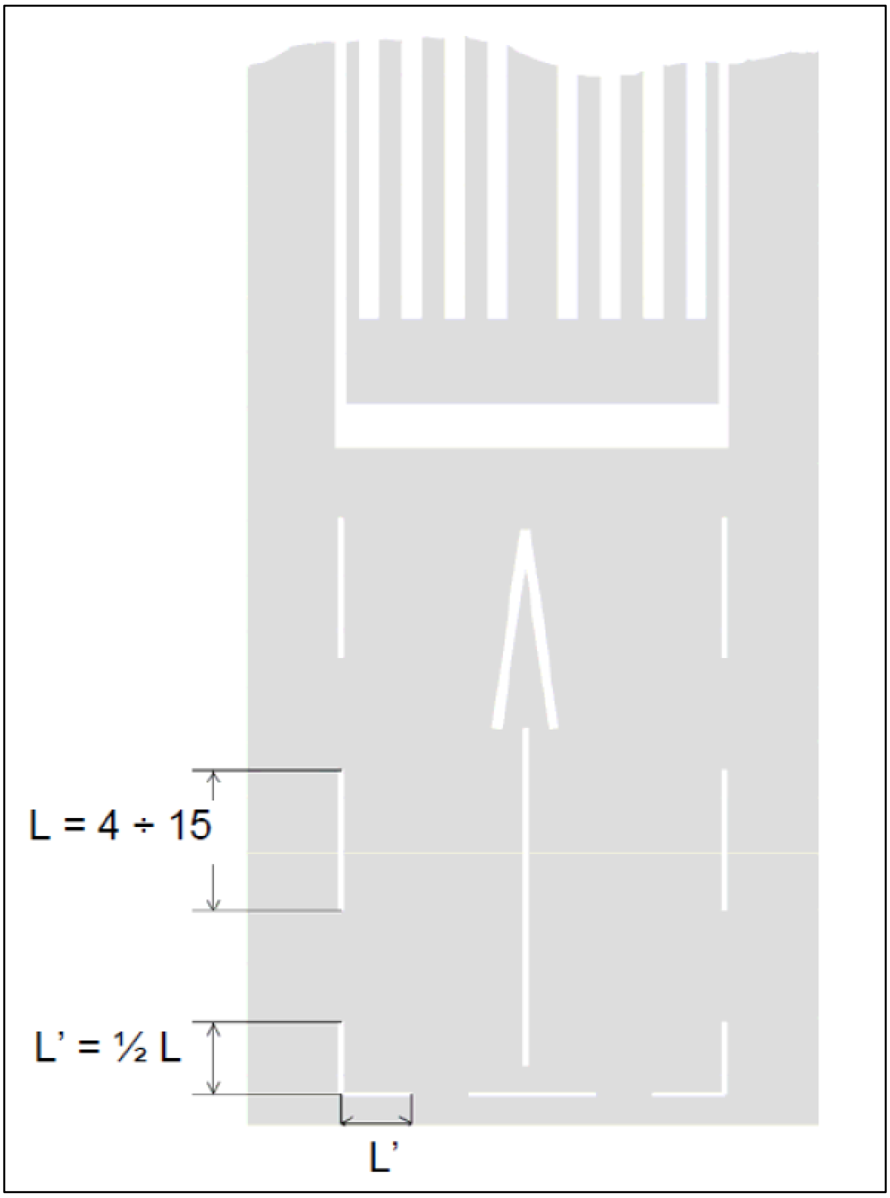


Figure GM-L-1. Dashed runway side stripe marking

Runway width (m)	Single dash dimensions	
	Length (minimum m)	Width (m)
60	15	0.45
45	15	0.45
30	10	0.45
23	6	0.25
18	4	0.25
Note: The length of the gap is as much as possible equal, but not longer, to the length of the corresponding marking		

Table GM-L-1. Runway dashed markings

GM1 ADR-DSN.L.560 Interruption of runway markings

(a) At an intersection of a runway and taxiway, the runway side stripe marking should be either continued across the intersection or interrupted. The interruption means one of the following:

(1) the runway side stripe marking stops at the point where the taxiway fillet starts at either side of the taxiway (see Figure GM-L-2(A)); or
(2) the runway side stripe marking stops at the point where the extended line of the taxiway edge crosses the runway (see Figure GM-L-2(B)); or
(3) the runway side stripe marking stops at a short distance on either side of the taxiway centre line marking in order to allow visible and continuous taxiway centre line marking guidance (see Figure GM-L-2(C)); or
(4) the taxiway centre line marking overlays and therefore interrupts a continuous runway side stripe marking (see Figure GM-L-2(D)).

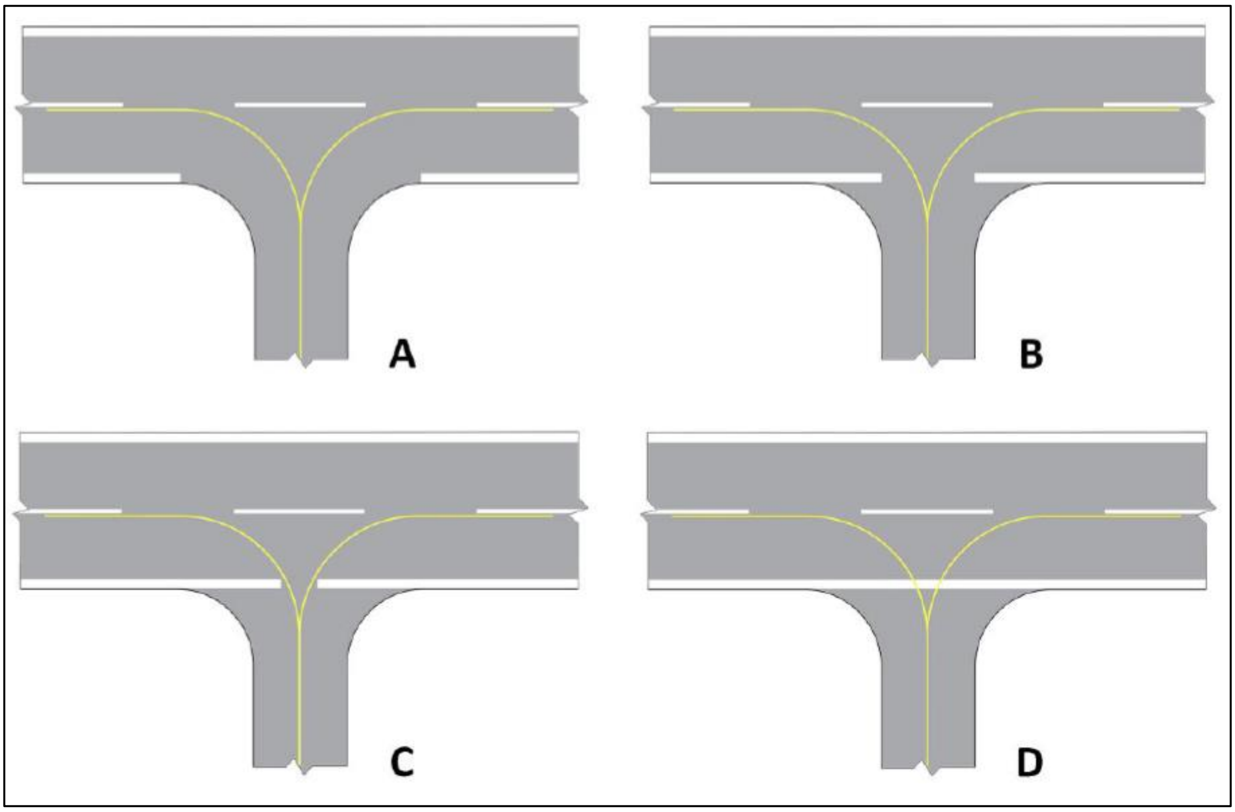


Figure GM-L-2. Illustration of runway side stripe marking interruption

(b) The overall perception of the runway side stripe marking depends on conspicuity needs and local conditions, such as the number, location and disposition of runway/taxiway intersections, nature of the surrounding terrain, operational needs at aerodrome, weather, etc.

GM1 ADR-DSN.L.565 Runway turn pad marking

Where a runway turn pad is not provided, a marking for continuous guidance to enable an aeroplane to complete a 180-degree turn and align with the runway centre line may be provided. Such marking should be yellow, at least 15 cm in width and continuous in length.

GM1 ADR-DSN.L.570 Enhanced taxiway centre line marking

The provision of enhanced taxiway centre line marking may form part of runway incursion prevention measures.

GM1 ADR-DSN.L.575 Runway-holding position marking

When the Runway-holding position marking is supplemented with the term ‘CAT II’ or ‘CAT III’ on the areas or taxiways exceeding 60 m in accordance with CS ADR-DSN.L.575 (a)(6) and should be placed along with the Mandatory instruction marking in accordance with CS ADR-DSN.L.605 both markings should be equally and symmetrically placed one next to another.

GM1 ADR-DSN.L.580 Intermediate holding position marking

Intentionally left blank

GM1 ADR-DSN.L.585 VOR aerodrome checkpoint marking

Further guidance on the selection of sites for VOR aerodrome checkpoints is given in ICAO Annex 10, Volume I, Attachment E.

GM1 ADR-DSN.L.590 Aircraft stand marking

(a) 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.

(b) Apron markings are installed to support the safe operation of aircraft on stands and apron areas. Where appropriate procedures are employed, markings may not be required, giving flexibility of operations. Examples would include situations where aircraft marshallers are used or where aircraft are required to self-park on an open apron where different combinations of aircraft preclude dedicated markings. Specific markings/stands are normally more applicable for larger aircraft.

GM1 ADR-DSN.L.595 Apron safety lines

(a) Ground equipment and vehicles should be kept outside predetermined limits when aircraft are manoeuvring or when the equipment is left unattended.

(b) Safety lines are required on an apron to mark the limits of parking areas for ground equipment, apron service roads and passengers' paths, etc. These lines are narrower and of a different colour to differentiate them from the guidelines used for aircraft.

(1) Wing tip clearance lines. These lines should delineate the safety zone clear of the path of the critical aeroplane wing tip. The line should be drawn at appropriate distance outside the normal path of the wing tip of the critical aeroplane;
(2) Equipment limit lines. These lines are used to indicate the limits of areas which are intended for parking vehicles and aircraft servicing equipment when they are not in use.

(c) Several methods may be used to identify which side of a safety line is safe for storage of such vehicles and equipment:

(1) Spurs or an additional line (a discontinuous line of the same colour or a continuous line of a different conspicuous colour) may be provided on one side of the safety line. The side on which such spurs or an additional line is located is considered safe for parking vehicles and equipment;
(2) The words 'Equipment Limit' may be painted on the side used by ground equipment and readable from that side;
(3) Passenger path lines. These lines are used to indicate to passengers and escorting personnel the route that needs to be followed, when walking on the apron, in order to be clear of hazards. A pair of lines with zebra hatching between them may be used.

GM1 ADR-DSN.L.597 Apron service road marking

(a) The term service road encompasses also other types of roads, such as the perimeter service roads, which are used to provide access to security or maintenance services etc. of the aerodrome. However, such types of service roads do not fall under the term 'apron service road'.

(b) When an apron service road crosses a taxiway, a separate road-holding position sign, in accordance with CS ADR-DSN.N.800, or road-holding position marking, in accordance with CS ADR-DSN.L.600, should indicate that vehicles are required to stop.

(c) Markings located on an apron are prescribed in CS ADR-DSN.L.555, CS ADR-DSN.L.590 and CS ADR-DSN.L.595.

GM1 ADR-DSN.L.600 Road-holding position marking

(a) Where a road that accesses a runway or a taxiway is unpaved, it may not be possible to install markings. In such cases, a road-holding position signs and/or lights should be installed, combined with appropriate instructions on how the driver of a vehicle should proceed.

(b) Where it is possible to install markings, they should conform to national regulations for traffic sings and markings.

GM1 ADR-DSN.L.605 Mandatory instruction marking

(a) Except where operationally required, a mandatory instruction marking should not be located on a runway.

(b) 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 illustrated in Figure GM-L-3. The shadowing only affects the vertical dimension.

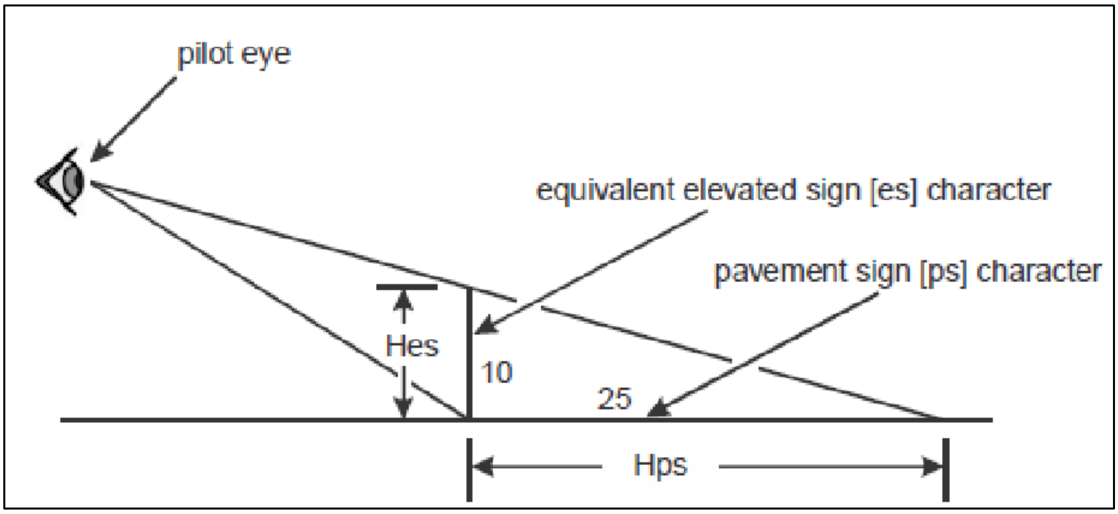


Figure GM-L-3. Illustration of pavement marking spacing calculation

(c) The following example illustrates how the pavement marking spacing is to be calculated:

(1) in the case of runway designator ‘10’, which is to have a height of 4 000 mm (Hps), the equivalent elevated sign character height is 4 000/2.5 = 1 600 mm (Hes);

(2) Table N-3(b) indicates numeral to numeral code 1 and from Table N-3(c) this code has a dimension of 96 mm, for a character height of 400 mm;

(3) the pavement marking spacing for ‘10’ is then (1 600/400) x 96 = 384 mm.

GM1 ADR-DSN.L.610 Information marking

(a) Applicability: Where operationally required information sign should be supplemented by a marking on the pavement surface.

(b) Location:

(1) An information (location/direction) marking should 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, and on the pavement surface at regular intervals along taxiways of great length.

(2) The information marking should 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.

CHAPTER M — VISUAL AIDS FOR NAVIGATION (LIGHTS)

GM1 ADR-DSN.M.615 General

(a) Aeronautical ground lights near navigable waters should be taken into consideration to ensure that the lights do not cause confusion to mariners.

(b) 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 should be of adequate intensity. To obtain the required intensity, it should usually be necessary to make the light directional, in which case the arcs over which the light shows should be adequate and so orientated as to meet the operational requirements. The runway lighting system should be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end.

(c) 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.

(d) 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 2 000 or 3 000 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.

(e) 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.

(f) 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 2 000 or 3 000 cd. In an endeavour to increase the range at which lights would first be sighted at night, their intensity should not be raised to an extent that a pilot might find excessively dazzling at diminished range.

(g) From the foregoing should 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 would disconcert the pilot. The appropriate intensity setting on any particular occasion should depend both on the conditions of background brightness and the visibility.

(h) Assessment on dazzle in the aerodrome vicinity:

(1) Human vision is a complex mechanism using both eye and brain. Even though this mechanism is quite handled for eye, there is still a lack of knowledge on the interpretation of it by the brain. Thus, vision varies from one human being to another.

(2) The field of view is defined by the area perceived by eyes. The perception of details is based on the luminance ratio between elements of the scene, taking into account spatial distribution. Luminance and contrast are key elements of vision mechanism.

(3) Four sectors can be identified in the field of view (FOV):

(i) sensation field, corresponding to the absolute boundaries of FOV; it opens up to approximately 90° on each side of the eye direction;

(ii) visibility field, which is narrower and enables the perception of an object; it opens up to 60°;

(iii) conspicuity field, which enables the recognition, it opens up to 30°;

(iv) working conspicuity field, which is further tightly centred on the eye direction (1 to 2°); it enables the identification and is the working area of the vision.

It is reminded that the retina is composed in its centre by cone cells (that see colours and details) and at the periphery by rod cells (that perceive movements and change of state).

(i) A safety assessment is conducted in order to identify situations where the risk of dazzling becomes unacceptable. Thus, it is noted that dazzle represents such a risk in the following situations:

(1) during approach, especially after the aircraft has descended below the decision height: the pilot should not lose any visual cue;

(2) at touchdown the pilot should not be surprised by a flash;

(3) during rolling (landing or take-off), the pilot should be able to perceive his environment and detect any deviation from the centre line: the pilot should not lose any visual cue.

(4) Thus:

(i) prejudicial dazzle due to veiling luminance should not occur during approach (slightly before the decision height) and rolling; and

(ii) surprise effect should not occur at touchdown.

(j) Regarding air traffic controllers, it has been considered that dazzle induced by veiling effect should not reduce the visual perception of aircraft operations on, and close to the runway.

(k) The elements here above can be applied to solar panels. The following assumptions can be made:

(1) solar panels are inclined so as to efficiently capture the sunlight, conducting to a range of cross section surfaces;

(2) the maximum acceptable luminance value has been fixed to 20 000 cd/m2; and

(3) the surfaces varied from 100 m2 to several hectares.

(l) It is assumed that the aircraft maintains precisely its trajectory whereas in reality the approach is conducted into a conical envelop around the expected trajectory.

GM1 ADR-DSN.M.620 Aeronautical beacons

Intentionally left blank

SECTION 1 — APPROACH LIGHTING SYSTEMS

GM1 ADR-DSN.M.625 Approach lighting systems

(a) Types and characteristics

(1) The approach lighting patterns that have been generally adopted are shown in Figures M-1 and M-2. A diagram of the inner 300 m of the precision approach Category II and III lighting system is shown in Figures M-3A and M-3B.

(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 CS ADR.DSN.M.615(d)(1). The characteristics of these inset lights should be in accordance with the specifications in CS ADR-DSN.U.940, Figures U-5 or U-6, as appropriate and the chromaticity should be in

accordance with the specifications in CS ADR-DSN.U.930 and Figure U-1A or U-1B, as appropriate.

(3) Examples of flight path envelopes used in designing the lighting are shown in Figure GM-M-2.

(b) Horizontal installation tolerances:

(1) The dimensional tolerances are shown in Figure M-1 and M-2.

(2) The centre line of an approach lighting system should be as coincident as possible with the extended centre line of the runway with a maximum tolerance of ±15′.

(3) The longitudinal spacing of the centre line lights should be such that one light (or group of lights) is located in the centre of each crossbar, and the intervening centre line lights are spaced as evenly as practicable, between two crossbars or a crossbar and a threshold.

(4) The crossbars and barrettes should be at right angles to the centre line of the approach lighting system with a tolerance of ±30′ if the pattern in Figure M-2(A) is adopted or ± 2° if Figure M-2(B) is adopted.

(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.

(6) When a crossbar in the system shown in Figure M-2(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 centre line of the approach lighting.

(c) Vertical installation tolerances:

(1) The ideal arrangement is to mount all the approach lights in the horizontal plane passing through the threshold as shown in Figure GM-M-1, 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.

(2) 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.

(3) 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 centre line protrudes through the plane of the approach lighting system. Where a tall object exists within 60 m of the centre line 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.

(4) 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.

(i) Centre line. The gradients of the centre line 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.

(ii) Crossbars. The crossbar lights should be so arranged as to lie on a straight line passing through the associated centre line 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.

(5) When the barrette is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

(6) 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.

(d) Clearance of obstacles:

(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 centre line. It starts at the threshold and extends 60 m beyond the approach end of the system, and is 120 m wide.

(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 operator and coordinated with the aerodrome air traffic control. Railroads, regardless of the amount of traffic, are considered as obstacles extending 5.4 m above the top of the rails.

(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.

(4) Where an ILS localiser is installed within the light plane boundaries, it is recognized that the localiser, 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 localiser is located 300 m from the threshold, the screen should be permitted to extend above the plane of the approach lighting system by 10 × 15 = 150 cm maximum but preferably should be kept as low as possible, consistent with proper operation of the ILS.

(5) In locating an MLS azimuth antenna the guidance contained in ICAO Annex 10, Volume I, Attachment G, should be followed. This material which also provides guidance on collocating an MLS azimuth antenna with an ILS localiser antenna, suggests that the MLS azimuth antenna may be sited within the light plane boundaries where it is not possible or practical to locate it beyond the outer end of the approach lighting for the opposite direction of approach. If the MLS azimuth antenna is located on the extended centre line of the runway, it should be as far as possible from the closest light position to the MLS azimuth antenna in the direction of the runway end. Furthermore, the MLS azimuth antenna phase centre should be at least 0.3 m above the light centre of the light position closest to the MLS azimuth antenna in the direction of the runway end. (This could be relaxed to 0.15 m if the site is otherwise free of significant multipath problems.)

(6) Compliance with this requirement which is intended to ensure that the MLS signal quality is not affected by the approach lighting system, could result in the partial obstruction of the lighting system by the MLS azimuth antenna. To ensure that

the resulting obstruction does not degrade visual guidance beyond an acceptable level, the MLS azimuth antenna should not be located closer to the runway end than 300 m and the preferred location is 25 m beyond the 300 m crossbar (this would place the antenna 5 m behind the light position 330 m from the runway end). Where an MLS azimuth antenna is so located, a central part of the 300 m crossbar of the approach lighting system would alone be partially obstructed. Nevertheless, it is important to ensure that the unobstructed lights of the crossbar remain serviceable all the time.

(7) 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.

(8) 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 % slope. Where such conditions exist and no alternative is possible, the 2 % 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.

(e) Consideration of the effects of reduced lengths:

(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, should 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 should support all the variations of such approaches is 900 m, and this should always be provided whenever possible.

(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.

(3) In such cases, every effort should be made to provide as much approach lighting system as possible. Restrictions on operations could be imposed on runways equipped with reduced lengths of approach 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 judgement 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 should increase substantially. There are many operational considerations which should be taken into account in deciding if any restrictions are necessary to any precision approach and these are detailed in ICAO Annex 6.

(f) For non-precision approach runways 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.

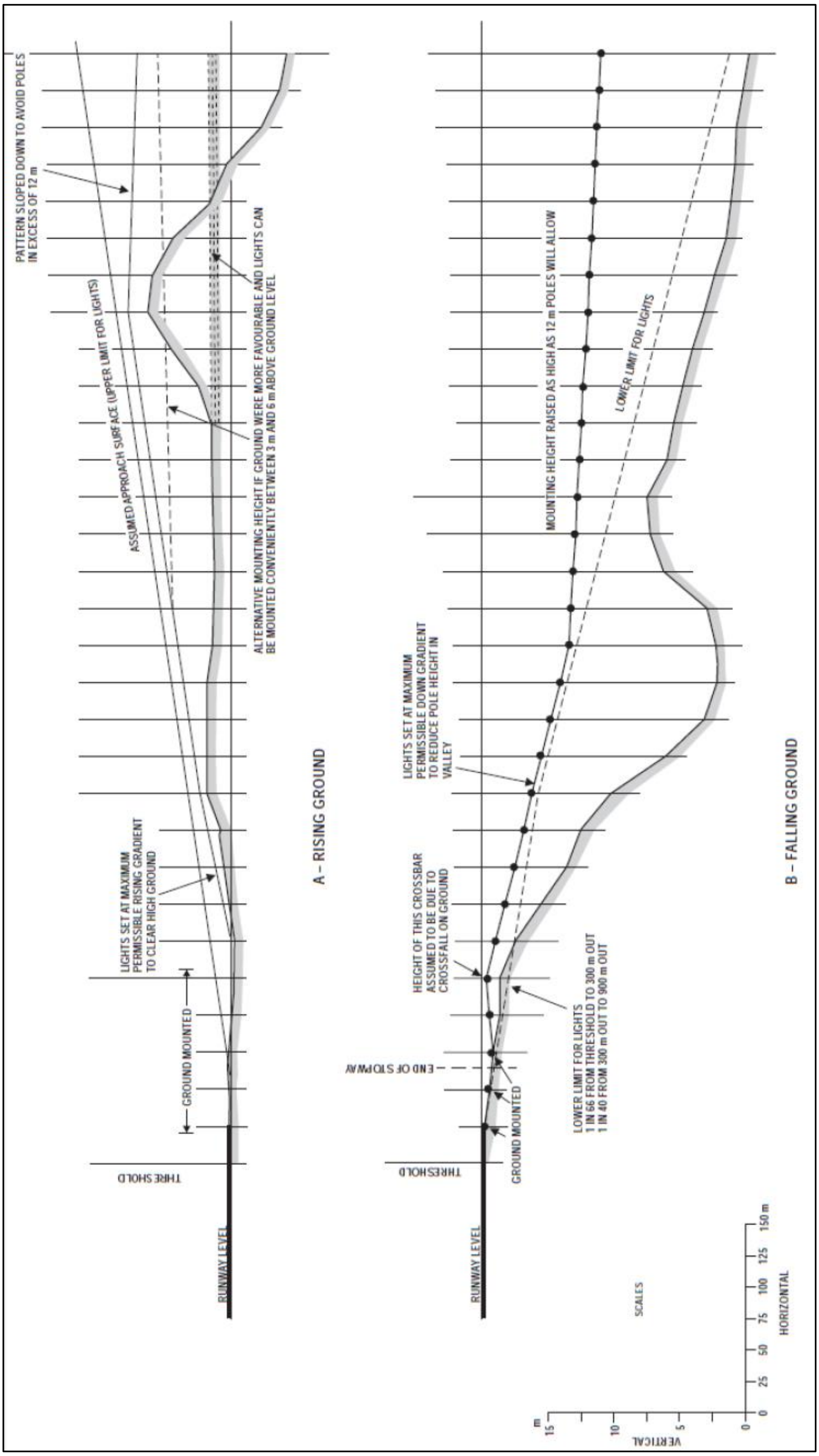


Figure GM-M-1. Vertical installation tolerances

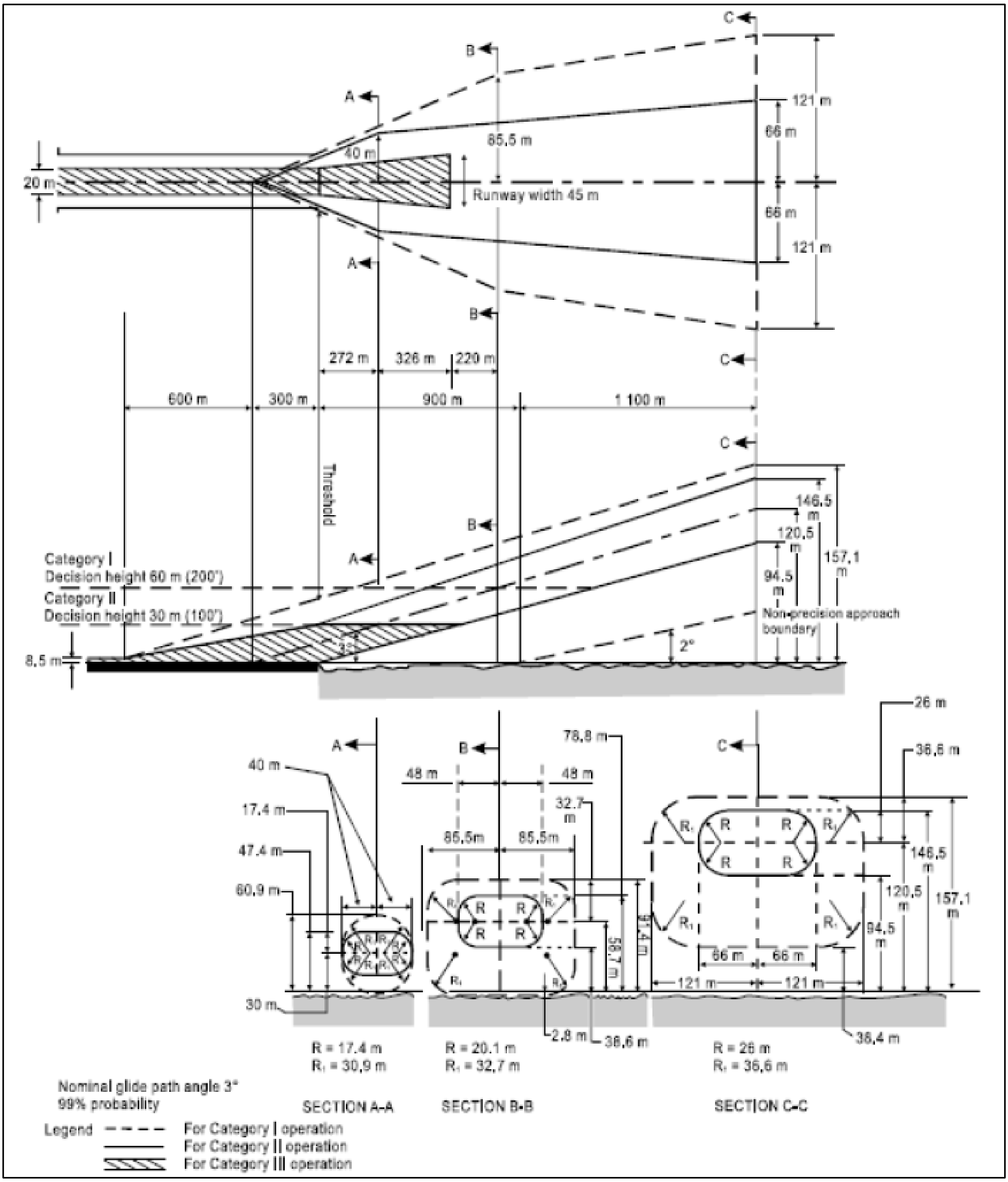


Figure GM-M-2. Flight path envelope examples for lighting design for Category I, II and III operations - Centre line lights

GM1 ADR-DSN.M.626 Simple approach lighting systems

Intentionally left blank

GM1 ADR-DSN.M.630 Precision approach category I lighting system

(a) 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.

(b) Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

(c) The flashing light system provides a long-distance information about the location and orientation of an active runway to the approaching pilots. Particularly in the surrounding of cities with urban lighting of streets, places and buildings, the flashing light system allows a clear identification of the approach by the flight crew. To prevent glare at night and have clear visibility, the high-intensity flashing light should be provided with an appropriate intensity control.

GM1 ADR-DSN.M.635 Precision approach category II and III lighting system

The length of 900 m is based on providing guidance for operations under Category I, II and III conditions. Reduced lengths may support Category II and III operations but may impose limitations on Category I operations. Additional guidance is given in Attachment 10 to the document “Technical requirements on design and operation of aerodromes” approved by the Civil Aviation Authority.

SECTION 2 — VISUAL APPROACH SLOPE INDICATOR SYSTEMS

GM1 ADR-DSN.M.640 Visual approach slope indicator systems

(a) Factors that should be considered when making a decision on which runway on an aerodrome should receive first priority for the installation of a visual approach slope indicator system are:

(1) frequency of use;
(2) seriousness of the hazard;
(3) presence of other visual and non-visual aids;
(4) type of aeroplanes using the runway; and
(5) frequency and type of adverse weather conditions under which the runway should be used.

(b) With respect to the seriousness of the hazard, the order given in the CS ADR-DSN.M.640 may be used as a general guide. These may be summarized as:

(1) 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.
(2) serious hazard in approach;
(3) serious hazard if aeroplanes undershoot or overrun; and
(4) unusual turbulence.

(c) The presence of other visual or non-visual aids is a very important factor. Runways equipped with ILS or MLS would 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 or MLS use a runway, priority might be given to installing a visual approach slope indicator on this runway.

(d) Priority may be given to runways used by turbojet aeroplanes.

(e) Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in paragraph (a) above exist, a PAPI should be provided except that where the code number is 1 or 2 either an APAPI may be provided.

GM1 ADR-DSN.M.645 Precision approach path indicator and Abbreviated precision approach path indicator (PAPI and APAPI)

Intentionally left blank

GM1 ADR-DSN.M.650 Approach slope and elevation setting of light units for PAPI and APAPI

Intentionally left blank

GM1 ADR-DSN.M.655 Obstacle protection surface for PAPI and APAPI

(a) The displacement of the system upwind of the threshold reduces the operational landing distance.

(b) Additional guidance on the calculation for siting PAPI/ APAPI on a runway with ILS/MLS is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

GM1 ADR-DSN.M.660 Circling guidance lights

Intentionally left blank

SECTION 3 — RUNWAY & TAXIWAY LIGHTS

Intentionally left blank

GM1 ADR-DSN.M.665 Runway lead-in lighting systems

(a) Applicability: A runway lead-in lighting system may be provided for purposes of noise abatement routing.

(b) Characteristics:

(1) Where practicable, the flashing lights in each group should flash in sequence towards the runway.
(2) The path of the system may be segmented, straight, or a combination thereof, as required.
(3) The starting point of the path may be at a point within easy visual range of a final approach fix.

GM1 ADR-DSN.M.670 Runway threshold identification lights

Intentionally left blank

GM1 ADR-DSN.M.675 Runway edge lights

Intentionally left blank

GM1 ADR-DSN.M.680 Runway threshold and wing bar lights

Intentionally left blank

GM1 ADR-DSN.M.685 Runway end lights

When the threshold is at the runway extremity, fittings serving as threshold lights may be used as runway end lights.

GM1 ADR-DSN.M.690 Runway centre line lights

(a) Runway centre line lights should be provided on a precision approach runway Category I when the runway is used by aircraft with high landing speeds or where the width between the runway edge lights is greater than 50 m.

(b) Runway centre line lights should be provided on a runway intended to be used for take-off with an operating minimum of an RVR of the order of 400 m or higher when used by aeroplanes with a very high take-off speed where the width between the runway edge lights is greater than 50 m.

(c) Consideration should be given to providing runway centre line lights where additional conspicuity is required (such as local environment, weather conditions, operational provisions and minima).

GM1 ADR-DSN.M.695 Runway touchdown zone lights

To allow for operations at lower visibility minima, it may be advisable to use a 30 m longitudinal spacing between barrettes.

GM1 ADR-DSN.M.696 Simple touchdown zone lights

Simple touchdown zone lights should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

GM1 ADR-DSN.M.700 Rapid exit taxiway indicator lights (RETILs)

(a) In low visibility conditions, rapid exit taxiway indicator lights provide useful situational awareness cues while allowing the pilot to concentrate on keeping the aircraft on the runway centre line.

(b) Rapid exit taxiway indicator lights should be considered on a runway intended for use in runway visual range conditions less than a value of 350 m where the traffic density is heavy.

(c) Rapid exit taxiway indicator lights should not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure GM-M-3.

(d) Following a landing, runway occupancy time has a significant effect on the achievable runway capacity. Rapid exit taxiway indicator lights 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 kt until the first RETIL (three-light barrette) is reached is seen as the optimum.

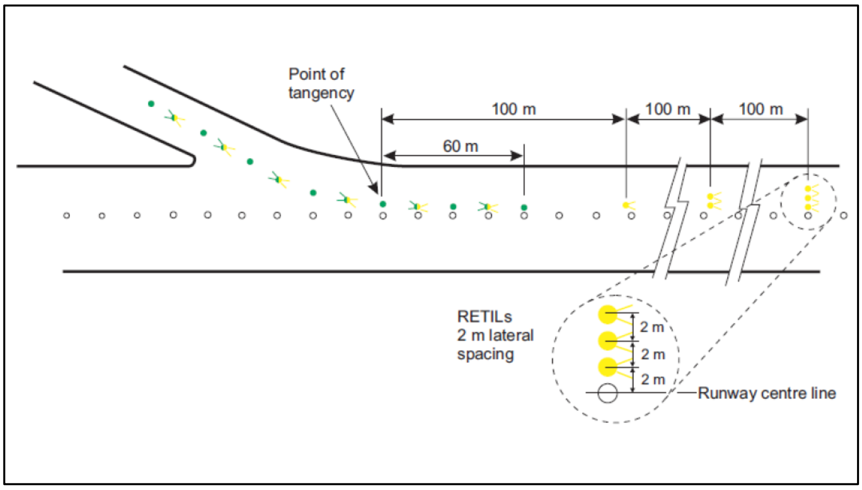


Figure GM-M-3. Rapid exit taxiway indicator lights (RETILs)

GM1 ADR-DSN.M.705 Stopway lights

Intentionally left blank

GM1 ADR-DSN.M.706 Runway status lights (RWSLs)

(a) Where two or more runway-holding positions are provided, the runway-holding position referred is that closest to the runway.

(b) Additional take-off hold lights (THLs) may be similarly provided at the starting point of the take-off roll.

(c) Consideration for reduced beam width may be required for some runway entrance lights (RELs) lights at acute-angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.

GM1 ADR-DSN.M.710 Taxiway centre line lights

(a) In the case where taxiway centre line lights are provided and where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway, narrow taxiway, or in snow conditions, this may be done with taxiway edge lights or markers. 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.

(b) Care should be taken to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

(c) The provisions of CS ADR-DSN.M.710(c)(3) can form part of effective runway incursion prevention measures.

GM1 ADR-DSN.M.715 Taxiway centre line lights on taxiways, runways, rapid exit taxiways, or on other exit taxiways

Intentionally left blank

GM1 ADR-DSN.M.720 Taxiway edge lights

Intentionally left blank

GM1 ADR-DSN.M.725 Runway turn pad lights

Intentionally left blank

GM1 ADR-DSN.M.730 Stop bar

(a) A stop bar is intended to be controlled either manually or automatically by air traffic services.

(b) 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.

(c) 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 snow or 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.

(d) Where necessary, to enhance conspicuity of an existing stop bar, extra lights are installed uniformly.

(e) Where the additional lights specified in (c) above are provided, these lights should be located not less than 3 m from the taxiway edge.

(f) Where the additional lights specified in (c) above are provided, these lights should have the same characteristics as the lights in the stop bar but should be visible to approaching aircraft up to the stop bar position.

(g) High-intensity stop bars should only be used in case of an absolute necessity and following a specific study.

(h) 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 ICAO Doc 9157, Aerodrome Design Manual, Part 5, Electrical Systems.

GM1 ADR-DSN.M.735 Intermediate holding position lights

Intentionally left blank

GM1 ADR-DSN.M.740 De-icing/anti-icing facility exit lights

Intentionally left blank

GM1 ADR-DSN.M.745 Runway guard lights

(a) Some other device or design, e.g. specially designed optics, may be used in lieu of the visor.

(b) Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities

(c) The optimum flash rate is dependent on the rise and fall times of the lamps used. Runway guard lights, Configuration A, installed on 6.6 ampere series circuits have been found to look best when operated at 45 to 50 flashes per minute per lamp. Runway guard lights, Configuration B, installed on 6.6 ampere series circuits have been found to look best when operated at 30 to 32 flashes per minute per lamp.

(d) 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.

(e) Active runway is to consider any runway or runways currently being used for take-off or landing. When multiple runways are used, they are all considered active runways.

SECTION 4 — APRON LIGHTING

GM1 ADR-DSN.M.750 Apron floodlighting

(a) Where a de-icing/anti-icing facility is located in close proximity to the runway and permanent floodlighting could be confusing to pilots, other means of illumination of the facility may be required.

(b) Additional guidance on apron floodlighting is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

GM1 ADR-DSN.M.755 Visual docking guidance system

(a) 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 manoeuvring into the parking position due to aircraft servicing installation, passenger loading bridges, etc.

(b) 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.

GM1 ADR-DSN.M.760 Advanced visual docking guidance system

(a) Advanced visual docking guidance systems should 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, distance-to-go information, and closing speed. Docking guidance information is usually provided in a single display unit.

(b) Advanced visual docking guidance systems should 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, distance-to-go information, and closing speed. Docking guidance information is usually provided in a single display unit.

(c) The use of the Advanced visual docking guidance systems in conditions such as weather, visibility, and background lighting both by day and night would need to be specified.

(d) 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.

(e) The use of colour needs to be appropriate and should follow signal convention, i.e. red, yellow and green mean hazard, caution and normal/correct conditions respectively. The effects of colour contrasts also need to be considered.

(f) The indication of the distance of the aircraft from the stop position may be colour-coded and presented at a rate and distance proportional to the actual closure rate, and distance of the aircraft approaching the stop point.

GM1 ADR-DSN.M.765 Aircraft stand manoeuvring guidance lights

Intentionally left blank

GM1 ADR-DSN.M.770 Road-holding position light

Where a road intersects a taxiway where operationally required, a suitable holding position light may be located adjacent to the roadway/taxiway intersection marking 1.5 m (±0.5 m) from one edge of the road, i.e. left or right as appropriate to the local road traffic regulations.

GM1 ADR-DSN.M.771 No-entry bar

(a) A no-entry bar is intended to be controlled either manually or automatically by air traffic services.

(b) Runway incursions may take place in all visibility or weather conditions. The provision of no-entry bars at taxiway/runway intersections and their use at night and in all visibility conditions can form part of effective runway incursion prevention measures.

(c) Where necessary to enhance conspicuity, extra lights should be installed uniformly.

(d) 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 snow or 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.

(e) 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 in CS ADR-DSN.U.940, Figures U-21, U-22 or U-23, as appropriate.

(f) High-intensity no-entry bars are typically used only in case of an absolute necessity and following a safety assessment.

(g) 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 in CS ADR-DSN.U.940, Figures U-21 or U-23, as appropriate.

(h) Care is required in the design of the electrical system to ensure that all of the lights of a no-entry bar will not fail at the same time. No-entry bar lights should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

CHAPTER N — VISUAL AIDS FOR NAVIGATION (SIGNS)

GM1 ADR-DSN.N.775 General

(a) Signs may need to be orientated to improve readability.

(b) 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.

(c) Guidance on signs is contained in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids, Chapter 11.

(d) Guidance on frangibility is contained in ICAO Doc 9157, Aerodrome Design Manual, Part 6, Frangibility.

(e) Guidance on measuring the average luminance of a sign is contained in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

GM1 ADR-DSN.N.780 Mandatory instruction signs

Intentionally left blank

GM1 ADR-DSN.N.785 Information signs

(a) When an installation of information sign on the left-hand side is not possible, e.g. due to infrastructural or operational restrictions, an installation on the right-hand side of the taxiway in accordance with the specifications given in Table N-1 may also be acceptable when a safety assessment indicates that it would not adversely affect the safety of operations of aeroplanes.

(b) At a 'T' intersection, information signs may be located in the direction of the taxiway centre line to the opposite side of the crossing taxiway when a safety assessment indicates that guidance could be assured under all intended operating conditions and that it would not adversely affect the safety of operations of aeroplanes.

GM1 ADR-DSN.N.790 VOR aerodrome checkpoint sign

Intentionally left blank

GM1 ADR-DSN.N.795 Aircraft stand identification signs

Intentionally left blank

GM1 ADR-DSN.N.800 Road-holding position sign

Intentionally left blank

CHAPTER P — VISUAL AIDS FOR NAVIGATION (MARKERS)

GM1 ADR-DSN.P.805 General

Intentionally left blank

GM1 ADR-DSN.P.810 Unpaved runway edge markers

Intentionally left blank

GM1 ADR-DSN.P.815 Stopway edge markers

Intentionally left blank

GM1 ADR-DSN.P.820 Edge markers for snow-covered runways

Characteristics: Runway lights could be used to indicate the limits

GM1 ADR-DSN.P.825 Taxiway edge markers

(a) At small aerodromes, taxiway edge markers may be used, in lieu of taxiway edge lights, to delineate the edges of taxiways, particularly at night (ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids, Chapter 2, paragraph 2.4.1).

(b) On a straight section of a taxiway, taxiway edge markers should be spaced at uniform longitudinal intervals of not more than 60 m. On a curve the markers should be spaced at intervals less than 60 m so that a clear indication of the curve is provided. The markers should be located as near as practicable to the edges of the taxiway, or outside the edges at a distance of not more than 3 m. Additional guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids, Chapter 2, paragraph 2.4.2.

(c) The markers commonly used are cylindrical in shape. Ideally, the design of the marker should be such that when installed properly, no portion should exceed 35 cm total height above the mounting surface. However, where significant snow heights are possible, markers exceeding 35 cm in height may be used but their total height should be sufficiently low to preserve clearance for propellers, and for the engine pods of jet aircraft. Additional guidance is given is ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids, Chapter 2, paragraph 2.4.4.

(d) A taxiway edge marker should be lightweight and frangible. One type of marker meeting these requirements is detailed in Figure GM-P-1. The post is made up of flexible PVC and its colour is blue. The sleeve which is retro-reflective, is also blue. Note that the area of the marked surface is 150 cm2. Additional guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids, Chapter 2, paragraph 2.4.5.

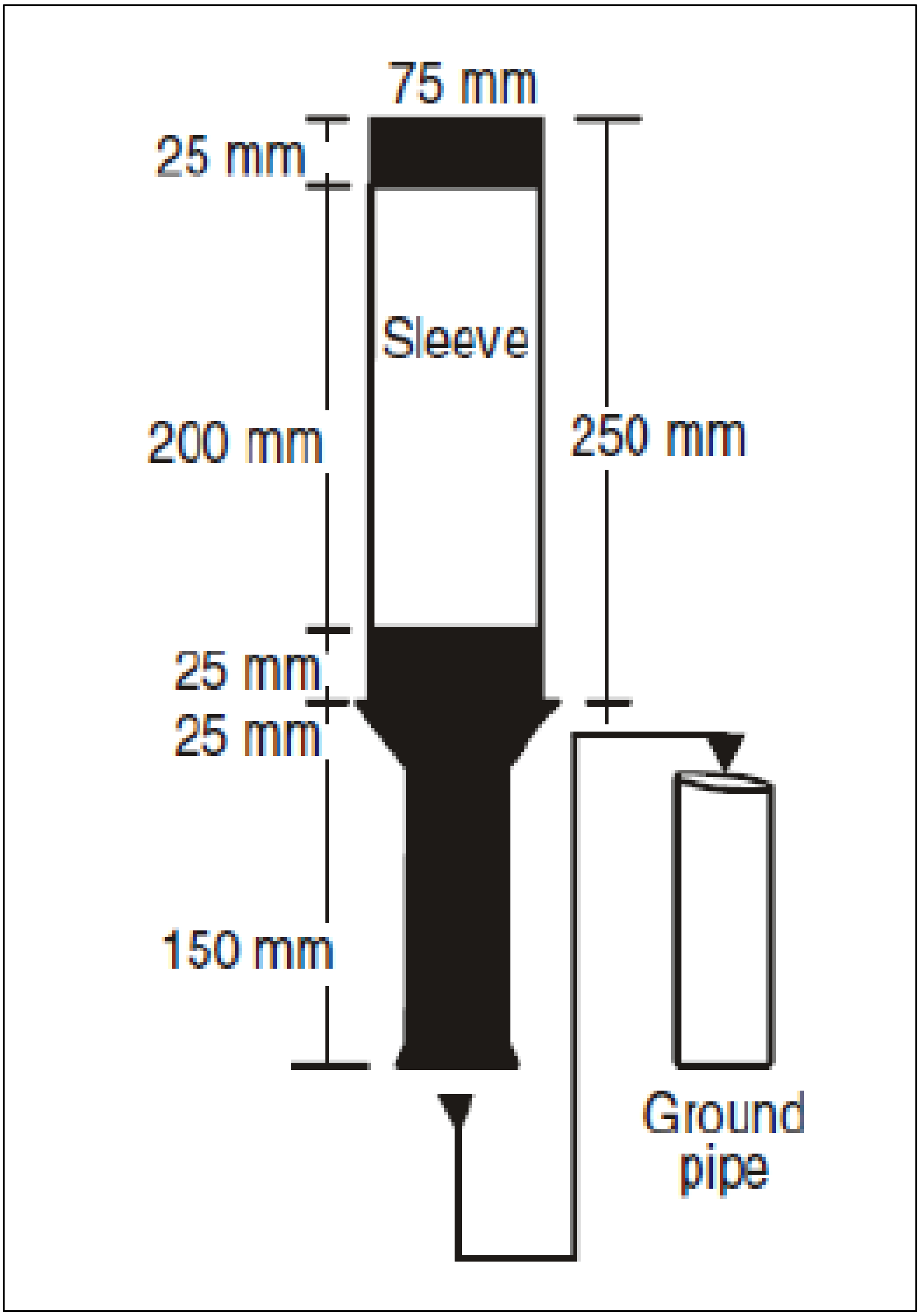


Figure GM-P-1. Taxiway edge marker

GM1 ADR-DSN.P.830 Taxiway centre line markers

Intentionally left blank

GM1 ADR-DSN.P.835 Unpaved taxiway edge markers

Intentionally left blank

CHAPTER Q — VISUAL AIDS FOR DENOTING OBSTACLES

GM1 ADR-DSN.Q.840 Objects to be marked and/or lighted within the lateral boundaries of the obstacle limitation surfaces

(a) 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.

(b) Other objects inside the obstacle limitation surfaces should be marked and/or lighted if a safety assessment indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).

(c) Overhead wires, cables, etc., crossing a river, waterway, valley or highway should be marked and their supporting towers marked and lighted if a safety assessment indicates that the wires or cables could constitute a hazard to aircraft.

GM1 ADR-DSN.Q.841 Objects to be marked and/or lighted outside the lateral boundaries of the obstacle limitation surfaces

(a) Other objects outside the obstacle limitation surfaces should be marked and/or lighted if a safety assessment indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).

(b) Overhead wires, cables, etc., crossing a river, waterway, valley or highway should be marked and their supporting towers marked and lighted if a safety assessment indicates that the wires or cables could constitute a hazard to aircraft.

GM1 ADR-DSN.Q.845 Marking of objects

(a) Orange and white or alternatively red and white are preferably used, except where such colours merge with the background.

(b) Table Q-4 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 colour.

(c) Against some backgrounds it may be found necessary to use a different colour from orange or red to obtain sufficient contrast.

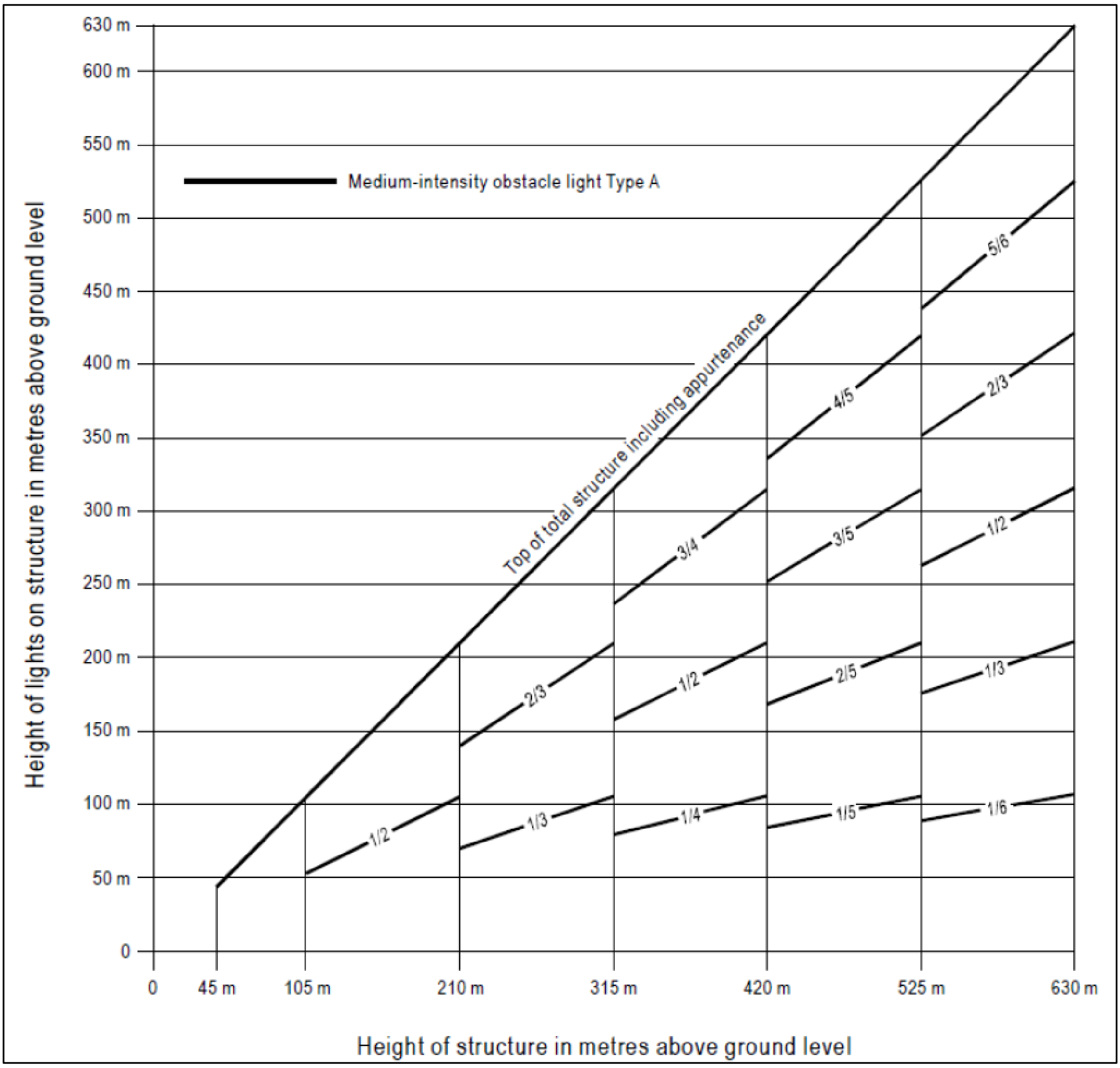
(d) Alternative spacing may be suitable; priority is to highlight the location and definition of the object.

GM1 ADR-DSN.Q.846 Lighting of fixed objects

(a) Guidance on how a combination of low-, medium-, and/or high-intensity lights on obstacles should be displayed is given in Figures GM-Q-1 to GM-Q-8.

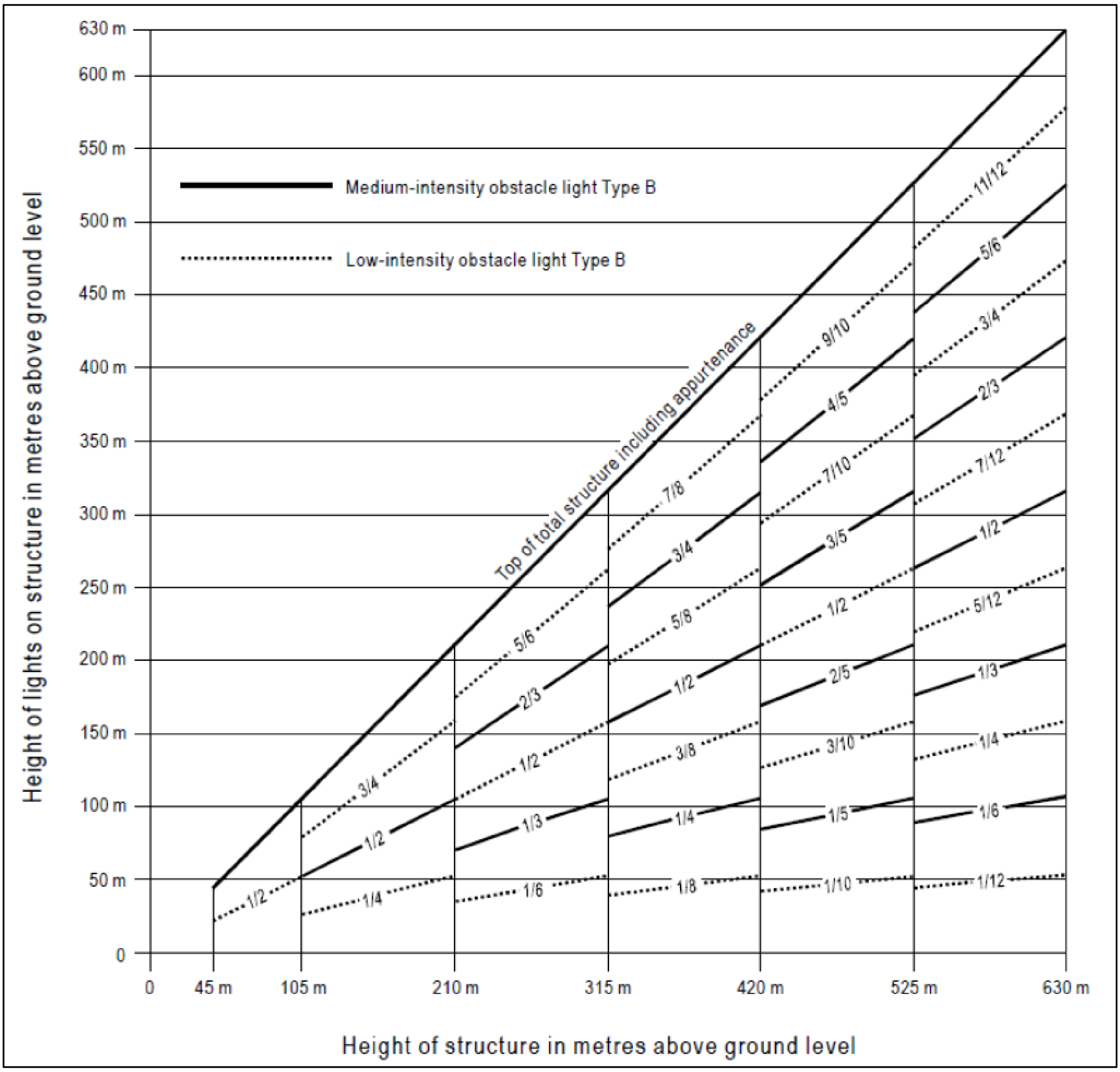
(b) High-intensity obstacle lights are intended for day use as well as night use. Care should be taken to ensure that these lights do not create disconcerting dazzle or environmental concerns. Guidance on the design, location, and operation of high-intensity obstacle lights is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

(c) Where, 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 should be provided. This system should 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.



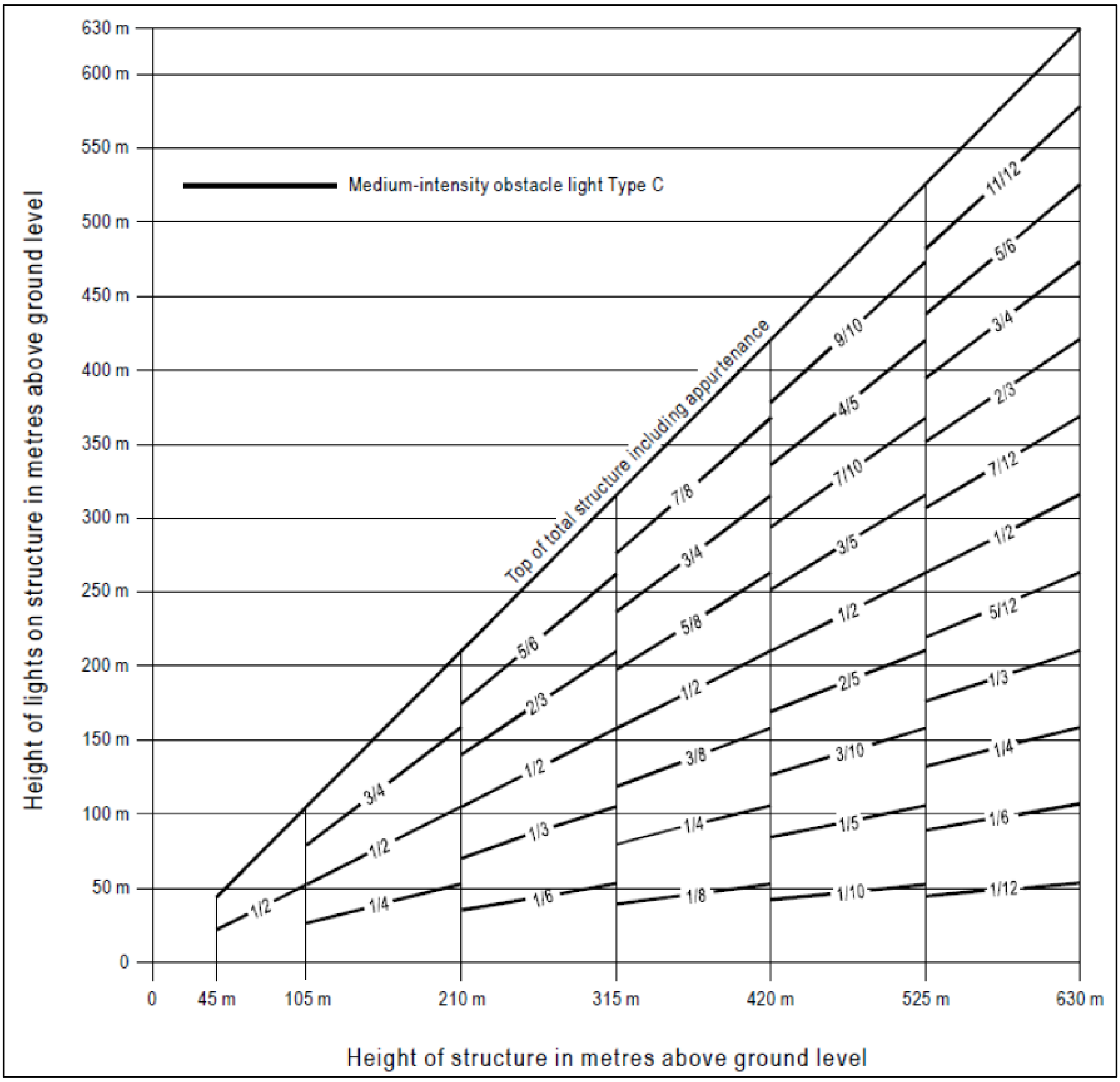
Note. – High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure GM-Q-1.Medium-intensity flashing-white obstacle lighting system, Type A



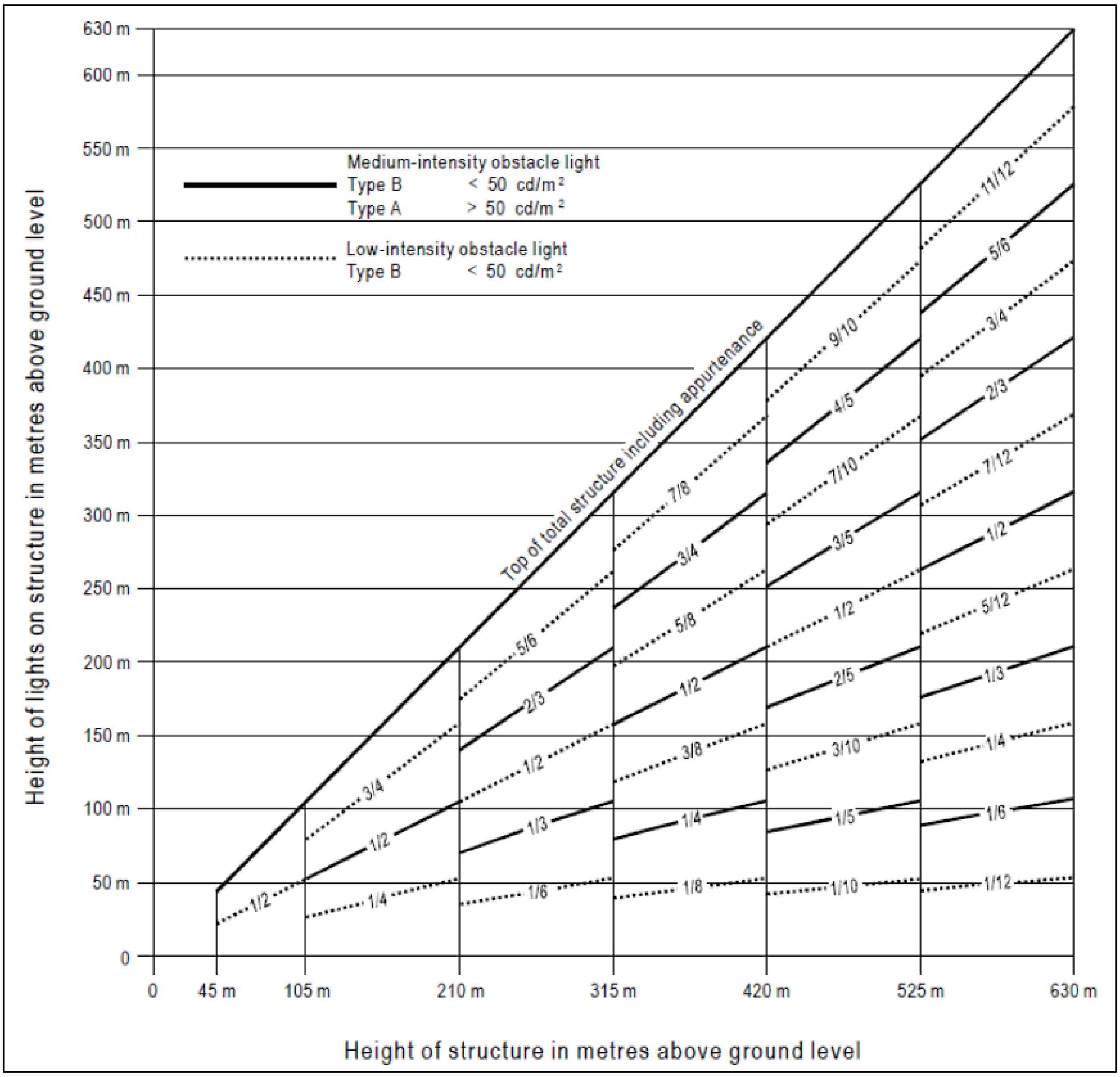
Note. – For night-time use only.

Figure GM-Q-2. Medium-intensity flashing-red obstacle lighting system, Type B



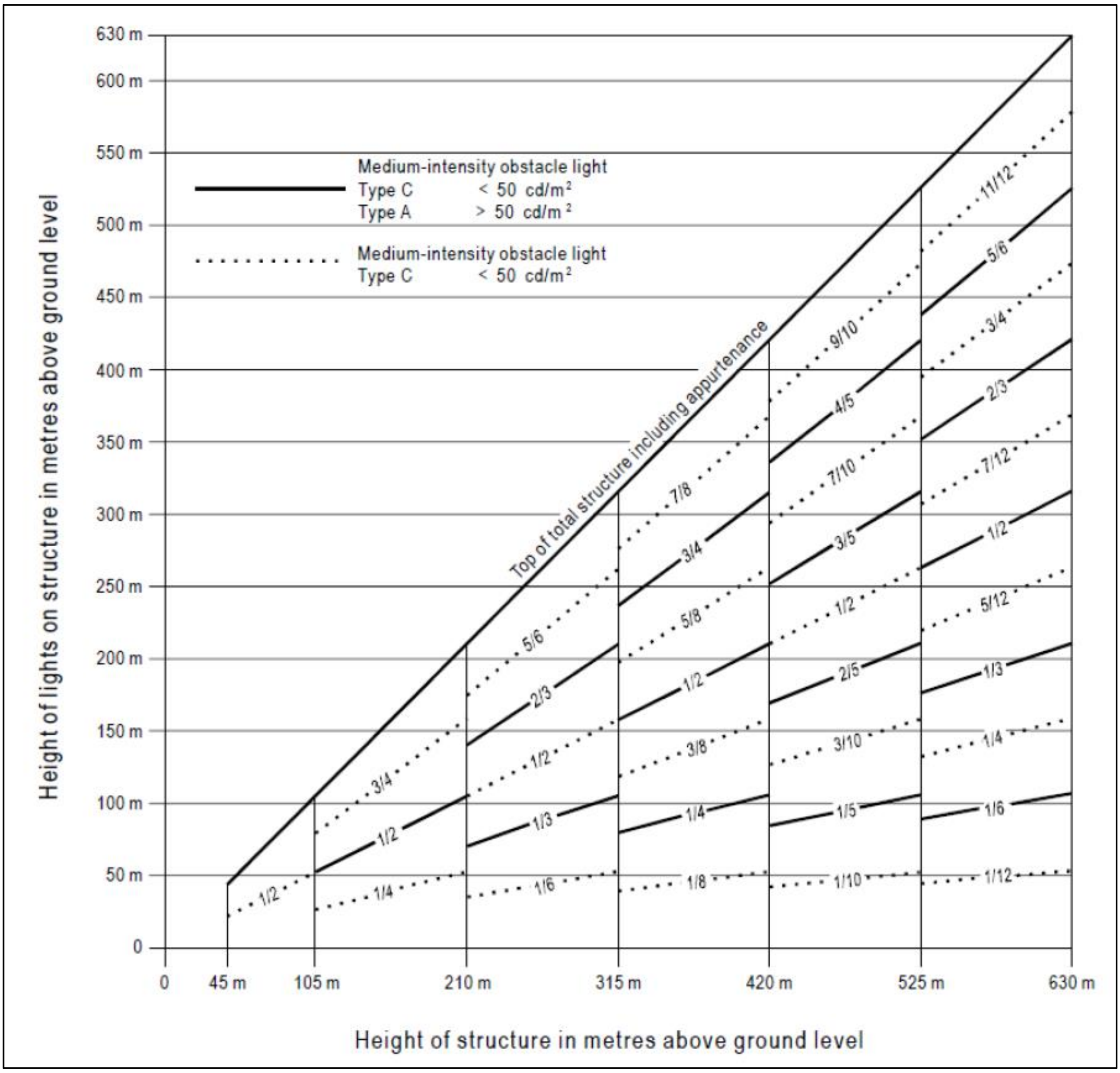
Note. – For night-time use only.

Figure GM-Q-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 GM-Q-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 GM-Q-5. Medium-intensity dual obstacle lighting system, Type A/Type C

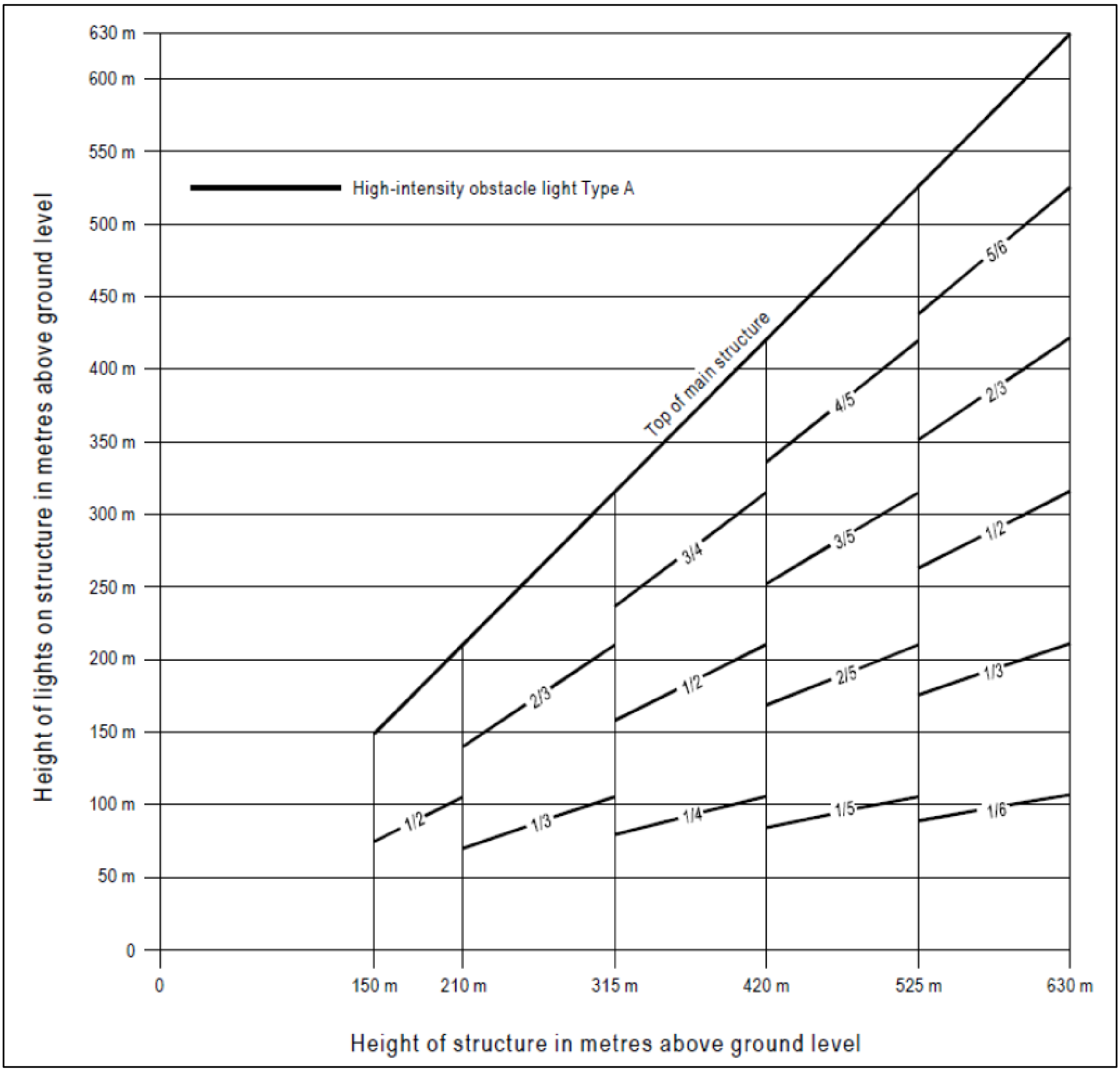


Figure GM-Q-6. High-intensity flashing-white obstacle lighting system, Type A

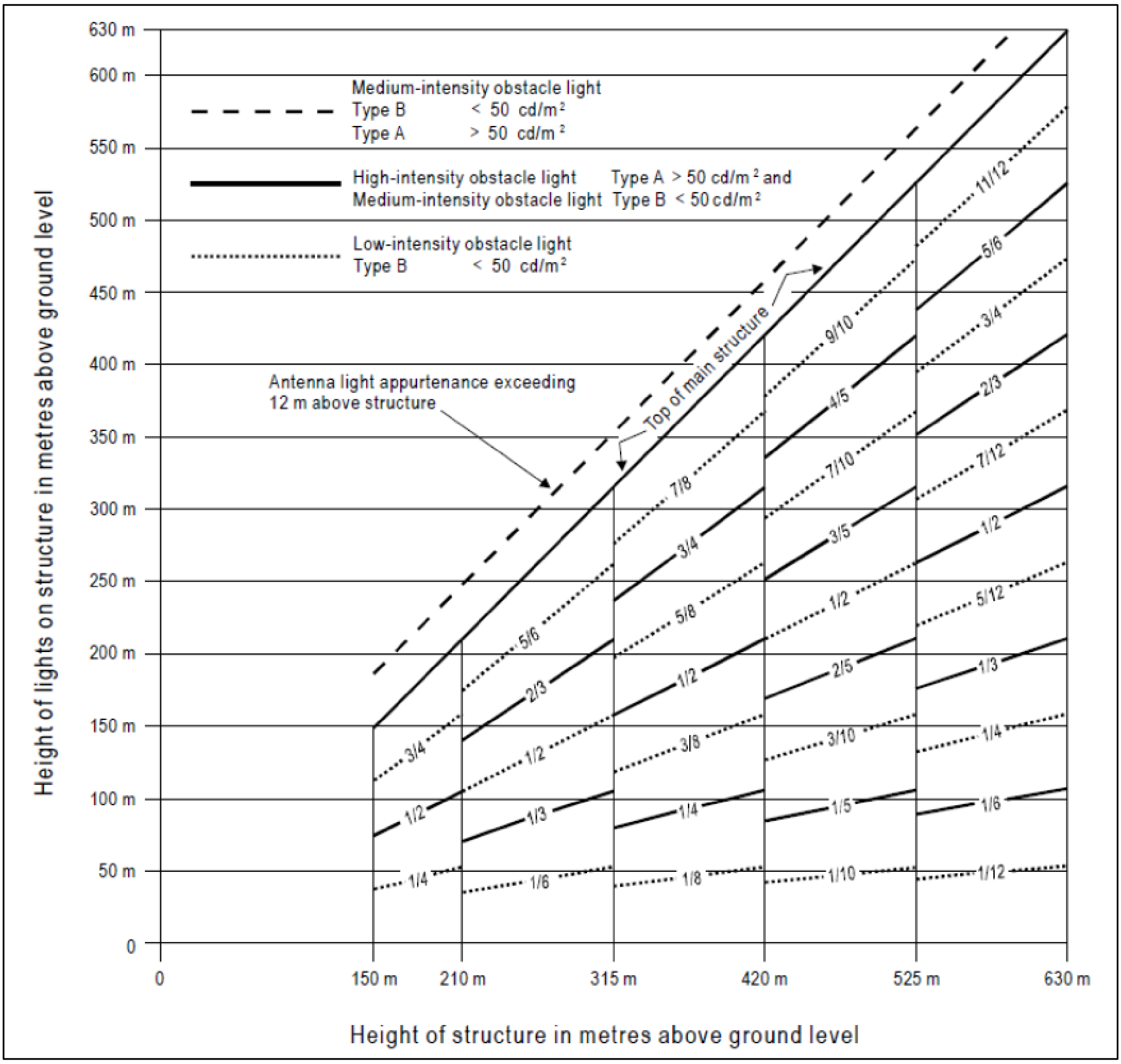


Figure GM-Q-7. High-/medium-intensity dual obstacle lighting system, Type A/Type B

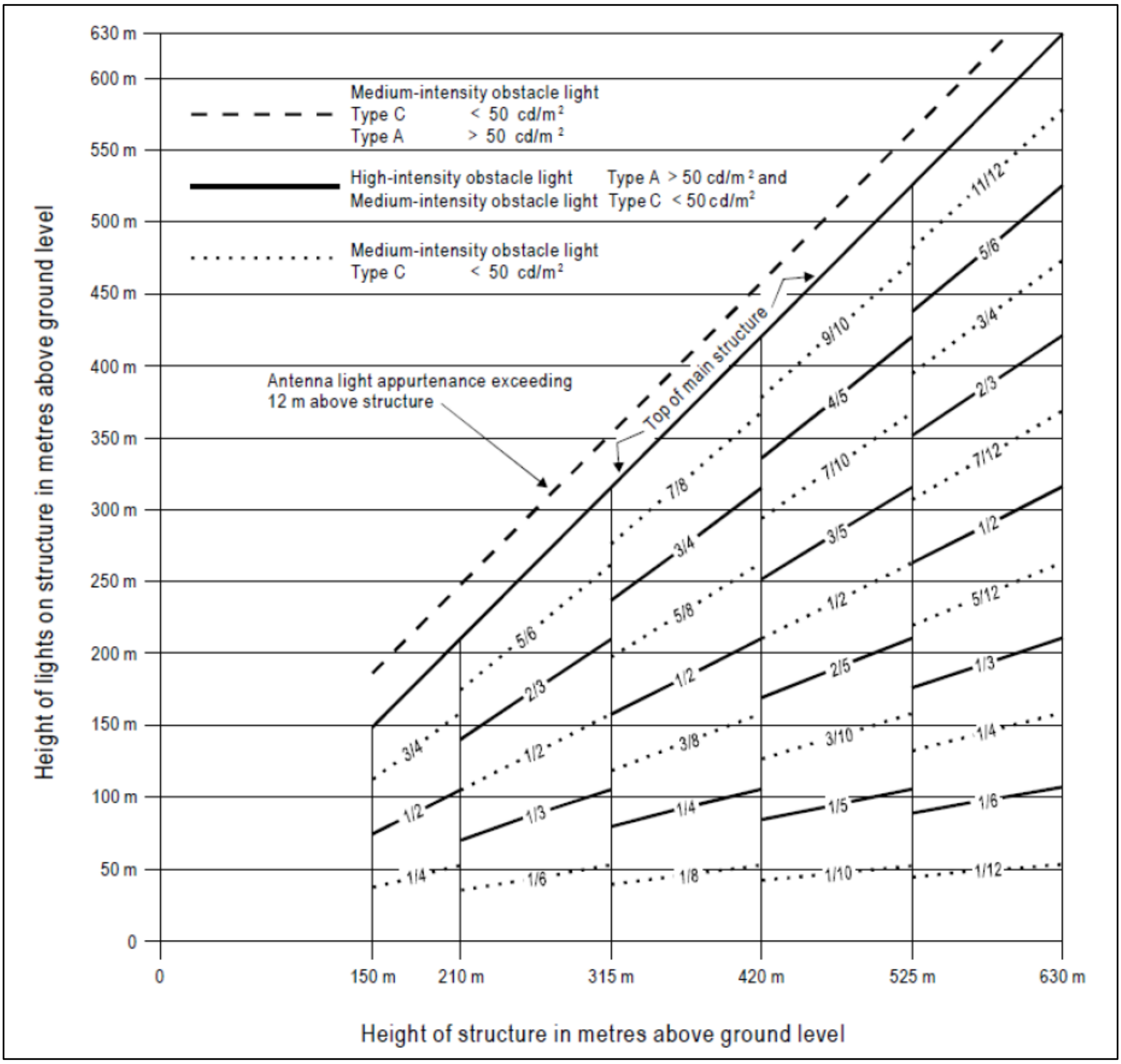


Figure GM-Q-8. High-/medium-intensity dual obstacle lighting system, Type A/Type C

In the cases as stated in CS ADR-DSN.Q.850(c)(7) and (c)(8), normally the spacing would not exceed 52 m.

GM1 ADR-DSN.Q.847 Lighting of fixed objects with a height less than 45 m above ground level

A group of buildings is regarded as an extensive object.

GM1 ADR-DSN.Q.848 Lighting of fixed objects with a height 45 m to a height less than 150 m above ground level

Low-intensity obstacle lights, Type A or B, may be used for obstacles higher than 45 m if it is determined to be sufficient.

GM1 ADR-DSN.Q.849 Lighting of fixed objects with a height 150 m or more above ground level

Where, 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, should be used alone, whereas medium-intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.

GM1 ADR-DSN.Q.850 Lighting of other objects

Intentionally left blank

GM1 ADR-DSN.Q.851 Marking and lighting of wind turbines

(a) Additional markings and lighting may be provided to the wind turbines if indicated by a safety assessment.

(b) Case by case studies for wind turbines of more than 315 m of overall height may conclude that additional markings and lighting are required.

GM1 ADR-DSN.Q.852 Marking and lighting of overhead wires, cables, supporting towers, etc.

(a) Where high-intensity obstacle lights, Type B, are used, and it is not possible to locate them as described in CS ADR-DSN.Q.852(d)(2), in some cases, this may require locating the lights off the tower.

(b) High-intensity obstacle lights are intended for day use as well as night use. Care should be taken to ensure that these lights do not create disconcerting dazzle or environmental concerns. Guidance on the design, location, and operation of high-intensity obstacle lights is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

(c) Where 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 should 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 should be installed at the same level as the high-intensity obstacle light Type B.

CHAPTER R — VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

GM1 ADR-DSN.R.855 Closed runways and taxiways, or parts thereof

Intentionally left blank

GM1 ADR-DSN.R.860 Non-load-bearing surfaces

(a) A taxi side stripe marking could also be placed along the edge of the load-bearing pavement to emphasize the location of the taxiway edge, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

(b) At intersections of taxiways and on other areas where, due to turning, the possibility for confusion between the side stripe markings and centre line markings may exist, or where the pilot may not be sure on which side of the edge marking the non-load bearing pavement is, the additional provision of transverse stripes on the non-load bearing surface has been found to be of assistance.

(c) As shown in Figure GM-R-1, the transverse stripes should be placed perpendicular to the side stripe marking.

(d) On curves, a stripe should be placed at each point of tangency of the curve and at intermediate points along the curve so that the interval between stripes does not exceed 15 m. If deemed desirable to place transverse stripes on small straight sections, the spacing should not exceed 30 m.

(e) The width of the marks should be 0.9 m, and they should extend to within 1.5 m of the outside edge of the stabilized paving or be 7.5 m long whichever is shorter. The colour of the transverse stripes should be the same as that of the edge stripes, i.e. yellow.

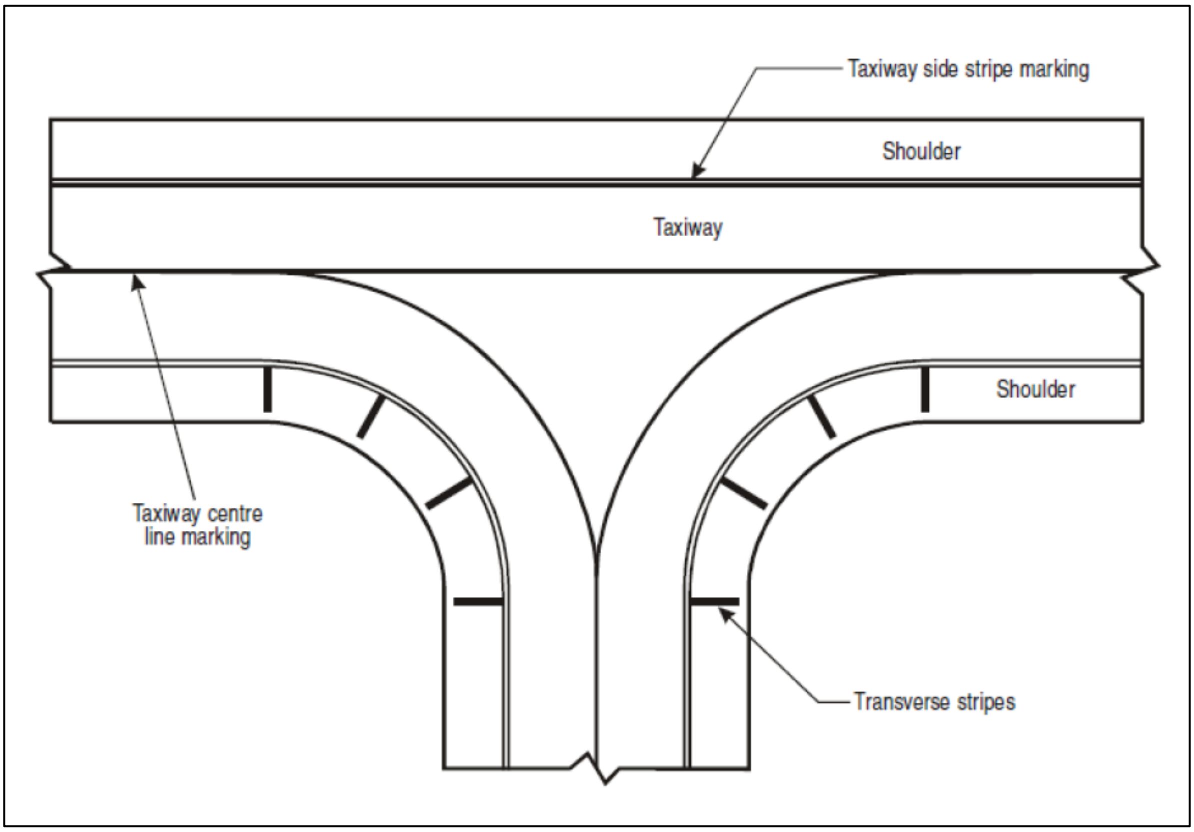


Figure GM-R-1. Marking of non-load bearing paved taxiway surface

More guidance on providing additional transverse stripes at an intersection or a small area on the apron is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

GM1 ADR-DSN.R.865 Pre-threshold area

For pre-threshold areas shorter than 60 m, markings may be modified or reduced in size so as to present the correct picture to aircrew.

GM1 ADR-DSN.R.870 Unserviceable areas

(a) 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.

(b) The spacing required for marking and lights should take into account visibility conditions, geometric configurations of the area, potential height differences of terrain so that the limits of unserviceable area is readily visible to pilot.

(c) Where a temporarily unserviceable area exists, it may be marked with fixed-red lights. These lights mark the most potentially dangerous extremities of the area.

(d) A minimum of four such lights may be used, except where the area is triangular in shape, in which case a minimum of three lights may be used.

(e) The number of lights may 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.

(f) 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 should approach.

(g) Where aircraft or vehicles should normally approach from several directions, consideration should be given to adding extra lights or using omnidirectional lights to show the area from these directions.

(h) Unserviceable area lights should be frangible. Their height should be sufficiently low to preserve clearance for propellers and for engine pods of jet aircraft.

CHAPTER S — ELECTRICAL SYSTEMS

GM1 ADR-DSN.S.875 Electrical power supply systems for air navigation facilities

(a) The safety of operations at aerodromes depends on the quality of the supplied power. The total electrical power supply system may include connections to one or more external sources of electric power supply, one or more local generating facilities, and to a distribution network including transformers and switchgear. Many other aerodrome facilities supplied from the same system need to be taken into account while planning the electrical power system at aerodromes.

(b) 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 ICAO Doc 9157, Aerodrome Design Manual, Part 5, Electrical Systems.

(c) Switch-over time is 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.

(d) As a good practice, a measurement of the photometric parameters may be used for the evaluation of the switch-over time.

(1) If the switch-over time is greater than 1 second, the following corrective actions may be used to decrease the switch-over time:

(i) use of enhanced constant current regulators (CCR); or

(ii) use of uninterruptible power supply (UPS).

(2) If the photometric based switch-over time is below or equal 1 second, it is recommended to analyze the electrical system in order to find out an equivalent electrical switch-over time.

(e) For periodic measurement of the switch-over time a measurement of the equivalent electrical switch-over time at the feeding point of an aeronautical ground lights (AGL) system may be established.

GM1 ADR-DSN.S.880 Electrical power supply

(a) At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of CS ADR-DSN.S.875(d) should be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system is provided and capable of being deployed in 15 minutes.

(b) Specifications for secondary power supply for radio navigation aids and ground elements of communications systems are given in ICAO Annex 10, Volume I, Aeronautical Telecommunications, Chapter 2.

(c) Requirements for a secondary power supply should be met by either of the following:

(1) 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

(2) standby power unit(s) which are engine generators, batteries, etc. from which electric power can be obtained.

(d) Guidance on electrical systems is included in ICAO Doc 9157, Aerodrome Design Manual, Part 5, Electrical Systems.

(e) The requirement for minimum lighting may be met by other than electrical means.

GM1 ADR-DSN.S.885 System design

Guidance on means of providing this protection is given in ICAO Doc 9157, Aerodrome Design Manual, Part 5, Electrical Systems.

GM1 ADR-DSN.S.890 Monitoring

(a) For a runway meant for use in runway visual range conditions less than a value of 550 m, the minimum serviceability level of any element of the lighting system detailed in Table S-1, below which operations should not continue, is set up by the competent authority.

(b) Additional guidance on air traffic control interface and visual aids monitoring is given in ICAO Doc 9157, Aerodrome Design Manual, Part 5, Electrical Systems.

GM1 ADR-DSN.S.895 Serviceability levels

(a) Serviceability levels are intended to define the maintenance performance level objectives.

(b) Guidance on preventive maintenance of visual aids is given in the, ICAO Doc 9137, Airport Services Manual, Part 9, Airport Maintenance Practices.

(c) With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

(1) laterally: in the same barrette or crossbar; or
(2) longitudinally: in the same row of edge lights or barrettes.

(d) In barrettes and crossbars, guidance is not lost by having two adjacent unserviceable lights.

CHAPTER T — AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATION

GM1 ADR-DSN.T.900 Emergency and service access roads

(a) Service roads at air side are installed to support all apron processes. Furthermore, service roads can be used as aerodrome perimeter service roads, providing access to navigation aids, as temporary roads for construction vehicles, etc.

(b) Some general considerations in the planning of roads are described as follows:

(1) Every effort should be made to plan service roads at air side so that they do not cross runways and taxiways.
(2) The planning of the aerodrome road layout should take into account the need to provide emergency access roads for use by rescue and firefighting vehicles to various areas on the aerodrome, and, in particular, to the approach areas. Service roads to navigation aids should be planned in such a manner as to present minimal interference to the function of the aids. If it is necessary for a service road to cross an approach area, the road should be located so that vehicles travelling on it are not obstacles to aircraft operations.
(3) The service roads at air side system should be designed to account for local security measures. Access points to the system should, thus, need to be restricted. Should ground vehicle movements affect surface movement of aircraft on runways and taxiways, it should be required that the ground vehicle movements be coordinated by the appropriate aerodrome control. Control is normally exercised by means of two-way radio communication although visual signals, such as signal lamps, are adequate when traffic at the aerodrome is light. Signs or signals may also be employed to aid control at intersections.
(4) At intersections with runways consideration should be given to providing runway guard lights or road-holding position lights as part of the aerodrome's runway incursion prevention programme. Runway guard lights should conform to the specifications provided in CS ADR-DSN.M.745.
(5) Roads should be designed and constructed to prevent FOD transfer to the runway and taxiways.
(6) Roads within 90 m of a runway centre line generally should be surfaced to prevent surface erosion, and the transfer of debris to the runway and taxiways.
(7) To facilitate the control and maintenance of the fencing, a perimeter service road should be constructed inside the aerodrome fencing.
(8) Perimeter service road is also used by security patrols.
(9) Where a fence is provided, the need for convenient access to outside areas should be taken into account. These access points should be of a suitable size to accommodate the passage of the largest RFFS vehicle in the aerodrome's fleet.
(10) When greater security is thought necessary, a cleared area should be provided on both sides of the fence or barrier to facilitate the work of patrols, and to make trespassing more difficult.
(11) Special measures should be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

(c) Emergency access roads should be considered on an aerodrome so as to facilitate achieving minimum response times for RFF vehicles.

(d) Emergency access roads should be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention should be given to the provision of ready access to approach areas up to 1 000 m from the threshold, or at least within the aerodrome boundary.

(e) Emergency access roads are not intended for use for the functions of aerodrome service roads. Therefore, it is possible to provide different access control which should be clearly visible for all service ground traffic. Road-holding position markings, lights, or runway guard lights are not necessary if the access to an emergency access road is ensured for RFF only.

(f) Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.

(g) Emergency access roads should be capable of supporting the heaviest vehicles which should use them, and be usable in all weather conditions. Roads within 90 m of a runway centre line should be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance should be provided from overhead obstructions for the largest vehicles.

(h) When the surface of the road is indistinguishable from the surrounding area, or in areas where snow may obscure the location of the roads, edge markers should be placed at intervals of about 10 m.

GM1 ADR-DSN.T.905 Fire stations

Intentionally left blank

GM1 ADR-DSN.T.910 Equipment frangibility requirements

(a) Equipment and supports required to be frangible should be designed and constructed so that they should break, distort, or yield in the event that they are accidentally impacted by an aircraft. The design materials selected should preclude any tendency for the components, including the electrical conductors, etc., to 'wrap around' the colliding aircraft or any part of it.

(b) Frangible structures should be designed to withstand the static and operational wind or jet blast loads with a suitable factor of safety but should break, distort, or yield readily when subjected to the sudden collision forces of a 3 000 kg aircraft airborne and travelling at 140 km/h (75 kt), or moving on the ground at 50 km/h (27 kt).

(c) Guidance on design for frangibility is contained in ICAO Doc 9157, Aerodrome Design Manual, Part 6, Frangibility.

GM1 ADR-DSN.T.915 Siting of equipment and installations on operational areas

(a) The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs and markers is specified in CS ADR-DSN.M.615, CS ADR-DSN.M.640, CS ADR-DSN.N.775, and in the CS-ADR-DSN Chapter P respectively.

(b) Guidance on siting of equipment and installations on operational areas is given in ICAO Doc 9157, Aerodrome Design Manuals, Part 2, Taxiways, Aprons and Holding Bays and Part 6, Frangibility.

(c) Guidance on the frangible design of visual and non-visual aids for navigation is given in the ICAO Doc 9157, Aerodrome Design Manual, Part 5, Electrical Systems.

(d) Requirements for obstacle limitation surfaces are specified in the Certification Specifications, Chapter J.

GM1 ADR-DSN.T.920 Fencing

(a) The fence or barrier should 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.

(b) Consideration should be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

(c) Special measures may be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

(d) Fencing can vary in design, height, and type depending on local needs. Generally, it is recommended that the fencing be galvanized steel, chain link fabric installed to a height of 2,5 m, and topped with a three-strand barbed wire overhang. The latter should have a minimum 15 cm separation between strands and extend outward at 45-degree angle from the horizontal. Fence posts should be installed at no greater than 3 m intervals and be located within 5 cm of any wall or structure forming part of the perimeter. Gates should be constructed with material of comparable strength and durability, and open to an angle of at least 90 degrees. Hinges should be such as to preclude unauthorized removal.

(e) Top and bottom selvages of the fence having a twisted and barbed finish. The bottom of the fence installed to within 5 cm of hard surfacing or stabilized soil. However, in areas where unstable soil conditions are prevalent, the fabric installed to extend at least 5 cm below the surface or imbedded in concrete curbing. All fencing should be grounded. Care should be taken that metallic fencing is not installed when it should interface with the operation of navigation aids. The fence itself should allow clear visibility and easy maintenance.

(f) The number of gates should be limited to the minimum required for the safe and efficient operation of the facility. Access points should need to be made in the fence to allow the passage of authorized vehicles and persons. While the number of access points should be kept to a minimum, adequate access points should be planned for routine operations, maintenance and emergency operations.

GM1 ADR-DSN.T.921 Autonomous runway incursion warning system (ARIWS)

(a) The implementation of autonomous systems are generally quite complex in design and operation and, as such, deserves careful consideration by all involved parties such as aerodrome operators, air traffic services (ATS) and aircraft operators. This guidance provides a more clear description of the system(s) and offer some suggested actions required in order to properly implement this system(s) at an aerodrome.

(b) An ARIWS may be installed in conjunction with enhanced taxiway centre line markings, stop bars or runway guard lights.

(c) The system(s) should be operational under all weather conditions, including low visibility.

(d) An ARIWS may share common sensory components of a surface movement guidance and control system (SMGCS) or advanced surface movement guidance and control system (A-SMGCS), however, it operates independently of either system.

(e) General description:

(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 departs from a runway (rolling) or arrives 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.

(2) In general, an ARIWS consists of an independent surveillance system (primary radar, multilateration, specialized cameras, dedicated radar, etc.) and a warning system in the form of extra airfield lighting systems connected through a processor that generates alerts independent from the air traffic control (ATC) directly to the flight crews and vehicle operators.

(3) An ARIWS does not require circuit interleaving, secondary power supply or operational connection to other visual aid systems.

(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.

(f) Flight crew actions:

(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 must then interpret the warning, evaluate the situation and communicate to the aircraft in question, would 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.

(2) It also has to be stressed that the extinguishing of the red lights does not, in itself, indicate a clearance to proceed. That clearance is still required from ATC. The absence of red warning lights only means that potential conflicts have not been detected.

(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.

(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 must 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 the previous paragraph.

(g) Aerodromes:

(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) may 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.

(2) Although there may be local specific requirements, some basic system requirements are applicable to all ARIWS:

(i) 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;

(ii) the system should operate independently from ATS communications;

(iii) the system should provide a globally accepted visual signal that is consistent and instantly understood by crews; and

(iv) local procedures should be developed in the case of malfunction or failure of a portion of or the entire system.

(h) Air traffic services:

(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 the 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 ATC.

(2) In the case where a clearance has been issued and a crew reports a non-compliance due to 'red lights', or aborts 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 the case where the system has failed, then procedures will need to be put into place, as described in paragraphs (f)(3) and (f)(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, the potential conflict existence or non-existence should be confirmed.

(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.

(4) Each aerodrome where the system is installed should develop procedures depending upon its unique situation. Again, it has to be stressed that under no circumstances should pilots or operators be instructed to 'cross the red lights'. As indicated above, the use of local runway safety teams may greatly assist in the development of this process.

(i) Promulgation of information:

(1) Specifications on providing information in the aeronautical information publication (AIP) are given in the document «Технические требования. Службы аэронавигационной информации». Information on the characteristics and status of an ARIWS at an aerodrome is promulgated in the AIP Section AD 2.9, and its status updated as necessary through notice to airmen (NOTAM) or automatic terminal information service (ATIS).

(2) Aircraft operators are to ensure that flight crews' documentation include procedures regarding ARIWS and appropriate guidance in compliance with ICAO Annex 6, Operation of Aircraft, Part I.

(3) Aerodromes may provide additional sources of guidance on operations and procedures for their personnel, aircraft operators, ATS and third-party personnel that may have to deal with an ARIWS.

CHAPTER U — COLOURS FOR AERONAUTICAL GROUND LIGHTS, MARKINGS, SIGNS AND PANELS

GM1 ADR-DSN.U.925 General

It is not possible to establish specifications for colours 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 colour not be greatly modified by selective atmospheric attenuations and that the observer's colour vision be adequate. There is also a risk of confusion of colour 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.

GM1 ADR-DSN.U.930 Colours for aeronautical ground lights

(a) The chromaticity for ground lights with filament-type light sources, where dimming is not required, or where observers with defective colour vision should be able to determine the colour of the light, green signals should be within the following boundaries:

Yellow boundary y = 0.726 – 0.726x

White boundary x = 0.650y

Blue boundary y = 0.390 – 0.171x

(b) Guidance on chromaticity changes resulting from the effect of temperature on filtering elements is given in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

(c) Where the colour signal is to be seen from long range, the current practice is to use colours within the boundaries specified in paragraph (a) above.

(d) For the chromaticity of ground lights with solid-state light sources, where observers with defective colour vision should be able to determine the colour of the light, green signals should be within the following boundaries:

Yellow boundary y = 0.726 – 0.726x

White boundary x = 0.625y – 0.041

Blue boundary y = 0.400

(e) For the chromaticity of ground lights having a solid state light source, in order to avoid a large variation of shades of green, and if colours within the boundaries below are selected, colours within the boundaries specified in paragraph (d) above should not be used:

Yellow boundary x= 0.310

White boundary x = 0.625y – 0.041

Blue boundary y = 0.726 – 0.726x

(f) Colour measurement for filament-type and solid state-type light sources:

(1) for the outermost isocandela curve, a measurement of colour coordinates should be made and recorded for review and judgement of acceptability; and

(2) certain light units may have an 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); then an assessment of the actual application should be conducted and, if necessary, a check of colour shift at angular ranges beyond the outermost curve carried out.

GM1 ADR-DSN.U.935 Colours for markings, signs and panels

Intentionally left blank

GM1 ADR-DSN.U.940 Aeronautical ground light characteristics

Intentionally left blank