Staatsblad
van het Koninkrijk der Nederlanden

Jaargang 2010

632

Beschikking van de Minister van Justitie van 4 oktober 2010 tot plaatsing in het Staatsblad van de tekst van het Besluit toezicht luchtvaart BES, zoals gewijzigd bij het Aanpassingsbesluit openbare lichamen Bonaire, Sint Eustatius en Saba

De Minister van Justitie,

Gelet op artikel 24, eerste lid, van de Invoeringswet openbare lichamen Bonaire, Sint Eustatius en Saba;

Besluit:

de tekst van het Besluit toezicht luchtvaart BES, zoals gewijzigd bij het Aanpassingsbesluit openbare lichamen Bonaire, Sint Eustatius en Saba in het Staatsblad te plaatsen als bijlage bij deze beschikking.

's-Gravenhage, 4 oktober 2010

De Minister van Justitie,
E. M. H. Hirsch Ballin

Uitgegeven de *zevende* oktober 2010

De Minister van Justitie,
E. M. H. Hirsch Ballin

STB13363
ISSN 0920 - 2064
's-Gravenhage 2010

TEKST VAN HET BESLUIT TOEZICHT LUCHTVAART BES, ZOALS GEWIJZIGD BIJ HET AANPASSINGSBESLUIT OPENBARE LICHAMEN BONAIRE, SINT EUSTATIUS EN SABA

HOOFDSTUK 1
Algemene bepalingen

Artikel 1

1. In dit landsbesluit en de daarop berustende bepalingen wordt verstaan onder:

AIS (Aeronautical Information Services): vluchtvoorlichtingsdienst die is belast met het geven van luchtvaartinlichtingen, die nodig zijn voor een veilig, ordelijk en vlot verloop van het luchtverkeer vòòr de vlucht en het in ontvangst nemen daarvan na de vlucht;

baan: een al dan niet verhard gedeelte van het landingsterrein uitsluitend bestemd voor het opstijgen of landen van luchtvaartuigen;

bij nacht: op enig tussen zonsondergang en zonsopgang gelegen tijdstip;

clearway: een aangegeven hindernisvrij rechthoekig gedeelte boven grond of water in het verlengde van de baan, zodat het mogelijk is dat een vliegtuig in het beginstadium van de stijgvlucht tot een voorgeschreven hoogte komt;

drempel: het begin van het voor het landen bestemde gedeelte van een verharde baan;

houder: degene die recht van gebruik heeft van een luchtvaartuig, anders dan ingevolge een hem in dienstverband verstrekte opdracht;

instrumentenbaan: een baan, welke is uitgerust met elektronische hulpmiddelen ten dienste van het opstijgen of landen van luchtvaartuigen;

instrumentweersomstandigheden: weersomstandigheden, die uitgedrukt in termen van zicht, afstand tot wolken en wolkenbasis, minder zijn dan de voorgeschreven minimumwaarden voor zichtweersomstandigheden;

kunstvlucht: een vlucht, waarbij met opzet bewegingen worden uitgevoerd, welke een plotselinge verandering in de stand, een abnormale stand of een abnormale verandering in de snelheid van het luchtvaartuig medebrengen;

platform: een gedeelte van het luchtvaartterrein dat bestemd is voor het opstellen van luchtvaartuigen, met het doel passagiers te laten in- of uitstappen, post te laden of te lossen, brandstof in te nemen, te parkeren of eenvoudige onderhoudswerkzaamheden te verrichten;

rijbaan: een al dan niet verhard gedeelte van het landingsterrein, bestemd voor het zich op de grond voortbewegen van luchtvaartuigen;

stopway: een aangegeven rechthoekig gedeelte op de grond aan het einde van de baan, dat een zodanig draagvermogen heeft, dat het mogelijk is dat een vliegtuig kan stoppen in het geval dat vliegtuig afziet van de start;

strook: een gedeelte van het landingsterrein waarin een baan is gelegen;

2. De definities, opgenomen in artikel 1 van het Besluit luchtverkeer BES, zijn van toepassing op dit besluit.

Artikel 2

De bepalingen van dit besluit gelden niet ten aanzien van militaire luchtvaartuigen, de leden van het boordpersoneel, passagiers en lading van deze luchtvaartuigen alsmede ten aanzien van militaire luchtvaartterreinen.

Artikel 2A

Door de minister worden regels gesteld betreffende meeteenheden met betrekking tot lucht- en grondoperaties waaromtrent bij of krachtens de Luchtvaartwet BES voorschriften zijn gesteld.

HOOFDSTUK 2 t/m 5

[vervallen]

HOOFDSTUK 6
Samenwerkingsovereenkomsten met andere landen

Artikel 129

1. Wanneer een of meer in het Nederlandse nationaliteitsregister ingeschreven luchtvaartuigen ingevolge een lease-, charter, of ruilovereenkomst of soortgelijke regeling wordt geëxploiteerd door een luchtvaartmaatschappij of een luchtvaartonderneming, welke haar hoofdkantoor of, bij afwezigheid daarvan, haar vaste woonplaats heeft in een buiten de openbare lichamen Bonaire, Sint Eustatius en Saba gelegen Staat welke aangesloten is bij het Verdrag kunnen de functies en taken met betrekking tot de luchtverkeersregels, het bewijs van luchtwaardigheid annex radiovergunning behorende bij het betreffende luchtvaartuig, alsmede het bewijs van bevoegdheid en de bevoegdverklaringen van het stuurhutpersoneel geheel of ten dele worden overgedragen, teneinde de Staat van Operatie in staat te stellen toezicht hierop uit te oefenen.

2. Het bepaalde in het eerste lid is van overeenkomstige toepassing op buitenlandse luchtvaartuigen van een Staat welke aangesloten is bij het Verdrag, die ingevolge een lease-, charter, of ruilovereenkomst of soortgelijke regeling worden geëxploiteerd door een luchtvaartmaatschappij of luchtvaartonderneming, waarvan haar hoofdkantoor of, bij afwezigheid daarvan, haar vaste woonplaats in de openbare lichamen Bonaire, Sint Eustatius en Saba is gelegen.

3. De overdracht van functies en taken aan de Staat van Operatie, bedoeld in het eerste lid, geschiedt op basis van een bilaterale overeenkomst.

4. Overeenkomsten als bedoeld in het eerste lid kunnen tevens worden aangegaan met betrekking tot luchtvaartuigen, welke geëxploiteerd worden door op te richten organisaties voor de gezamenlijke exploitatie van luchtvervoer of internationale exploitatiebureaus, dan wel van het gemeenschappelijk uitoefenen van luchtdiensten op enige route of in enig gebied.

5. Aan de sluiting van een overeenkomst als bedoeld in het derde en vierde lid gaat een evaluatie van de normen en voorschriften vooraf, zulks met inachtneming van de regels inzake gelijkstelling van buitenlandse bewijzen van luchtwaardigheid en buitenlandse bewijzen van bevoegdheid zoals bepaald bij of krachtens de Wet luchtvaart.

HOOFDSTUK 7
Luchtvaartterreinen

§ 1 Algemeen

Artikel 130

1. De bepalingen in dit hoofdstuk en de bij dit besluit behorende bijlage CARNA Part 14 zijn van toepassing op alle burgerlijke luchtvaart-terreinen in de openbare lichamen Bonaire, Sint Eustatius en Saba.
2. De zorg voor de uitvoering van de in dit hoofdstuk en de bij dit besluit behorende bijlage CARNA Part 14 genoemde bepalingen berust bij de exploitant van het luchtvaartterrein.
3. Door de Minister kunnen nadere regels gesteld worden met betrekking tot de bepalingen in dit hoofdstuk.

Artikel 131

1. De aanleg van een luchtvaartterrein is ter beoordeling door de Minister zodanig, dat luchtvaartuigen daarvan een veilig gebruik kunnen maken. Hiertoe worden desgevraagd gegevens overgelegd.
2. Er worden ten genoegen van de Minister voorzieningen getroffen, dat de aan- en uitvlieghoogtes zodanig zijn, dat luchtvaartuigen veilig kunnen landen op en opstijgen van het luchtvaartterrein.

Artikel 132

1. Door de Minister wordt de lengte van een baan op een luchtvaart-terrein vastgesteld.
2. De minimale breedte van een rijbaan wordt vastgesteld conform hoofdstuk 3, paragraaf 3.4 van de bij dit besluit behorende bijlage CARNA Part 14.
3. Op verzoek van de exploitant kan door de Minister voor de baan of rijbaan een breedte worden toegestaan, welke kleiner is dan aangegeven in hoofdstuk 3 van de bij dit besluit behorende bijlage CARNA Part 14, mits:
   a. de exploitant de afwijking met redenen omkleed heeft voorgelegd;
   b. de exploitant een schatting van de veiligheid heeft gemaakt, die volgens de directie aan de minimale veiligheidsvereisten voldoet;
   c. de exploitant, voorzover fysiek mogelijk, een actieplan heeft ingediend ter verbreding van de baan of rijbaan.
4. Door de Minister kunnen regels gesteld worden met betrekking tot de minimale veiligheidsvereiste.

Artikel 133

Op verzoek van de exploitant kan door de Minister, indien het betreft een instrumentenbaan niet zijnde een precisiebaan met als codenummer 3 of 4 ontheffing worden verleend inzake de strookbreedte van 150 meter zoals vereist onder paragraaf 3.4.4 van de bij dit besluit behorende bijlage CARNA Part 14 mits de afstand tussen de lengteas van de baan en de lange zijde van de strook niet minder dan 75 meter bedraagt; en
   a. de exploitant de afwijking met redenen omkleed heeft voorgelegd;
   b. de exploitant een schatting van de veiligheid heeft gemaakt, die volgens de Minister aan de minimale veiligheidsvereiste voldoet;
   c. de exploitant een actieplan heeft ingediend ter verbreding van de strook om tegemoet te komen aan het vereiste neergelegd onder paragraaf 3.4.4 van de bij dit besluit bijbehorende bijlage CARNA Part 14.

Artikel 134

1. Een gedeelte of gedeelten van een luchtvaartterrein kan worden bestemd tot platform.
2. De inrichting en de regels voor het gebruik van platforms behoeven de goedkeuring van de Minister.
3. De Minister onthoudt de goedkeuring, bedoeld in het tweede lid, indien de regels voor het gebruik van het platform de orde en veiligheid van het platform naar zijn oordeel onvoldoende waarborgen bevatten.

Artikel 135

1. De exploitant draagt er zorg voor dat op het luchtvaartterrein aan alle vereisten wordt voldaan zoals neergelegd in de bij dit besluit bijbehorende bijlage CARNA Part 14.
2. Door de Minister kan op verzoek van de exploitant ontheffing worden verleend van de bepalingen neergelegd in hoofdstuk 6 «Visual Aids for denoting obstacles»; hoofdstuk 7 «Visual Aids for denoting restricted use areas»; hoofdstuk 8 «Electrical systems»; hoofdstuk 9 «aerodrome operational services equipment and installations» welke opgenomen zijn in de bij dit besluit behorende bijlage CARNA Part 14, mits:
a. de exploitant de afwijking met redenen omkleed heeft voorgelegd;
b. de exploitant schriftelijk heeft aangetoond een schatting van de veiligheid te hebben gemaakt en de gedetailleerde beoordeling hiervan door de Minister uitwijst dat het minimale veiligheidsniveau wordt bereikt.
3. De exploitant draagt er zorg voor dat bij operaties van luchtvaartterreinen rekening wordt gehouden met de richtlijnen neergelegd in Doc 9137 AN/898 «Airport Services Manual».
De exploitant draagt er zorg voor dat bij het opstellen van systemen, visuele hulpmiddelen, uitrusting en faciliteiten rekening wordt gehouden met de aanwijzingen en/of richtlijnen neergelegd in Doc 9157 AN/901 «Aerodrome Design Manual».

Artikel 136

1. Een luchtvaartterreinreferentiecode (codenummer en letter), die wordt bepaald bij de planning van een luchtvaartterrein, wordt vastgesteld in overeenstemming met de kenmerken van de vliegtuigen waarvoor de luchtvaartterreinvoorzieningen zijn bestemd zulks conform tabel 1.1. «Aerodrome Reference code» van hoofdstuk 1 van de bij dit besluit behorende bijlage CARNA Part 14.
2. Voor een luchtvaartterrein wordt een referentiepunt vastgesteld.
3. De referentietemperatuur van een luchtvaartterrein wordt vastgesteld in graden Celsius.

Artikel 137

[vervallen]

Artikel 138

Luchtvaartdata, luchtvaartterrein referentie, luchtvaartterrein referentie temperatuur, luchtvaartterreindimensies en daaraan gerelateerde informatie alsmede de sterkte van de banen, rijbanen en het platform worden aangegeven conform hoofdstuk 2 «Aerodrome data» van de bij dit besluit behorende bijlage CARNA Part 14.

Artikel 139

1. Op een baan bestemd voor internationale verkeersvluchten worden de afstanden berekend van:
a. de beschikbare baan (take-off runway available);
b. de beschikbare baan plus de lengte van de clearway, indien aanwezig (take-off distance available);
c. de beschikbare baan plus de lengte van de stopway indien aanwezig (accelerate stop distance available); en
d. de beschikbare baan die geschikt is voor het landen tot het tot stilstand komen van een luchtvaartuig (landing distance available).
2. Voor de berekening van de afstanden bedoeld in het eerste lid wordt gebruik gemaakt van de richtlijnen neergelegd in attachment A section 3 van de bij dit besluit behorende bijlage CARNA Part 14.

Artikel 140

1. Informatie met betrekking tot de toestand waarin het landingsterrein, het platform en de daarbij behorende voorzieningen zich bevinden, wordt onverwijld aan de vluchtvoorlichtingsdienst (AIS) en voor wat betreft het landingsterrein tevens aan de luchtverkeersdienst doorgegeven, opdat de noodzakelijke inlichtingen verstrekt kunnen worden aan de luchtvaartuigen, die landen of vertrekken. De informatie moet bijgewerkt zijn en veranderingen moeten onverwijld gemeld worden.
2. De toestand, waarin het landingsterrein, het platform en de daarbij behorende voorzieningen zich bevinden, worden voor wat betreft hun werking gecontroleerd en met betrekking tot zaken die van belang zijn voor vluchtvoorbereiding en vluchtuitvoering of die de prestaties van luchtvaartuigen betreffen, wordt in het bijzonder melding gemaakt van:
a. constructie- en onderhoudswerkzaamheden;
b. ruw of beschadigd oppervlak op een baan of rijbaan;
c. water op de baan;
d. andere gevaren van tijdelijke aard, daaronder begrepen geparkeerde luchtvaartuigen;
e. uitvallen of onregelmatige werking van een deel of van alle lichten van het luchtvaartterrein;
f. uitvallen van de normale of reserve energievoorziening.
3. Ten aanzien van de informatie, controles en meldingen, bedoeld in het eerste en tweede lid, kunnen door de Minister nadere voorschriften worden vastgesteld en kunnen aanwijzingen worden gegeven.
4. De exploitant van een luchtvaartterrein draagt er zorg voor dat een regeling tot stand komt met de AIS inzake de ontvangst en distributie van de informatie bedoeld in het eerste en tweede lid.

Artikel 141

1. Inzake het verplaatsen van onklaar geraakte luchtvaartuigen worden de aanwijzingen van paragraaf 9.3 van de bij dit besluit behorende bijlage CARNA Part 14 opgevolgd.
2. Ten aanzien van het verplaatsen van onklaar geraakte luchtvaartuigen wordt door de exploitant van het luchtvaartterrein een plan opgemaakt ten aanzien van de wijze waarop het een en ander wordt uitgevoerd.

Artikel 142

1. Op een luchtvaartterrein is informatie beschikbaar met betrekking tot de mate van hulpverlening aan luchtvaartuigen en brandbestrijding.
2. Indien belangrijke wijzigingen optreden in de voorzieningen, bedoeld in het eerste lid, worden deze medegedeeld aan de desbetreffende luchtverkeersdiensten en de vluchtvoorlichtingsdienst (AIS), opdat deze

diensten in staat zijn de luchtvaartuigen, die vertrekken en landen, van de noodzakelijke informatie te voorzien.

Artikel 143

1. Elke luchtvaartterrein met een luchtvaartterreinreferentiecode 3 of 4, bedoeld in artikel 136, beschikt over een PAPI (Precision Approach Path Indicator)
2. Elke luchtvaartterrein met een luchtvaartterreinreferentiecode 1 of 2, bedoeld in artikel 136, beschikt over een PAPI (Precision Approach Path Indicator) of APAPI (Abbreviated Precision Approach Path Indicator)

Artikel 144

[vervallen]

Artikel 145

1. Op het luchtvaartterrein wordt een plaats aangewezen of wordt aan de plaatselijke luchtverkeersleidingsdienst een plaats gemeld waar luchtvaartuigen kunnen parkeren, die vermoed worden betrokken te zijn bij een wederrechtelijk vergrijp of die anderszins afgezonderd moeten worden van normale werkzaamheden op het luchtvaartterrein.
2. De exploitant houdt bij de keuze van de plaats bedoeld in het eerste lid rekening met de specificaties van paragraaf 3.14 van de bij dit besluit behorende bijlage CARNA Part 14.

Artikel 146

Hindernissen, welke gevaar voor luchtvaartuigen opleveren dan wel kunnen opleveren en welke zich bevinden op het luchtvaartterrein worden verwijderd, of indien dit niet mogelijk is, worden deze aangeduid door vlaggen, tekens of kleuren zoals aangegeven in hoofdstuk 6 «Visual Aids for denoting obstacles» van de bij dit besluit behorende bijlage CARNA Part 14.

Artikel 147

Een licht op de grond, dat geen verband houdt met de luchtvaart, wordt gedoofd of afgeschermd, indien het de vliegveiligheid in gevaar brengt.

Artikel 148

1. De exploitant van een luchtvaartterrein, dat gedurende de nacht of tijdens instrument-weersomstandigheden kan worden gebruikt, draagt zorg dat:
a. indien geen verharde banen op het luchtvaartterrein zijn aangelegd, lichten zijn geplaatst ter aanduiding van de grens van het landingsterrein of van en gedeelte hiervan; indien wel verharde banen op het luchtvaartterrein zijn aangelegd, lichten zijn geplaatst ter aanduiding van de verharde banen en de daarbij behorende verharde rijbanen;
b. een naderingsverlichting is aangebracht ter vergemakkelijking van het landen bij zowel goed als bij slecht zicht;
c. een krachtinstallatie aanwezig is voor elektrische energievoorziening in noodgevallen.
2. Ten aanzien van de verlichting en lichten, bedoeld in het eerste lid, kunnen door de Minister nadere voorschriften worden vastgesteld en aanwijzingen worden gegeven.

Artikel 149

De exploitant plaatst lichten ter aanduiding van de hindernissen, bedoeld in artikel 146, overeenkomstig de voorschriften opgenomen in artikel 135, eerste lid, onderdeel g.

Artikel 150

1. Op een luchtvaartterrein dat gedurende de nacht of tijdens instrumentweersomstandigheden (IMC) wordt gebruikt, handelt de exploitant in geval van een gehele of gedeeltelijke sluiting van het luchtvaartterrein conform de voorschriften neergelegd in hoofdstuk 7 «Visual Aids for denoting restricted use areas» van de bij dit besluit behorende bijlage CARNA Part 14.
2. Ten aanzien van het gebruik van lichten kunnen door de Minister voorschriften gegeven worden.

Artikel 151

Indien een gedeelte van het landingsterrein of van het platform van een luchtvaartterrein dat gedurende de nacht of tijdens instrumentweersomstandigheden (IMC) wordt gebruikt, niet geschikt is voor het gebruik door luchtvaartuigen, wordt dit tevens door lichten aangegeven.

Artikel 152 en 153

[vervallen]

Artikel 154

1. Op het luchtvaartterrein zijn voldoende middelen aanwezig voor het op verantwoorde wijze verlenen van eerste hulp bij ongevallen.
2. Op het luchtvaartterrein is tenminste één persoon aanwezig, die in staat is tot het verlenen van eerste hulp bij ongevallen en die in het bezit is van een bewijs waaruit blijkt, dat hij met het verlenen van eerste hulp vertrouwd is. Door de Minister kan worden vastgesteld welke bewijzen hiervoor in aanmerking komen.
3. Voor zover een voor het openbaar luchtverkeer aangewezen luchtvaartterrein ingevolge de beschikking tot aanwijzing mede voor het internationale luchtverkeer is bestemd, draagt de exploitant zorg dat op het luchtvaartterrein een gezondheidsorganisatie functioneert, welke doorlopend beantwoord aan hetgeen nodig is om ziekten te voorkomen en welke in elk geval de medewerking van een geneesheer verzekert, zo dikwijls diens aanwezigheid nodig kan zijn voor een ingevolge een internationale overeenkomst of een wettelijk voorschrift te verrichten geneeskundig onderzoek.

Artikel 155

1. Op het luchtvaartterrein zijn voldoende materieel en middelen alsmede voldoende deskundig en bedreven personeel aanwezig voor het redden van mensenlevens en tot het voorkomen, beperken en bestrijden van brand ten gevolge van ongevallen met luchtvaartuigen op of in de onmiddellijke omgeving van het luchtvaartterrein.
2. Het bepaalde in het eerste lid geschiedt met inachtneming van de voorschriften van Hoofdstuk 9 «Aerodrome operational services equipment and installation» van de bij dit besluit behorende bijlage CARNA Part 14.
3. Het materieel verkeert te allen tijde in bedrijfszekere toestand en het personeel wordt regelmatig geoefend.

4. Er worden maatregelen genomen opdat het personeel met het materieel te allen tijde kan uitrukken bij ongevallen met luchtvaartuigen op of in de onmiddellijke omgeving van het luchtvaartterrein dan wel bij brand of gevaar voor brand op het luchtvaartterrein.

5. Er wordt door de Minister een regeling vastgesteld waarin het geheel van de te nemen maatregelen is opgenomen voor een doelmatige bestrijding van ongevallen als bedoeld in eerste en vierde lid, alsmede van rampen welke zich op het luchtvaartterrein kunnen voordoen.

Artikel 156

1. De exploitant draagt zorg dat van het luchtvaartterrein een veilig gebruik kan worden gemaakt.

2. De exploitant draagt zorg dat:

a. de in artikel 135 bedoelde grondtekens, cijfers, dagkenmerken, en het seinvierkant, alsmede de in artikel 146 bedoelde aanduiding van hindernissen in goede staat worden gehouden;

b. de lichten, inrichting en verlichting, bedoeld in de artikelen 147 tot en met 151, in goede staat worden gehouden;

3. Door de Minister kunnen aanwijzingen worden gegeven aan de exploitant in verband met de in de vorige leden gestelde bepalingen.

Artikel 157

1. De exploitant draagt zorg dat aan het Bestuurscollege en aan de Minister halfjaarlijks een verslag over de toestand van het luchtvaartterrein wordt aangeboden.

2. De Minister kan voorschriften geven ten aanzien van de orde en veiligheid op het luchtvaartterrein.

3. De Minister kan de exploitant opdragen op basis van en ter aanvulling van de in het eerste lid gegeven voorschriften nadere maatregelen vast te stellen. Deze behoeven de goedkeuring van het Bestuurscollege.

Artikel 158

1. De exploitant neemt maatregelen voor een behoorlijk toezicht op de veiligheid en de goede orde op het luchtvaartterrein.

2. Terzake de uitvoering van het toezicht, bedoeld in het eerste lid, kunnen door de Minister nadere voorschriften worden gegeven.

Artikel 159

Met betrekking tot het luchtvaartterreinverkeer op het landingsterrein, uitgezonderd luchtvaartuigen, en met betrekking tot het verkeer van luchtvaartuigen naar, van en op het platform wordt coördinatie gevoerd tussen de exploitant en de plaatselijke luchtverkeersleidingsdienst.

Artikel 160

De exploitant staat toe dat op het luchtvaartterrein elektronische, meteorologische en eventueel andere hulpmiddelen aanwezig zijn vanwege de aan de relevante luchtverkeersdienstverleners en verleners van meteorologische diensten opgedragen taken met betrekking tot de luchtverkeersbeveiliging en de luchtvaartmeteorologische dienstverlening.

§ 2 De luchthavenmeester

Artikel 161

1. De luchthavenmeester wordt door de exploitant van het luchtvaartterrein benoemd.
2. De luchthavenmeester verricht zijn taak onverminderd de verantwoordelijkheid van de exploitant.
3. De functie van luchthavenmeester mag verenigd worden met die van exploitant.

Artikel 162

De luchthavenmeester is belast met de dagelijkse uitvoering van het toezicht op het luchtvaartterrein en in het bijzonder met het toezicht op de veiligheid en de goede orde daarop.

Artikel 163

1. De luchthavenmeester van een gecontroleerd luchtvaartterrein deelt de luchtverkeersleidingsdienst steeds tijdig mede welk gedeelte van het landingsterrein gebruikt kan worden voor het verkeer met luchtvaartuigen.
2. Dit gedeelte van het landingsterrein wordt aangeduid als het in gebruik zijnde deel van het landingsterrein.
3. De luchtverkeersleidingsdienst bepaalt op grond van verkeerstechnische overwegingen welk gedeelte van het in gebruik zijnde deel van het landingsterrein daadwerkelijk wordt bestemd voor het landen en opstijgen van luchtvaartuigen en daarmede verband houdende bewegingen.

Artikel 164

De luchthavenmeester draagt zorg dat bij nacht of tijdens instrumentweersomstandigheden (IMC) de verlichting en de lichten, bedoeld in de artikel 148, tijdig en voor zover nodig worden ontstoken en blijven branden zolang dit voor de veiligheid van het luchtvaartterrein nodig wordt geacht.

Artikel 165

De luchthavenmeester draagt zorg dat:
a. in het seinvierkant steeds de benodigde tekens worden geplaatst;
b. in geval van windstilte de op het luchtvaartterrrein aanwezige landings-T wordt vastgezet in de richting waarin moet worden geland en opgestegen, waarbij onder windstilte wordt verstaan wind met een snelheid van ten hoogste 2,5 m per seconde.

Artikel 166

1. De luchthavenmeester draagt zorg dat het in gebruik zijnde deel van het landingsterrein niet onveilig wordt gemaakt door enig roerend goed.
2. Indien zich op het landingsterrein roerend goed bevindt, hetwelk gevaar voor luchtvaartuigen kan opleveren, wordt dit roerend goed door de zorg van de luchthavenmeester verwijderd dan wel aangeduid overeenkomstig het bepaalde in de artikel 150.
3. Indien een gedeelte van het landingsterrein geheel of gedeeltelijk gesloten is verklaard of niet geschikt is voor het gebruik door luchtvaartuigen, wordt dat gedeelte door de zorg van de luchthavenmeester

aangeduid overeenkomstig hoofdstuk 7 «Visual Aids for denoting restricted use areas» van de bij dit besluit behorende bijlage CARNA Part 14.

4. Indien een gedeelte van het landingsterrein op een luchtvaartterrein, dat gedurende de nacht of tijdens instrumentweersomstandigheden (IMC) wordt gebruikt, geheel of gedeeltelijk gesloten is verklaard of niet geschikt is voor het gebruik door luchtvaartuigen, wordt dat gedeelte door de zorg van de luchthavenmeester aangeduid door lichten overeenkomstig het bepaalde in de artikel 148 en 150.

Artikel 167

1. De luchthavenmeester draagt zorg dat een platform niet onveilig wordt gemaakt door enig roerend goed.

2. Indien op een platform zich roerend goed bevindt, hetwelk naar het oordeel van of vanwege de Minister gevaar voor luchtvaartuigen kan opleveren, wordt dit roerend goed door de zorg van de luchthavenmeester verwijderd dan wel aangeduid overeenkomstig de in artikel 146 voor hindernissen vastgestelde voorschriften.

3. Indien een gedeelte van het platform geheel of gedeeltelijk gesloten is verklaard of niet geschikt voor het gebruik door luchtvaartuigen, wordt dat gedeelte door de zorg van de luchthavenmeester aangeduid overeenkomstig het bepaalde in hoofdstuk 7 «Visual Aids for denoting restricted use areas» van de bij dit besluit behorende bijlage CARNA Part 14.

4. Indien een gedeelte van het platform op een luchtvaartterrein, dat gedurende de nacht of tijdens instrumentweersomstandigheden (IMC) wordt gebruik, geheel of gedeeltelijk gesloten is verklaard of niet geschikt is voor het gebruik door luchtvaartuigen, wordt dat gedeelte door de zorg van de luchthavenmeester aangeduid door lichten overeenkomstig het bepaalde in de artikelen 150 en 151.

Artikel 168

1. De luchthavenmeester stelt, indien het landingsterrein door enigerlei omstandigheid gevaarlijk is geworden of kan worden voor luchtvaartuigen, de Minister daarvan zo spoedig mogelijk in kennis onder vermelding van de bijzonderheden dienaangaande.

2. Gelijke mededeling als bedoeld in het eerste lid wordt gegeven indien door enigerlei omstandigheid één of meer van de in artikelen 135, 146, 148, 150 en 151 bedoelde tekens, cijfers, dagkenmerken, kleuren, lichten, verlichting en inrichting niet meer aan de ter zake geldende voorschriften voldoen of indien daarin wijziging wordt gebracht.

3. Wanneer de omstandigheid welke aanleiding heeft gegeven tot de mededeling, bedoeld in het eerste of tweede lid, ophoudt te bestaan, stelt de luchthavenmeester de Minister daarvan eveneens zo spoedig mogelijk in kennis.

Artikel 169

1. De luchthavenmeester legt een register aan, waarin gegevens worden opgenomen omtrent elk luchtvaartuig dat op het luchtvaartterrein landt of daarvan opstijgt.

2. De aantekeningen in dit register zijn duidelijk en houdbaar, terwijl zij niet uitgewist, verwijderd of onleesbaar mogen worden gemaakt. De aantekeningen worden ten minste twee jaar bewaard.

3. De luchthavenmeester houdt van niet-verkeersvluchten de volgende gegevens bij:

a. het nationaliteits- en inschrijvingskenmerk alsmede het type luchtvaartuig, tevens inhoudende de inrichting van het vliegtuig en de naam van de eigenaar of houder;

b. de naam van de gezagvoerder van het luchtvaartuig;
c. het luchtvaartterrein, waarvan het luchtvaartuig het laatst is vertrokken, alsmede het tijdstip van aankomst;
d. het luchtvaartterrein van bestemming, alsmede het tijdstip van vertrek;
e. de aard van de vlucht, alsmede het aantal inzittenden;
f. de baan- en circuitrichting.
4. De luchthavenmeester houdt van verkeersvluchten dezelfde gegevens bij als van niet-verkeersvluchten, met uitzondering van het onder het derde lid, onderdelen b en e, gestelde, doch houdt daarentegen van verkeersvluchten de volgende additionele gegevens bij:
a. het vluchtnummer;
b. de herkomst of bestemming van de vervoerde passagiers, zowel voor passagiers met bestemming respectievelijk herkomst Bonaire, Sint Eustatius of Saba als voor overstappende passagiers en doorgaande passagiers;
c. de herkomst of bestemming van de vervoerde vracht en post, zowel voor vracht en post met bestemming respectievelijk herkomst Bonaire, Sint Eustatius of Saba als voor vracht en post met overslag.
5. Vanwege het karakter van de gegevens, bedoeld in het vierde lid, worden deze gegevens vertrouwelijk behandeld.
6. De luchthavenmeester verleent desgewenst aan de Minister inzage van het register, bedoeld in het eerste lid.

Artikel 170

De luchthavenmeester draagt zorg dat op de daarvoor geëigende en duidelijk waarneembare plaats ter inzage aanwezig zijn:
a. de vastgestelde tarieven voor het gebruik dat door luchtvaartuigen wordt gemaakt van het betreffende luchtvaartterrein en van de zich daarop bevindende opstallen;
b. een lijst betreffende eventueel te heffen vergoedingen voor het gebruik van de verschillende inlichtingen, de herstellingen aan luchtvaartuigen en al hetgeen daarmee samenhangt.

Artikel 170a

De Minister kan ontheffing verlening van het bij of krachtens de artikelen 134, 146, 148, 150, 154, derde lid, 155 en 165, onderdeel b, bepaalde. De ontheffing kan onder beperkingen worden verleend. Aan de ontheffing kunnen voorschriften worden verbonden.

§ 3. Certificatie van luchtvaartterreinen

Artikel 171

1. Een voor het openbaar luchtverkeer aangewezen luchtvaartterrein wordt, met inachtneming van de bepalingen in de voorgaande paragrafen, gecertificeerd conform de in deze paragraaf vastgelegde regels en procedures.
2. Voor de toepassing van deze paragraaf wordt verstaan onder:
a. *certificaat luchtvaartterrein:* een certificaat verleend door de Minister conform vastgestelde regels inzake de veilige operatie van een luchtvaartterrein binnen de openbare lichamen Bonaire, Sint Eustatius en Saba;
b. *faciliteiten en uitrusting luchtvaartterrein:* faciliteiten en uitrusting, binnen of buiten de grenzen van een luchtvaartterrein, welke worden gebouwd of aangelegd en in stand gehouden voor de aankomst, het vertrek en de grondbewegingen van luchtvaartuigen;

c. *handboek luchtvaartterrein:* de handleiding deel uitmakende van de aanvraag voor een certificaat luchtvaartterrein, met inbegrip van wijzigingen hierop, zoals goedgekeurd;

d. *exploitant van een luchtvaartterrein:* de exploitant van een luchtvaartterrein aan wie een certificaat luchtvaartterrein is afgegeven;

e. *gecertificeerd luchtvaartterrein:* een luchtvaartterrein aan de exploitant waarvan een certificaat luchtvaartterrein is afgegeven.

Artikel 172

1. De exploitant van een gecertificeerd luchtvaartterrein heeft ten behoeve van de operatie hiervan de beschikking over een handboek luchtvaartterrein.

2. Het handboek, bedoeld in het eerste lid, heeft ten doel aan te tonen dat het luchtvaartterrein voldoet aan de certificatievoorschriften genoemd in artikel 173, tweede lid en dat er geen tekortkomingen zijn die de veiligheid van operaties met luchtvaartuigen nadelig beïnvloeden.

3. Het handboek bevat in ieder geval de bijzonderheden genoemd in «Appendix 1» van «ICAO Manual on Certification of Aerodromes»

4. Indien een bijzonderheid als bedoeld in het derde lid niet van toepassing is op het luchtvaartterrein, wordt door de exploitant van het luchtvaartterrein de reden hiervan vermeld.

5. Het handboek:

a. wordt in gedrukte vorm opgesteld en ondertekend door de exploitant van het luchtvaartterrein;

b. is van zodanig formaat dat dit gemakkelijk kan worden herzien;

c. is voorzien van een systeem om de geldigheid der pagina's en wijzigingen hierop bij te houden, met inbegrip van een pagina om revisies te noteren;

d. is zodanig samengesteld en ingedeeld dat het proces van voorbereiding, de inspectie en de goedkeuring ervan wordt vergemakkelijkt;

e. wordt door de exploitant van het luchtvaartterrein waar nodig gewijzigd, ten einde de nauwkeurigheid van de inlichtingen te handhaven, terwijl de exploitant de Minister in kennis dient te stellen van aanvullingen in het handboek

6. Het handboek en de wijzigingen hierop worden, met inachtneming van het bepaalde in dit artikel, goedgekeurd door de Minister.

7. De exploitant van een luchtvaartterrein stelt een volledig en geldig exemplaar van het handboek ter beschikking van de directeur van de Minister.

Artikel 173

1. De afgifte, verlenging van de geldigheidstermijn, vernieuwing, schorsing en intrekking van een certificaat luchtvaartterrein geschieden door de Minister.

2. Een certificaat luchtvaartterrein, waarvan het model door de Minister is goedgekeurd, kan worden verleend voor een termijn van ten hoogste drie jaar, indien en ten genoegen van de Minister is aangetoond dat:

a. zowel de exploitant van een luchtvaartterrein als het onder hem dienende staf de vereiste bekwaamheid en ervaring bezitten om het luchtvaartterrein te opereren en in stand te houden in overeenstemming met het handboek luchtvaartterrein zoals goedgekeurd;

b. alle faciliteiten, de dienstverlening en uitrusting op of van het luchtvaartterrein in overeenstemming zijn met de bepalingen van dit hoofdstuk, alsmede dat de faciliteiten op behoorlijke en efficiënte wijze in stand worden gehouden;

c. de operationele procedures van het luchtvaartterrein in voldoende mate voorzien in de veiligheid van luchtvaartuigen;

d. er een acceptabel veiligheidssysteem is ingesteld door de exploitant van een luchtvaartterrein en voorhanden is op het luchtvaartterrein, in welk systeem tevens de organisatiestructuur, de verplichtingen, bevoegdheden en verantwoordelijkheden van de stafleden is omschreven, ten einde te verzekeren dat de operaties correct worden uitgevoerd.

3. Aan een certificaat luchtvaartterrein kunnen voorschriften worden verbonden.

4. Een certificaat luchtvaartterrein kan onder beperkingen worden verleend

5. De tarieven voor de behandeling van een aanvraag voor de eerste afgifte en de instand houding van een certificaat luchtvaartterrein worden door de Minister vastgesteld.

Artikel 174

1. De exploitant van een luchtvaartterrein draagt zorg voor:

a. indienstneming van voldoende personeelsleden, die bekwaam en deskundig zijn om de taken verbonden aan operaties op het luchtvaartterrein en de instandhouding hiervan, te vervullen;

b. de instelling van een programma tot bijscholing van het personeel, genoemd onderdeel a.

2. De exploitant van een luchtvaartterrein draagt zorg voor de beoordeling van het veiligheidssysteem, met inbegrip van de inspectie der faciliteiten en uitrusting van het luchtvaartterrein.

3. De exploitant van een luchtvaartterrein voert tenminste eenmaal per jaar een interne beoordeling uit van het veiligheidssysteem.

Artikel 175

1. De afgifte van een certificaat luchtvaartterrein wordt aangevraagd door de exploitant van een luchtvaartterrein door middel van indiening van een behoorlijk ingevuld en ondertekend formulier, waarvan het model door de Minister is vastgesteld en waarvan exemplaren kosteloos verkrijgbaar zijn bij de Minister.

2. Bij de aanvraag van een certificaat luchtvaartterrein wordt het handboek luchtvaartterrein overgelegd door de exploitant van het luchtvaartterrein.

3. Voor de behandeling van een aanvraag voor wijziging van een certificaat luchtvaartterrein zijn de door de Minister vastgestelde tarieven verschuldigd.

4. Het certificaat luchtvaartterrein kan door de Minister worden gewijzigd:

a. op verzoek van de exploitant van het luchtvaartterrein;

b. bij wijziging van de eigendom van het luchtvaartterrein of in het bestuur van de exploitant van het luchtvaartterrein;

c. bij wijziging in het gebruik of van de operatie van het luchtvaartterrein;

d. bij wijziging van de grenzen van het luchtvaartterrein.

5. De geldigheid van een certificaat luchtvaartterrein kan worden geschorst indien blijkt dat:

a. het veiligheidssysteem van de exploitant van een luchtvaartterrein ontoereikend is;

b. de schorsing in het belang is van de operationele veiligheid;

c. alle overige maatregelen voor de tijdige correctie van de onveilige toestand of voor het veilig stellen van operaties met luchtvaartuigen niet de gewenste resultaten hebben opgeleverd;

d. de exploitant van een luchtvaartterrein onvoldoende technisch bekwaam of geschikt is om de veiligheidstaken te vervullen voortvloeiende uit de bepalingen van deze paragraaf;

e. de exploitant van een luchtvaartterrein zich verzet tegen het nemen van maatregelen of niet bereid is maatregelen te nemen om verbetering te brengen in de bestaande onveilige situatie op het luchtvaartterrein;

f. de exploitant van een luchtvaartterrein met opzet te kort schiet in het nemen van een reeds overeengekomen correctieve actie en de schorsing van het certificaat luchtvaartterrein als laatste redmiddel kan worden aangewend om onveilige operaties op het platform en het manoeuvreergebied te vermijden.

6. Een certificaat luchtvaartterrein wordt ingetrokken indien de exploitant van een luchtvaartterrein:

a. ongeschikt of niet bereid is om correctieve acties te nemen of ernstige inbreuken heeft gepleegd op de bepalingen van deze paragraaf danwel zich herhaaldelijk hieraan heeft schuldig gemaakt;

b. getoond heeft geen verantwoordelijkheid te dragen, zoals het met opzet niet voldoen aan en handelen in strijd met de bepalingen van deze paragraaf of zich schuldig maakt aan vervalsing van documenten, waardoor de veiligheid van de luchtvaart in gevaar wordt gebracht.

c. op overtuigende wijze duidelijk heeft gemaakt dat het voortzetten van operaties op het luchtvaartterrein schadelijk zal zijn voor het algemeen belang.

Artikel 176

Het certificatieproces verloopt met inachtneming van de procedurele voorschriften neergelegd in de paragrafen 4.1. t/m 4.4 van hoofdstuk 4 «Aerodrome certification procedures» van de ICAO-Manual on Aerodrome Certification DOC 9774 AN/969.

Artikel 177

1. Indien het luchtvaartterrein of de faciliteiten, de dienstverlening en de uitrusting op of van het luchtvaartterrein geen voldoende waarborgen bieden om de luchtvaart op veilige wijze uit te oefenen, wordt door de Minister afwijzend beschikt op de aanvraag.

2. Binnen veertien dagen na de datum van de beslissing van de Minister wordt de afwijzing bekend gemaakt aan de aanvrager in een aangetekend schrijven, onder vermelding van de gronden waarop de afwijzing berust.

HOOFDSTUK 8
Luchtvaartinlichtingen en kaarten

Artikel 178

1. Ten behoeve van de veiligheid, de regelmaat en de doelmatigheid van de luchtvaart worden ten behoeve van de delen van het Vluchtinformatiegebied Curaçao en het Vluchtinformatiegebied San Juan waarvoor de Minister de verantwoordelijkheid voor het verzorgen van luchtverkeersdiensten heeft aanvaard de volgende publicaties uitgegeven:

a. Aeronautical Information Publication (AIP), zijnde een luchtvaartgids, inhoudende inlichtingen van blijvende aard, welke van belang zijn voor de uitoefening van de luchtvaart;

b. Notices to Airmen (NOTAM), zijnde een kennisgeving, gedistribueerd door middel van telecommunicatie, bevattende inlichtingen met betrekking tot de instelling, toestand of verandering van luchtvaartfaciliteiten, -dienstverlening, -procedures of -gevaar, waarvan de tijdige inkennisstelling van essentieel belang is voor de uitoefening van de luchtvaart;

c. Aeronautical Information Regulation (AIRAC), zijnde een systeem om omstandigheden die een belangrijke wijziging of implementatie op operationeel gebied inhouden, vooraf bekend te maken op de in de ICAO Aeronautical Information Services Manual (DOC 8126 AN/872) vastgestelde data.

d. Luchtvaartkaart, een afbeelding van een deel van de aarde, de beloning en verhevenheid, specifiek bestemd om aan de eisen van de luchtvaartnavigatie te voldoen.;

e. Aeronautical Information Circular (AIC), een circulaire voor de luchtvaart met inlichtingen die niet in aanmerking komen voor publicatie in een NOTAM of de AIP, maar wel in verband staan met de vliegveiligheid, vluchtuitvoering of technische, administratieve of wetgevende aangelegenheden;

f. Publicaties, bevattende de inlichtingen van algemeen en technisch belang en inlichtingen met betrekking tot administratieve zaken, ongeschikt voor publicatie in AIP of NOTAM;

2. Indien de veiligheid, de regelmaat en de doelmatigheid van de luchtvaart dit vereist kunnen, extra luchtvaartinlichtingen van blijvende aard worden verstrekt.

Permanente aanpassingen van de luchtvaartgids worden verstrekt middels een amendement, overeenkomstig Bijlagen 4 en 15 van het Verdrag.

Tijdelijke aanpassingen van de luchtvaartgids worden verstrekt middels een supplement, overeenkomstig Bijlagen 4 en 15 van het Verdrag.

3. De publicaties kunnen tevens worden uitgegeven in de Engelse taal.

Artikel 179

De AIP, NOTAM, AIC en de Luchtvaartkaarten, waaronder naderings-, landings- en hinderniskaarten worden samengesteld overeenkomstig de richtlijnen vervat in Bijlage 15 van het Verdrag.

Artikel 180

1. De abonnementsgelden voor de publicaties, bedoeld in artikel 178, worden door de Minister vastgesteld.

2. De betaling van de abonnementsgelden, bedoeld in het eerste lid, geschiedt volgens door de Minister vastgestelde regels.

Artikel 181

1. Op de luchtvaartterreinen binnen de openbare lichamen Bonaire, Sint Eustatius en Saba worden inlichtingen gegeven voor het uitvoeren van vluchten.

2. Deze inlichtingen betreffen onderwerpen, welke zijn opgenomen in de relevante AIP's en NOTAM, alsmede gegevens van luchtvaartkaarten, welke verband houden met de te vliegen route.

3. Indien nodig wordt ten behoeve van de leden van het stuurhutpersoneel van een luchtvaartuig een uittreksel van de van kracht zijnde NOTAM en andere inlichtingen van dringende aard, welke voor de vluchtuitvoering van belang zijn, beschikbaar gesteld.

HOOFDSTUK 9
Luchtvaartvertoningen en Luchtvaartwedstrijden

Artikel 182

1. Voor het verkrijgen van ontheffing tot het houden van een luchtvaartvertoning of luchtvaartwedstrijd als bedoeld in artikel 28, derde lid, van de Luchtvaartwet BES, wordt ten minste 21 dagen voor de dag van de vertoning of van de wedstrijd een daartoe strekkend verzoekschrift bij de Minister ingediend.

2. Bij het verzoekschrift worden overgelegd:

a. een omschrijving van de vertoning of wedstrijd met aanduiding van het (de) te gebruiken terrein(en) en van de te volgen route, alsmede met vermelding in hoeverre kunstvluchten zullen plaatshebben;

b. een verzoek om ontheffing van de verbodsbepaling van artikel 26, eerste lid, van de Luchtvaartwet BES, indien een terrein niet zijnde luchtvaartterrein zal worden gebruikt, met vermelding van het openbare lichaam, waarop het terrein is gelegen en met een duidelijke tekening van het terrein en van de onmiddellijke omgeving daarvan, waaruit de afmetingen blijken;

c. een schriftelijke verklaring, dat tegen de te houden vertoning of wedstrijd geen bezwaar bestaat, welke wordt afgegeven door de Gezaghebber van het openbare lichaam waar deze zal worden gehouden.

3. Een verzoekschrift als bedoeld in dit artikel wordt eerst in behandeling genomen, indien alle benodigde gegevens en de verklaring zijn overgelegd.

Artikel 183

1. Voor het aanvragen van een ontheffing van het in artikel 26, eerste lid, van de Luchtvaartwet BES vervatte verbod, wordt tenminste 21 dagen voor de eerste dag waarop het terrein zal worden gebruikt een daartoe strekkend verzoekschrift bij de Minister ingediend.

2. Bij het verzoekschrift worden overgelegd:

a. fabrikaat en type van het te gebruiken luchtvaartuig;

b. datum waarop het terrein zal worden gebruikt;

c. de reden(en) waarom dit terrein zal worden gebruikt;

d. het eiland en de plaats waarin het betrokken terrein is gelegen;

e. de afmetingen van het terrein;

f. een duidelijke kaart waaruit de geografische ligging en de aard van de omgeving van het betrokken terrein duidelijk blijkt;

g. een verklaring van geen bezwaar afgegeven door de Gezaghebber van het openbare lichaam waarin het betrokken terrein is gelegen;

h. een verklaring van geen bezwaar van de eigenaar dan wel de zakelijk gerechtigde van het betrokken terrein;

i. een schriftelijke verklaring van de aanvrager dat het beoogde terrein aan de gestelde criteria voor een veilig gebruik voldoet.

3. Indien de ontheffing voor drie dagen of minder wordt aangevraagd, is het gestelde in het tweede lid van dit artikel van toepassing met dien verstande dat de verklaringen als bedoeld in onderdelen h en i tijdens het daadwerkelijke gebruik van het terrein ter inzage aanwezig moeten zijn.

4. Voor het aanvragen van en ontheffing van het in artikel 26, eerste lid, van de Luchtvaartwet BES vervatte verbod ten behoeve van het opstijgen met een vrije bemande ballon geldt in afwijking van het gestelde in het eerste lid, een termijn van 14 dagen.

5. Voor het aanvragen van een ontheffing van het in artikel 37, eerste lid, onderdelen a en b, van de Luchtvaartwet BES vervatte verbod, wordt tenminste 21 dagen voor het begin van de periode waarvoor de aanvrage geldt een daartoe strekkend verzoekschrift bij de Minister ingediend.

6. Voor het aanvragen van een ontheffing van het in artikel 39, eerste lid, onderdelen a, b en c, van de Luchtvaartwet BES vervatte verbod, wordt tenminste 21 dagen voor het begin van de periode waarvoor de aanvrage geldt, een daartoe strekkend verzoekschrift bij de Minister ingediend.

HOOFDSTUK 10

[vervallen]

HOOFDSTUK 11
Strafbepalingen

Artikel 185

1. Overtreding van de artikelen 135, eerste lid, 146, 148, eerste lid, 154, 155, eerste tot en met derde lid, 156, eerste en tweede lid, 157, eerste lid, 158, eerste lid, 163, 164, 165, 166, 167, 168, 169, 170 en 170a is een strafbaar feit als bedoeld in artikel 50, vierde lid, van de Luchtvaartwet BES.
2. Overtreding van een aanwijzing, regel of voorschrift gegeven krachtens de 135, tweede lid, 146, 147, 148, tweede lid, 149, 151, tweede lid, 152, derde lid, 153, tweede lid, 155, vierde lid, 156, derde lid, 157, tweede lid, 158, eerste lid, is, voor zover die overtreding uitdrukkelijk als strafbaar feit is aangemerkt, een strafbaar feit als bedoeld in artikel 50, vierde lid, van de Luchtvaartwet BES.

HOOFDSTUK 12
Slot- en overgangsbepalingen

Artikel 186

De vóór de inwerkingtreding van dit besluit door de Minister afgegeven bewijzen van inschrijving, van luchtwaardigheid, van gelijkstelling treden in de plaats van de overeenkomstige in dit besluit vermelde bewijzen. Voor bewijzen, waarvan het model afwijkt van de bedoelde overeenkomstige bewijzen geschiedt dit slechts voor de duur van ten hoogste zes maanden. In deze periode worden de bewijzen van afwijkend model door de Minister vervangen door overeenkomstige in dit besluit vermelde bewijzen zonder dat daarbij enige kosten in rekening worden gebracht.

Artikel 187

Dit besluit berust op de artikelen 37, tweede lid, 50, vierde lid, 66, eerste en tweede lid, en 68 van de Luchtvaartwet BES.

Artikel 188

Dit besluit wordt aangehaald als: Besluit toezicht luchtvaart BES.

Bijlage behorende bij het Besluit toezicht luchtverkeer BES: CARNA Part 14

CHAPTER 1. GENERAL

1.1 Definitions

When the following terms are used in this regulation they have the following meanings:

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

Note – For measured positional data, the accuracy is normally expressed in terms of a distance from a stated position within which there is a defined confidence of the true position falling.

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

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

Aerodrome certificate. A certificate issued by the Minister of Traffic and Transport under established regulations for the safe operation of an aerodrome within the Netherlands Antilles.

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

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

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

Aerodrome traffic density.
a) Light. Where the number of movements in the mean busy hour is not greater than 15 per runway or typically less than 20 total aerodrome movements.
b) Medium. Where the number of movements in the mean busy hour is of the order of 16 to 25 per runway or typically between 20 to 35 total aerodrome movements.
c) Heavy. Where the number of movements in the mean busy hour is of the order of 26 or more per runway or typically more than 35 total aerodrome movements.

Note – The number of movements in the mean busy hour is the arithmetic mean over the year of the number of movements in the daily busiest hour.

Note 2 – Either a take-off or a landing constitutes a movement.

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

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

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

Note – Attachment A, Section 2 provides information on the concept of balanced field length and the Airworthiness Manual (Doc 9760) contains detailed guidance on matters related to take-off distance.

Aircraft Classification Number (ACN). A number expressingthe relative effect of an aircraft on a pavement for a specified standard subgrade category.

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

Aircraft stand. A designated area on an apron intended to beused for parking an aircraft.

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

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

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

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

Capacitor discharge light. A lamp in which high-intensityflashes of extremely short duration are produced by the discharge of electricity at high voltage through a gas enclosed in a tube.

Certified aerodrome. An aerodrome whose operator has beengranted an aerodrome certificate.

Clearway. A defined rectangular area on the ground or waterunder the control of the appropriate authority, selected or prepared as a suitable area over which an airplane may make a portion of its initial climb to a specified height.

Cyclic Redundancy Check (CRC). A mathematical algorithmapplied to the digital expression of data that provides a level of assurance against loss or alteration of data.

Data quality. A degree or level of confidence that the dataprovided meet the requirements of the data user in terms of accuracy, resolution and integrity.

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

Declared distances.
a) Take-Off Run Available (TORA). The length of runway declared available and suitable for the ground run of an airplane taking off.
b) Take-Off Distance Available (TODA). The length of the take-off run available plus the length of the clearway, if provided.
c) Accelerate-Stop Distance Available (ASDA). The length of the take-off run available plus the length of the stopway, if provided.
d) Landing Distance Available (LDA). The length of runway which is declared available and suitable for the ground run of an airplane landing.

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

DCA NA. The Directorate of Civil Aviation Netherlands Antilles.

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

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

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

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

Note – Guidance on design for frangibility is contained in the Aerodrome Design Manual, Part 6 (in preparation).

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

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

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

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

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

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

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

Hazard beacon. An aeronautical beacon used to designate adanger to air navigation.

Heliport. An aerodrome or a defined area on a structureintended to be used wholly or in part for the arrival,
departure and surface movement of helicopters.

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

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

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

Identification beacon. An aeronautical beacon emitting acoded signal by means of which a particular point of reference can be identified.

Instrument runway. One of the following types of runwaysintended for the operation of aircraft using instrument approach procedures:
a) **Non-precision approach runway**. An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach.
b) **Precision approach runway, category I** . An instrument runway served by ILS and/or MLS and visual aids intended for operations with a decision height not lower than 60 m (200 ft) and either a visibility not less than 800 m or a runway visual range not less than 550 m.
c) **Precision approach runway, category II**. An instrument runway served by ILS and/or MLS and visual aids intended for operations with a decision height lower than 60 m (200 ft) but not lower than 30 m (100 ft) and a runway visual range not less than 350 m.
d) **Precision approach runway, category III**. An instrument runway served by ILS and/or MLS to and along the surface of the runway and:

A – intended for operations with a decision height lower than 30 m (100 ft), or no decision height and a runway visual range not less than 200 m.
B – intended for operations with a decision height lower than 15 m (50 ft), or no decision height and a runway visual range less than 200 m but not less than 50 m.
C – intended for operations with no decision height and no runway visual range limitations.
Note 1 – See Part 10, Volume I for related ILS and/or MLS specifications.

Note 2 – Visual aids need not necessarily be matched to the scale of non-visual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

Integrity (aeronautical data). A degree of assurance that anaeronautical data and its value has not been lost nor altered since the data origination or authorized amendment.

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

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

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

Laser-beam Critical Flight Zone (LCFZ). Airspace in theproximity of an aerodrome but beyond the LFFZ where the irradiance is restricted to a level unlikely to cause glare effects.

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

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

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

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

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

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

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

Non-instrument runway. A runway intended for the operationof aircraft using visual approach procedures.

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

Obstacle. All fixed (whether temporary or permanent) andmobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

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

Orthometric height. Height of a point related to the geoid,generally presented as an MSL elevation.
Note 2 – Gravity-related heights (elevations) are also referred to as orthometric heights while distances of points above the ellipsoid are referred to as ellipsoidal heights.

Pavement Classification Number (PCN). A number expressingthe bearing strength of a pavement for unrestricted operations.

Precision approach runway, see Instrument runway.

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

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

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

Road-holding position. A designated position at whichvehicles may be required to hold.

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

Runway End Safety Area (RESA). An area symmetrical about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an airplane undershooting or overrunning the runway.

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

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

Note – In radiotelephony phraseologies, the expression «holding point» is used to designate the runway holding position.

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

a) to reduce the risk of damage to aircraft running off a runway; and

b) to protect aircraft flying over it during take-off or landing operations.

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

Runway Visual Range (RVR). The range over which the pilotof an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

Safety Management System (SMS). A system for the management ofsafety at aerodromes, including the organizational structure, responsibilities, procedures, processes and provisions for the implementation of aerodrome safety policies by an aerodrome operator, which provides for control of safety at, and the safe use of, the aerodrome.

Shoulder. An area adjacent to the edge of a pavement soprepared as to provide a transition between the pavement and the adjacent surface.

Sign.

a) Fixed message sign. A sign presenting only one message.

b) Variable message sign. A sign capable of presenting several pre-determined messages or no message, as applicable.

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

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

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

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

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

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

a) **Aircraft stand taxi lane**. A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

b) **Apron taxiway**. A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.

c) **Rapid exit taxiway** . A taxiway connected to a runway at an acute angle and designed to allow landing airplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

Taxiway intersection. A junction of two or more taxiways.

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

Threshold. The beginning of that portion of the runway usablefor landing.

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

Usability factor. The percentage of time during which the useof a runway or system of runways is not restricted because of the cross-wind component.

Note – Crosswind component means the surface wind component at right angles to the runway centre line.

1.2 Applicability

1.2.1 The interpretation of some of the specifications herein expressly requires the exercising of discretion, the taking of a decision or the performance of a function. The responsibility for whatever determination or action is necessary shall rest with the Aerodrome Authority having jurisdiction over the aerodrome.

1.2.2 The specifications, unless otherwise indicated in a particular context, shall apply to all aerodromes open to public use in accordance with the requirements of Article 15 of the Convention. The specifications of this part Chapter 3 shall apply only to land aerodromes. The specifica-

tions in this regulation shall apply, where appropriate, to heliports but shall not apply to stolports.

Note – Although there are at present no specifications relating to stolports, it is intended that specifications for these aerodromes will be included as they are developed. In the interim, guidance material on stolports is given in the Stolport Manual.

1.2.3 Wherever a color is referred to herein, the specifications for that color given in Appendix 1 shall apply.

1.3 Common reference systems

1.3.1 Horizontal reference system

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

Note – aerodrome operators shall consult WGS-84 is contained in the World Geodetic System – 1984 (WGS-84) Manual (Doc 9674) when determining coordinates and orthometric height of points on the aerodrome.

1.3.2 Vertical reference system

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

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

1.3.3 Temporal reference system

1.3.3.1 The Gregorian calendar and Coordinated Universal Time (UTC) shall be used as the temporal reference system.

1.4 Certification of aerodromes

1.4.1 All aerodromes open to public use within the Netherlands Antilles shall be in the possession of an aerodrome certificate issued by the Minister of Traffic and Transport of the Netherlands Antilles by means of established criteria as mentioned in article 173, paragraph 2 of the Government Decree on Civil Aviation Safety Oversight (Landsbesluit Toezicht Luchtvaart).

1.4.2 Open

1.4.3 Open

1.4.4 A certified aerodrome shall have in operation a safety management system.

Note – The intent of a safety management system is to have in place an organized and orderly approach in the management of aerodrome safety by the aerodrome operator. Guidance on an aerodrome safety

management system is given in the Manual on Certification of Aerodromes.

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

1.5 Airport design

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

Note – Guidance on all aspects of the planning of aerodromes including security considerations is contained in the Airport Planning Manual, Part 1.

1.5.2 The design of aerodromes shall take into account, where appropriate, land-use and environmental control measures.

Note – Guidance on land-use planning and environmental control measures is contained in the Airport Planning Manual, Part 2.

1.6 Reference code

Note – The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the airplanes 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 airplane performance characteristics and dimensions. Element 1 is a number based on the airplane reference field length and element 2 is a letter based on the airplane wing span and outer main gear wheel span. A particular specification is related to the more appropriate of the two elements of the code or to an appropriate combination of the two code elements. The code letter or number within an element selected for design purposes is related to the critical airplane characteristics for which the facility is provided. When applying this document, the airplanes which the aerodrome is intended to serve are first identified and then the two elements of the code.

1.6.1 An aerodrome reference code – code number and letter – which is selected for aerodrome planning purposes shall be determined in accordance with the characteristics of the airplane for which an aerodrome facility is intended.

1.6.2 The aerodrome reference code numbers and letters shall have the meanings referred to them in Table 1-1.

1.6.3 The code number for element 1 shall be determined from Table 1-1, column 1, selecting the code number corresponding to the highest value of the airplane reference field lengths of the airplanes for which the runway is intended.

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

1.6.4 The code letter for element 2 shall be determined from Table 1-1, column 3, by selecting the code letter which corresponds to the greatest wing span, or the greatest outer main gear wheel span, whichever gives the more demanding code letter of the airplanes for which the facility is intended.

Table 1-1. Aerodrome reference code
(see 1.6.2 to 1.6.4)

Code element 1		Code element 2		
Code number (1)	Aeroplane reference field length (2)	Code letter (3)	Wing span (4)	Outer main gear wheel span[a] (5)
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m

a. Distance between the outside edges of the main gear wheels.

Note – Guidance on planning for airplanes with wing spans greater than 80 m is given in the Aerodrome Design Manual, Parts 1 and 2.

CHAPTER 2. AERODROME DATA

2.1 Aeronautical data

2.1.1 Determination and reporting of aerodrome related aeronautical data shall be in accordance with the accuracy and integrity requirements set forth in Tables 1 to 5 contained in Appendix 5 while taking into account the established quality system procedures. Accuracy requirements for aeronautical data are based upon a 95 per cent confidence level and in that respect, three types of positional data shall be identified: surveyed points (e.g. runway threshold), calculated points (mathematical calculations from the known surveyed points of points in space, fixes) and declared points (e.g. flight information region boundary points).
Note – Specifications governing the quality system are given in Annex 15, Chapter 3.

2.1.2 The integrity of aeronautical data is maintained throughout the data process from survey/origin to the next intended user. Aeronautical data integrity requirements shall be based upon the potential risk resulting from the corruption of data and upon the use to which the data item is put. Consequently, the following classification and data integrity level shall apply:

a) critical data, integrity level 1 × 10–8: there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe;

b) essential data, integrity level 1 × 10–5: there is a low probability when using corrupted essential data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe; and

c) routine data, integrity level 1 × 10–3: there is a very low probability when using corrupted routine data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe.

2.1.3 Protection of electronic aeronautical data while stored or in transit shall be totally monitored by the cyclic redundancy check (CRC). To achieve protection of the integrity level of critical and essential aeronautical data as classified in 2.1.2, a 32 or 24 bit CRC algorithm shall apply respectively.

2.1.4 To achieve protection of the integrity level of routine aeronautical data as classified in 2.1.2, a 16 bit CRC algorithm shall apply.

Note – Guidance material on the aeronautical data quality requirements (accuracy, resolution, integrity, protection and traceability) is contained in the World Geodetic System – 1984 (WGS-84) Manual (Doc 9674). Supporting material in respect of the provisions of Appendix 5 related to accuracy and integrity of aeronautical data, is contained in RTCA Document DO-201A and European Organization for Civil Aviation Equipment (EUROCAE) Document ED-77, entitled Industry Requirements for Aeronautical Information.

2.1.5 Geographical coordinates indicating latitude and longitude shall be determined and reported to the aeronautical information services authority in terms of the World Geodetic System – 1984 (WGS-84) geodetic reference datum, identifying those geographical coordinates which have been transformed into WGS-84 coordinates by mathematical means and whose accuracy of original field work does not meet the requirements in Appendix 5, Table A5-1.

2.1.6 The order of accuracy of the field work shall be such that the resulting operational navigation data for the phases of flight will be within the maximum deviations, with respect to an appropriate reference frame, as indicated in tables contained in Appendix 5.

2.1.7 In addition to the elevation (referenced to mean sea level) of the specific surveyed ground positions at aerodromes, geoid undulation (referenced to the WGS-84 ellipsoid) for those positions as indicated in Appendix 5, shall be determined and reported to the aeronautical information services authority.

Note 1 – An appropriate reference frame is that which enables WGS-84 to be realized on a given aerodrome and with respect to which all coordinate data are related.

Note 2 – Specifications governing the publication of WGS-84 coordinates are given in Part 4, Chapter 2 and Annex 15, Chapter 3.

2.2 Aerodrome reference point

2.2.1 An aerodrome reference point shall be established for an aerodrome.

2.2.2 The aerodrome reference point shall be located near the initial or planned geometric centre of the aerodrome and shall normally remain where first established.

2.2.3 The position of the aerodrome reference point shall be measured and reported to the Aeronautical Information Services in degrees, minutes and seconds.

2.3 Aerodrome and runway elevations

2.3.1 The aerodrome elevation and geoid undulation at the aerodrome elevation position shall be measured to the accuracy of one-half meter or foot and reported to the aeronautical information services authority.

2.3.2 For an aerodrome used by international civil aviation for non-precision approaches, the elevation and geoid undulation of each threshold, the elevation of the runway end and any significant high and low intermediate points along the runway shall be measured to the accuracy of one-half meter or foot and reported to the aeronautical information services authority.

2.3.3 For precision approach runway, the elevation and geoid undulation of the threshold, the elevation of the runway end and the highest elevation of the touchdown zone shall be measured to the accuracy of one-quarter meter or foot and reported to the aeronautical information services authority.

Note – Geoid undulation must be measured in accordance with the appropriate system of coordinates.

2.4 Aerodrome reference temperature

2.4.1 An aerodrome reference temperature shall be determined for an aerodrome in degrees Celsius.

2.4.2 The aerodrome reference temperature shall be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature). This temperature shall be averaged over a period of years.

2.5 Aerodrome dimensions and related information

2.5.1 The following data shall be measured or described, as appropriate, for each facility provided on an aerodrome:

a) runway – true bearing to one-hundredth of a degree, designation number, length, width, displaced threshold location to the nearest meter or foot, slope, surface type, type of runway and, for a precision approach runway category I, the existence of an obstacle free zone when provided;

b) strip, runway end safety area, stopway: width to the nearest meter or foot, surface type;

c) taxiway – designation, width, surface type;

d) apron – surface type, aircraft stands;

e) the boundaries of the air traffic control service;

f) clearway – length to the nearest meter or foot, ground profile;

g) visual aids for approach procedures, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including taxi-holding positions and stopbars, and location and type of visual docking guidance systems;

h) location and radio frequency of any VOR aerodrome check-point;

i) location and designation of standard taxi-routes; and

j) distances to the nearest meter or foot of localizer and glide path elements comprising an instrument landing system (ILS) or azimuth and elevation antenna of microwave landing system (MLS) in relation to the associated runway extremities.

2.5.2 The geographical coordinates of each threshold shall be measured and reported to the Aeronautical Information Services in degrees, minutes, seconds and hundredths of seconds.

2.5.3 Open.

2.5.4 The geographical coordinates of each aircraft stand shall be measured and reported to the Aeronautical Information Services in degrees, minutes, seconds and hundredths of seconds.

2.5.5 The geographical coordinates of obstacles in Area 2 (the part within the aerodrome boundary) and in Area 3 shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation, type, marking and lighting (if any) of obstacles shall be reported to the aeronautical information services authority.

Note 1 – See Annex 15, Appendix 8, for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in Areas 2 and 3.

Note 2 – Appendix 5 provides requirements for obstacle data determination in Areas 2 and 3.

2.6 Strength of pavements

2.6.1 The bearing strength of a pavement shall be determined.

2.6.2 The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5700 kg shall be made available using the aircraft classification number – pavement classification number (ACN-PCN) method by reporting all of the following information:

a) the pavement classification number (PCN);

b) pavement type for ACN-PCN determination;

c) subgrade strength category;

d) maximum allowable tire pressure category or maximum allowable tire pressure value; and

e) evaluation method.

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

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

2.6.4 The ACN of an aircraft shall be determined in accordance with the standard procedures associated with the ACN-PCN method as indicated in the Aerodrome Design Manual Part 3.

Note – The standard procedures for determining the ACN of an aircraft are given in the Aerodrome Design Manual, Part 3. For convenience several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade categories in 2.6.6 b) below and the results tabulated in that manual.

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

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

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

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

b) Subgrade strength category:	Code
High strength: characterized by K = 150 MN/m3 and representing all K values above 120 MN/m3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.	A
Medium strength: characterized by K = 80 MN/m3 and representing a range in K of 60 to 120 MN/m3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.	B
Low strength: characterized by K = 40 MN/m3 and representing a range in K of 25 to 60 MN/m3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.	C
Ultra low strength: characterized by K = 20 MN/m3 and representing all K values below 25 MN/m3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.	D

c) Maximum allowable tire pressure category:	Code
High: no pressure limit	W
Medium: pressure limited to 1.50 MPa	X
Low : pressure limited to 1.00 MPa	Y
Very low: pressure limited to 0.50 MPa	Z

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

Note – The following examples illustrate how pavement strength data are reported under the ACN-PCN method.

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

Example 2 – If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCN 50 and the maximum tire pressure allowable is 1.00 MPa, then the reported information would be: PCN 50 / F / A / Y / U

Note – Composite construction.

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

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

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

2.6.7 Aerodrome operators shall establish criteria to regulate the use of a pavement by an aircraft with an ACN higher than the PCN reported for that pavement in accordance with 2.6.2 and 2.6.3.

Note – Attachment A, Section 19 details a simple method for regulating overload operations while the Aerodrome Design Manual, Part 3 includes the descriptions of more detailed procedures for evaluation of pavements and their suitability for restricted overload operations.

2.6.8 The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5700 kg shall be made available by reporting the following information:
a) maximum allowable aircraft mass; and
b) maximum allowable tire pressure.

Example: 4000 kg/0.50 MPa.

2.7 Pre-flight altimeter check location

2.7.1 One or more pre-flight altimeter check locations shall be established for an aerodrome.

2.7.2 A pre-flight check location shall be located on an apron.

Note 1 – Locating a pre-flight altimeter check location on an apron enables an altimeter check to be made prior to obtaining taxi clearance and eliminates the need for stopping for that purpose after leaving the apron.

Note – Normally an entire apron can serve as a satisfactory altimeter check location.

2.7.3 The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest meter or foot, of the area on which it is located. The elevation of any portion of a pre-flight altimeter check location shall be within 3 m (10 ft) of the average elevation for that location.

2.8 Declared distances

The following distances shall be calculated to the nearest meter or foot for a runway intended for use by international commercial air transport:
a) take-off run available;
b) take-off distance available;
c) accelerate-stop distance available; and
d) landing distance available.

Note – Guidance on calculation of declared distances is given in Attachment A, Section 3.

2.9 Condition of the movement area and related facilities

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

2.9.2 The condition of the movement area and the operational status of related facilities shall be monitored and reports on matters of operational significance or affecting aircraft performance given, particularly in respect of the following:

a) construction or maintenance work;

b) rough or broken surfaces on a runway, a taxiway or an apron;

d) water on a runway, a taxiway or an apron;

g) other temporary hazards, including parked aircraft;

h) failure or irregular operation of part or all of the aerodrome visual aids; and

i) failure of the normal or secondary power supply.

2.9.3 To facilitate compliance with 2.9.1 and 2.9.2 inspections of the movement area shall be carried out each day at least once where the code number is 1 or 2 and at least twice where the code number is 3 or 4.

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

Water on a runway

2.9.4 Whenever water is present on a runway, a description of the runway surface conditions on the centre half of the width of the runway, including the possible assessment of water depth, where applicable, shall be made available using the following terms:

DAMP – the surface shows a change of color due to moisture.

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

WATER PATCHES – significant patches of standing water are visible.

FLOODED – extensive standing water is visible.

2.9.5 Information that a runway or portion thereof may be slippery when wet shall be made available.

2.9.6 A runway or portion thereof shall be determined as being slippery when wet when the measurements specified in 10.2.3 show that the runway surface friction characteristics as measured by a continuous friction measuring device are below the minimum friction level specified by the State.

Note – Guidance on determining and expressing the minimum friction level is provided in Attachment A, Section 7.

2.9.7 Information on the minimum friction level specified by the State for reporting slippery runway conditions and the type of friction measuring device used shall be made available.

2.9.8 When it is suspected that a runway may become slippery under unusual conditions, then additional measurements shall be made when such conditions occur, and information on the runway surface friction characteristics made available when these additional measurements show that the runway or a portion thereof has become slippery.

2.10 Disabled aircraft removal

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

2.10.2 Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area shall be made available to the Directorate of Civil Aviation Netherlands Antilles, aircraft operators and the Aeronautical Information Service.

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

2.11 Rescue and fire fighting

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

2.11.2 The level of protection normally available at an aerodrome shall be expressed in terms of the category of the rescue and fire fighting services as described in 9.2 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

2.11.3 Significant changes in the level of protection normally available at an aerodrome for rescue and fire fighting shall be notified to Air Traffic Services and Aeronautical Information Services to enable those units to provide the necessary information to arriving and departing aircraft. When such a change has been corrected, the above units shall be advised accordingly.

Note – A significant change in the level of protection is considered to be a change in the category of the rescue and fire fighting service from the category normally available at the aerodrome, resulting from a change in availability of extinguishing agents, equipment to deliver the agents or personnel to operate the equipment, etc.

2.11.4 A significant change shall be expressed in terms of the new category of the rescue and fire fighting service available at the aerodrome.

2.12 Visual approach slope indicator systems

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

a) associated runway designation number;

b) type of system according to 5.3.5.2. For an AT-VASIS, PAPI or APAPI installation, the side of the runway on which the lights are installed, i.e. left or right, shall be given;

c) where the axis of the system is not parallel to the runway centre line, the angle of displacement and the direction of displacement, i.e. left or right shall be indicated;

d) nominal approach slope angle(s). For a T-VASIS or an AT-VASIS this shall be angle θ according to the formula in Figure 5-17 and for a PAPI and an APAPI this shall be angle (B + C) ÷ 2 and (A + B) ÷ 2, respectively as in Figure 5-19; and

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

2.13 Coordination between Aeronautical Information Services and aerodrome authorities

2.13.1 To ensure that Aeronautical Information Services obtains information to enable the provision of up-to-date pre-flight information and to meet the need for in-flight information, arrangements shall be made between Aeronautical Information Services and aerodrome authorities responsible for aerodrome services to report to Aeronautical Information Services, with a minimum of delay:

a) information on aerodrome conditions (ref. 2.9, 2.10, 2.11 and 2.12);

b) the operational status of associated facilities, services and navigation aids within their area of responsibility; c) any other information considered to be of operational significance.

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

2.13.3 Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system, as specified in Annex 15, Chapter 6 and Appendix 4. The predetermined, internationally agreed AIRAC effective dates in addition to 14 days postage time shall be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

2.13.4 The aerodrome services responsible for the provision of raw aeronautical information/data to the aeronautical information services shall do that while taking into account accuracy and integrity requirements for aeronautical data as specified in Appendix 5 to this Part.

Note 1 – Specifications for the issue of a NOTAM is contained in Annex 15, Chapter 5 and Appendix 6.

Note 2 – AIRAC information is distributed by the AIS at least 42 days in advance of the AIRAC effective dates with the objective of reaching recipients at least 28 days in advance of the effective date.

Note 3 – The schedule of the predetermined internationally agreed AIRAC common effective dates at intervals of 28 days, including 6 November 1997 and guidance for the AIRAC use are contained in the Aeronautical Information Services Manual (Doc 8126, Chapter 2).

2.14 Aerodrome Information to be provided to the AIS office

2.14. 1 **Aerodrome diagram.** An aerodrome diagram must be provided to illustrate:
(a) layout of runways, taxiways and apron(s);
(b) nature of the runway surfaces;
(c) designations and length of runways;
(d) designations of the taxiways, where applicable;
(e) location of illuminated and non-illuminated wind direction indicators;
(f) location of the aerodrome reference point;
(g) the direction and distance to the nearest town;
(h) location of terminal buildings; and
(i) location of helipads.

2.14.2 **Aerodrome administration.** This must include:
(a) name, address, telephone and facsimile numbers of the aerodrome operator; including after hours contacts;
(b) aerodrome usage, public or private;
(c) aerodrome charges, where notification is desired.

2.14.3 **Aerodrome location.** This information must include;
(a) name of aerodrome;
(b) State or Territory of Australia;
(c) World Aeronautical Chart number, if known;
(d) latitude and longitude, based on the aerodrome reference point;
(e) magnetic variation;
(f) time conversion-universal time coordinated (UTC) plus local time difference;
(g) AVFAX and «Y» location code indicator, if known;
(h) aerodrome elevation;
(i) currency of Type A charts, if provided.

2.14.4 **Movement area.** Must include for each runway designation;
(a) aerodrome reference code number;
(b) runway bearings-in degrees magnetic;
(c) runway length and surface type;
(d) runway pavement strength rating;
(e) runway and runway strip width;
(f) runway slope;
(g) runway declared distances, and STODA.
(h) elevation of the mid point of runway threshold, for instrument runways.

2.14.5 **Lighting systems.** This information must include;
(a) lighting systems for runways;
(b) approach lighting system;
(c) visual approach slope indicator system;
(d) pilot activated lighting;
(e) aerodrome beacon;
(f) lighting systems for taxiways; and
(g) any other lighting systems.

2.14.6 **Navigation aids.** Details of any navigation aid, which is provided by the aerodrome operator.

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

2.14.8 **Ground services.** This information must include:
(a) fuel suppliers and their contact details, including after hours;
(b) automatic weather information broadcast if provided by aerodrome operator;
(c) ground to air communication systems such as Unicom, aerodrome frequency response unit (AFRU) or approved air ground operator service provided by the aerodrome operator, and
(d) any other services available to pilots.

2.14.9 **Special procedures.** Include any special procedures unique to the aerodrome, which pilots need to be advised; in cases where the flying procedure is generated by the aerodrome operator.

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

2.14.11 **Aeronautical data quality requirements**
a. The altitude and longitude of points mentioned in Table A5-1 of Appendix 5 of this part;
b. elevation/height of points mentioned Table A5-1 of Appendix 5 of this part;
c. declination and magnetic variation of points mentioned in Table A5-3 of Appendix 5 of this part;
d. the bearing of points mentioned in Table A5-4 of Appendix 5 of this part;
e. the lengths/ distance/dimensions of elements mentioned Table A5-5 of Appendix 5 of this part.

CHAPTER 3. PHYSICAL CHARACTERISTICS

3.1 Runways

Number and orientation of runways

Note. – Many factors affect the determination of the orientation, siting and number of runways.

One important factor is the usability factor, as determined by the wind distribution, which is specified hereunder. Another important factor is the alignment of the runway to facilitate the provision of approaches conforming to the approach surface specifications of Chapter 4. In Attachment A, Section 1, information is given concerning these and other factors.

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

3.1.1 The number and orientation of runways at an aerodrome shall be such that the usability factor of the aerodrome is not less than 95 per cent for the airplanes that the aerodrome is intended to serve.

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

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

3.1.3 Choice of maximum permissible cross-wind components

In the application of 3.1.1 it shall be assumed that landing or take-off of airplanes is, in normal circumstances, precluded when the cross-wind component exceeds:

– 37 km/h (20 kt) in the case of airplanes whose reference field length is 1500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a cross-wind component not exceeding 24 km/h (13 kt) shall be assumed;

– 24 km/h (13 kt) in the case of airplanes whose reference field length is 1200 m or up to but not including 1500 m; and

– 19 km/h (10 kt) in the case of airplanes whose reference field length is less than 1200 m.

Note – In Attachment A, Section 1, guidance is given on factors affecting the calculation of the estimate of the usability factor and allowances which may have to be made to take account of the effect of unusual circumstances.

3.1.4 Data to be used

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

Note – These winds are mean winds. Reference to the need for some allowance for gusty conditions is made in Attachment A, Section 1.

Location of threshold

3.1.5 A threshold shall normally be located at the extremity of a runway unless operational considerations justify the choice of another location.

Note – Guidance on the siting of the threshold is given in Attachment A, Section 10.

3.1.6 When it is necessary to displace a threshold, either permanently or temporarily, from its normal location, account shall be taken of the various factors which may have a bearing on the location of the threshold. Where this displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 m in length shall be available between the unserviceable area and the displaced threshold. Additional distance shall also be provided to meet the requirements of the runway end safety area as appropriate.

Note – Guidance on factors which may be considered in the determination of the location of a displaced threshold is given in Attachment A, Section 10.

Actual length of runways

3.1.7 Primary runway

Exceptas provided in 3.1.9, theactual runway length to be provided for a primary runway shall be adequate to meet the operational requirements of the airplanes for which the runway is intended and shall be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant airplanes.

Note 1 – This specification does not necessarily mean providing for operations by the critical airplane at its maximum mass.

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

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

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

3.1.8 Secondary runway

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

3.1.9 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 3.1.7 or 3.1.8, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided shall permit compliance with the operational requirements for take-off and landing of the airplanes the runway is intended to serve.

Note – Guidance on use of stopways and clearways is given in Attachment A, Section 2.

Width of runways

3.1.10 The width of a runway shall be not less than the appropriate dimension specified in the following tabulation:

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

Code letter

Code number	A	B	C	D	E	F
1[a]	*18 m*	*18 m*	*23 m*	–	–	–
2[a]	*23 m*	*23 m*	*30 m*	–	–	–
3	*30 m*	*30 m*	*30 m*	*45 m*	–	–
4	–	–	*45 m*	*45 m*	*45 m*	*60 m*

Note 1 – The combinations of code numbers and letters for which widths are specified have been developed for typical airplane characteristics.

Note 2 – Factors affecting runway width are given in the Aerodrome Design Manual, Part 1.

3.1.10. 1 Where additional runway distances are required for take-off, these may be achieved by adding a starter extension to the beginning of the runway. Provided this extension is not more than 150 m in length, its width may be reduced to not less than two-thirds of the normal requirement (see paragraph 3.1.10).

It may be necessary to provide extra width at the end of a runway or starter extension to enable airplanes to turn around.

3.1.12 open

Slopes on Runways

3.1.13 Longitudinal Slopes

The slope computed by dividing difference between the maximum and minimum elevation along the runway along the runway centerline by the runway length shall not exceed:
– 1 per cent where the code number is 3 or 4; and
– 2 per cent where the code number is 1 or 2.

3.1.14 Along no portion of the runway shall the longitudinal slope exceed:

– 1.25 per cent where the code number is 4, except that for the first and last quarter of the length of the runway, the longitudinal slope shall not exceed 0.8 per cent.
– 1.5 per cent where the code number is 3, except that for the first and last quarter of the length of a precision approach runway category II or III, the longitudinal slope shall not exceed 0.8 per cent.
– 2 per cent where the code number is 1 or 2.

3.1.15 Longitudinal slope changes

Where slope changes cannot be avoided, a slope change between two consecutive slopes shall not exceed:
– 1.5 per cent where the code number is 3 or 4, and
– 2 per cent where the code number is 1 or 2.

Note – Guidance on slope changes before a runway are given in Attachment A, Section 4.

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

– 0.1 per cent per 30m (minimum radius of curvature of 30000m) where the code number is 4;
– 0.2 per cent per 30m (minimum radius of curvature of 15000m) where the code number is 3;
– 0.4 per cent per 30m (minimum radius of curvature of 5700m) where the code number is 1 or 2.

3.1.17 Sight distance

Where slope changes cannot be avoided, they shall be such that there will be an unobstructed line of sight from:
any point 3m above a runway to all other points 3m above the runway within a distance of at least half the length of the runway where the code letter is C, D, E or F
any point 2 m above a runway to all other points 2 m above the runway within a distance of at least half the length of the runway where the code letter is B; and
any point 1.5 m above a runway to all other points 1.5 m above the runway within a distance of at least half the length of the runway where the code letter is A.

Note. Consideration will have to be given to providing an unobstructed line of sight over the entire length of a single runway where a full-length parallel taxiway is not available. Where an aerodrome has intersecting runways, additional criteria on the line of sight of the intersection area would need to be considered for operational safety. See the Aerodrome Design Manual, Part I.

3.1.18 Distance between slope changes

Undulations or appreciable changes in slopes located close together along a runway shall be avoided. The distance between the points of intersection of two successive curves shall not be less than:
a) the sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value as follows:
30 000 m where the code number is 4;
15 000 m where the code number is 3; and
5 000 m where the code number is 1 or 2; or
b) 45 m; whichever is greater.

Note. Guidance on implementing this specification is given in Attachment A, Section 4.

3.1.19 Transverse slopes

To promote the most rapid drainage of water, the runway surface shall, f practicable, be cambered except where a single crossfall from high to low in the direction of the wind most frequently associated with rain would ensure rapid drainage. The transverse slope shall ideally be:
1.5 per cent where the code letter is C, D, E or F; and
2 per cent where the code letter is A or B;

but in any event shall not exceed 1.5 per cent or 2 per cent, as applicable, nor be less than 1 per cent except at runway or taxiway intersections where flatter slopes may be necessary.

For a cambered surface the transverse slope on each side of the center line shall be symmetrical.

Note. On wet runways with cross-wind conditions the problem of aquaplaning from poor drainage is apt to be accentuated. In Attachment A, Section 7 information is given concerning this problem and other relevant factors.

3.1.20 The transverse slope shall be substantially the same throughout the length of a runway except at an intersection with another runway or a taxiway where an even transition shall be provided taking account of the need for adequate drainage.

Note. Guidance on transverse slope is given in the Aerodrome Design Manual, Part 3.

Strength of runways

3.1.21 A runway shall be capable of withstanding the traffic of airplanes the runway is intended to serve.

Surface of runways

3.1.22 The surface of a runway shall be constructed without irregularities that would result in loss in friction
characteristics or otherwise adversely affect the take-off or landing of an airplane.

Note 1. Surface irregularities may adversely affect the take-off or landing of an airplane by causing excessive bouncing, pitching, vibration, or other difficulties in the control of an airplane.

Note 2. Guidance on design tolerances and other information is given in Attachment A, Section 5. Additional guidance is included in the Aerodrome Design Manual, Part 3.

3.1.23 The surface of a paved runway shall be so constructed as to provide good friction characteristics when the runway is wet.

3.1.24 Measurement of the friction characteristics of a new or resurfaced runway shall be made with a continuous friction measuring device using self-wetting features in order to assure that the design objectives with respect to its friction characteristics have been achieved.

Note. Guidance on friction characteristics of new runway surfaces is given in Attachment A, Section 7. Additional guidance is included in the Airport Services Manual, Part 2.

3.1.25 The average surface texture depth of a new surface shall be not less than 1.0 mm.

Note 1. This normally requires some form of special surface treatment.

Note 2. Guidance on methods used to measure surface texture is given in the Airport Services Manual, Part 2.

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

Note Guidance on methods for improving the runway surface texture is given in the Aerodrome Design Manual, Part 3.

3.2 Runway shoulders

General

Note. Guidance on characteristics and treatment of runway shoulders is given in Attachment A, Section 8, and in the Aerodrome Design Manual, Part 1.

3.2.1 Runway shoulders shall be provided for a runway where the code letter is D or E, and the runway width is less than 60 m.

3.2.2 Runway shoulders shall be provided for a runway where the code letter is F

Width of runway shoulders

Note: Strong crosswinds may result in significant deviation from the runway centerline.
With some large aircraft the wing-mounted engines may overhang the runway
edge and there is then 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.
To overcome the potential problems indicated above, runway shoulders
should be provided for runways where the code letter is D or E, except that this is
not necessary where the runway width is 60 m or more.
Runway shoulders should extend symmetrically on both sides of the runway so
that the overall width of runway plus shoulders is not less than 60 m.

3.2.3 The runway shoulders shall extend symmetrically on each side of the runway so that the overall width of the runway and its shoulders is not less than:
60 m where the code letter is D or E and
75 m where the code letter is F

Slopes on runway shoulders

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

Strength of runway shoulders

3.2.5 A runway shoulder shall be prepared or constructed so as to be capable, in the event of an airplane running off the runway, of supporting the airplane without inducing structural damage to the airplane and of supporting ground vehicles which may operate on the shoulder.

Note. Guidance on strength of runway shoulders is given in the Aerodrome Design Manual, Part I.

3.3 Runway turn pads

General

3.3.1 Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is
D, E or F, a runway turn pad shall be provided to facilitate a 180-degree turn of airplanes. (See Figure 3-1.)

3.3.2 Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is A, B or C, a runway turn pad shall be provided to facilitate a 180-degree turn of airplanes.

Note 1. Such areas may also be useful f provided along a runway to reduce taxiing time and distance for airplanes which may not require the full length of the runway.

Note 2. Guidance on the design of the runway turn pads is available in the Aerodrome Design Manual, Part I. Guidance on taxiway turnaround as an alternate facility is available in the Aerodrome Design Manual, Part 2.

3.3.3 The runway turn pad may be located on either the left or right side of the runway and adjoining the runway pavement at both ends of the runway and at some intermediate locations where deemed necessary.

Note The initiation of the turn would be facilitated by locating the turn pad on the left side of the runway, since the left seat is the normal position of the pilot-in-command.

3.3.4 The intersection angle of the runway turn pad with the runway shall not exceed 30 degrees.

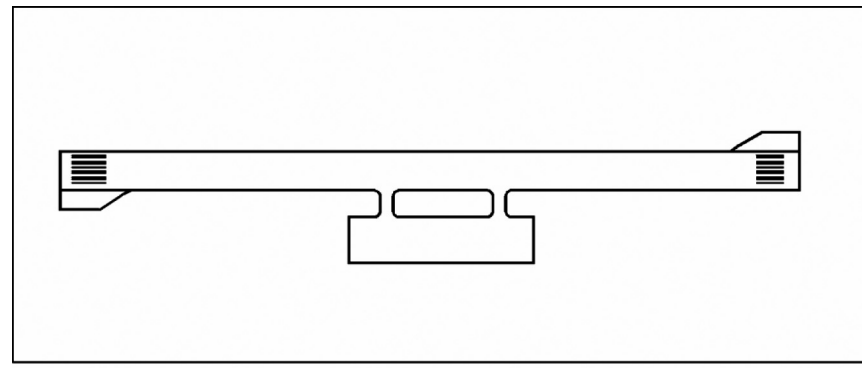


Figure 3-1. Typical turn pad layout

3.3.5 Recommendation. The nose wheel steering angle to be used in the design of the runway turn pad shall not exceed 45 degrees.

3.3.6 The design of a runway turn pad shall be such that, when the cockpit of the airplane for which the turn pad is intended remains over the turn pad marking, the clearance distance between any wheel of the airplane landing gear and the edge of the turn pad shall be not less than that given by the following tabulation:

Code letter	Clearance
A	1.5m
B	2.25m
C	3 m if the turn pad is intended to be used by airplanes with a wheel base less than 18 m; 4.5 m if the turn pad is intended to be used by airplanes with a wheel base equal to or greater than 18 m.
D	4.5m
E	4.5m
F	4.5m

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

3.3.7 Where severe weather conditions and resultant lowering of surface friction characteristics prevail, a larger wheel-to-edge clearance of 6 m shall be provided where the code letter is E or F.

Slopes on runway turn pads

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

Strength of runway turn pads

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

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

Surface of runway turn pads

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

3.3.11 The surface of a runway turn pad shall be so constructed as to provide good friction characteristics for airplanes using the facility when the surface is wet.

Shoulders for runway turn pads

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

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

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

3.4 Runway strips

Note A runway strip is an area enclosing a runway and any associated stopway. Its purpose is to:

(a) reduce the risk of damage to an airplane running off the runway by providing a graded area which meets specified longitudinal and transverse slopes, and bearing strength requirements, and

(b) protect airplanes flying over it during landing, balked landing or take-off by providing an area which is cleared of obstacles except permitted aids to air navigation.

Ideally the whole of a runway strip should be clear of obstacles but in practice it is recognized that the strip facilitates the installation of visual, radio and radar aids, and some of these cannot perform their function if they are sited outside the runway strip. Equipment essential to an approach, landing or balked landing is permitted within the runway strip provided thatthe entire structure complies with the frangibility requirements.

Drainage channels, catch pits and other essential design features at aerodromes should not constitute hazards to airplanes. Whenever possible, items which are not required to be at ground level should be buried to a depth of not less than 0.45 m. Within the graded area of the runway strip constructions such as plinths, runway ends, paved taxiway edges, etc 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.

To eliminate a buried vertical surface, a slope should be provided which extends from the top of the construction to not less than 0.3 m below ground level. The slope should be no greater than 1:10.

Agricultural crops other than long grass should not be grown within the runway strip since they would either conflict with the requirements of paragraph 4.1.1(a), provide a bird-attractive environment or be a fire hazard. See paragraph 11.3.3.

The total area within the runway strip should be capable of supporting unrestricted access for emergency service vehicles.

General

3.4.1 A runway and any associated stopways shall be included in a strip.

Length of runway strips

3.4.2 A runway strip shall extend beyond each end of a runway and of any associated stopway for a distance of at least 60 m where the code number is 2, 3 or 4, and where the code number is 1 and the runway is an instrument runway. When the code number is 1 and the runway is a non-instrument runway the distance shall be 30 m.

When a starter extension is provided (paragraph 3.2.2) the runway strip before the starter extension need only provide for wing overhang plus a safety margin of 7.5 m or 20% of wingspan, whichever is the greater. This distance may need to be increased for other factors, e.g. blast (see Fig 3.2).

A strip shall extend before the threshold and beyond the end of the runway or stopway for a distance of at least:

60 m where the code number is 2, 3 or 4;

60 m where the code number is 1 and the runway is an instrument one; and

30 m where the code number is 1 and the runway is a non-instrument one.

Width of runway strips

3.4.3 A strip including a precision approach runway shall, wherever practicable, extend laterally to a distance of at least:
150 m where the code number is 3 or 4; and
75 m where the code number is 1 or 2;

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

3.4.4 A strip including a non-precision approach runway shall extend laterally to a distance of at least:
150 m where the code number is 3 or 4; and
75 m where the code number is 1 or 2;

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

3.4.5 A strip including a non-instrument runway shall extend on each side of the centre line of the runway and its extended centre line throughout the length of the strip, to a distance of at least:
75 m where the code number is 3 or 4;
40 m where the code number is 2; and
30 m where the code number is 1.

Objects on runway strips

Note. See 9.9 for information regarding siting of equipment and installations on runway strips.

3.4.6 An object situated on a runway strip which may endanger airplanes shall be regarded as an obstacle and shall, as far as practicable, be removed.

3.4.7 No fixed object, other than visual aids required for air navigation purposes and satisfying the relevant frangibility requirement in Chapter 5, shall be permitted on a runway strip:
a) within 77.5 m of the runway centre line of a precision approach runway category I, II or III where the code number is 4 and the code letter is F; or
b) within &) m of the runway centre line of a precision approach runway category I, II or III where the code number is 3 or 4; or
c) within 45 m of the runway centre line of a precision approach runway category I where the code number is 1 or 2.

No mobile object shall be permitted on this part of the runway strip during the use of the runway for landing or take-off.

Grading of runway strips

3.4.8 That portion of a strip of an instrument runway within a distance of at least:
75 m where the code number is 3 or 4; and
40 m where the code number is 1 or 2;

from the centre line of the runway and its extended centre line shall provide a graded area for airplanes which the runway is intended to serve in the event of an airplane running off the runway.

Note Guidance on grading of a greater area of a strip including a precision approach runway where the code number is 3 or 4 is given in Attachment A, Section 8.

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

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

from the centre line of the runway and its extended centre line shall provide a graded area for airplanes which the runway is intended to serve in the event of an airplane running off the runway.

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

3.4.11 That portion of a strip to at least 30 m before a threshold shall be prepared against blast erosion in order to protect a landing airplane from the danger of an exposed edge.

Slopes on runway strips

3.4.12 Longitudinal slopes

A longitudinal slope along that portion of a strip to be graded shall not exceed:

1.5 per cent where the code number is 4;
1.75 per cent where the code number is 3; and
2 per cent where the code number is 1 or 2.

3.4.13 Longitudinal slope changes

Slope changes on that portion of a strip to be graded shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.

3.4.14 Transverse slopes

Transverse slopes on that portion of a strip to be graded shall be adequate to prevent the accumulation of water on the surface but shall not exceed:

2.5 per cent where the code number is 3 or 4; and
3 per cent where the code number is 1 or 2;

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

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

Strength of runway strips

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

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

from the centre line of the runway and its extended centre line shall be so prepared or constructed as to minimize hazards arising from differences in load bearing capacity to airplanes which the runway is intended to serve in the event of an airplane running off the runway.

Note. Guidance on preparation of runway strips is given in the Aerodrome Design Manual, Part 1.

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

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

from the centre line of the runway and its extended centre line shall be so prepared or constructed as to minimize hazards arising from difference in load bearing capacity to airplanes which the runway is intended to serve in the event of an airplane running off the runway.

3.5 Runway end safety areas

General

3.5.1 A runway end safety area shall be provided at each end of a runway strip where:

the code number is 3 or 4; and
the code number is 1 or 2 and the runway is an instrument one.

Note. Guidance on runway end safety areas is given in Attachment A, Section 9.

Dimensions of runway end safety areas

3.5.2 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m.

3.5.3 A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:

240 m where the code number is 3 or 4; and
120 m where the code number is 1 or 2.

3.5.4 The width of a runway end safety area shall be at least twice that of the associated runway.

3.5.5 The width of a runway end safety area shall, wherever practicable, be equal to that of the graded portion of the associated runway strip.

Objects on runway end safety areas

Note. See 9.9 for information regarding siting of equipment and installations on runway end safety areas.

3.5.6 An object situated on a runway end safety area which may endanger airplanes shall be regarded as an obstacle and shall, as far as practicable, be removed.

Clearing and grading of runway end safety areas

3.5.7 A runway end safety area shall provide a cleared and graded area for airplanes which the runway is intended to serve in the event of an airplane undershooting or overrunning the runway.

Note. The surface of the ground in the runway end safety area does not need to be prepared to the same quality as the runway strip. See, however, 3.5.11.

Slopes on runway end safety areas

3.5.8 General

The slopes of a runway end safety area shall be such that no part of the runway end safety area penetrates the approach or take-off climb surface.

3.5.9 Longitudinal slopes

The longitudinal slopes of a runway end safety area shall not exceed a downward slope of 5 per cent. Longitudinal slope changes shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.

3.5.10 Transverse slopes

The transverse slopes of a runway end safety area shall not exceed an upward or downward slope of 5 per cent. Transitions between differing slopes shall be as gradual as practicable.

Strength of runway end safety areas

3.5.11 A runway end safety area shall be so prepared or constructed as to reduce the risk of damage to an airplane undershooting or overrunning the runway, enhance airplane deceleration and facilitate the movement of rescue and fire fighting vehicles as required in 9.2.26 to 9.2.28.

Note Guidance on strength of a runway end safety area is given in the Aerodrome Design Manual, Part I.

3.6 Clearways

Note. The inclusion of detailed specifications for clearways in this section is not intended to imply that a clearway has to be provided. Attachment A, Section 2 provides information on the use of clearways.

Location of clearways

3.6.1 The origin of a clearway shall be at the end of the take-off run available.

Length of clearways

3.6.2 The length of a clearway shall not exceed half the length of the take-off run available.

Width of clearways

3.6.3 A clearway shall extend laterally to a distance of at least 75 m on each side of the extended centre line of the runway.

Slopes on clearways

3.6.4 The ground in a clearway shall not project above a plane having an upward slope of].25 per cent, the lower limit of this plane being a horizontal line which:

a) is perpendicular to the vertical plane containing the runway centre line; and

b) passes through a point located on the runway centre line at the end of the take-off run available.

Note. Because of transverse or longitudinal slopes on a runway, shoulder or strip, in certain cases the lower limit of the clearway plane specified above may be below the corresponding elevation of the runway, shoulder or strip. It is not intended that these surfaces be graded to conform with the lower limit of the clearway plane nor is it intended that terrain or objects which are above the clearway plane beyond the end of the strip but below the level of the strip be removed unless it is considered they may endanger airplanes.

3.6.5 Abrupt upward changes in slope shall 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 shall generally conform with those of the runway with which the clearway is associated.

Note. See 9.9 for information regarding siting of equipment and installations on clearways.

3.6.6 An object situated on a clear- way which may endanger airplanes in the air shall be regarded as an obstacle and shall be removed.

Objects on clearways

3.7 Stopways

Note. The inclusion of detailed specifications for stop- ways in this section is not intended to imply that a stopway has to be provided. Attachment A, Section 2 provides information on the use of stopways.

Width of stopways

3.7.1 A stopway shall have the same width as the runway with which it is associated.

Slopes on stopways

3.7.2 Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, shall comply with the specifications of 3.1.13 to 3.1.19 for the runway with which the stopway is associated except that:

a) the limitation in 3.1.14 of a 0.8 per cent slope for the first and last quarter of the length of a runway need not be applied to the stopway; and

b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be 0.3 per cent per 30 m (minimum radius of curvature of 10 000 m) for a runway where the code number is 3 or 4.

Strength of stopways

3.7.3 A stopway shall be prepared or constructed so as to be capable, in the event of an abandoned take-off of supporting the airplane which the stopway is intended to serve without inducing structural damage to the airplane.

Note. Attachment A, Section 2 presents guidance relative to the support capability of a stopway.

Surface of stopways

3.7.4 The surface of a paved stopway shall be so constructed as to provide a good coefficient of friction to be compatible with that of the associated runway when the stopway is wet.

3.7.5 The friction characteristics of an unpaved stopway shall not be substantially less than that of the runway with which the stopway is associated.

3.8 Radio altimeter operating area

General

3.8.1 A radio altimeter operating area shall be established in the pre-threshold area of a precision approach runway.

Length of the area

3.8.2 A radio altimeter operating area shall extend before the threshold for a distance of at least 300 m.

Width of the area

3.8.3 A radio altimeter operating area shall extend laterally, on each side of the extended centre line of the runway, to a distance of 60 m, except that, when special circumstances so warrant, the distance may be reduced to no less than 30 m an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft.

Longitudinal slope changes

3.8.4 On a radio altimeter operating area, slope changes shall be avoided or kept to a minimum. Where slope changes cannot be avoided, the slope changes shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes shall not exceed 2 per cent per 30 m.

Note Guidance on radio altimeter operating area is given in Attachment A, Section 4.3 and in the Manual of All Weather Operations, (Doc 9365,), Section 5.2. Guidance on the use of radio altimeter is given in the PANS-OPS, Volume II, Part III, Chapter 21.

3.9 Taxiways

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

General

3.9.1 Taxiways shall be provided to permit the safe and expeditious surface movement of aircraft.

Note. Guidance on layout of taxiways is given in the Aerodrome Design Manual, Part 2.

3.9.2 Sufficient entrance and exit taxiways for a runway shall be provided to expedite the movement of airplanes to and from the runway and provision of rapid exit taxiways considered when traffic volumes are high.

3.9.3 The design of a taxiway shall be such that, when the cockpit of the airplane for which the taxiway is intended remains over the taxiway centre line markings, the clearance distance between the outer main wheel of the airplane and the edge of the taxiway shall be not less than that given by the following tabulation:

Code letter	Clearance
A	1.5m
B	2.25m
C	3 m f the taxiway is intended to be used by airplanes with a wheel base less than 18 m; 4.5 m if the taxiway is intended to be used by airplanes with a wheel base equal to or greater than 18 m.
D	4.5m
E	4.5m
F	4.5m

Note 1. Wheel base means the distance from the nose gear to the geometric centre of the main gear.

Note 2. Where the code letter is F and the traffic density is high, a wheel-to-edge clearance greater than 4.5 m may be provided to permit higher taxiing speeds.

3.9.4 As of 20 November 2008, the design of a taxiway shall be such that, when the cockpit of the airplane for which the taxiway is intended remains over the taxiway centre line markings, the clearance distance between the outer main wheel of the airplane and the edge of the taxiway shall be not less than that given by the following tabulation:

Code letter	Clearance
A	1.5m
B	2.25m
C	3 m if the taxiway is intended to be used by airplanes with a wheel base less than 18 m; 4.5 m if the taxiway is intended to be used by airplanes with a wheel base equal to or greater than 18 m.
D	4.5m
E	4.5m
F	4.5m

Note 1. Wheel base means the distance from the nose gear to the geometric centre of the main gear.

Note 2. Where the code letter is F and the traffic density is high, a wheel-to-edge clearance greater than 4.5 m may be provided to permit higher taxiing speeds.

Width of taxiways

3.9.5 A straight portion of a taxi- way shall have a width of not less than that given by the following tabulation:

Code letter	Taxiway width
A	7.5m
B	10.5m
C	15 m if the taxiway is intended to be used by airplanes with a wheel base less than 18 m; 18 m if the taxiway is intended to be used by airplanes with a wheel base equal to or greater than 18 m.
D	18 m if the taxiway is intended to be used by airplanes with an outer main gear wheel span of less than 9 m; 23 m if the taxiway is intended to be used by airplanes with an outer main gear wheel span equal to or greater than 9 m.
E	23m
F	25m

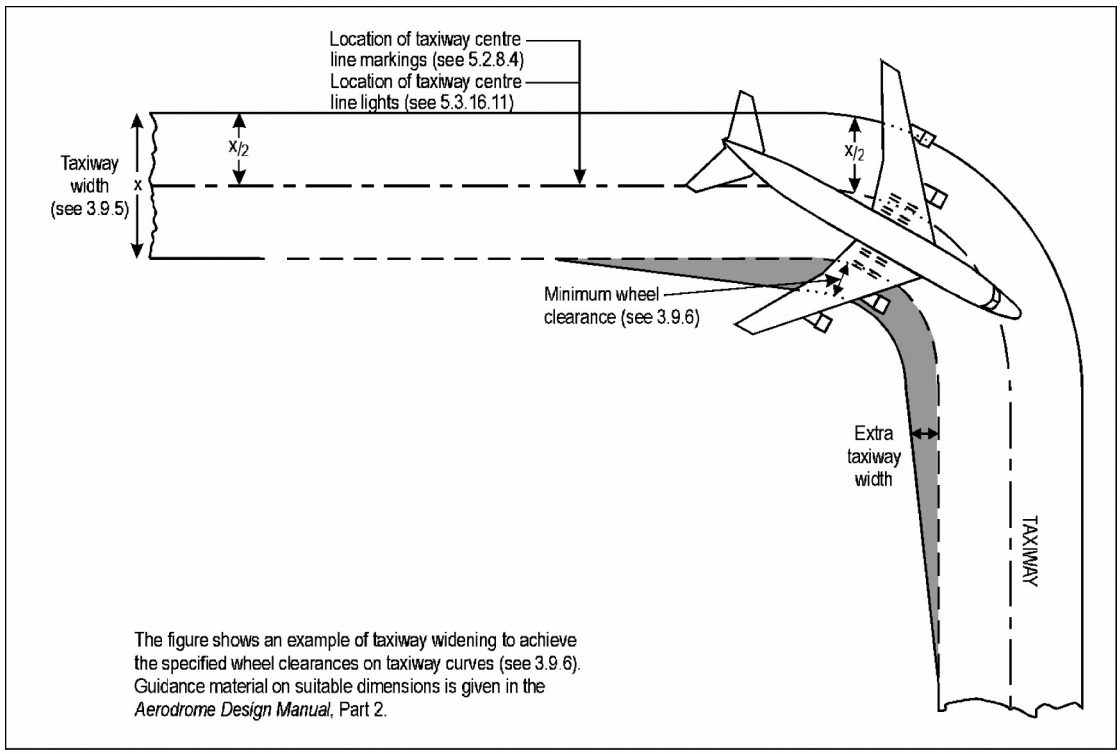


Figure 3-2. Taxiway curve

Note. Guidance on width of taxiways is given in the Aerodrome Design Manual, Part 2.

Taxiway curves

3.9.6 Changes in direction of taxiways shall be as few and small as possible. The radii of the curves shall be compatible with the maneuvering capability and normal taxiing speeds of the airplanes for which the taxiway is intended. The design of the curve shall be such that, when the cockpit of the airplane remains over the taxiway centre line markings, the clearance distance between the outer main wheels of the airplane and the edge of the taxiway shall not be less than those specified in 3.9.3.

Note 1. An example of widening taxiways to achieve the wheel clearance specified is illustrated in Figure 3-2. Guidance on the values of suitable dimensions is given in the Aerodrome Design Manual, Part 2.

Note 2. The location of taxiway centre line markings and lights is specified in 5.2.8.4 and 5.3.16.11.

Note 3. Compound curves may reduce or eliminate the need for extra taxiway width.

Junctions and intersections

3.9.7 To facilitate the movement of airplanes, fillets shall be provided at junctions and intersections of taxiways with runways, aprons and other taxiways. The design of the fillets shall ensure that the minimum wheel clearances specified in 3.9.3 are maintained when airplanes are maneuvering through the junctions or intersections.

Note Consideration will have to be given to the airplane datum length when designing fillets. Guidance on the design of fillets and the definition of the term airplane datum length are given in the Aerodrome Design Manual, Part 2.

Taxiway minimum separation distances

3.9.8 The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway or an object shall not be less than the appropriate dimension specified in Table 3-1, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

Note 1 – Guidance on factors which may be considered in the aeronautical study is given in the Aerodrome Design Manual, Part 2.

Note 2 – 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 Part 10, Volume I, Attachments C and G (respectively).

Note 3 – The separation distances of Table 3-1, 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 the Aerodrome Design Manual, Part 2.

Note 4 – The separation distance between the centre line of an aircraft stand taxi lane and an object shown in Table 3-1, column 12, may need to be increased when jet exhaust wake velocity may cause hazardous conditions for ground servicing.

Slopes on taxiways

3.9.9 Longitudinal slopes

The longitudinal slope of a taxiway shall not exceed:
– 1.5 per cent where the code letter is C, D, E or F; and
– 3 per cent where the code letter is A or B.

3.9.10 Longitudinal slope changes

Where slope changes on a taxiway cannot be avoided, the transition from one slope to another slope shall be accomplished by a curved surface with a rate of change not exceeding:
– 1 per cent per 30 m (minimum radius of curvature of 3 000 m) where the code letter is C, D, E or F; and
– 1 per cent per 25 m (minimum radius of curvature of 2 500 m) where the code letter is A or B.

3.9.11 Sight distance

Where a change in slope on a taxi- way cannot be avoided, the change shall be such that, from any point:

3 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 300m from that point, where the code letter is C, D, E or F;

2 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 200m from that point, where the code letter is B; and

1.5 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 150m from that point, where the code letter is A.

3.9.12 Transverse slopes

The transverse slopes of a taxiway shall be sufficient to prevent the accumulation of water on the surface of the taxiway but shall not exceed:

1.5 per cent where the code letter is C, D, E or F; and
2 per cent where the code letter is A or B.

Note See 3.13.4 regarding transverse slopes on an aircraft stand taxi lane.

Strength of taxiways

3.9.13 The strength of a taxiway shall be at least equal to that of the runway it serves, due consideration being given to the fact that a taxiway will be subjected to a greater density of traffic and, as a result of slow moving and stationary airplanes, to higher stresses than the runway it serves.

Note Guidance on the relation of the strength of taxi- ways to the strength of runways is given in the Aerodrome Design Manual, Part 3.

Surface of taxiways

3.9.14 The surface of a taxiway shall not have irregularities that cause damage to airplane structures.

3.9.15 The surface of a paved taxiway shall be so constructed as to provide good friction characteristics when the taxiway is wet.

Rapid exit taxiways

Note. The following specifications detail requirements particular to rapid exit taxiways. See Figure 3-3. General requirements for taxiways also apply to this type of taxiway. Guidance on the provision, location and design of rapid exit taxiways is included in the Aerodrome Design Manual, Part 2.

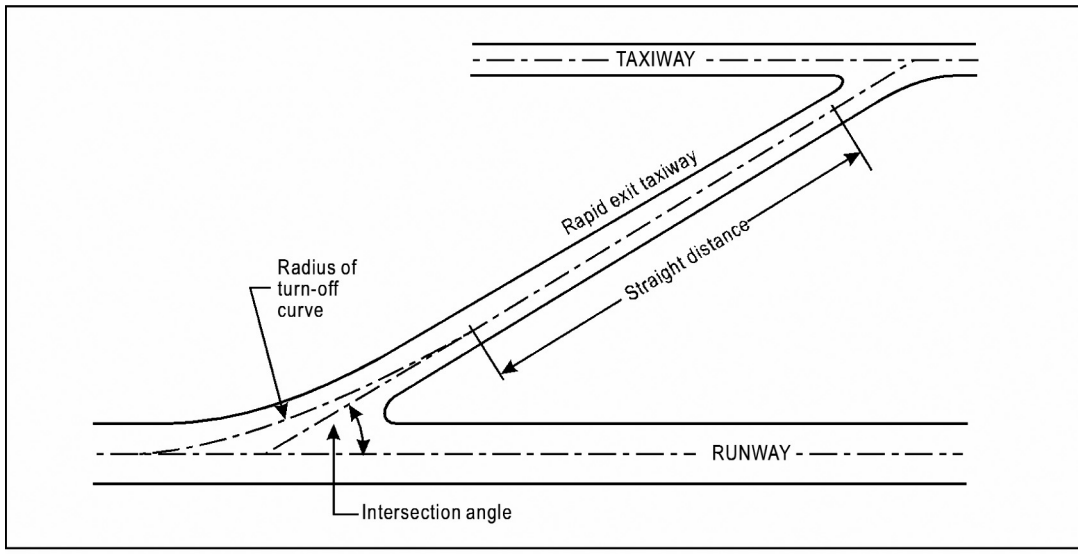


Figure 3-3. Rapid exit taxiway

3.9.16 A rapid exit taxiway shall be designed with a radius of turn-off curve of at least:

550 m where the code number is 3 or 4; and
275 m where the code number is 1 or 2;

to enable exit speeds under wet conditions of

93 km h where the code number is 3 or 4; and
65 km h where the code number is 1 or 2.

Note. The locations of rapid exit taxiways along a runway are based on several criteria described in the Aerodrome Design Manual, Part 2, in addition to different speed criteria.

3.9.17 The radius of the fillet on the inside of the curve at a rapid exit taxiway shall be sufficient to provide a widened taxiway throat in order to facilitate early recognition of the entrance and turn-off onto the taxiway.

3.9.18 A rapid exit taxiway shall include a straight distance after the turn-off curve sufficient for an exiting aircraft to come to a full stop clear of any intersecting taxiway.

3.9.19 The intersection angle of a rapid exit taxiway with the runway shall not be greater than 45° nor less than 25° and preferably shall be 30°.

3.9.20 Open.

3.9.21 Open.

3.9.22 Open.

3.10 Taxiway shoulders

Note. Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the Aerodrome Design Manual, Part 2.

3.10.1 Straight portions of a taxiway where the code letter is C, D, E or F shall be provided with shoulders which extend symmetrically on each side of the taxiway so that the overall width of the taxiway and its shoulders on straight portions is not less than:

60 m where the code letter is F;
44 m where the code letter is E;
38 m where the code letter is D; and
25 m where the code letter is C.

On taxiway curves and on junctions or intersections where increased pavement is provided, the shoulder width shall be not less than that on the adjacent straight portions of the taxiway.

3.10.2 When a taxiway is intended to be used by turbine-engined airplanes, the surface of the taxiway shoulder shall be so prepared as to resist erosion and the ingestion of the surface material by airplane engines.

3.11 Taxiway strips

Note. Guidance on characteristics of taxiway strips is given in the Aerodrome Design Manual, Part 2, General.

3.11.1 A taxiway, other than an aircraft stand taxi lane, shall be included in a strip.

Width of taxiway strips

3.11.2 A taxiway strip shall extend symmetrically on each side of the centre line of the taxiway throughout the length of the taxiway to at least the distance from the centre line given in Table 3-1 column 11.

Objects on taxiway strips

Note. See 9.9 for information regarding siting of equipment and installations on taxiway strips.

3.11.3 The taxiway strip shall provide an area clear of objects which may endanger taxiing airplanes.

Note. Consideration will have to be given to the location and design of drains on a taxiway strip to prevent damage to an airplane accidentally running off a taxiway. Suitably designed drain covers may be required.

Grading of taxiway strips

3.11.4 The centre portion of a taxiway strip shall provide a graded area to a distance from the centre line of the taxiway of at least:

11 m where the code letter is A;
12.5 m where the code letter is B or C;
19 m where the code letter is D;
22 m where the code letter is E; and
30 m where the code letter is F

Slopes on taxiway strips

3.11.5 The surface of the strip shall be flush at the edge of the taxiway or shoulder, if provided, and the graded portion shall not have an upward transverse slope exceeding:

2.5 per cent for strips where the code letter is C, D, E or F; and
3 per cent for strips of taxiways where the code letter is A or B;

the upward slope being measured with reference to the transverse slope of the adjacent taxiway surface and not the horizontal. The downward transverse slope shall not exceed 5 per cent measured with reference to the horizontal.

3.11.6 The transverse slopes on any portion of a taxiway strip beyond that to be graded shall not exceed an upward or downward slope of 5 per cent as measured in the direction away from the taxiway.

3.12 Holding bays, runway-holding positions, intermediate holding positions and road-holding positions

General

3.12.1 Holding bay(s) shall be provided when the traffic density is medium or heavy.

3.12.2 A runway-holding position or positions shall be established:
a) on the taxiway, at the intersection of a taxiway and a runway; and
b) at an intersection of a runway with another runway when the former runway is part of a standard taxi-route.

3.12.3 A runway-holding position shall be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operation of radio navigation aids.

3.12.4 An intermediate holding position shall be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.

3.12.5 A road-holding position shall be established at an intersection of a road with a runway.

Location

3.12.6 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 shall be in accordance with Table 3-2 and, in the case of a precision approach runway. such that a holding aircraft or vehicle will not interfere with the operation of radio navigation aids.

3.12.7 At elevations greater than 700 m (2300ft) the distance of 90 m specified in Table 3-2 for a precision approach runway code number 4 shall be increased as follows:

a) up to an elevation of 2000 m (6600 ft); 1 m for every 100 m (330ft) in excess of 700 m (2300ft);

b) elevation in excess of 2000 m (6600 ft) and up to 400(1 m (13320 ft,); 13 m plus 1.5 m for every 100 m (330ft) in excess of 2000 m (6600 ft); and

c) elevation in excess of 4000 m (13320 ft) and up to 5000 m (16650 ft); 43 m plus 2 m for every 100 m (330ft) in excess of 4000 m (13320 ft).

3.12.8 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 of 90 m or 107.5 m, as appropriate, specified in Table 3-2 shall be further increased 5 m for every meter the bay or position is higher than the threshold.

3.12.9 The location of a runway-holding position established in accordance with 3.12.3 shall be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS/MLS critical/sensitive area or interfere with the operation of radio navigation aids.

Table 3-2. Minimum distance from the runway centre line to a holding bay, runway-holding position or road-holding position

Type of runway	Code number 1	2	3	4
Non-instrument	30 m	40 m	75 m	75 m
Non-precision approach	40 m	40 m	75 m	75 m
Precision approach category I	60 m[b]	60 m[b]	90 m[a,b]	90 m[a,b,c]
Precision approach categories II and III	–	–	90 m[a,b]	90 m[a,b,c]
Take-off runway	30 m	40 m	75 m	75 m

a. If a holding bay, runway-holding position or road-holding position is at a lower elevation compared to the threshold, the distance may be decreased 5 m for every metre the bay or holding position is lower than the threshold, contingent upon not infringing the inner transitional surface.

b. This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive areas of ILS and MLS is contained in Annex 10, Volume I, Attachments C and G, respectively (see also 3.12.6).

Note 1.— The distance of 90 m for code number 3 or 4 is based on an aircraft with a tail height of 20 m, a distance from the nose to the highest part of the tail of 52.7 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone and not accountable for the calculation of OCA/H.

Note 2.— The distance of 60 m for code number 2 is based on an aircraft with a tail height of 8 m, a distance from the nose to the highest part of the tail of 24.6 m and a nose height of 5.2 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

c. Where the code letter is F, this distance should be 107.5 m.

Note.— The distance of 107.5 m for code number 4 where the code letter is F is based on an aircraft with a tail height of 24 m, a distance from the nose to the highest part of the tail of 62.2 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

3.13 Aprons

General

3.13.1 Aprons shall be provided where necessary to permit the on- and offloading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.

Size of aprons

3.13.2 The total apron area shall be adequate to permit expeditious handling of the aerodrome traffic at its maximum anticipated density.

Strength of aprons

3.13.3 Each part of an apron shall be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.

Slopes on aprons

3.13.4 Slopes on an apron, including those on an aircraft stand taxi lane, shall be sufficient to prevent accumulation of water on the surface of the apron but shall be kept as level as drainage requirements permit.

3.13.5 On an aircraft stand the maximum slope shall not exceed 1 per cent.

Clearance distances on aircraft stands

3.13.6 An aircraft stand shall provide the following minimum clearances between an aircraft using the stand and any adjacent building, aircraft on another stand and other objects:

Code letter	Clearance
A	3m
B	3m
C	4.5m
D	7.5m
E	7.5m
F	7.5m

When special circumstances so warrant, these clearances may be reduced at a nose-in aircraft stand, where the code letter is D, E or F:

a) between the terminal, including any fixed passenger bridge, and the nose of an aircraft; and

b) over any portion of the stand provided with azimuth guidance by a visual docking guidance system.

Note. On aprons, consideration also has to be given to the provision of service roads and to maneuvering and storage area for ground equipment (see the Aerodrome Design Manual, Part 2, for guidance on storage of ground equipment).

3.14 Isolated aircraft parking position

3.14.1 An isolated aircraft parking position shall be designated or the aerodrome control tower shall be advised of an area or areas suitable for the parking of an aircraft which is known or believed to be the subject of unlawful interference, or which for other reasons needs isolation from normal aerodrome activities.

3.14.2 The isolated aircraft parking position shall be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. Care shall be

taken to ensure that the position is not located over underground utilities such as gas and aviation fuel and, to the extent feasible, electrical or communication cables.

CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

Introduction

The effective utilisation of an aerodrome may be considerably influenced by natural features and man-made constructions inside and 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 air space must be regarded as integral parts of the aerodrome environment. The degree of freedom from obstacles in these areas is as important in the granting and retention of an aerodrome certificate as the more obvious physical requirements of the runways and their associated runway strips.

The method of assessing the significance of any existing or proposed object within the aerodrome boundary or in the vicinity of the aerodrome is to establish defined obstacle limitation surfaces particular to a runway and its intended use.

The purpose of this chapter, is to define the obstacle limitation surfaces and their characteristics and describe the action to be taken by the inspector air traffic services and operation of aerodromes in respect to objects which infringe them.

If the island council where the respective aerodromes are located publish more stringent obstacle limitation requirements, then the « inspecteur luchtverkeersbeveiling en operaties luchtvaartterreinen» shall take these into consideration when making safety assessment of obstacles in the vicinity of the aerodrome.

It is the permanent policy of the Directorate of Civil aviation that the « inspecteur luchtverkeersbeveiliging en operaties luchtvaartterreinen», makes use of the obstacle limitation surfaces as defined in annex 14, as incorporated in this chapter, during the execution of its responsibilities unless more stringent requirements are establishedby the respective island governments where the aerodromes are located.

The «inspecteur luchtverkeersbeveiliging en operaties luchtvaartterreinen» shall on an on going basis conduct survey of the aerodromes and their surroundings and report infringements of the specifications of annex 14 as soon as practicable to the aerodrome operator and the government of the respective island.

In ideal circumstances all the surfaces will be free from obstacles but when a surface is infringed, any safety measures required by the Directorate of Civil Aviation will have regard to:

(a) *the nature of the obstacle and its location relative to the surface origin, to the extended centerline of the runway or normal approach and departure paths and to existing obstructions;*

(b) *the amount by which the surface is infringed;*

(c) *the gradient presented by the obstacle to the surface origin;*

(d) *the volume and type of air traffic at the aerodrome; and*

(e) *the instrument approach procedures published for the aerodrome.*

Safety measures could be as follows:

(a) *promulgation in the AIP of the Netherlands Antilles appropriate information;*
(b) *marking and/or lighting of the obstacle;*
(c) *variation of the runway distances declared as available;*
(d) *limitation of the use of the runway to visual approaches only;*
(e) *restrictions on the type or amount of traffic.*

In addition to the requirements described in this chapter it may be necessary to call for other restrictions to development 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.

For an effective restriction of obstacles around the aerodromes, effective communication and constant coordination is required between the Directorate of Civil Aviation and other stakeholders.

Note 1 – Objects which penetrate the obstacle limitation surfaces contained in this chapter may in certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circling procedure. Criteria for evaluating obstacles are contained in Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) (Doc 8168).

Note 2 – The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in 5.3.5.41 to 5.3.5.45.

4.1 Obstacle limitation surfaces

Note – See Figure 4-1.

Specification of the outer horizontal surface

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.

An outer horizontal surface is established for every aerodrome where the main runway is 1100 m or more in length.

The outer horizontal surface extends from the periphery of the conical surface to a minimum radius of 15 000 m from the aerodrome reference point when the main runway is 1860 m or more in length and to a minimum radius of 10 000 m where the main runway is 1100 m or more but less than 1860 m in length.

Conical surface

4.1.1 Description – Conical surface. A surface sloping upwards and outwards from the periphery of the inner horizontal surface. It represents the level above which consideration needs to be given to the control of new obstructions and the removal or marking of existing obstructions so as to ensure safe visual manoeuvring in the vicinity of an aerodrome.

4.1.1.1 A conical surface is established for every aerodrome.

4.1.2 Characteristics – The limits of the conical surface shall comprise:
a) a lower edge coincident with the periphery of the inner horizontal surface; and
b) an upper edge located at a specified height above the inner horizontal surface.
c) The outer limits of the conical surface are contained in a horizontal plane located 105 m above the inner horizontal surface except where the code number of a visual runway is 2 or 1. In these cases the plane is located 55 m above the inner horizontal surface where the code number is 2 and 35 m above the inner horizontal surface where the code number is 1.

4.1.3 The slope of the conical surface, 5% (1:20), shall be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

Inner horizontal surface

4.1.4An inner horizontal surface is a horizontal plane located above an aerodrome and its vicinity. It represents the level above which consideration needs to be given to the control of new obstacles and the removal or marking of existing obstacles to ensure safe visual manoeuvring of airplanes in the vicinity of the aerodrome.

4.1.4.1 An inner horizontal surface is established for every aerodrome.

4.1.5 The inner horizontal surface is contained in a horizontal plane located 45 m above the elevation of the lowest runway threshold existing or proposed for the aerodrome.

4.1.5.1 The limits of the inner horizontal surface are established as follows:
(a) Where the main runway is 1800 m or more in length circles of radius 4000 m are described centered on the strip ends of the runway. These circles are joined by common tangents parallel to the runway centerline to form a racetrack pattern. The boundary of this pattern is the boundary of the inner horizontal surface.
b) Where a main runway is less than 1800 m in length the inner horizontal surface is circular and is centered on the mid-point of the runway. The radius is 4000 m except in the case of non-intrument runways where the code number is 1 or 2. For these runways the radii are 2000 m and 2500 m respectively.
(c) Where an end of a subsidiary runway more than 1800 m long is less than 3000 m from any point on the periphery of the surface constructed in accordance with the specifications under a and b the dimensions of the surface are modified. A circle of radius 3000 m is described centered on the strip end of the subsidiary runway and this is joined by common tangents to the pattern already established.

4.1.6 Where the inner horizontal surface is at any point lower than an approach surface or take-off climb surface the inner horizontal surface is the obstacle limitation surface at that point.

Approach surface

4.1.7 Description – Approach surface. An inclined plane or combination of planes preceding the threshold.

4.1.7.1 An approach surface is established for each runway direction intended to be used for the landing of aircraft.

4.1.8 Characteristics – The limits of the approach surface shall comprise:

a) a horizontal inner edge of specified length (as indicated in table 4-1 Dimensions and slopes of obstacle limitation surfaces) perpendicular to the centreline of the runway located at a distance of 60 m before the landing threshold, except in the case of visual runways where the code number is 1 where the distance is 30 m;

b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate (10 % for non-instrument runways, 15 % for instrument runways) from the extended centre line of the runway;

c) an outer edge parallel to the inner edge; and

d) The above surfaces shall be varied when lateral offset, offset or curved approaches are utilized, specifically, two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the lateral offset, offset or curved ground track.

4.1.9 The elevation of the inner edge shall be equal to the elevation of the mid-point of the threshold.

4.1.10 The slope(s) of the approach surface shall be measured in the vertical plane containing the centre line of the runway and shall continue containing the centre line of any lateral offset or curved ground track.

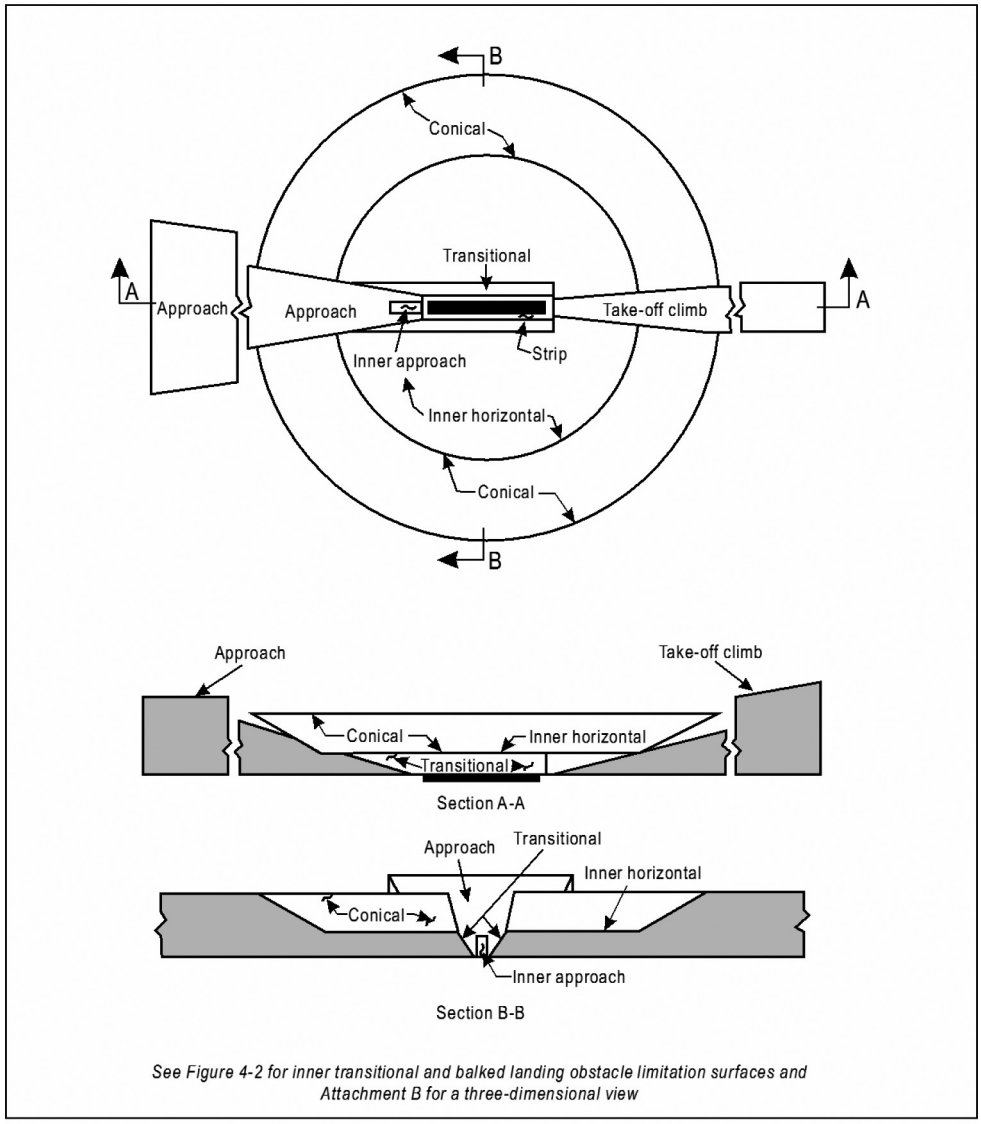


Figure 4-1. Obstacle limitation surfaces

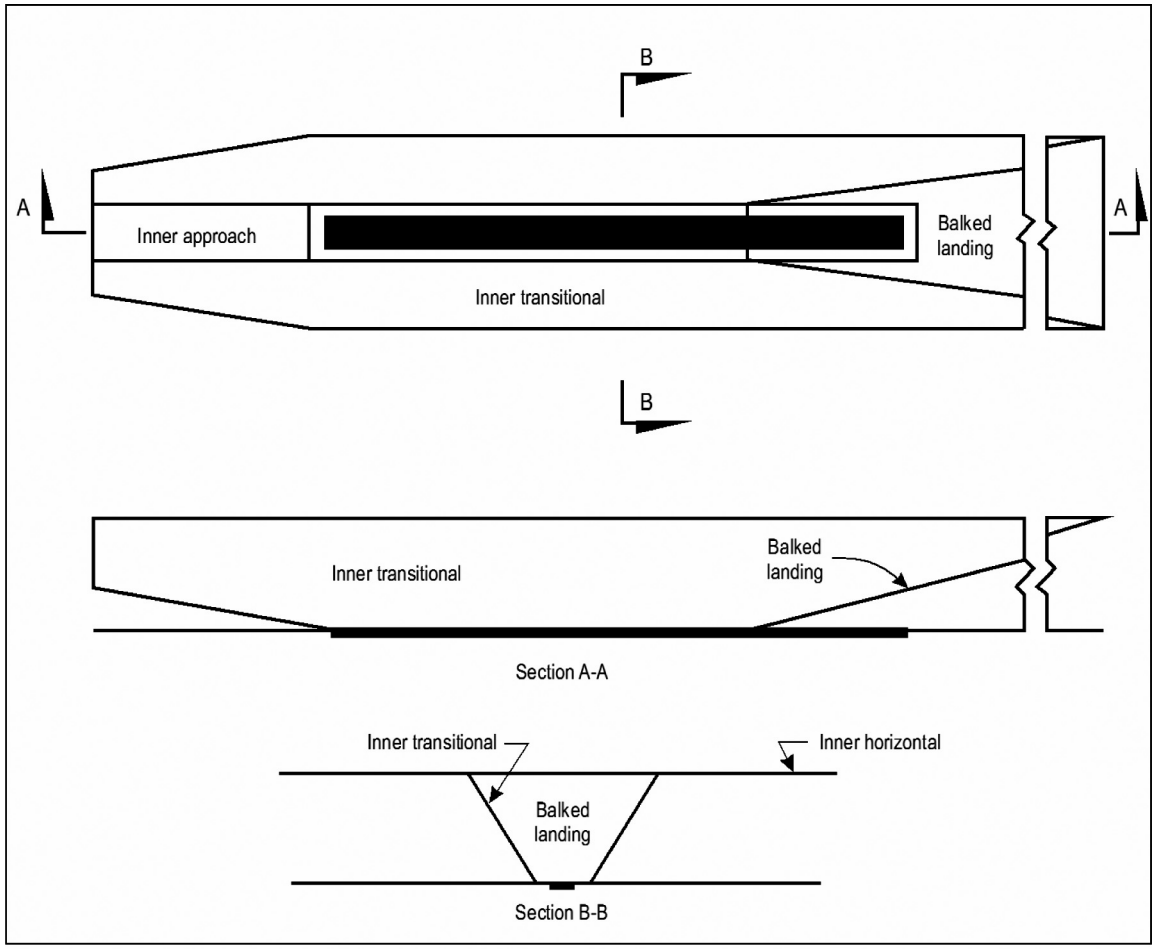


Figure 4-2. Inner approach, inner transitional and balked landing obstacle limitation surfaces

Inner approach surface

4.1.11 Description – Inner approach surface. A rectangular portion of the approach surface immediately preceding the threshold.

4.1.12 Characteristics – The limits of the inner approach surface shall comprise:

a) an inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;

b) two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the centre line of the runway; and

c) an outer edge parallel to the inner edge.

Transitional surface

4.1.13 Description – Transitional surface. A complex surface along the side of the strip and part of the side of the approach surface, that slopes upwards and outwards to the inner horizontal surface.

4.1.14 Characteristics – The limits of a transitional surface shall comprise:

a) a lower edge beginning at the intersection of the side of the approach surface with the inner horizontal surface and extending down the side of the approach surface to the inner edge of the approach surface and from there along the length of the strip parallel to the runway centre line; and
b) an upper edge located in the plane of the inner horizontal surface.

4.1.15 The elevation of a point on the lower edge shall be:
a) along the side of the approach surface – equal to the elevation of the approach surface at that point; and
b) along the strip – equal to the elevation of the nearest point on the centre line of the runway or its extension.

Note – As a result of b) the transitional surface along the strip will be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The intersection of the transitional surface with the inner horizontal surface will also be a curved or a straight line depending on the runway profile.

4.1.16 The slope of the transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

Inner transitional surface

Note – It is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids, aircraft and other vehicles that must be near the runway and which is not to be penetrated except for frangible objects. The transitional surface described in 4.1.13 is intended to remain as the controlling obstacle limitation surface for buildings, etc.

4.1.17 Description – Inner transitional surface. A surface similar to the transitional surface but closer to the runway.

4.1.18 Characteristics – The limits of an inner transitional surface shall comprise:
a) a lower edge beginning at the end of the inner approach surface and extending down the side of the inner approach surface to the inner edge of that surface, from there along the strip parallel to the runway centre line to the inner edge of the balked landing surface and from there up the side of the balked landing surface to the point where the side intersects the inner horizontal surface; and
b) an upper edge located in the plane of the inner horizontal surface.

4.1.19 The elevation of a point on the lower edge shall be:
a) along the side of the inner approach surface and balked landing surface – equal to the elevation of the particular surface at that point; and
b) along the strip – equal to the elevation of the nearest point on the centre line of the runway or its extension.

Note – As a result of b) the inner transitional surface along the strip will be curved if the runway profile is curved or a plane if the runway profile is a straight line. The intersection of the inner transitional surface with the inner horizontal surface will also be a curved or straight line depending on the runway profile.

4.1.20 The slope of the inner transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

Balked landing surface

4.1.21 Description – Balked landing surface. An inclined plane located at a specified distance after the threshold, extending between the inner transitional surface.

4.1.22 Characteristics – The limits of the balked landing surface shall comprise:
a) an inner edge horizontal and perpendicular to the centre line of the runway and located at a specified distance after the threshold;
b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the runway; and
c) an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface.

4.1.23 The elevation of the inner edge shall be equal to the elevation of the runway centre line at the location of the inner edge.

4.1.24 The slope of the balked landing surface shall be measured in the vertical plane containing the centre line of the runway.

Take-off climb surface

4.1.25 Description – Take-off climb surface. An inclined plane or other specified surface beyond the end of a runway or clearway.

4.1.26 Characteristics – The limits of the take-off climb surface shall comprise:
a) an inner edge horizontal and perpendicular to the centre line of the runway and located either at a specified distance beyond the end of the runway or at the end of the clearway when such is provided and its length exceeds the specified distance;
b) two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off track to a specified final width and continuing thereafter at that width for the remainder of the length of the take-off climb surface; and
c) an outer edge horizontal and perpendicular to the specified take-off track.

4.1.27 The elevation of the inner edge shall be equal to the highest point on the extended runway centre line between the end of the runway and the inner edge, except that when a clearway is provided the elevation shall be equal to the highest point on the ground on the centre line of the clearway.

4.1.28 In the case of a straight take-off flight path, the slope of the take-off climb surface shall be measured in the vertical plane containing the centre line of the runway.

4.1.29 In the case of a take-off flight path involving a turn, the take-off climb surface shall be a complex surface containing the horizontal normals to its centre line, and the slope of the centre line shall be the same as that for a straight take-off flight path.

4.2 Obstacle limitation requirements

Note – The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a runway, i.e. take-off or landing and type of approach, and are intended to be applied when such use is made

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

Non-instrument runways

4.2.1 The following obstacle limitation surfaces shall be established for a non-instrument runway:
– conical surface;
– inner horizontal surface;
– approach surface; and
– transitional surfaces.

4.2.2 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1.

4.2.3 New objects or extensions of existing objects shall not be permitted above an approach or transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.3.1 Principles of Shielding

4.2.3.1.1 General

4.2.3.1.1.1 A new obstacle located in the vicinity of an existing obstacle and assessed as not being a hazard to aircraft is deemed to be shielded.

4.2.3.1.1.2 Unless specifically directed by the Authority, a shielded obstacle does not require removal, lowering, marking or lighting and should not impose any additional restrictions to aircraft operations.

4.2.3.1.1.3 DCANA shall assess and determine whether an obstacle is shielded. The aerodrome operator is to notify the Authority of the presence of all obstacles.

4.2.3.1.1.4 Only existing permanent obstacles may be considered in assessing shielding of new obstacles.

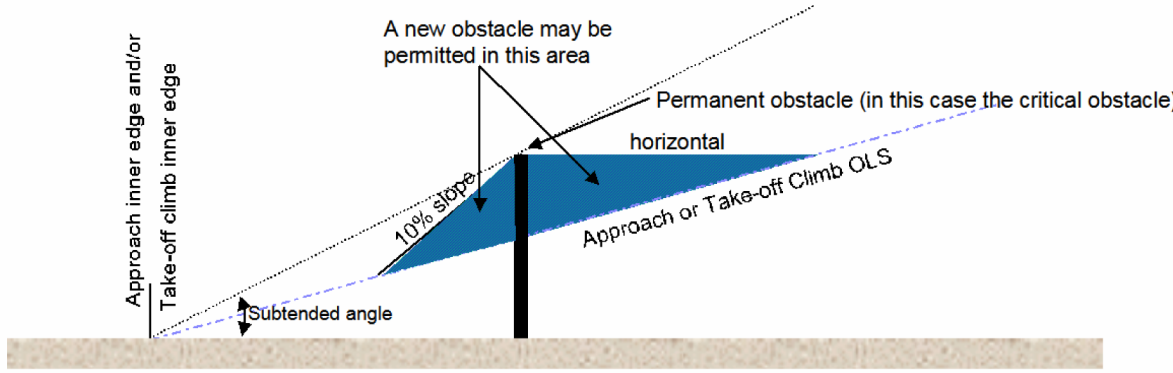
4.2.3.1.1.5 In assessing whether an existing obstacle shields an obstacle, DCANA will be guided by the principles of shielding detailed below.

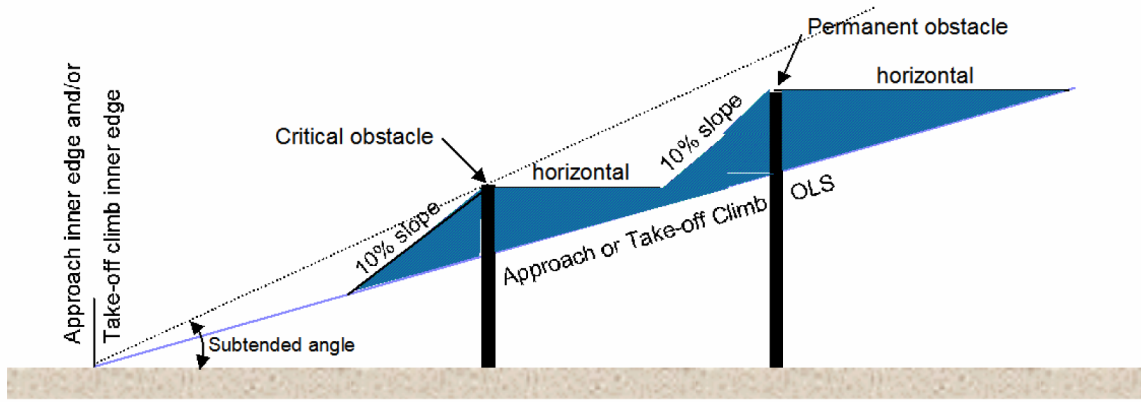
4.2.3.1.1.6 Obstacles penetrating the approach and take-off climb surfaces
(a) (a) An existing obstacle within the approach and take-off climb area is called the critical obstacle. Where a number of obstacles exist closely together, the critical obstacle is the one which subtends the greatest vertical angle measured from the appropriate inner edge.
(b) (b) As illustrated below, a new obstacle may be assessed as not imposing additional restrictions if:
(i) when located between the inner edge end and the critical obstacle, the new obstacle is below a plane sloping downwards at 10% from the top of the critical obstacle toward the inner edge;
(ii) when located beyond the critical obstacle from the inner edge end, the new obstacle is not higher than the height of the permanent obstacle;
(iii) where there is more than one critical obstacle within the approach and take-off climb area, and the new obstacle is located between two critical obstacles, the height of the new obstacle is not above a plane sloping downwards at 10% from the top of the next critical obstacle.

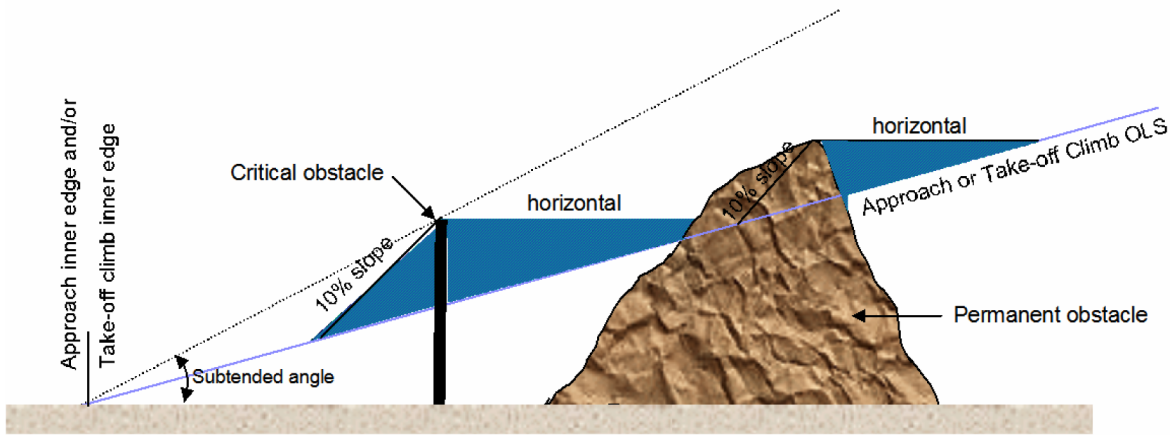
4.2.3.1.1.7 Obstacles penetrating the inner and outer horizontal and conical surfaces.The new obstacle may be accepted if it is in the vicinity of an existing obstacle, and does not penetrate a 10% downward sloping conical shaped surface from the top of the existing obstacle, i.e. the new obstacle is shielded radially by the existing obstacle.

4.2.3.1.1.8 Obstacles Penetrating the Transitional Surfaces.A new obstacle maybe assessed as not imposing additional restrictions if it does not exceed the height of an existing obstacle which is closer to the runway strip and the new obstacle is located perpendicularly behind the existing obstacle relative to the runway centerline.

Figure 4-3: Shielding of obstacles penetrating the approach and take-off climb surfaces







Note – Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, Part 6.

4.2.4 New objects or extensions of existing objects shall not be permitted above the conical surface or inner horizontal surface except when, in the opinion of the DCA NA, the object would be shielded by an existing immovable object, or after aeronautical study it is determined

that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

4.2.5 Existing objects above any of the surfaces required by 4.2.1 shall as far as practicable be removed except when, in the opinion of the DCA NA, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

Note – Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger airplanes.

4.2.6 In considering proposed construction, account shall be taken of the possible future development of an instrument runway and consequent requirement for more stringent obstacle limitation surfaces.

Non-precision approach runways

4.2.7 The following obstacle limitation surfaces shall be established for a non-precision approach runway:
– conical surface;
– inner horizontal surface;
– approach surface; and
– transitional surfaces.

4.2.8 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.9).

4.2.9 The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:
a) a horizontal plane 150 m above the threshold elevation; or
b) the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H);
whichever is higher.

Table 4-1. Dimensions and slopes of obstacle limitation surfaces —Approach runways

APPROACH RUNWAYS

	RUNWAY CLASSIFICATION									
	Non-instrument				Non-precision approach			Precision approach category I		II or III
	Code number				Code number			Code number		Code number
Surface and dimensions[a]	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	—	—	—	—	—	—	—	90 m	120 m[e]	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	60 m	60 m	60 m
Length	—	—	—	—	—	—	—	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	150 m	300 m	300 m	150 m	300 m	300 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	—	—	—	—	—	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	—	—	—	—	—	8 400 m[b]	8 400 m[b]	—	8 400 m[b]	8 400 m[b]
Total length	—	—	—	—	—	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	—	—	—	—	—	—	—	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	—	—	—	—	—	—	—	90 m	120 m[e]	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	[c]	1 800 m[d]	1 800 m[d]
Divergence (each side)	—	—	—	—	—	—	—	10%	10%	10%
Slope	—	—	—	—	—	—	—	4%	3.33%	3.33%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Distance to the end of strip.
d. Or end of runway whichever is less.
e. Where the code letter is F (Column (3) of Table 1-1), the width is increased to 155 m.

4.2.10 New objects or extensions of existing objects shall not be permitted above an approach surface within 3000 m of the inner edge or above a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note – Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, Part 6.

4.2.11 New objects or extensions of existing objects shall not be permitted above the approach surface beyond 3000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of the DCA NA, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

4.2.12 Existing objects above any of the surfaces required by 4.2.7 shall as far as practicable be removed except when, in the opinion of the DCA NA, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

4.2.12.1Existing objects above an approach surface, transitional surface, take-off climb surface, inner horizontal surface or conical surface should as far as practicable be removed, except when in the opinion of the DCANA the object is shielded by an existing immovable object.

4.2.12.2Objects which do not penetrate an approach surface to a new runway or a proposed runway extension but which would nevertheless adversely affect the optimum performance of visual or non-visual aids should be removed.

4.2.12.3Anything which may, in the opinion of the DCANA endanger aircraft on the movement area must be removed.

4.2.12.4 Except for those objects or vehicles on essential aerodrome duties which because of their function must be positioned within the runway strip (but outside the cleared and graded area) to meet air navigation requirements, any object or vehicle situated on a runway strip which may endanger aircraft must be removed.

4.2.12.5 The inner approach, inner transitional and balked landing surfaces together define a volume of airspace in the immediate facility of a precision approach runway which is known as the obstacle free zone.
No object whether fixed or mobile is to be permitted to penetrate the OFZ during the use of a runway for landing in Category I, II or III operational conditions, except essential visual aids which are frangibly mounted.

4.2.12.6No object whether fixed or mobile is to be permitted to penetrate the baulked landing surface of an OFZ established for Category II or III operations, see paragraph 8.5(c) (ii) and (iv). Where this surface intercepts the Basic ILS missed approach obstacle clearance surface, the latter becomes limiting. The Basic ILS missed approach surface is a 2.5% (1:40) slope commencing 900 metres after the threshold, at the same elevation as the threshold.

4.2.12.7 Confirmation that the extended OFZ baulked landing surface is obstacle free up to the height where it intersects with the Category I ILS missed approach surface will normally be necessary only when the OFZ is initially established. Thereafter the normal safeguarding procedures as well as observance of the conditions of the aerodrome licence will ensure that either the extended OFZ missed approach surface will remain

obstacle free or that proposed constructions which might infringe the surface are referred to the DCANA for consideration.

4.2.12.8 Objects which would endanger aircraft in the air are not permitted in a clearway.
Essential aids to navigation, providing they are frangible and do not exceed 0.9 m above ground level or the clearway plane, as appropriate, are acceptable.

4.2.12. 9 Objects which would endanger aircraft on the ground are not permitted in a stopway or runway end safety area. When it is essential for approach light fittings to be situated in a stopway, they must be frangible and not exceed 0.46 m in height.
February 2001 4/17 9.12 Where there are transverse or longitudinal slopes on a strip or clearway the inner edge of a take-off climb surface or an approach surface may lie partly or wholly below the level of the ground in the strip or clearway. It is not necessary that the strip or clearway should, in such cases, be graded to conform with the inner edge of the take-off climb or approach surface.

4.2.12.10 Because of the difficulty of recognition special restrictions must be applied to elevated wires and their supports. Where no other object penetrates a given obstacle limitation surface, overhead wires and their supports should not penetrate a surface passing through the top of the highest existing object and parallel to the established surface for a distance of 1500 m from the runway threshold. The shielding criteria at paragraph 10 do not apply to the shielding of overhead wires.

Licensing of Aerodromes

Note – Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger airplanes.

Precision approach runways

Note 1 – See 9.9 for information regarding siting of equipment and installations on operational areas.

Note 2 – Guidance on obstacle limitation surfaces for precision approach runways is given in the Airport Services Manual, Part 6.

4.2.13 The following obstacle limitation surfaces shall be established for a precision approach runway category I:
– conical surface;
– inner horizontal surface;
– approach surface; and
– transitional surfaces.
– inner approach surface;
– inner transitional surfaces; and
– balked landing surface.

4.2.14 Open.

4.2.15 The following obstacle limitation surfaces shall be established for a precision approach runway category II or III:

– conical surface;
– inner horizontal surface;
– approach surface and inner approach surface;
– transitional surfaces;
– inner transitional surfaces; and
– balked landing surface.

4.2.16 The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.17).

4.2.17 The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:
a) a horizontal plane 150 m above the threshold elevation; or
b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;
whichever is higher.

4.2.18 Fixed objects shall not be permitted above the inner approach surface, the inner transitional surface or the balked landing surface, except for frangible objects which because of their function must be located on the strip. Mobile objects shall not be permitted above these surfaces during the use of the runway for landing.

4.2.19 New objects or extensions of existing objects shall not be permitted above an approach surface or a transitional surface except when, in the opinion of the DCA NA, the new object or extension would be shielded by an existing immovable object.

Note – Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, Part 6.

4.2.20 New objects or extensions of existing objects shall not be permitted above the conical surface and the inner horizontal surface except when, in the opinion of the DCA NA, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

4.2.21 Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface shall as far as practicable be removed except when, in the opinion of the DCA NA, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

Note – Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger airplanes.

Runways meant for take-off

4.2.22 The following obstacle limitation surface shall be established for a runway meant for take-off:
– take-off climb surface.

4.2.23 The dimensions of the surface shall be not less than the dimensions specified in Table 4-2, except that a lesser length may be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of airplanes.

4.2.24 The operational characteristics of airplanes for which the runway is intended shall be examined to see if it is desirable to reduce the slope specified in Table 4-2 when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of take-off climb surface shall be made so as to provide protection to a height of 300 m.

Note – When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in Table 4-2 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 airplanes for which the runway is intended.

4.2.25 New objects or extensions of existing objects shall not be permitted above a take-off climb surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note – Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, Part 6.

4.2.26 If no object reaches the 2 per cent (1:50) take-off climb surface, new objects shall be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 per cent (1:62.5).

Table 4-2. Dimensions and slopes of obstacle limitation surfaces

RUNWAYS MEANT FOR TAKE-OFF

Surface and dimensions[a]	Code number 1	2	3 or 4
(1)	(2)	(3)	(4)
TAKE-OFF CLIMB			
Length of inner edge	60 m	80 m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10%	10%	12.5%
Final width	380 m	580 m	1 200 m 1 800 m[c]
Length	1 600 m	2 500 m	15 000 m
Slope	5%	4%	2%[d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2.24 and 4.2.26.

4.2.27 Existing objects that extend above a take-off climb surface shall as far as practicable be removed except when, in the opinion of the DCA NA, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

Note – Because of transverse slopes on a strip or clearway, in certain cases portions of the inner edge of the take-off climb surface may be below the corresponding elevation of the strip or clearway. It is not intended that the strip or clearway be graded to conform with the inner edge of the take-off climb surface, nor is it intended that terrain or objects which are above the take-off climb surface beyond the end of the strip or clearway, but below the level of the strip or clearway, be removed unless it is considered they may endanger airplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.

4.3 Objects outside the obstacle limitation surfaces

4.3.1 Arrangements shall be made to enable the DCA NA to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of airplanes.

4.3.2 In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation shall be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to airplanes.

Note – This study may have regard to the nature of operations concerned and may distinguish between day and night operations.

4.4 Other objects

4.4.1 Objects which do not project through the approach surface but which would nevertheless adversely affect the optimum siting or performance of visual or non-visual aids shall, as far as practicable, be removed.

4.4.2 Anything which may, in the opinion of the DCA NA after aeronautical study, endanger airplanes on the movement area or in the air within the limits of the inner horizontal and conical surfaces shall be regarded as an obstacle and shall be removed in so far as practicable.

Note – In certain circumstances, objects that do not project above any of the surfaces enumerated in 4.1 may constitute a hazard to airplanes as, for example, where there are one or more isolated objects in the vicinity of an aerodrome.

CHAPTER 5. VISUAL AIDS FOR NAVIGATION

5.1 Indicators and signaling devices

5.1.1 Wind direction indicators

Application

5.1.1.1 An aerodrome shall be equipped with at least one wind direction indicator.

Location

5.1.1.2 A wind direction indicator shall be located so as to be visible from aircraft in flight or on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby objects.

Characteristics

5.1.1.3 The wind direction indicator shall be in the form of a truncated cone made of fabric and shall have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It shall be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed. The color or colors shall be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300 m, having regard to background. Where practicable, a single color, preferably white or orange, shall be used. Where a combination of two colors is required to give adequate conspicuity against changing backgrounds, they shall preferably be orange and white, red and white, or black and white, and shall be arranged in five alternate bands, the first and last bands being the darker color.

5.1.1.4 The location of at least one wind direction indicator shall be marked by a circular band 15 m in diameter and 1.2 m wide. The band shall be centered about the wind direction indicator support and shall be in a color chosen to give adequate conspicuity, preferably white.

5.1.1.5 Provision shall be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

5.1.2 Landing direction indicator

Location

5.1.2.1 Where provided, a landing direction indicator shall be located in a conspicuous place on the aerodrome.

Characteristics

5.1.2.2 The landing direction indicator shall be in the form of a «T».

5.1.2.3 The shape and minimum dimensions of a landing «T» shall be as shown in Figure 5-1. The color of the landing «T» shall be either white or orange, the choice being dependent on the color that contrasts best with the back-ground against which the indicator will be viewed. Where required for use at night the landing «T» shall either be illuminated or outlined by white lights.

5.1.3 Signaling lamp

Application

5.1.3.1 A signaling lamp shall be provided at a con-trolled aerodrome in the aerodrome control tower.

Characteristics

5.1.3.2 A signaling lamp shall be capable of producing red, green and white signals, and of:

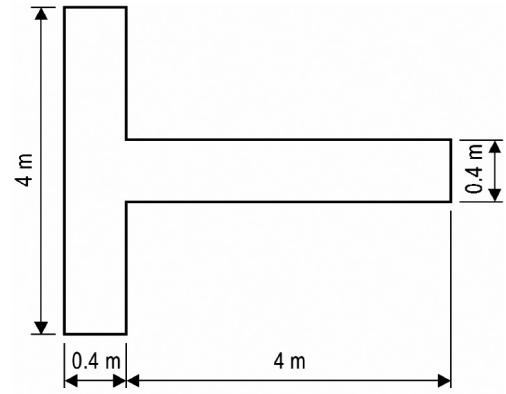


Figure 5-1. Landing direction indicator

a) being aimed manually at any target as required;
b) giving a signal in any one color followed by a signal in either of the two other colors; and
c) transmitting a message in any one of the three colors by Morse Code up to a speed of at least four words per minute.

When selecting the green light, use shall be made of the restricted boundary of green as specified in Appendix 1, 2.1.2.

5.1.3.3 The beam spread shall be not less than 1° nor greater than 3°, with negligible light beyond 3°. When the signaling lamp is intended for use in the daytime the intensity of the colored light shall be not less than 6 000 cd.

5.1.4 Signal panels and signal area

Note – The inclusion of detailed specifications for a signal area in this section is not intended to imply that one has to be provided. Attachment A, Section 15 provides guidance on the need to provide ground signals. Part 2, Appendix 1 specifies the shape, color and use of visual ground signals. The Aerodrome Design Manual, Part 4 provides guidance on their design.

Location of signal area

5.1.4.1 The signal area shall 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.

Characteristics of signal area

5.1.4.2 The signal area shall be an even horizontal surface at least 9 m square.

5.1.4.3 The color of the signal area shall be chosen to contrast with the colors of the signal panels used, and it shall be surrounded by a white border not less than 0.3 m wide.

5.2 Markings

5.2.1 General

Interruption of runway markings

5.2.1.1 At an intersection of two (or more) runways the markings of the more important runway, except for the runway side stripe marking, shall be displayed and the markings of the other runway(s) shall be interrupted. The runway side stripe marking of the more important runway may be either continued across the intersection or interrupted.

5.2.1.2 The order of importance of runways for the display of runway markings shall be as follows:

1st – precision approach runway;
2nd – non-precision approach runway; and
3rd – non-instrument runway.

5.2.1.3 At an intersection of a runway and taxiway the markings of the runway shall be displayed and the markings of the taxiway interrupted, except that runway side stripe markings may be interrupted.

Note – See 5.2.8.5 regarding the manner of connecting runway and taxiway centre line markings.

Color and conspicuity

5.2.1.4 Runway markings shall be white.

Note 1 – It has been found that, on runway surfaces of light color, the conspicuity of white markings can be improved by outlining them in black.

Note 2 – It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practicable by the use of a suitable kind of paint.

Note 3 – Markings may consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.

5.2.1.5 Taxiway markings, runway turn pad markings and aircraft stand markings shall be yellow.

5.2.1.6 Apron safety lines shall be of a conspicuous color which shall contrast with that used for aircraft stand markings.

5.2.1.7 At aerodromes where operations take place at night, pavement markings shall be made with reflective materials designed to enhance the visibility of the markings.

Note – Guidance on reflective materials is given in the Aerodrome Design Manual, Part 4.

Unpaved taxiways

5.2.1.8 An unpaved taxiway shall be provided, so far as practicable, with the markings prescribed for paved taxiways.

5.2.2 Runway designation marking

Application

5.2.2.1 A runway designation marking shall be provided at the thresholds of a paved runway.

5.2.2.2 A runway designation marking shall be provided, so far as practicable, at the thresholds of an unpaved runway.

Location

5.2.2.3 A runway designation marking shall be located at a threshold as shown in Figure 5-2 as appropriate.

Note – If the runway threshold is displaced from the extremity of the runway, a sign showing the designation of the runway may be provided for airplanes taking off.

Characteristics

5.2.2.4 A runway designation marking shall consist of a two-digit number and on parallel runways shall be supplemented with a letter. On a single runway, dual parallel runways and triple parallel runways the two-digit number shall be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach. On four or more parallel runways, one set of adjacent runways shall be numbered to the nearest one-tenth magnetic azimuth and the other set of adjacent runways numbered to the next nearest one-tenth of the magnetic azimuth. When the above rule would give a single digit number, it shall be preceded by a zero.

5.2.2.5 In the case of parallel runways, each runway designation number shall be supplemented by a letter as follows, in the order shown from left to right when viewed from the direction of approach:

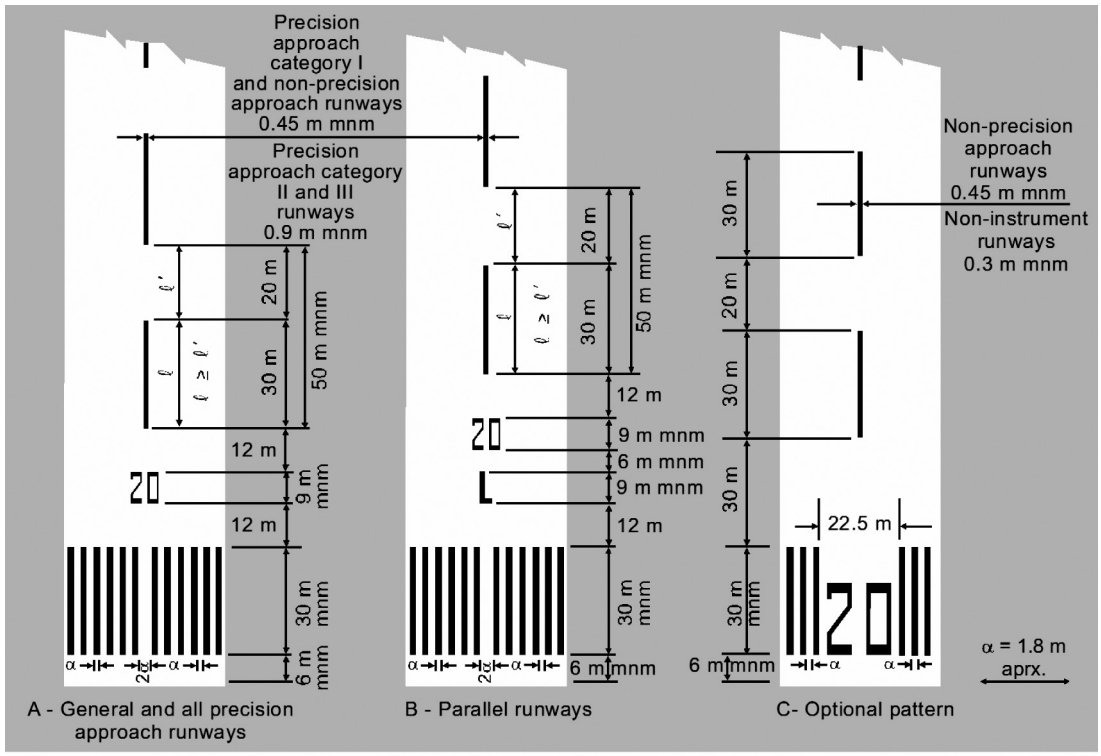
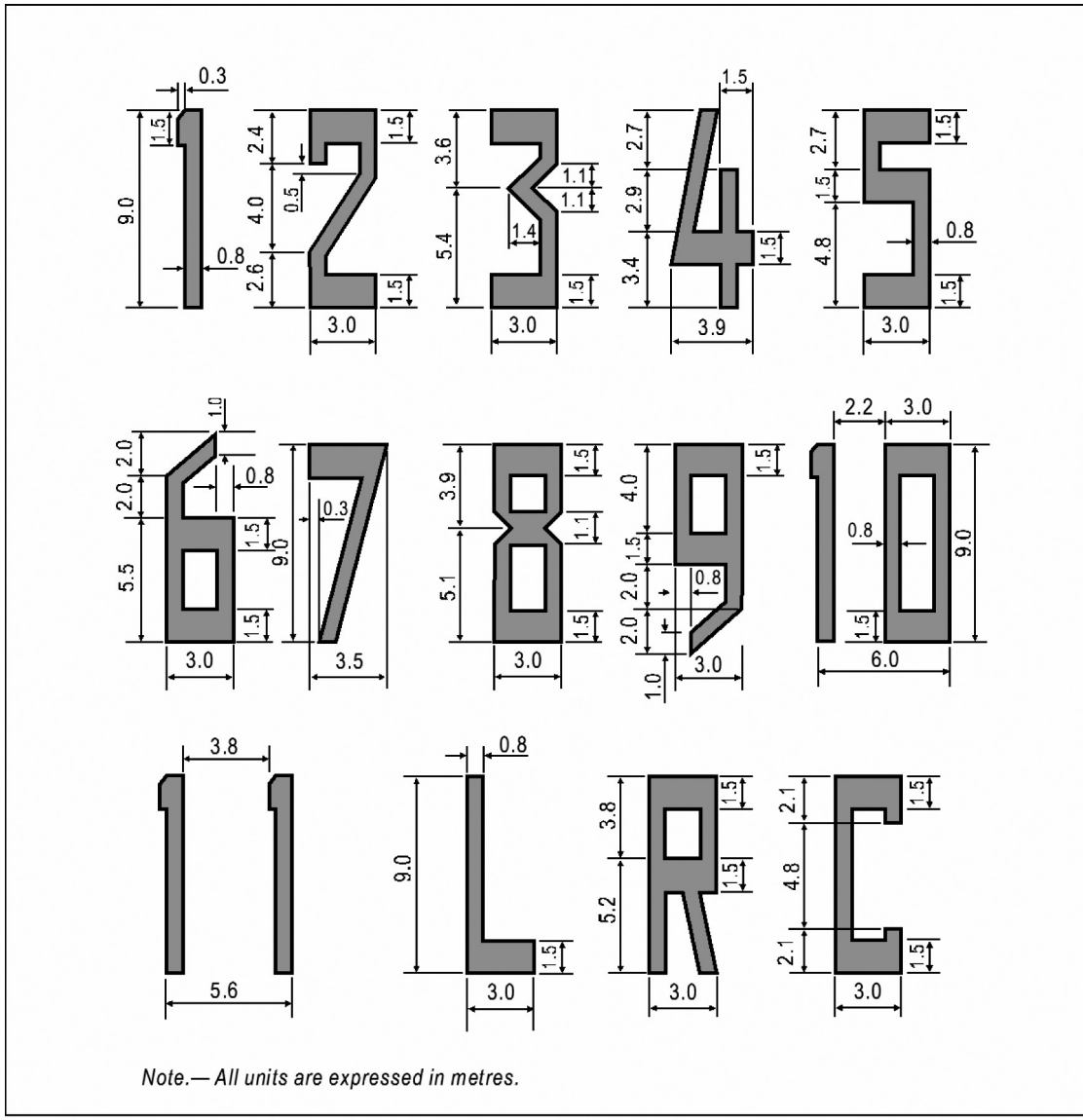


Figure 5-2. Runway designation, centre line and threshold markings



Note.— All units are expressed in metres.

Figure 5-3. Form and proportions of numbers and letters for runway designation markings

– for two parallel runways: «L» «R»;
– for three parallel runways: «L» «C» «R»;
– for four parallel runways: «L» «R» «L» «R»;
– for five parallel runways: «L» «C» «R» «L» «R» or «L» «R» «L» «C» «R»; and
– for six parallel runways: «L» «C» «R» «L» «C» «R».

5.2.2.6 The numbers and letters shall be in the form and proportion shown in Figure 5-3. The dimensions shall be not less than those shown in Figure 5-3, but where the numbers are incorporated in the threshold marking, larger dimensions shall be used in order to fill adequately the gap between the stripes of the threshold marking.

5.2.3 Runway centre line marking

Application

5.2.3.1 A runway centre line marking shall be provided on a paved runway.

Location

5.2.3.2 A runway centre line marking shall be located along the centre line of the runway between the runway designation markings as shown in Figure 5-2, except when interrupted in compliance with 5.2.1.1.

Characteristics

5.2.3.3 A runway centre line marking shall consist of a line of uniformly spaced stripes and gaps. The length of a stripe plus a gap shall be not less than 50 m or more than 75 m. The length of each stripe shall be at least equal to the length of the gap or 30 m, whichever is greater.

5.2.3.4 The width of the stripes shall be not less than:
– 0.90 m on precision approach category II and III runways;
– 0.45 m on non-precision approach runways where the code number is 3 or 4, and precision approach category I runways; and
– 0.30 m on non-precision approach runways where the code number is 1 or 2, and on non-instrument runways.

5.2.4 Threshold marking

Application

5.2.4.1 A threshold marking shall be provided at the threshold of a paved instrument runway, and of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by international commercial air transport.

5.2.4.2 A threshold marking shall be provided at the threshold of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by other than international commercial air transport.

5.2.4.3 A threshold marking shall be provided, so far as practicable, at the thresholds of an unpaved runway.

Note – The Aerodrome Design Manual, Part 4, shows a form of marking which has been found satisfactory for the marking of downward slopes immediately before the threshold.

Location

5.2.4.4 The stripes of the threshold marking shall commence 6 m from the threshold.

Characteristics

5.2.4.5 A runway threshold marking shall consist of a pattern of longitudinal stripes of uniform dimensions disposed symmetrically about the centre line of a runway as shown in Figure 5-2 (A) and (B) for a runway width of 45 m. The number of stripes shall be in accordance with the runway width as follows:

Runway width	Number of stripes
18 m	4
23 m	6
30 m	8
45 m	12
60 m	16

except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in Figure 5-2 (C).

5.2.4.6 The stripes shall extend laterally to within 3 m of the edge of a runway or to a distance of 27 m on either side of a runway centre line, whichever results in the smaller lateral distance. Where a runway designation marking is placed within a threshold marking there shall be a minimum of three stripes on each side of the centre line of the runway. Where a runway designation marking is placed above a threshold marking, the stripes shall be continued across the runway. The stripes shall be at least 30 m long and approximately 1.80 m wide with spacing of approximately 1.80 m between them except that, where the stripes are continued across a runway, a double spacing shall be used to separate the two stripes nearest the centre line of the runway, and in the case where the designation marking is included within the threshold marking this spacing shall be 22.5 m.

Transverse stripe

5.2.4.7 Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centre line, a transverse stripe as shown in Figure 5-4 (B) shall be added to the threshold marking.

5.2.4.8 A transverse stripe shall be not less than 1.80 m wide.

Arrows

5.2.4.9 Where a runway threshold is permanently displaced, arrows conforming to Figure 5-4 (B) shall be provided on the portion of the runway before the displaced threshold.

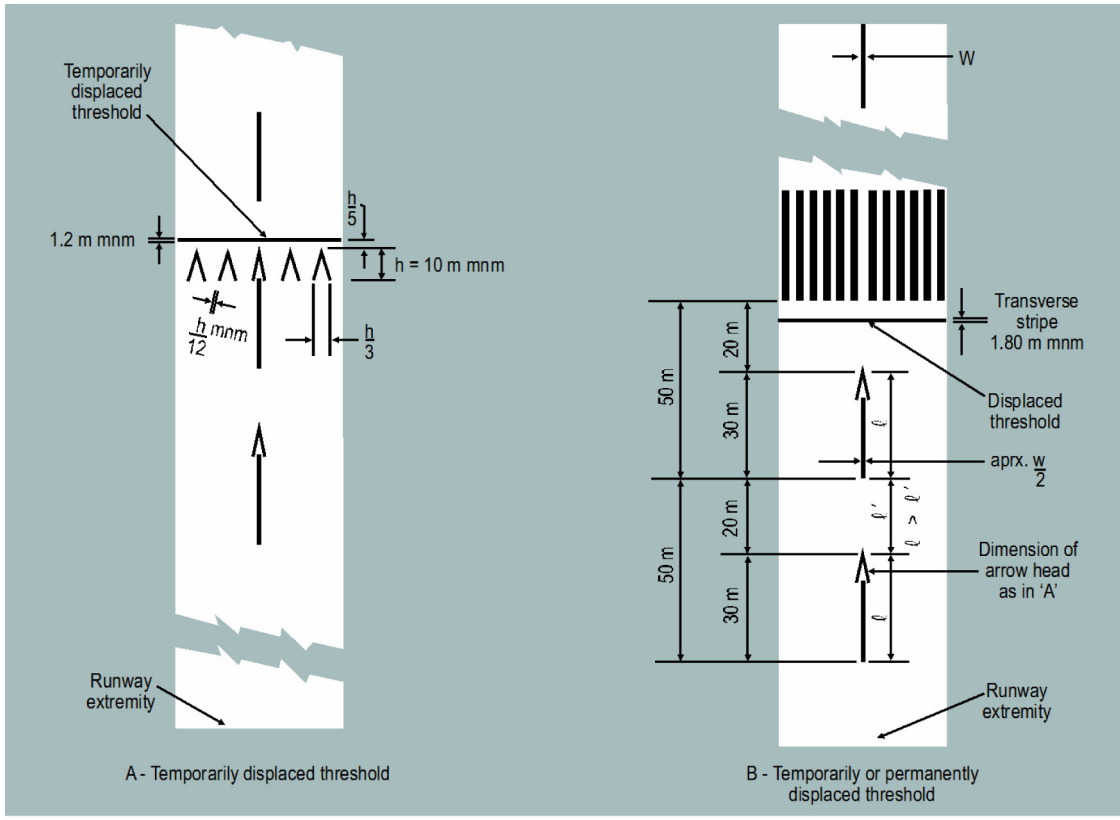


Figure 5-4. Displaced threshold markings

5.2.4.10 When a runway threshold is temporarily displaced from the normal position, it shall be marked as shown in Figure 5-4 (A) or 5-4 (B) and all markings prior to the displaced threshold shall be obscured except the runway centre line marking, which shall be converted to arrows.

Note 1 – In the case where a threshold is temporarily displaced for only a short period of time, it has been found satisfactory to use markers in the form and color of a displaced threshold marking rather than attempting to paint this marking on the runway.

Note 2 – When the runway before a displaced threshold is unfit for the surface movement of aircraft, closed markings, as described in 7.1.4, are required to be provided.

5.2.5 Aiming point marking

Application

5.2.5.1 The provisions of Sections 5.2.5 and 5.2.6 shall not require the replacement of existing markings before 1 January 2005.

5.2.5.2 An aiming point marking shall be provided at each approach end of a paved instrument runway where the code number is 2, 3 or 4.

5.2.5.3 An aiming point marking shall be provided at each approach end of:

a) *a paved non-instrument runway where the code number is 3 or 4,*

b) *a paved instrument runway where the code number is 1, when additional conspicuity of the aiming point is desirable.*

Location

5.2.5.4 The aiming point marking shall commence no closer to the threshold than the distance indicated in the appropriate column of Table 5-1, except that, on a runway equipped with a visual approach slope indicator system, the beginning of the marking shall be coincident with the visual approach slope origin.

Table 5-1. Location and dimensions of aiming point marking

	Landing distance available			
Location and dimensions	Less than 800 m	800 m up to but not including 1 200 m	1 200 m up to but not including 2 400 m	2 400 m and above
(1)	(2)	(3)	(4)	(5)
Distance from threshold to beginning of marking	150 m	250 m	300 m	400 m
Length of stripe[a]	30-45 m	30-45 m	45-60 m	45-60 m
Width of stripe	4 m	6 m	6-10 m[b]	6-10 m[b]
Lateral spacing between inner sides of stripes	6 m[c]	9 m[c]	18-22.5 m	18-22.5 m

a. The greater dimensions of the specified ranges are intended to be used where increased conspicuity is required.
b. The lateral spacing may be varied within these limits to minimize the contamination of the marking by rubber deposits.
c. These figures were deduced by reference to the outer main gear wheel span which is element 2 of the aerodrome reference code at Chapter 1, Table 1-1.

5.2.5.5 An aiming point marking shall consist of two conspicuous stripes. The dimensions of the stripes and the lateral spacing between their inner sides shall be in accordance with the provisions of the appropriate column of Table 5-1. Where a touchdown zone marking is provided, the lateral spacing between the markings shall be the same as that of the touch-down zone marking.

5.2.6 Touchdown zone marking

Application

5.2.6.1 A touchdown zone marking shall be provided in the touchdown zone of a paved precision approach runway where the code number is 2, 3 or 4.

5.2.6.2 A touchdown zone marking shall be provided in the touchdown zone of a paved non-precision approach or non-instrument runway where the code number is 3 or 4 and additional conspicuity of the touchdown zone is desirable.

Location and characteristics

5.2.6.3 A touchdown zone marking shall consist of pairs of rectangular markings symmetrically disposed about the runway centre line with the number of such pairs related to the landing distance available and, where the marking is to be displayed at both the approach directions of a runway, the distance between the thresholds, as follows:

Landing distance available or the distance between thresholds	Pair(s) of markings
less than 900 m	1
900 m up to but not including 1200 m	2
1200 m up to but not including 1500 m	3
1500 m up to but not including 200 m	4
2400 m or more	6

5.2.6.4 A touchdown zone marking shall conform to either of the two patterns shown in Figure 5-5. For the pattern shown in Figure 5-5 (A), the markings shall be not less than 22.5 m long and 3 m wide. For the pattern shown in Figure 5-5 (B), each stripe of each marking shall be not less than 22.5 m long and 1.8 m wide with a spacing of 1.5 m between adjacent stripes. The lateral spacing between the inner sides of the rectangles shall be equal to that of the aiming point marking where provided. Where an aiming point marking is not provided, the lateral spacing between the inner sides of the rectangles shall correspond to the lateral spacing specified for the aiming point marking in Table 5-1 (columns 2, 3, 4 or 5, as appropriate). The pairs of markings shall be provided at longitudinal spacing of 150 m beginning from the threshold except that pairs of touchdown zone markings coincident with or located within 50 m of an aiming point marking shall be deleted from the pattern.

5.2.6.5 On a non-precision approach runway where the code number is 2, an additional pair of touchdown zone marking stripes shall be provided 150 m beyond the beginning of the aiming point marking.

5.2.7 Runway side stripe marking

Application

5.2.7.1 A runway side stripe marking shall be provided between the thresholds of a paved runway where there is a lack of contrast between the runway edges and the shoulders or the surrounding terrain.

5.2.7.2 A runway side stripe marking shall be provided on a precision approach runway irrespective of the contrast between the runway edges and the shoulders or the surrounding terrain.

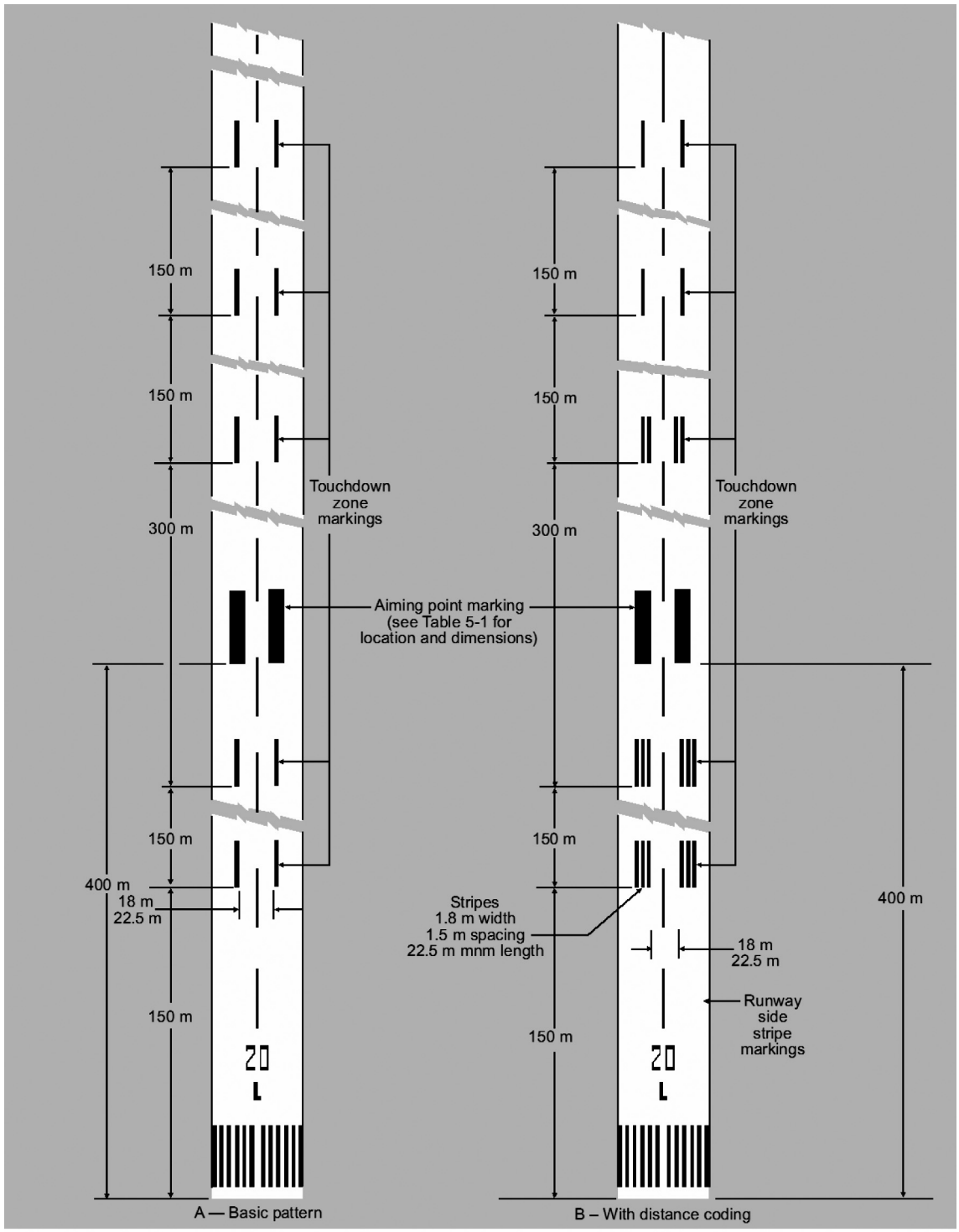


Figure 5-5. Aiming point and touchdown zone markings
(illustrated for a runway with a length of 2 400 m or more)

Location

5.2.7.3 A runway side stripe marking shall consist of two stripes, one placed along each edge of the runway with the outer edge of each stripe approximately on the edge of the runway, except that, where the runway is greater than 60 m in width, the stripes shall be located 30 m from the runway centre line.

5.2.7.4 Where a runway turn pad is provided, the runway side stripe marking shall be continued between the runway and the runway turn pad.

Characteristics

5.2.7.5 A runway side stripe shall have an overall width of at least 0.9 m on runways 30 m or more in width and at least 0.45 m on narrower runways.

5.2.8 Taxiway centre line marking

Application

5.2.8.1 Taxiway centre line marking shall be provided on a paved taxiway and apron where the code number is 3 or 4 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

5.2.8.2 Taxiway centre line marking shall be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

5.2.8.3 Taxiway centre line marking shall be provided on a paved runway when the runway is part of a standard taxi-route and:
a) there is no runway centre line marking; or
b) where the taxiway centre line is not coincident with the runway centre line.

Location

5.2.8.4 On a straight section of a taxiway the taxiway centre line marking shall be located along the taxiway centre line. On a taxiway curve the marking shall continue from the straight portion of the taxiway at a constant distance from the outside edge of the curve.

Note – See 3.9.6 and Figure 3-2.

5.2.8.5 At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway centre line marking shall be curved into the runway centre line marking as shown in Figures 5-6 and 5-25. The taxiway centre line marking shall be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.

5.2.8.6 Where taxiway centre line marking is provided on a runway in accordance with 5.2.8.3, the marking shall be located on the centre line of the designated taxiway.

Characteristics

5.2.8.7 A taxiway centre line marking shall be at least 15 cm in width and continuous in length except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in Figure 5-6.

5.2.9 Runway turn pad marking

Application

5.2.9.1 Where a runway turn pad is provided, a runway turn pad marking shall be provided for continuous guidance to enable an airplane to complete a 180-degree turn and align with the runway centre line.

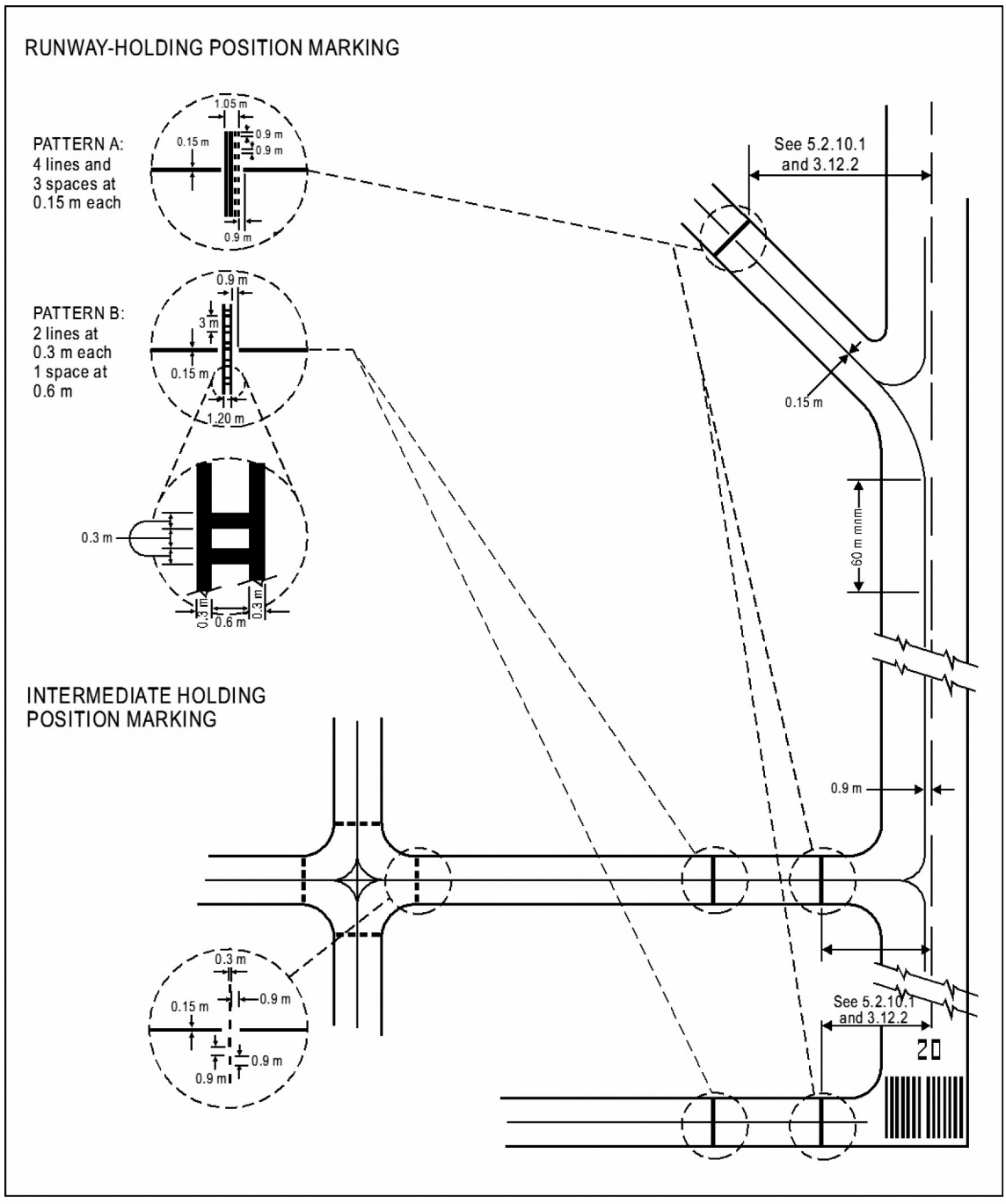


Figure 5-6. Taxiway markings
(shown with basic runway markings)

Location

5.2.9.2 The runway turn pad marking shall be curved from the runway centre line into the turn pad. The radius of the curve shall be compatible with the maneuvering capability and normal taxiing speeds of the airplanes for which the runway turn pad is intended. The intersection angle of the runway turn pad marking with the runway centre line shall not be greater than 30 degrees.

5.2.9.3 The runway turn pad marking shall be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.

5.2.9.4 A runway turn pad marking shall guide the airplane in such a way as to allow a straight portion of taxiing before the point where a 180-degree turn is to be made. The straight portion of the runway turn pad marking shall be parallel to the outer edge of the runway turn pad.

5.2.9.5 The design of the curve allowing the airplane to negotiate a 180-degree turn shall be based on a nose wheel steering angle not exceeding 45 degrees.

5.2.9.6 The design of the turn pad marking shall be such that, when the cockpit of the airplane remains over the runway turn pad marking, the clearance distance between any wheel of the airplane landing gear and the edge of the runway turn pad shall be not less than those specified in 3.3.6.

Note – For ease of maneuvering, consideration may be given to providing a larger wheel-to-edge clearance for codes E and F airplanes. See 3.3.7.

Characteristics

5.2.9.7 A runway turn pad marking shall be at least 15 cm in width and continuous in length.

5.2.10 Runway-holding position marking

Application and location

5.2.10.1 A runway-holding position marking shall be displayed along a runway-holding position.

Note – See 5.4.2 concerning the provision of signs at runway-holding positions.

5.2.10.2 At an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway, the runway-holding position marking shall be as shown in Figure 5-6, pattern A.

5.2.10.3 Where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking shall be as shown in Figure 5-6, pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer (closest) to the runway shall be as shown in Figure 5-6, pattern A and the markings farther from the runway shall be as shown in Figure 5-6, pattern B.

5.2.10.4 The runway-holding position marking displayed at a runway-holding position established in accordance with 3.12.3 shall be as shown in Figure 5-6, pattern A.

5.2.10.5 Where increased conspicuity of the runway-holding position is required, the runway-holding position marking shall be as shown in Figure 5-7, pattern A or pattern B, as appropriate.

5.2.10.6 Where a pattern B runway-holding position marking is located on an area where it would exceed 60 m in length, the term «CAT II» or «CAT III» as appropriate shall be marked on the surface at the ends of the runway-holding position marking and at equal intervals of 45 m maximum between successive marks. The letters shall be not less than 1.8 m high and shall be placed not more than 0.9 m beyond the holding position marking.

5.2.10.7 The runway-holding position marking displayed at a runway/runway intersection shall be perpendicular to the centre line of the runway forming part of the standard taxi-route. The pattern of the marking shall be as shown in Figure 5-7, pattern A.

5.2.11 Intermediate holding position marking

Application and location

5.2.11.1 An intermediate holding position marking shall be displayed along an intermediate holding position.

5.2.11.2 Open.

5.2.11.3 Where an intermediate holding position marking is displayed at an intersection of two paved taxiways, it shall be located across the taxiway at sufficient distance from the near edge of the intersecting taxiway to ensure safe clearance between taxiing aircraft. It shall be coincident with a stop bar or intermediate holding position lights, where provided.

5.2.11.4 Open.

Characteristics

5.2.11.5 An intermediate holding position marking shall consist of a single broken line as shown in Figure 5-6.

5.2.12 VOR aerodrome check-point marking

Application

5.2.12.1 When a VOR aerodrome check-point is established, it shall be indicated by a VOR aerodrome check-point marking and sign.

Note – See 5.4.4 for VOR aerodrome check-point sign.

5.2.12.2 Site selection

Note – Guidance on the selection of sites for VOR aerodrome check-points is given in Part 10, Volume I, Attachment E.

Location

5.2.12.3 A VOR aerodrome check-point marking shall be centered on the spot at which an aircraft is to be parked to receive the correct VOR signal.

Characteristics

5.2.12.4 A VOR aerodrome check-point marking shall consist of a circle 6 m in diameter and have a line width of 15 cm (see Figure 5-8 (A)).

5.2.12.5 When it is preferable for an aircraft to be aligned in a specific direction, a line shall be provided that passes through the centre of the circle on the desired azimuth. The line shall extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line shall be 15 cm (see Figure 5-8 (B)).

5.2.12.6 A VOR aerodrome check-point marking shall preferably be white in color but shall differ from the color used for the taxiway markings.

Note – To provide contrast, markings may be bordered with black.

5.2.13 Aircraft stand markings

Note – Guidance on the layout of aircraft stand markings is contained in the Aerodrome Design Manual, Part 4.

Application

5.2.13.1 Aircraft stand markings shall be provided for designated parking positions on a paved apron and on a de-icing/anti-icing facility.

Location

5.2.13.2 Aircraft stand markings on a paved apron and on a de-icing/anti-icing facility shall be located so as to provide the clearances specified in 3.13.6 and in 3.15.9 respectively, when the nose wheel follows the stand marking.

Characteristics

5.2.13.3 Aircraft stand markings shall include such elements as stand identification, lead-in line, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids.

5.2.13.4 An aircraft stand identification (letter and/or number) shall be included in the lead-in line a short distance after the beginning of the lead-in line. The height of the identification shall be adequate to be readable from the cockpit of aircraft using the stand.

5.2.13.5 Where two sets of aircraft stand markings are superimposed on each other in order to permit more flexible use of the apron and it is difficult to identify which stand marking shall be followed, or safety would be impaired if the wrong marking was followed, then identification of the aircraft for which each set of markings is intended shall be added to the stand identification.

Note – Example: 2A-B747, 2B-F28.

5.2.13.6 Lead-in, turning and lead-out lines shall normally be continuous in length and have a width of not less than 15 cm. Where one or more sets of stand markings are superimposed on a stand marking, the lines shall be continuous for the most demanding aircraft and broken for other aircraft.

5.2.13.7 The curved portions of lead-in, turning and lead-out lines shall have radii appropriate to the most demanding aircraft type for which the markings are intended.

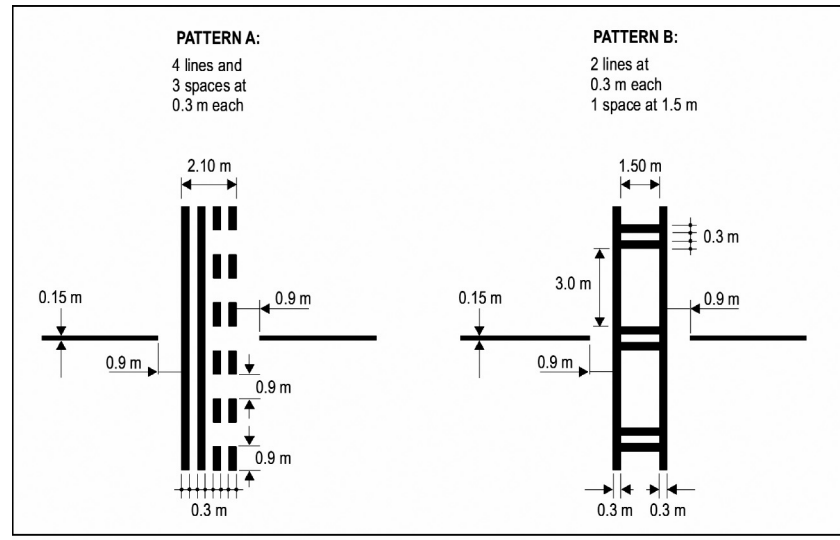


Figure 5-7. Runway-holding position markings

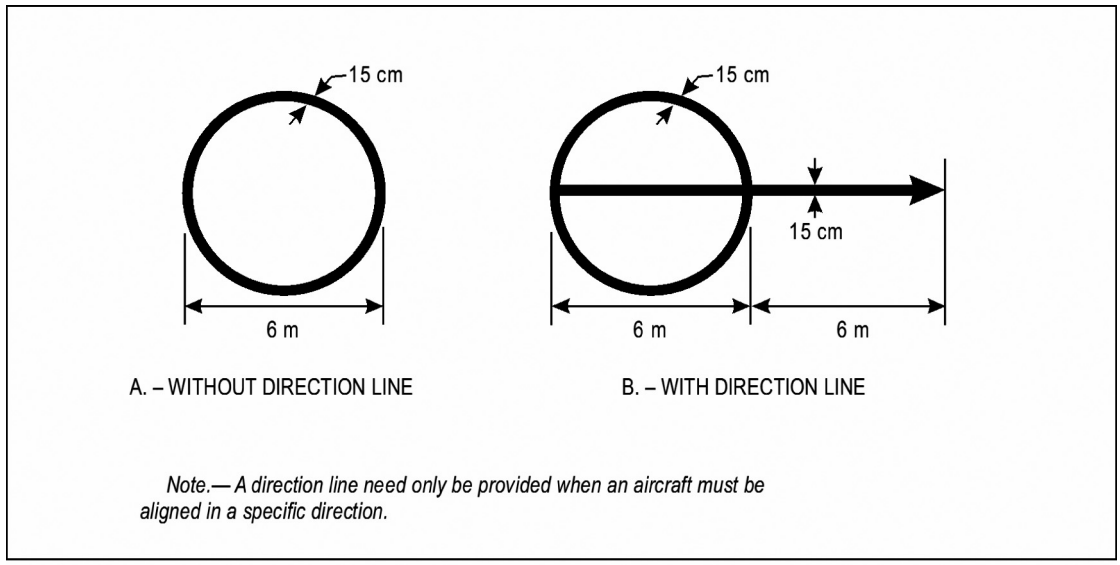


Figure 5-8. VOR aerodrome check-point marking

5.2.13.8 Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed shall be added as part of the lead-in and lead-out lines.

5.2.13.9 A turn bar shall be located at right angles to the lead-in line, abeam the left pilot position at the point of initiation of any intended turn. It shall have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.

Note – The distances to be maintained between the turn bar and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

5.2.13.10 If more than one turn bar and/or stop line is required, they shall be coded.

5.2.13.11 An alignment bar shall be placed so as to be coincident with the extended centre line of the aircraft in the specified parking position and visible to the pilot during the final part of the parking maneuver. It shall have a width of not less than 15 cm.

5.2.13.12 A stop line shall be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It shall have a length and width of not less than 6 m and 15 cm, respectively.

Note – The distances to be maintained between the stop line and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

5.2.14 Apron safety lines

Note – Guidance on apron safety lines is contained in the Aerodrome Design Manual, Part 4.

Application

5.2.14.1 Apron safety lines shall be provided on a paved apron as required by the parking configurations and ground facilities.

Location

5.2.14.2 Apron safety lines shall be located so as to define the areas intended for use by ground vehicles and other aircraft servicing equipment, etc., to provide safe separation from aircraft.

Characteristics

5.2.14.3 Apron safety lines shall include such elements as wing tip clearance lines and service road boundary lines as required by the parking configurations and ground facilities.

5.2.14.4 An apron safety line shall be continuous in length and at least 10 cm in width.

5.2.15 Road-holding position marking

Application

5.2.15.1 A road-holding position marking shall be provided at all road entrances to a runway.

Location

5.2.15.2 The road-holding position marking shall be located across the road at the holding position.

Characteristics

5.2.15.3 The road-holding position marking shall be in accordance with the local road traffic regulations.

5.2.16 Mandatory instruction marking

Note – Guidance on mandatory instruction marking is given in the Aerodrome Design Manual, Part 4.

Application

5.2.16.1 Where it is impracticable to install a mandatory instruction sign in accordance with 5.4.2.1, a mandatory instruction marking shall be provided on the surface of the pavement.

5.2.16.2 Where operationally required, such as on taxiways exceeding 60 m in width, a mandatory instruction sign shall be supplemented by a mandatory instruction marking.

Location

5.2.16.3 The mandatory instruction marking shall be located on the left-hand side of the taxiway centre line marking and on the holding side of the runway-holding position marking as shown in Figure 5-9. The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1 m.

5.2.16.4 Except where operationally required, a mandatory instruction marking shall not be located on a runway.

Characteristics

5.2.16.5 A mandatory instruction marking shall consist of an inscription in white on a red background. Except for a NO ENTRY marking, the inscription shall provide information identical to that of the associated mandatory instruction sign.

5.2.16.6 A NO ENTRY marking shall consist of an inscription in white reading NO ENTRY on a red background.

5.2.16.7 Where there is insufficient contrast between the marking and the pavement surface, the mandatory instruction marking shall include an appropriate border, preferably white or black.

5.2.16.8 The character height shall be 4 m. The inscriptions shall be in the form and proportions shown in Appendix 3.

5.2.16.9 The background shall be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.

5.2.17 Information marking

Note – Guidance on information marking is contained in the Aerodrome Design Manual, Part 4.

Application

5.2.17.1 Where an information sign would normally be installed and is impractical to install, as determined by the appropriate aerodrome authority, an information marking shall be displayed on the surface of the pavement.

5.2.17.2 Where operationally required an information sign shall be supplemented by an information marking.

5.2.17.3 An information (location/ direction) marking shall be displayed prior to and following complex taxiway intersections and where operational experience has indicated the addition of a taxiway location marking could assist flight crew ground navigation.

5.2.17.4 An information (location) marking shall be displayed on the pavement surface at regular intervals along taxiways of great length.

Location

5.2.17.5 The information marking shall be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.

Characteristics

5.2.17.6 An information marking shall consist of:
a) an inscription in yellow upon a black background, when it replaces or supplements a location sign; and
b) an inscription in black upon a yellow background, when it replaces or supplements a direction or destination sign.

5.2.17.7 Where there is insufficient contrast between the marking background and the pavement surface, the marking shall include:
a) a black border where the inscriptions are in black; and
b) a yellow border where the inscriptions are in yellow.

5.2.17.8 The character height shall be 4 m. The inscriptions shall be in the form and proportions shown in Appendix 3.

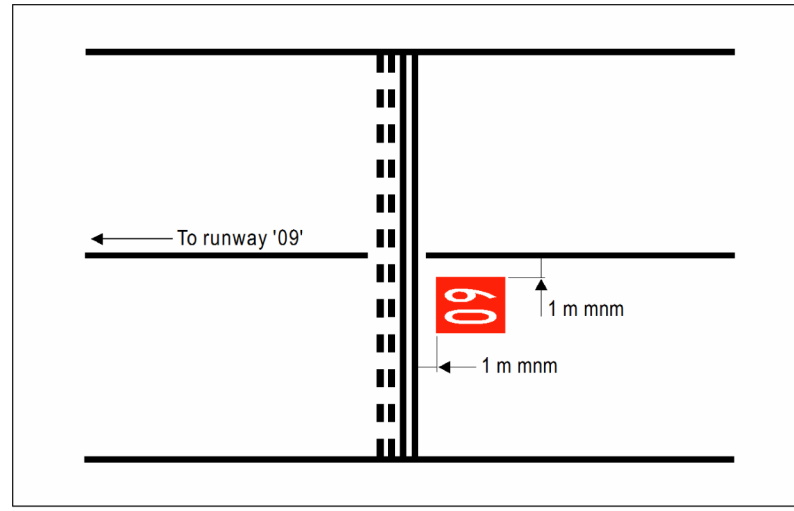


Figure 5-9. Mandatory instruction marking

5.3 Lights

5.3.1 General

Lights which may endanger the safety of aircraft

5.3.1.1 A non-aeronautical ground light near an aerodrome which might endanger the safety of aircraft shall be extinguished, screened or otherwise modified so as to eliminate the source of danger.

Laser emissions which may endanger the safety of aircraft

5.3.1.2 To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones shall be established around aerodromes:
– a laser-beam free flight zone (LFFZ)
– a laser-beam critical flight zone (LCFZ)
– a laser-beam sensitive flight zone (LSFZ).

Note 1– Figures 5-10, 5-11 and 5-12 may be used to determine the exposure levels and distances that adequately protect flight operations.

Note 2 – The restrictions on the use of laser beams in the three protected flight zones, LFFZ, LCFZ and LSFZ, refer to visible laser beams only. Laser emitters operated by the authorities in a manner compatible with flight safety are excluded. In all navigable air space, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE) unless such emission has been notified to the authority and permission obtained.

Note 3 – The protected flight zones are established in order to mitigate the risk of operating laser emitters in the vicinity of aerodromes.

Note 4 – Further guidance on how to protect flight operations from the hazardous effects of laser emitters is contained in the Manual on Laser Emitters and Flight Safety (Doc 9815).

Note 5 – See also Part 11 – Air Traffic Services, Chapter 2.

Lights which may cause confusion

5.3.1.3 A non-aeronautical ground light which, by reason of its intensity, configuration or color, might prevent, or cause confusion in, the clear interpretation of aeronautical ground lights shall be extinguished, screened or otherwise modified so as to eliminate such a possibility. In particular, attention shall be directed to a non-aeronautical ground light visible from the air within the areas described hereunder:
a) *Instrument runway – code number 4:*
within the areas before the threshold and beyond the end of the runway extending at least 4 500 m in length from the threshold and runway end and 750 m either side of the extended runway centre line in width.
b) *Instrument runway – code number 2 or 3: as in a), except that the length shall be at least 3 000 m.*
c) *Instrument runway – code number 1; and non-instrument runway: within the approach area.*

5.3.1.3.1 An existing or proposed non-aeronautical ground light in the vicinity of an aerodrome, which, by reason of its intensity, configuration or color, might endanger the safety of aircraft, must be notified to the DCANA for a safety assessment. In general, vicinity of the aerodrome can be taken as within a 6 km radius of the aerodrome. Within this 6 km area, the following specific areas are the most likely to cause problems to aircraft operations:
(a) for a code 4 instrument runway – within a rectangular area the length of which extends at least 5000 m before each threshold and the width of which is at least 750 m either side of the extended runway centreline;
(b) for a code 2 or 3 instrument runway, within an area with the same width as (a) with the length extending to at least 3000 m from the threshold;

(c) for other cases, within the approach area.

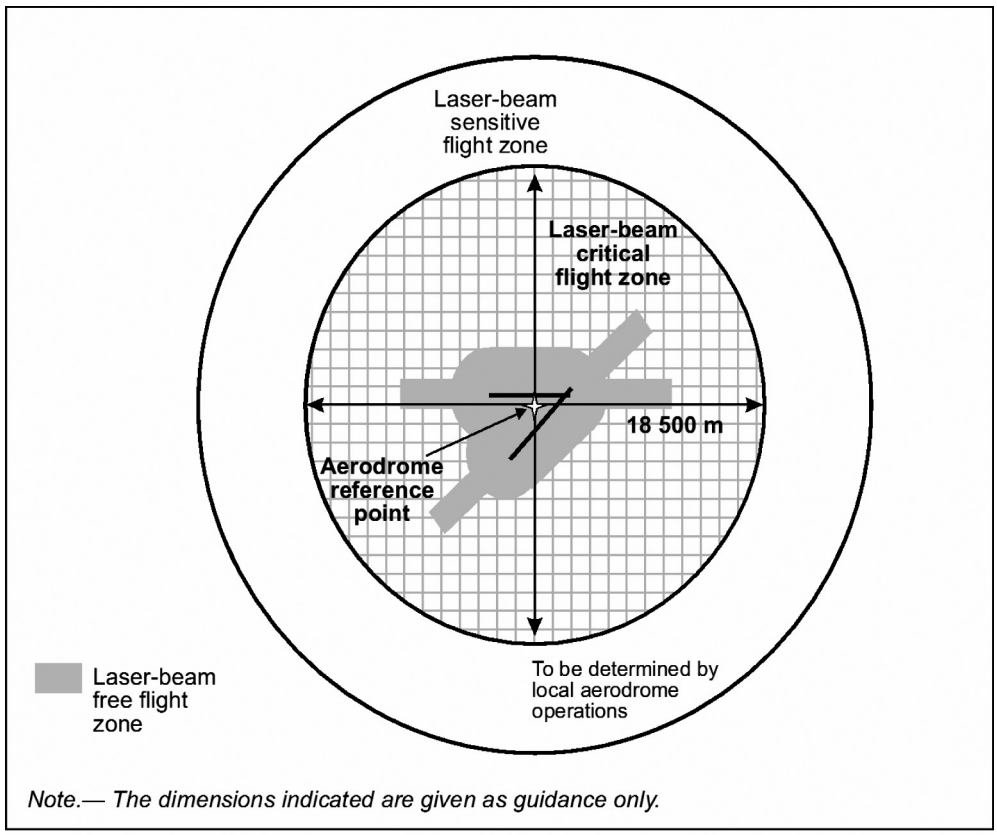
Note: 1: Aerodrome operators should liaise with local electricity and planning authorities, so that they can be alerted of lighting proposals in the vicinity of their aerodromes.

Aeronautical ground lights which may cause confusion to mariners

Note – In the case of aeronautical ground lights near navigable waters, consideration needs to be given to ensuring that the lights do not cause confusion to mariners.

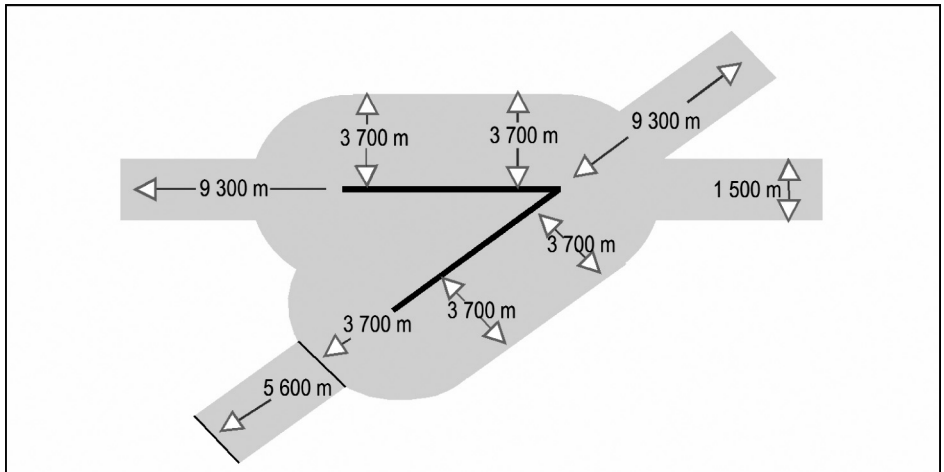
Light fixtures and supporting structures

Note – See 9.9 for information regarding siting of equipment and installations on operational areas, and the Aerodrome Design Manual, Part 6 (in preparation) for guidance on frangibility of light fixtures and supporting structures.



Note.— The dimensions indicated are given as guidance only.

Figure 5-10. Protected flight zones



Note.— The dimensions indicated are given as guidance only.

Figure 5-11. Multiple runway laser-beam free flight zone

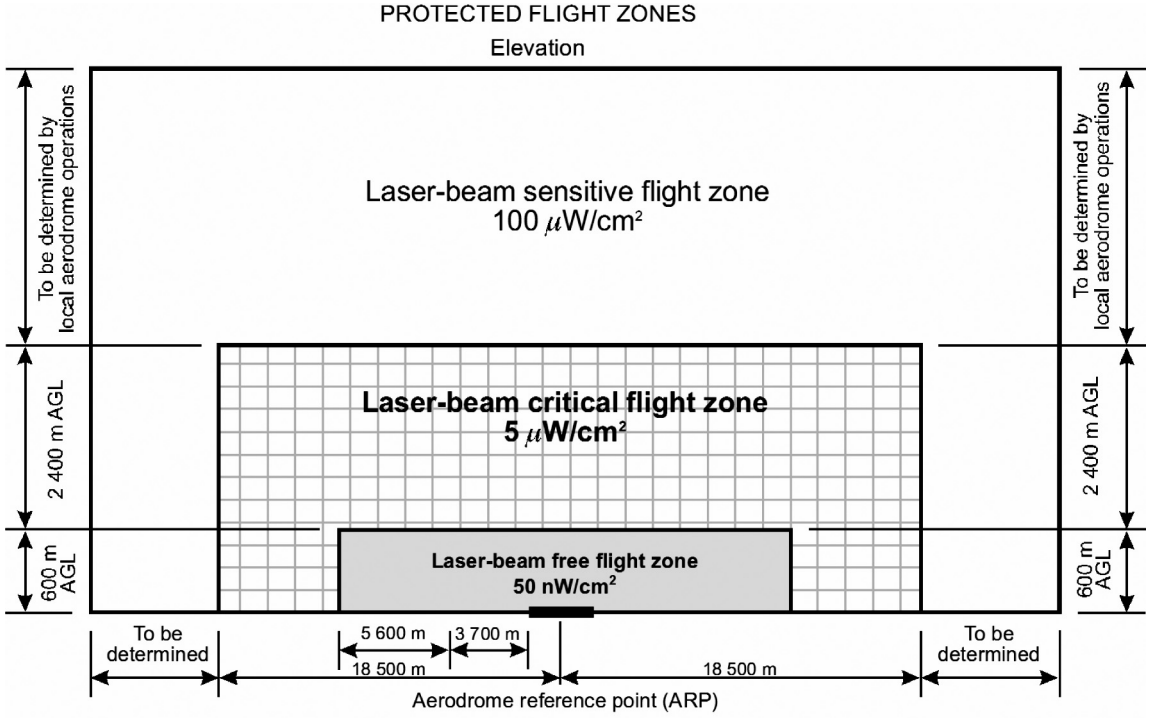


Figure 5-12. Protected flight zones with indication of maximum irradiance levels for visible laser beams

Elevated approach lights

5.3.1.4 Elevated approach lights and their supporting structures shall be frangible except that, in that portion of the approach lighting system beyond 300 m from the threshold:

a) where the height of a supporting structure exceeds 12 m, the frangibility requirement shall apply to the top 12 m only; and

b) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects shall be frangible.

5.3.1.5 The provisions of 5.3.1.4 shall not require the replacement of existing installations before 1 January 2005.

5.3.1.6 When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it shall be suitably marked.

Elevated lights

5.3.1.7 Elevated runway, stopway and taxiway lights shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

Surface lights

5.3.1.8 Light fixtures inset in the surface of runways, stopways, taxiways and aprons shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.

5.3.1.9 The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire shall not exceed 160°C during a 10-minute period of exposure.
Note – Guidance on measuring the temperature of inset lights is given in the Aerodrome Design Manual, Part 4.

Light intensity and control

Note – In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end. (See Attachment A, Section 14, and the Aerodrome Design Manual, Part 4.)

5.3.1.10 The intensity of runway lighting shall be adequate for the minimum conditions of visibility and ambient light in which use of the runway is intended, and compatible with that of the nearest section of the approach lighting system when provided.

Note – While the lights of an approach lighting system may be of higher intensity than the runway lighting, it is good practice to avoid abrupt changes in intensity as these could give a pilot a false impression that the visibility is changing during approach.

5.3.1.11 Where a high-intensity lighting system is provided, a suitable intensity control shall be incorporated to allow for adjustment of the light intensity to meet the prevailing conditions. Separate intensity controls or other suitable methods shall be provided to ensure that the following systems, when installed, can be operated at compatible intensities:
– approach lighting system;
– runway edge lights;
– runway threshold lights;

– runway end lights;
– runway centre line lights;
– runway touchdown zone lights; and
– taxiway centre line lights.

5.3.1.12 On the perimeter of and within the ellipse defining the main beam in Appendix 2, Figures A2-1 to A2-10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-1 to A2-11, Note 2.

5.3.1.13 On the perimeter of and within the rectangle defining the main beam in Appendix 2, Figures A2-12 to A2-20, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-12 to A2-21, Note 2.

5.3.2 Emergency lighting

Application

5.3.2.1 At an aerodrome provided with runway lighting and without a secondary power supply, sufficient emergency lights shall be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.

Note – Emergency lighting may also be useful to mark obstacles or delineate taxiways and apron areas.

Location

5.3.2.2 When installed on a runway the emergency lights shall, as a minimum, conform to the configuration required for a non-instrument runway.

Characteristics

5.3.2.3 The color of the emergency lights shall conform to the color requirements for runway lighting, except that, where the provision of colored lights at the threshold and the runway end is not practicable, all lights may be variable white or as close to variable white as practicable.

5.3.3 Aeronautical beacons

Application

5.3.3.1 Where operationally necessary an aerodrome beacon or an identification beacon shall be provided at each aerodrome intended for use at night.

5.3.3.2 The operational requirement shall be determined having regard to the requirements of the air traffic using the aerodrome, the conspicuity of the aerodrome features in relation to its surroundings and the installation of other visual and non-visual aids useful in locating the aerodrome.

Aerodrome beacon

5.3.3.3 An aerodrome beacon shall be provided at an aerodrome intended for use at night if one or more of the following conditions exist:
a) aircraft navigate predominantly by visual means;
b) reduced visibilities are frequent; or
c) it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.

Location

5.3.3.4 Where provided, the aerodrome beacon shall be located on or adjacent to the aerodrome in an area of low ambient background lighting.

5.3.3.5 The location of the beacon shall be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

Characteristics

5.3.3.6 The aerodrome beacon shall show either colored flashes alternating with white flashes, or white flashes only. The frequency of total flashes shall be from 20 to 30 per minute. Where used, the colored flashes emitted by beacons at land aerodromes shall be green and colored flashes emitted by beacons at water aerodromes shall be yellow. In the case of a combined water and land aerodrome, colored flashes, if used, shall have the color characteristics of whichever section of the aerodrome is designated as the principal facility.

5.3.3.7 The light from the beacon shall show at all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation deter-mined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used and the effective intensity of the flash shall be not less than 2000 cd.

Note – At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

Identification beacon

Application

5.3.3.8 An identification beacon shall be provided at an aerodrome which is intended for use at night and cannot be easily identified from the air by other means.

Location

5.3.3.9 The identification beacon shall be located on the aerodrome in an area of low ambient background lighting.

5.3.3.10 The location of the beacon shall be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

Characteristics

5.3.3.11 An identification beacon at a land aerodrome shall show at all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used and the effective intensity of the flash shall be not less than 2 000 cd.

Note – At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

5.3.3.12 An identification beacon shall show flashing-green at a land aerodrome and flashing-yellow at a water aerodrome.

5.3.3.13 The identification characters shall be transmitted in the International Morse Code.

5.3.3.14 The speed of transmission shall be between six and eight words per minute, the corresponding range of duration of the Morse dots being from 0.15 to 0.2 seconds per dot.

5.3.4 Approach lighting systems

Note – It is intended that existing lighting systems not conforming to the specifications in 5.3.4.21, 5.3.4.39, 5.3.9.10, 5.3.10.10, 5.3.10.11, 5.3.11.5, 5.3.12.8, 5.3.13.6 and 5.3.16.8 be replaced not later than 1 January 2005.

Application

5.3.4.1 Application
A – Non-instrument runway
Where physically practicable, asimple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 shall be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility, and sufficient guidance is provided by other visual aids.
Note – A simple approach lighting system can also provide visual guidance by day.
B – Non-precision approach runway
Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 shall be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.
Note – It is advisable to give consideration to the installation of a precision approach category I lighting system or to the addition of a runway lead-in lighting system.
C – Precision approach runway category I
Where physically practicable, a precision approach category I lighting system as specified in 5.3.4.10 to 5.3.4.21 shall be provided to serve a precision approach runway category I.
D – Precision approach runway categories II and III A precision approach category II and III lighting system as specified in 5.3.4.22 to 5.3.4.39 shall be provided to serve a precision approach runway category II or III.

Simple approach lighting system

Location

5.3.4.2 A simple approach lighting system shall consist of a row of lights on the extended centre line of the runway extending, whenever possible, over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 18 m or 30 m in length at a distance of 300 m from the threshold.

5.3.4.3 The lights forming the crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights of the crossbar shall be spaced so as to produce a linear effect, except that, when a crossbar of 30 m is used, gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note 1 – Spacing 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 fire fighting vehicles.

Note 2 – See Attachment A, Section 11 for guidance on installation tolerances.

5.3.4.4 The lights forming the centre line shall be placed at longitudinal intervals of 60 m, except that, when it is desired to improve the guidance, an interval of 30 m may be used. The innermost light shall be located either 60 m or 30 m from the threshold, depending on the longitudinal interval selected for the centre line lights.

5.3.4.5 If it is not physically possible to provide a centre line extending for a distance of 420 m from the threshold, it shall be extended to 300 m so as to include the crossbar. If this is not possible, the centre line lights shall be extended as far as practicable, and each centre line light shall then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.

5.3.4.6 The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:
a) no object other than an ILS or MLS azimuth antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and
b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) shall be screened from an approaching aircraft.

Any ILS or MLS azimuth antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

Characteristics

5.3.4.7 The lights of a simple approach lighting system shall be fixed lights and the color of the lights shall be such as to ensure that the system is readily distinguishable from other aeronautical ground lights, and from extraneous lighting if present. Each centre line light shall consist of either:
a) a single source; or
b) a barrette at least 3 m in length.

Note 1 – When the barrette as in b) is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

Note 2 – It may be advisable to use barrettes 4 m in length if it is anticipated that the simple approach lighting system will be developed into a precision approach lighting system.

Note 3 – At locations where identification of the simple approach lighting system is difficult at night due to surrounding lights, sequence flashing lights installed in the outer portion of the system may resolve this problem.

5.3.4.8 Where provided for a non-instrument runway, the lights shall show at all angles in azimuth necessary to a pilot on base leg and final approach. The intensity of the lights shall be adequate for all conditions of visibility and ambient light for which the system has been provided.

5.3.4.9 Where provided for a non-precision approach runway, the lights shall show at all angles in azimuth necessary to the pilot of an aircraft which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid. The lights shall be designed to provide guidance during both day and night in the most adverse conditions of visibility and ambient light for which it is intended that the system shall remain usable.

Precision approach category I lighting system

Location

5.3.4.10 A precision approach category I lighting system shall consist of a row of lights on the extended centre line of the runway extending, wherever possible, over a distance of 900 m from the runway threshold with a row of lights forming a crossbar 30 m in length at a distance of 300 m from the runway threshold.

Note – 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. See Attachment A, Section 11.

5.3.4.11 The lights forming the crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights of the crossbar shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note 1 – Spacing 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 fire fighting vehicles.

Note 2 – See Attachment A, Section 11 for guidance on installation tolerances.

5.3.4.12 The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.

5.3.4.13 The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

a) no object other than an ILS or MLS azimuth antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and

b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) shall be screened from an approaching aircraft.

Any ILS or MLS azimuth antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

Characteristics

5.3.4.14 The centre line and crossbar lights of a precision approach category I lighting system shall be fixed lights showing variable white. Each centre line light position shall consist of either:

a) a single light source in the innermost 300 m of the centre line, two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line to provide distance information; or

b) a barrette.

5.3.4.15 Where the serviceability level of the approach lights specified as a maintenance objective in 10.4.10 can be demonstrated, each centre line light position may consist of either:

a) a single light source; or

b) a barrette.

5.3.4.16 The barrettes shall be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights shall be uniformly spaced at intervals of not more than 1.5 m.

5.3.4.17 If the centre line consists of barrettes as described in 5.3.4.14 b) or 5.3.4.15 b), each barrette shall be supplemented by a capacitor discharge light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

5.3.4.18 Each capacitor discharge light as described in 5.3.4.17 shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.19 If the centre line consists of lights as described in 5.3.4.14 a) or 5.3.4.15 a), additional crossbars of lights to the crossbar provided at 300 m from the threshold shall be provided at 150 m, 450 m, 600 m and 750 m from the threshold. The lights forming each crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note – See Attachment A, Section 11 for detailed configuration.

5.3.4.20 Where the additional crossbars described in 5.3.4.19 are incorporated in the system, the outer ends of the crossbars shall lie on two straight lines that either are parallel to the line of the centre line lights or converge to meet the runway centre line 300 m from threshold.

5.3.4.21 The lights shall be in accordance with the specifications of Appendix 2, Figure A2-1.

Note – The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-4.

Precision approach category II and III lighting system

Location

5.3.4.22 The approach lighting system shall consist of a row of lights on the extended centre line of the runway, extending, wherever possible, over a distance of 900 m from the runway threshold. In addition, the system shall have two side rows of lights, extending 270 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 5-13. Where the serviceability level of the approach lights specified as maintenance objectives in 10.4.7 can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 5-14.

Note – 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. See Attachment A, Section 11.

5.3.4.23 The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost lights located 30 m from the threshold.

5.3.4.24 The lights forming the side rows shall be placed on each side of the centre line, at a longitudinal spacing equal to that of the centre line lights and with the first light located 30 m from the threshold. Where the serviceability level of the approach lights specified as maintenance objectives in 10.4.7 can be demonstrated, lights forming the side rows may be placed on each side of the centre line, at a longitudinal spacing of 60 m with the first light located 60 m from the threshold.

The lateral spacing (or gauge) between the innermost lights of the side rows shall be not less than 18 m nor more than 22.5 m, and preferably 18 m, but in any event shall be equal to that of the touchdown zone lights.

5.3.4.25 The crossbar provided at 150 m from the threshold shall fill in the gaps between the centre line and side row lights.

5.3.4.26 The crossbar provided at 300 m from the threshold shall extend on both sides of the centre line lights to a distance of 15 m from the centre line.

5.3.4.27 If the centre line beyond a distance of 300 m from the threshold consists of lights as described in 5.3.4.31 b) or 5.3.4.32 b), additional crossbars of lights shall be provided at 450 m, 600 m and 750 m from the threshold.

5.3.4.28 Where the additional crossbars described in 5.3.4.27 are incorporated in the system, the outer ends of these crossbars shall lie on two straight lines that either are parallel to the centre line or converge to meet the runway centre line 300 m from the threshold.

5.3.4.29 The system shall lie as nearly as practicable in the horizontal

plane passing through the threshold, provided that:

a) no object other than an ILS or MLS azimuth antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and

b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) shall be screened from an approaching aircraft.

Any ILS or MLS azimuth antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

Characteristics

5.3.4.30 The centre line of a precision approach category II and III lighting system for the first 300 m from the threshold shall consist of barrettes showing variable white, except that, where the threshold is displaced 300 m or more, the centre line may consist of single light sources showing variable white. Where the serviceability level of the approach lights specified as maintenance objectives in 10.4.7 can be demonstrated, the centre line of a precision approach category II and III lighting system for the first 300 m from the threshold may consist of either:

a) barrettes, where the centre line beyond 300 m from the threshold consists of barrettes as described in 5.3.4.32 a); or

b) alternate single light sources and barrettes, where the centre line beyond 300 m from the threshold consists of single light sources as described in 5.3.4.32 b), with the innermost single light source located 30 m and the innermost barrette located 60 m from the threshold; or

c) single light sources where the threshold is displaced 300 m or more;

all of which shall show variable white.

5.3.4.31 Beyond 300 m from the threshold each centre line light position shall consist of either:

a) a barrette as used on the inner 300 m; or

b) two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line;

all of which shall show variable white.

5.3.4.32 Where the serviceability level of the approach lights specified as maintenance objectives in 10.4.7 can be demonstrated, beyond 300 m from the threshold each centre line light position may consist of either:

a) a barrette; or

b) a single light source;

all of which shall show variable white.

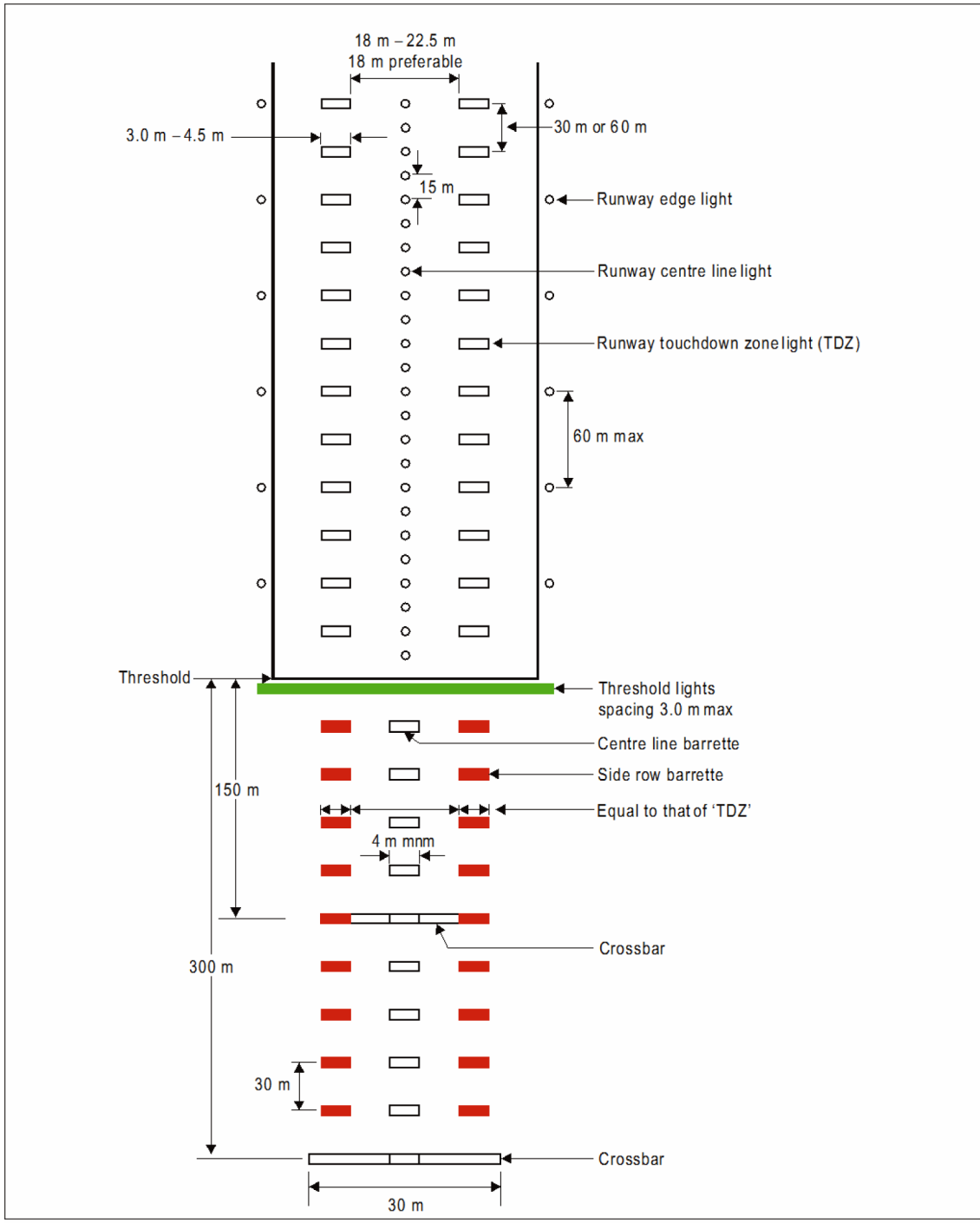


Figure 5-13. Inner 300 m approach and runway lighting
for precision approach runways categories II and III

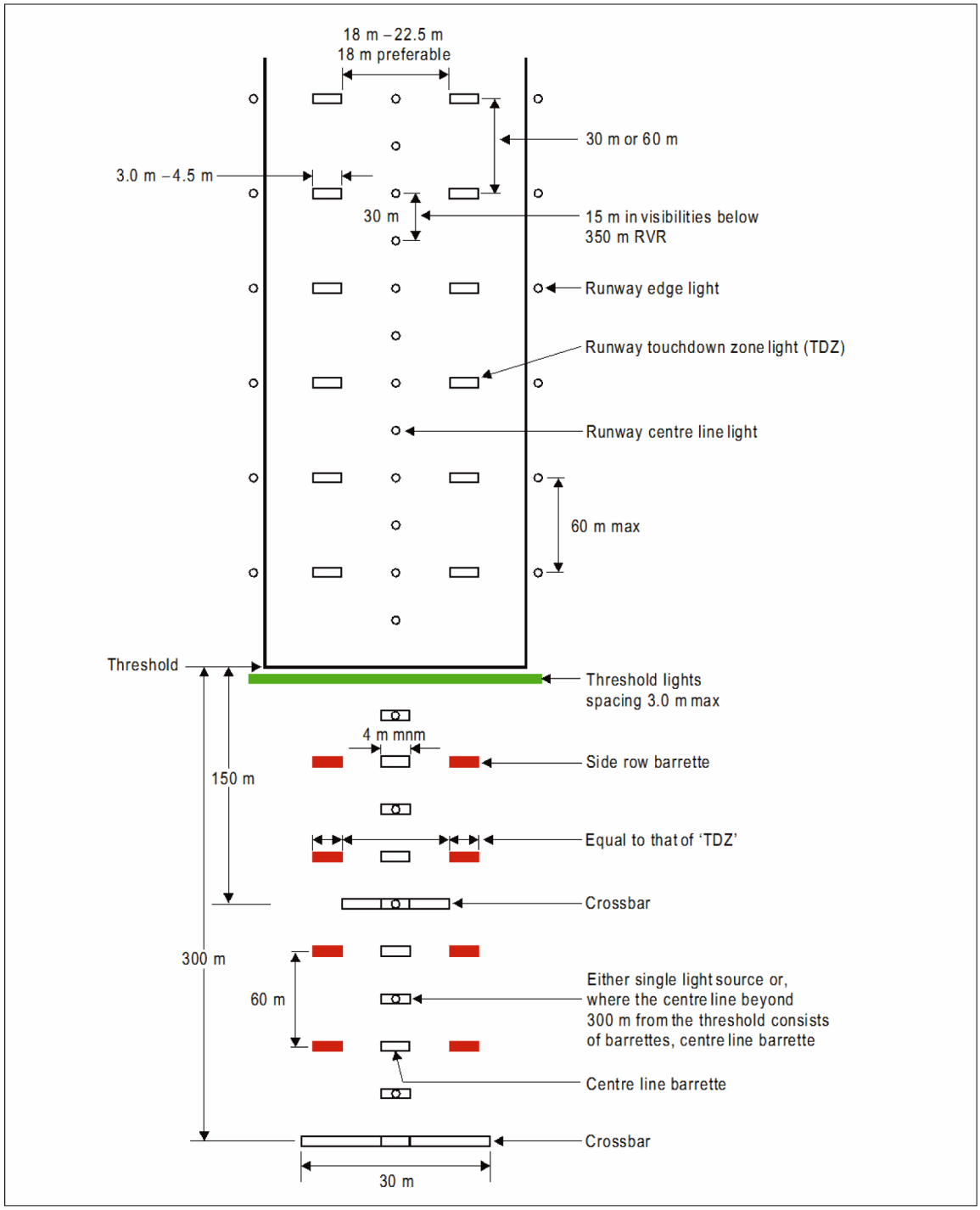


Figure 5-14. Inner 300 m approach and runway lighting for precision approach runways categories II and III where the serviceability levels of the lights specified as maintenance objectives in Chapter 10 can be demonstrated

5.3.4.33 The barrettes shall be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights shall be uniformly spaced at intervals of not more than 1.5 m.

5.3.4.34 If the centre line beyond 300 m from the threshold consists of barrettes as described in 5.3.4.31 a) or 5.3.4.32 a), each barrette beyond 300 m shall be supplemented by a capacitor discharge light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

5.3.4.35 Each capacitor discharge light shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.36 The side row shall consist of barrettes showing red. The length of a side row barrette and the spacing of its lights shall be equal to those of the touchdown zone light barrettes.

5.3.4.37 The lights forming the crossbars shall be fixed lights showing variable white. The lights shall be uniformly spaced at intervals of not more than 2.7 m.

5.3.4.38 The intensity of the red lights shall be compatible with the intensity of the white lights.

5.3.4.39 The lights shall be in accordance with the specifications of Appendix 2, Figures A2-1 and A2-2.

Note – The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-4.

5.3.5 Visual approach slope indicator systems

Application

5.3.5.1 A visual approach slope indicator system shall be provided to serve the approach to a runway whether or not the runway is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist:
a) the runway is used by turbojet or other airplanes with similar approach guidance requirements;
b) the pilot of any type of airplane may have difficulty in judging the approach due to:
1) inadequate visual guidance such as is experienced during an approach over water or featureless terrain by day or in the absence of sufficient extraneous lights in the approach area by night, or
2) misleading information such as is produced by deceptive surrounding terrain or runway slopes;
c) the presence of objects in the approach area may involve serious hazard if an airplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects;
d) physical conditions at either end of the runway present a serious hazard in the event of an airplane undershooting or overrunning the runway; and
e) terrain or prevalent meteorological conditions are such that the airplane may be subjected to unusual turbulence during approach.

Note – Guidance on the priority of installation of visual approach slope indicator systems is contained in Attachment A, Section 12.

5.3.5.2 The standard visual approach slope indicator systems shall

consist of the following:
a) T-VASIS and AT-VASIS conforming to the specifications contained in 5.3.5.6 to 5.3.5.22 inclusive;
b) PAPI and APAPI systems conforming to the specifications contained in 5.3.5.23 to 5.3.5.40 inclusive;
as shown in Figure 5-15.

5.3.5.3 PAPI, T-VASIS or AT-VASIS shall be provided where the code number is 3 or 4 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.4 PAPI or APAPI shall be provided where the code number is 1 or 2 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.5 Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 5.3.5.1 exist, a PAPI shall be provided except that where the code number is 1 or 2 an APAPI may be provided.

T-VASIS and AT-VASIS

Description

5.3.5.6 The T-VASIS shall consist of twenty light units symmetrically disposed about the runway centre line in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, as shown in Figure 5-16.

5.3.5.7 The AT-VASIS shall consist of ten light units arranged on one side of the runway in the form of a single wing bar of four light units with a bisecting longitudinal line of six lights.

5.3.5.8 The light units shall be constructed and arranged in such a manner that the pilot of an airplane during an approach will:
a) when above the approach slope, see the wing bar(s) white, and one, two or three fly-down lights, the more fly-down lights being visible the higher the pilot is above the approach slope;
b) when on the approach slope, see the wing bar(s) white; and
c) when below the approach slope, see the wing bar(s) and one, two or three fly-up lights white, the more fly-up lights being visible the lower the pilot is below the approach slope; and when well below the approach slope, see the wing bar(s) and the three fly-up lights red.

When on or above the approach slope, no light shall be visible from the fly-up light units; when on or below the approach slope, no light shall be visible from the fly-down light units.

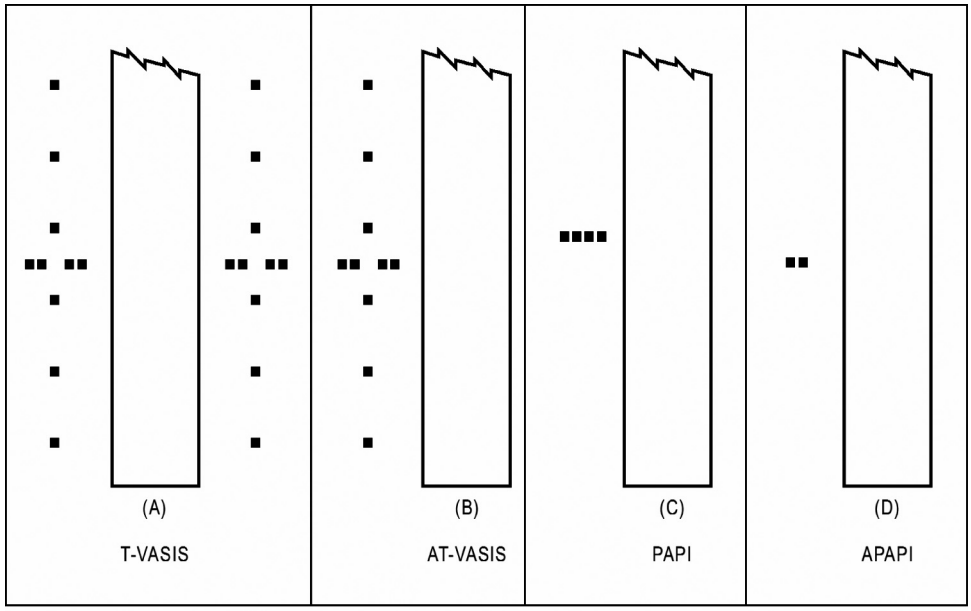


Figure 5-15. Visual approach slope indicator systems

Siting

5.3.5.9 The light units shall be located as shown in Figure 5-16, subject to the installation tolerances given therein.

Note – The siting of T-VASIS will provide, for a 3° slope and a nominal eye height over the threshold of 15 m (see 5.3.5.6 and 5.3.5.19), a pilot's eye height over threshold of 13 m to 17 m when only the wing bar lights are visible. If increased eye height at the threshold is required (to provide adequate wheel clearance), then the approaches may be flown with one or more fly-down lights visible. The pilot's eye height over the threshold is then of the following order:

Wing bar lights and one fly-down light visible	*17 m to 22 m*
Wing bar lights and two fly-down lights visible	22 m to 28 m
Wing bar lights and three fly-down lights visible	*28 m to 54 m*

Characteristics of the light units

5.3.5.10 The systems shall be suitable for both day and night operations.

5.3.5.11 The light distribution of the beam of each light unit shall be of fan shape showing over a wide arc in azimuth in the approach direction. The wing bar light units shall produce a beam of white light from 1°54' vertical angle up to 6° vertical angle and a beam of red light from 0° to 1°54' vertical angle. The fly-down light units shall produce a white beam extending from an elevation of 6° down to approximately the approach slope, where it shall have a sharp cut-off. The fly-up light units shall produce a white beam from approximately the approach slope down to

1°54' vertical angle and a red beam below a 1°54' vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with 5.3.5.21.

5.3.5.12 The light intensity distribution of the fly-down, wing bar and fly-up light units shall be as shown in Appendix 2, Figure A2-22.

5.3.5.13 The color transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur over a vertical angle of not more than 15'.

5.3.5.14 At full intensity the red light shall have a Y coordinate not exceeding 0.320.

5.3.5.15 A suitable intensity control shall be provided to allow adjustments to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.16 The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, shall be mounted so as to appear to the pilot of an approaching airplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

5.3.5.17 The light units shall be so designed that deposits of condensation, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall in no way affect the elevation of the beams or the contrast between the red and white signals. The construction of the light units shall be such as to minimize the probability of the slots being wholly or partially blocked by snow or ice where these conditions are likely to be encountered.

Approach slope and elevation setting of light beams

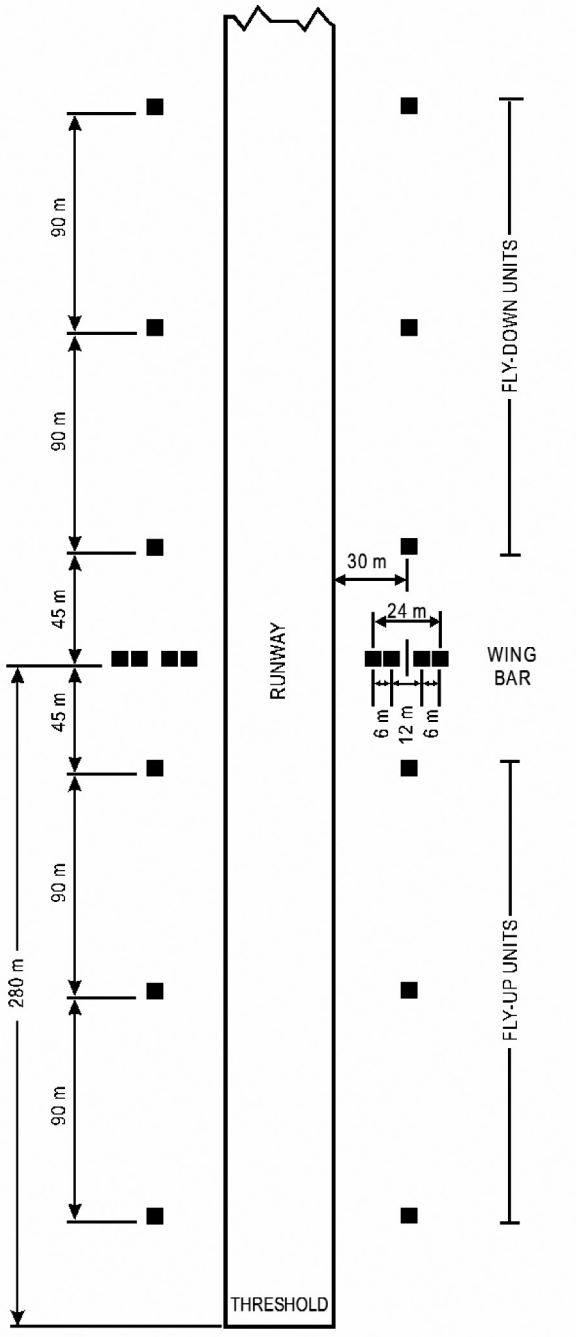
5.3.5.18 The approach slope shall be appropriate for use by the airplanes using the approach.

5.3.5.19 When the runway on which a T-VASIS is provided is equipped with an ILS and/or MLS, the siting and elevations of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.20 The elevation of the beams of the wing bar light units on both sides of the runway shall be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and that of the bottom of the beam of the fly-down light unit nearest to each wing bar, shall be equal and shall correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up light units shall decrease by 5' of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units shall increase by 7' of arc at each successive unit away from the wing bar (see Figure 5-17).

5.3.5.21 The elevation setting of the top of the red light beams of the wing bar and fly-up light units shall be such that, during an approach, the pilot of an airplane to whom the wing bar and three fly-up light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.

5.3.5.22 The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.



INSTALLATION TOLERANCES

The appropriate authority may:

a) vary the nominal eye height over the threshold of the on-slope signal between the limits of 12 m and 16 m, except in cases where a standard ILS glide path and/or MLS minimum glide path is available; the height over threshold should be varied to avoid any conflict between the visual approach slope indications and the usable portion of the ILS glide path and/or MLS minimum glide path indications;

b) vary the longitudinal distance between individual light units or the overall length of the system by not more than 10 per cent;

c) vary the lateral displacement of the system from the runway edge by not more than ± 3 m;

Note.— The system must be symmetrically displaced about the runway centre line.

d) where there is a longitudinal slope of the ground, adjust the longitudinal distance of a light unit to compensate for its difference in level from that of the threshold; and

e) where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of 5.3.5.16.

The distance between the wing bar and the threshold is based on an approach slope of 3° to a level runway with a nominal eye height over the threshold of 15 m. In practice, the threshold to wing bar distance is determined by:

a) the selected approach slope;

b) the longitudinal slope of the runway; and

c) the selected nominal eye height over the threshold.

Figure 5-16. Siting of light units for T-VASIS

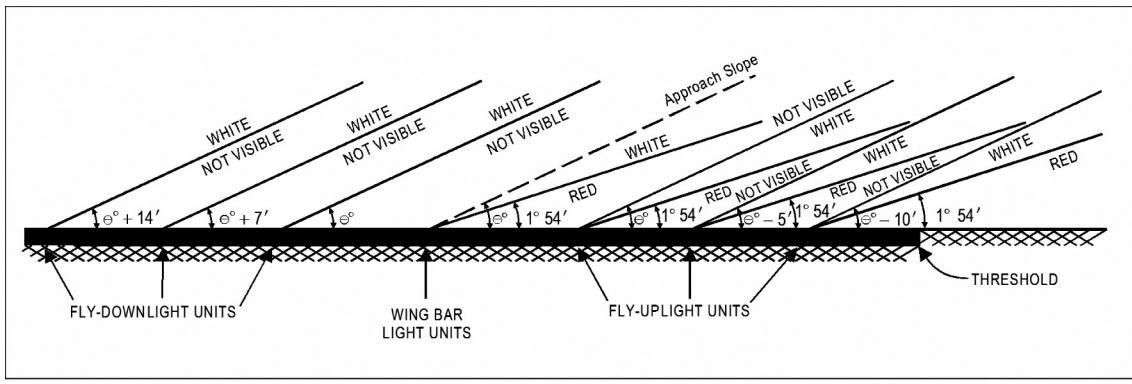


Figure 5-17. Light beams and elevation settings of T-VASIS and AT-VASIS

Note – See 5.3.5.41 to 5.3.5.45 concerning the related obstacle protection surface.

PAPI and APAPI

Description

5.3.5.23 The PAPI system shall consist of a wing bar of 4 sharp transition multi-lamp (or paired single lamp) units equally spaced. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note – Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

5.3.5.24 The APAPI system shall consist of a wing bar of 2 sharp transition multi-lamp (or paired single lamp) units. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note – Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

5.3.5.25 The wing bar of a PAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a) when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;

b) when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and

c) when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.

5.3.5.26 The wing bar of an APAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a) when on or close to the approach slope, see the unit nearer the runway as red and the unit farther from the runway as white;

b) when above the approach slope, see both the units as white; and

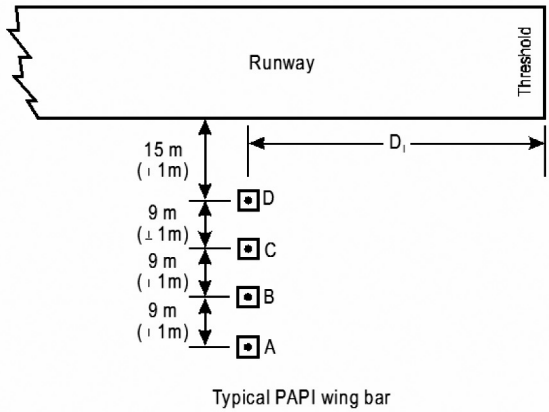
c) when below the approach slope, see both the units as red.

Siting

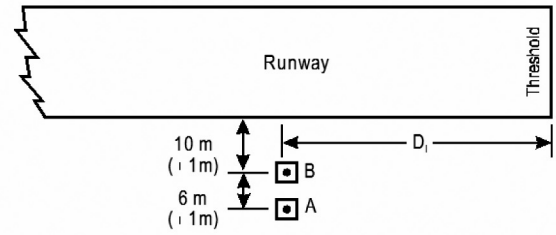
5.3.5.27 The light units shall be located as in the basic configuration illustrated in Figure 5-18, subject to the installation tolerances given therein. The units forming a wing bar shall be mounted so as to appear to the pilot of an approaching airplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

Characteristics of the light units

5.3.5.28 The system shall be suitable for both day and night operations.



Typical PAPI wing bar



Typical APAPI wing bar

INSTALLATION TOLERANCES

a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D_1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure 5-19, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table 5-2 for the most demanding amongst aeroplanes regularly using the runway.

b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and/or MLS, the distance D_1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. The distance shall be equal to that between the threshold and the effective origin of the ILS glide path or MLS minimum glide path, as appropriate, plus a correction factor for the variation of eye-to-antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. However, the distance shall be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of Table 5-2.

Note.— See Section 5.2.5 for specifications on aiming point marking. Guidance on the harmonization of PAPI, ILS and/or MLS signals is contained in the *Aerodrome Design Manual,* Part 4.

c) If a wheel clearance, greater than that specified in a) above is required for specific aircraft, this can be achieved by increasing D_1.

d) Distance D_1 shall be adjusted to compensate for differences in elevation between the lens centres of the light units and the threshold.

e) To ensure that units are mounted as low as possible and to allow for any transverse slope, small height adjustments of up to 5 cm between units are acceptable. A lateral gradient not greater that 1.25 per cent can be accepted provided it is uniformly applied across the units.

f) A spacing of 6 m (±1 m) between PAPI units should be used on code numbers 1 and 2. In such an event, the inner PAPI unit shall be located not less than 10 m (±1 m) from the runway edge.

Note.— Reducing the spacing between light units results in a reduction in usable range of the system.

g) The lateral spacing between APAPI units may be increased to 9 m (±1 m) if greater range is required or later conversion to a full PAPI is anticipated. In the latter case, the inner APAPI unit shall be located 15 m (±1 m) from the runway edge.

Figure 5-18. Siting of PAPI and APAPI

5.3.5.29 The color transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3'.

5.3.5.30 At full intensity the red light shall have a Y coordinate not exceeding 0.320.

5.3.5.31 The light intensity distribution of the light units shall be as shown in Appendix 2, Figure A2-23.

Note – See the Aerodrome Design Manual, Part 4 for additional guidance on the characteristics of light units.

5.3.5.32 Suitable intensity control shall be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.33 Each light unit shall be capable of adjustment in elevation so that the lower limit of the white part of the beam may be fixed at any desired angle of elevation between 1° 30' and at least 4° 30' above the horizontal.

5.3.5.34 The light units shall be so designed that deposits of condensation, snow, ice, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall not affect the contrast between the red and white signals and the elevation of the transition sector.

Approach slope and elevation setting of light units

5.3.5.35 The approach slope as defined in Figure 5-19 shall be appropriate for use by the airplanes using the approach.

5.3.5.36 When the runway is equipped with an ILS and/or MLS, the siting and the angle of elevation of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.37 The angle of elevation settings of the light units in a PAPI wing bar shall be such that, during an approach, the pilot of an airplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin.

5.3.5.38 The angle of elevation settings of the light units in an APAPI wing bar shall be such that, during an approach, the pilot of an airplane observing the lowest on slope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin.

5.3.5.39 The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the PAPI or APAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

Note – See 5.3.5.41 to 5.3.5.45 concerning the related obstacle protection surface.

5.3.5.40 Where wing bars are installed on each side of the runway to provide roll guidance, corresponding units shall be set at the same angle so that the signals of each wing bar change symmetrically at the same time.

Obstacle protection surface

Note – The following specifications apply to T-VASIS, AT-VASIS, PAPI and APAPI.

5.3.5.41 An obstacle protection surface shall be established when it is intended to provide a visual approach slope indicator system.

5.3.5.42 The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope shall correspond to those specified in the relevant column of Table 5-3 and in Figure 5-20.

5.3.5.43 New objects or extensions of existing objects shall not be permitted above an obstacle protection surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note – Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual, Part 6.

5.3.5.44 Existing objects above an obstacle protection surface shall be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of airplanes.

5.3.5.45 Where an aeronautical study indicates that an existing object extending above an obstacle protection surface could adversely affect the safety of operations of airplanes one or more of the following measures shall be taken:
a) suitably raise the approach slope of the system;
b) reduce the azimuth spread of the system so that the object is outside the confines of the beam;
c) displace the axis of the system and its associated obstacle protection surface by no more than 5°;
d) suitably displace the threshold; and
e) where d) is found to be impracticable, suitably displace the system upwind of the threshold to provide an increase in threshold crossing height equal to the height of the object penetration.
Note – Guidance on this issue is contained in the Aerodrome Design Manual, Part 4.

5.3.6 Circling guidance lights

Application

5.3.6.1 Circling guidance lights shall be provided when existing approach and runway lighting systems do not satisfactorily permit identification of the runway and/or approach area to a circling aircraft in the conditions for which it is intended the runway be used for circling approaches.

Location

5.3.6.2 The location and number of circling guidance lights shall be adequate to enable a pilot, as appropriate, to:
a) join the downwind leg or align and adjust the aircraft's track to the runway at a required distance from it and to distinguish the threshold in passing; and

b) keep in sight the runway threshold and/or other features which will make it possible to judge the turn on to base leg and final approach, taking into account the guidance provided by other visual aids.

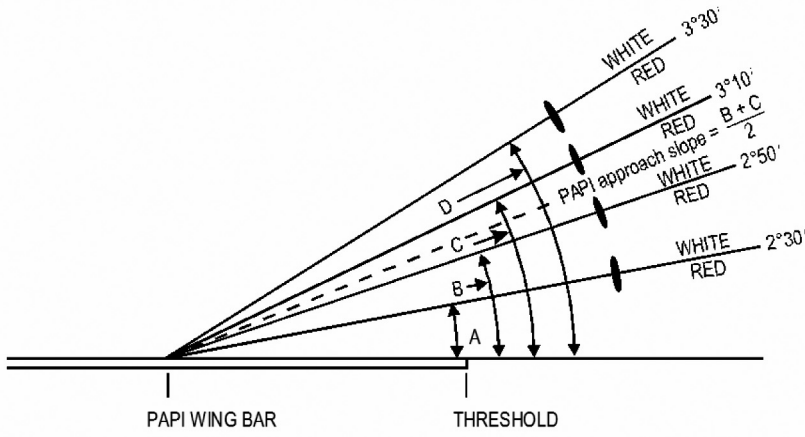
5.3.6.3 Circling guidance lights shall consist of:
a) lights indicating the extended centre line of the runway and/or parts of any approach lighting system; or
b) lights indicating the position of the runway threshold; or
c) lights indicating the direction or location of the runway;
or a combination of such lights as is appropriate to the runway under consideration.

Note – Guidance on installation of circling guidance lights is given in the Aerodrome Design Manual, Part 4.

Characteristics

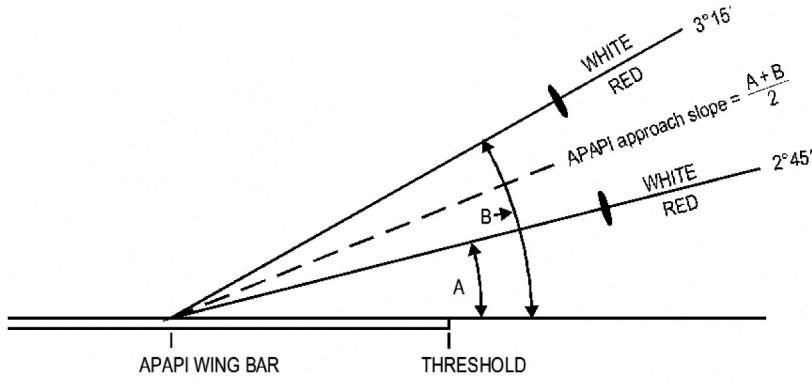
5.3.6.4 Circling guidance lights shall be fixed or flashing lights of an intensity and beam spread adequate for the conditions of visibility and ambient light in which it is intended to make visual circling approaches. The flashing lights shall be white, and the steady lights either white or gaseous discharge lights.

5.3.6.5 The lights shall be designed and be installed in such a manner that they will not dazzle or confuse a pilot when approaching to land, taking off or taxiing.



The height of the pilot's eye above the aircraft's ILS glide path/MLS antenna varies with the type of aeroplane and approach attitude. Harmonization of the PAPI signal and ILS glide path and/or MLS minimum glide path to a point closer to the threshold may be achieved by increasing the on-course sector from 20′ to 30′. The setting angles for a 3° glide slope would then be 2°25′, 2°45′, 3°15′ and 3°35′.

A — 3° PAPI ILLUSTRATED



B — 3° APAPI ILLUSTRATED

Figure 5-19. Light beams and angle of elevation setting of PAPI and APAPI

Table 5-2. Wheel clearance over threshold for PAPI and APAPI

Eye-to-wheel height of aeroplane in the approach configuration[a]	Desired wheel clearance (metres)[b,c]	Minimum wheel clearance (metres)[d]
(1)	(2)	(3)
up to but not including 3 m	6	3[e]
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

a. In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis shall be considered. The most demanding amongst such aeroplanes shall determine the eye-to-wheel height group.

b. Where practicable the desired wheel clearances shown in column (2) shall be provided.

c. The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.

d. When a reduced wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway.

e. This wheel clearance may be reduced to 1.5 m on runways used mainly by light-weight non-turbo-jet aeroplanes.

Table 5-3. Dimensions and slopes of the obstacle protection surface

	Runway type/code number							
	Non-instrument				Instrument			
	Code number				Code number			
Surface dimensions	1	2	3	4	1	2	3	4
Length of inner edge	60 m	80 m[a]	150 m	150 m	150 m	150 m	300 m	300 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%
Total length	7 500 m	7 500 m[b]	15 000 m	15 000 m	7 500 m	7 500 m[b]	15 000 m	15 000 m
Slope								
a) T-VASIS and AT-VASIS	–[c]	1.9°	1.9°	1.9°	–	1.9°	1.9°	1.9°
b) PAPI[d]	–	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
c) APAPI[d]	A–0.9°	A–0.9°	–	–	A–0.9°	A–0.9°	–	–

a. This length is to be increased to 150 m for a T-VASIS or AT-VASIS.
b. This length is to be increased to 15 000 m for a T-VASIS or AT-VASIS.
c. No slope has been specified if a system is unlikely to be used on runway type/code number indicated.
d. Angles as indicated in Figure 5-19.

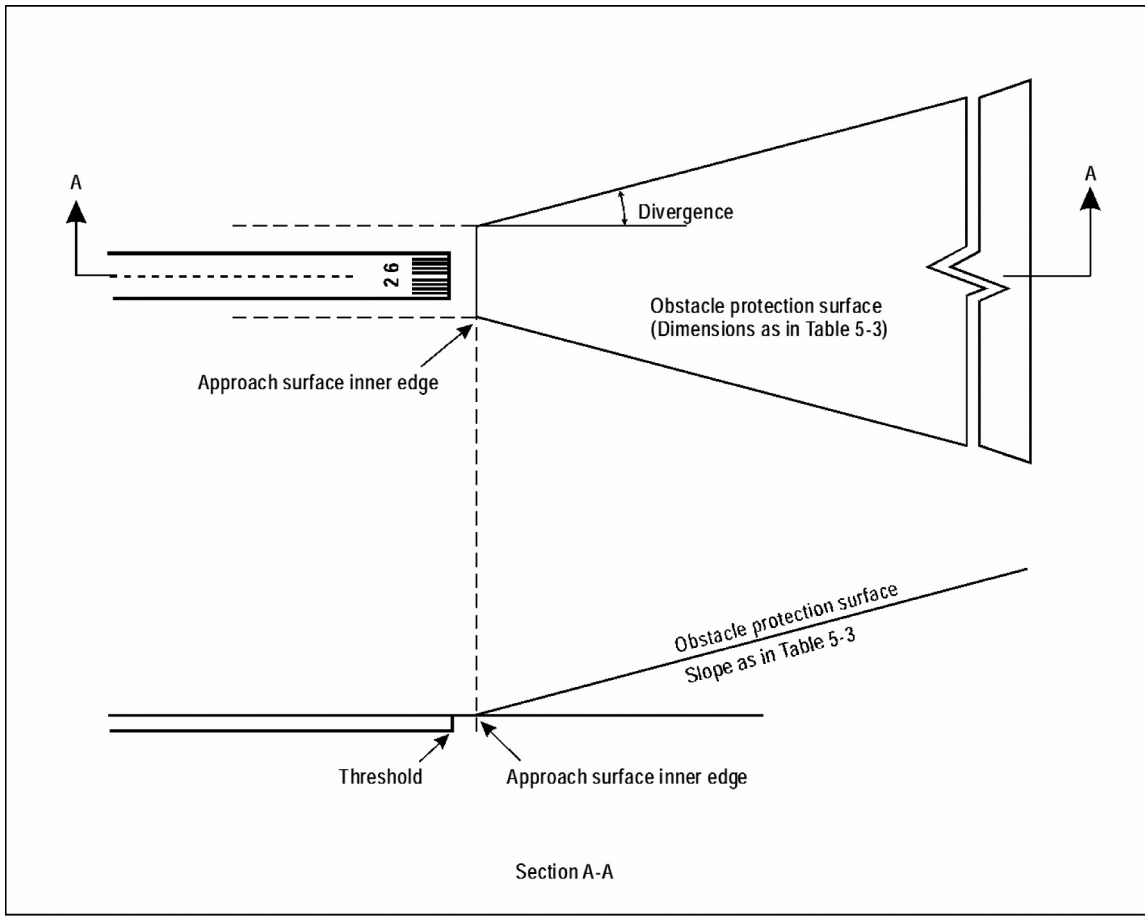


Figure 5-20. Obstacle protection surface for visual approach slope indicator systems

5.3.7 Runway lead-in lighting systems

Application

5.3.7.1 A runway lead-in lighting system shall be provided where it is desired to provide visual guidance along a specific approach path, for reasons such as avoiding hazardous terrain or for purposes of noise abatement.

Note – Guidance on providing lead-in lighting systems is given in the Aerodrome Design Manual, Part 4.

Location

5.3.7.2 A runway lead-in lighting system shall consist of groups of lights positioned so as to define the desired approach path and so that one group may be sighted from the preceding group. The interval between adjacent groups shall not exceed approximately 1600 m.

Note – Runway lead-in lighting systems may be curved, straight or a combination thereof.

5.3.7.3 A runway lead-in lighting system shall extend from a point as determined by the appropriate authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

Characteristics

5.3.7.4 Each group of lights of a runway lead-in lighting system shall consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.

5.3.7.5 The flashing lights shall be white, and the steady burning lights gaseous discharge lights.

5.3.7.6 Where practicable, the flashing lights in each group shall flash in sequence towards the runway.

5.3.8 Runway threshold identification lights

Application

5.3.8.1 Runway threshold identification lights shall be installed:
a) at the threshold of a non-precision approach runway when additional threshold conspicuity is necessary or where it is not practicable to provide other approach lighting aids; and
b) where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.

Location

5.3.8.2 Runway threshold identification lights shall be located symmetrically about the runway centre line, in line with the threshold and approximately 10 m outside each line of runway edge lights.

Characteristics

5.3.8.3 Runway threshold identification lights shall be flashing white lights with a flash frequency between 60 and 120 per minute.

5.3.8.4 The lights shall be visible only in the direction of approach to the runway.

5.3.9 Runway edge lights

Application

5.3.9.1 Runway edge lights shall be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

5.3.9.2 Runway edge lights shall be provided on a runway intended for take-off with an operating minimum below an RVR of the order of 800 m by day.

Location

5.3.9.3 Runway edge lights shall be placed along the full length of the runway and shall be in two parallel rows equidistant from the centre line, commencing one-light spacing from the threshold and continuing to one-light spacing from the runway end.

5.3.9.4 Runway edge lights shall be placed along the edges of the area declared for use as the runway or outside the edges of the area at a distance of not more than 3 m.

5.3.9.5 Where the width of the area which could be declared as runway exceeds 60 m, the distance between the rows of lights shall be determined taking into account the nature of the operations, the light distribution characteristics of the runway edge lights, and other visual aids serving the runway.

5.3.9.6.The longitudinal spacing of runway edge lights must be uniform and be:
(a) for an instrument runway, 60 m +0 / –5 m;
(b) for a non-instrument runway, 90 m ± 10 m, or 60 m +0 / –5 m if there is an intention to upgrade the runway to an instrument runway at some time in the future.
(c) for non-precision instrument runways intended to be used in visibility conditions of 1.5 km or greater, where existing edge lights are spaced at 90 m ±10 m, it is acceptable to retain this spacing until the next replacement or improvement of the edge lighting system. (This situation typically arises from an existing non-instrument runway being upgraded to a non-precision instrument runway, but without re-installing the runway edge lights to the 60 m +0 / -5 m standard.)

5.3.9.6.1 The lights on opposite sides of the runway axis shall be on lines at right angels to that axis. At intersections of runways, lights may be spaced irregularly or omitted, provided that adequate guidance remains available to the pilot.

5.3.9.6.2 Where the runway is a non-instrument or a non-precision instrument runway, and it is intersected by other runways or taxiways:
(a) within 600 m of the threshold, lights may be spaced irregularly, but not omitted, and
(b) more than 600 m from the threshold, lights may be spaced irregularly or omitted, but no two consecutive lights may be omitted; provided that such irregular spacing or omission does not significantly alter the visual guidance available to a pilot using the runway.

5.3.9.6.3 Runway edge lights must not to be omitted on a precision approach runway.

5.3.9.6.4 Where a runway edge light cannot be omitted, inset runway edge lights must be provided in place of elevated lights.

5.3.9.6.5 Unless a light is omitted or displaced in accordance with Paragraph 5.3.9.6.2, a runway edge light must be aligned with a light on the opposite side of the runway

Characteristics

5.3.9.7 Runway edge lights shall be fixed lights showing variable white, except that:

a) in the case of a displaced threshold, the lights between the beginning of the runway and the displaced threshold shall show red in the approach direction; and

b) a section of the lights 600 m or one-third of the runway length, whichever is the less, at the remote end of the runway from the end at which the take-off run is started, may show yellow.

5.3.9.8 The runway edge lights shall show at all angles in azimuth necessary to provide guidance to a pilot landing or taking off in either direction. When the runway edge lights are intended to provide circling guidance, they shall show at all angles in azimuth (see 5.3.6.1).

5.3.9.9 In all angles of azimuth required in 5.3.9.8, runway edge lights shall show at angles up to 15° above the horizontal with an intensity adequate for the conditions of visibility and ambient light in which use of the runway for take-off or landing is intended. In any case, the intensity shall be at least 50 cd except that at an aerodrome without extraneous lighting the intensity of the lights may be reduced to not less than 25 cd to avoid dazzling the pilot.

5.3.9.10 Runway edge lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-9 or A2-10.

5.3.10 Runway threshold and wing bar lights (see Figure 5-21).

Application of runway threshold lights

5.3.10.1 Runway threshold lights shall be provided for a runway equipped with runway edge lights except on a non-instrument or non-precision approach runway where the threshold is displaced and wing bar lights are provided.

Location of runway threshold lights

5.3.10.2 When a threshold is at the extremity of a runway, the threshold lights shall be placed in a row at right angles to the runway axis as near to the extremity of the runway as possible and, in any case, not more than 3 m outside the extremity.

5.3.10.3 When a threshold is displaced from the extremity of a runway, threshold lights shall be placed in a row at right angles to the runway axis at the displaced threshold.

5.3.10.4 Threshold lighting shall consist of:

a) on a non-instrument or non-precision approach runway, at least six lights;

b) on a precision approach runway category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of runway edge lights; and

c) on a precision approach runway category II or III, lights uniformly spaced between the rows of runway edge lights at intervals of not more than 3 m.

5.3.10.5 The lights prescribed in 5.3.10.4 a) and b) shall be either:

a) equally spaced between the rows of runway edge lights, or

b) symmetrically disposed about the runway centre line in two groups, with the lights uniformly spaced in each group and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.

Application of wing bar lights

5.3.10.6 Wing bar lights shall be provided on a precision approach runway when additional conspicuity is considered desirable.

5.3.10.7 Wing bar lights shall be provided on a non-instrument or non-precision approach runway where the threshold is displaced and runway threshold lights are required, but are not provided.

Location of wing bar lights

5.3.10.8 Wing bar lights shall be symmetrically disposed about the runway centre line at the threshold in two groups, i.e. wing bars. Each wing bar shall be formed by at least five lights extending at least 10 m outward from, and at right angles to, the line of the runway edge lights, with the innermost light of each wing bar in the line of the runway edge lights.

Characteristics of runway threshold and wing bar lights

5.3.10.9 Runway threshold and wing bar lights shall be fixed unidirectional lights showing green in the direction of approach to the runway. The intensity and beam spread of the lights shall be adequate for the conditions of visibility and ambient light in which use of the runway is intended.

5.3.10.10 Runway threshold lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-3.

5.3.10.11 Threshold wing bar lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-4.

5.3.11 Runway end lights (see Figure 5-21)

Application

5.3.11.1 Runway end lights shall be provided for a run-way equipped with runway edge lights.

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

Location

5.3.11.2 Runway end lights shall be placed on a line at right angles to the runway axis as near to the end of the runway as possible and, in any case, not more than 3 m outside the end.

5.3.11.3 Runway end lighting shall consist of at least six lights. The lights shall be either:
a) equally spaced between the rows of runway edge lights, or
b) symmetrically disposed about the runway centre line in two groups with the lights uniformly spaced in each group and with a gap between the groups of not more than half the distance between the rows of runway edge lights.

For a precision approach runway category III, the spacing between runway end lights, except between the two innermost lights if a gap is used, shall not exceed 6 m.

Characteristics

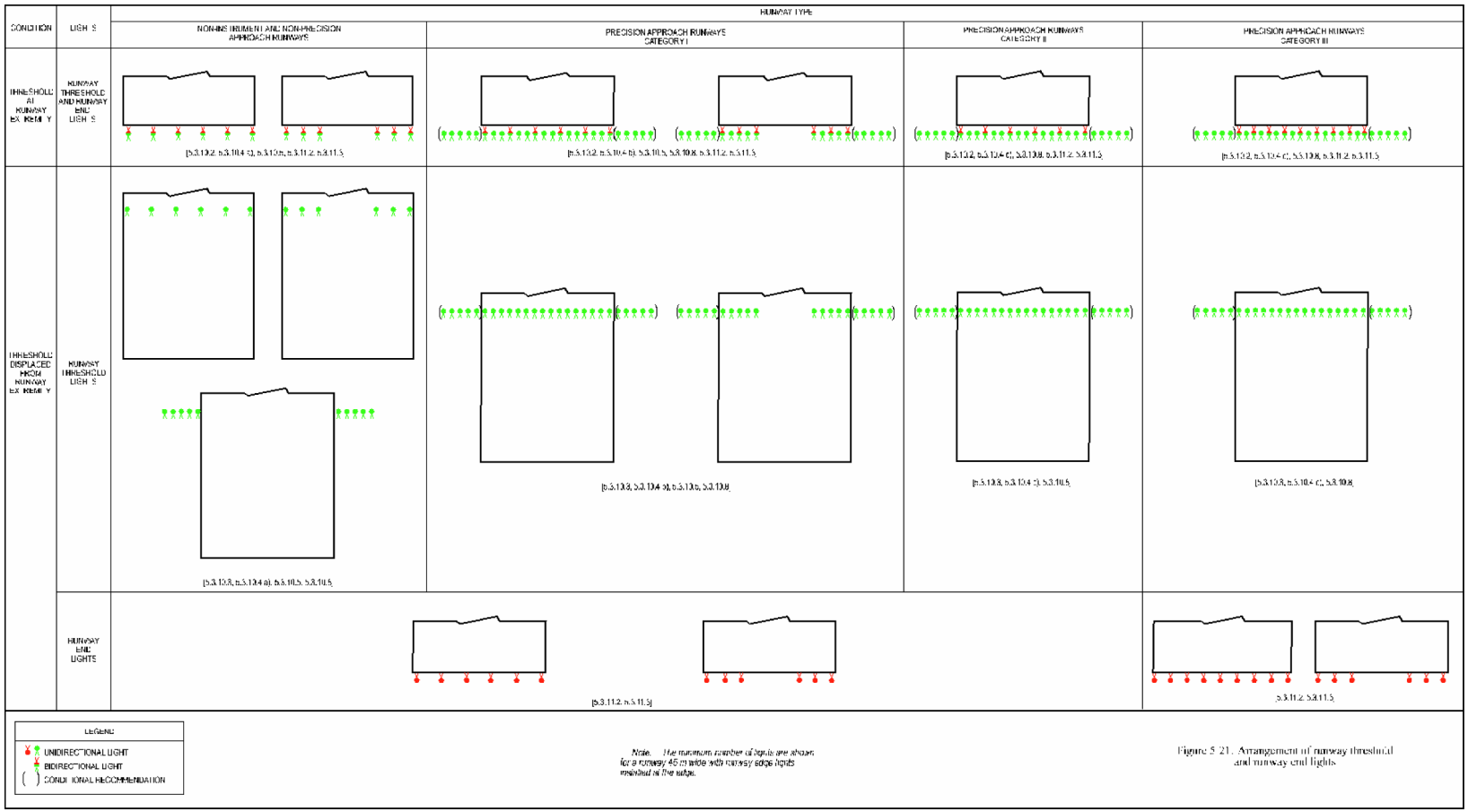
5.3.11.4 Runway end lights shall be fixed unidirectional lights showing red in the direction of the runway. The intensity and beam spread of the lights shall be adequate for the conditions of visibility and ambient light in which use of the runway is intended.

5.3.11.5 Runway end lights on a precision approach run-way shall be in accordance with the specifications of Appendix 2, Figure A2-8.

5.3.12 Runway centre line lights

Application

5.3.12.1 Runway centre line lights shall be provided on a precision approach runway category II or III.



Note.— The minimum number of lights are shown for a runway 45 m wide with runway edge lights installed at the edge.

Figure 5-21. Arrangement of runway threshold and runway end lights

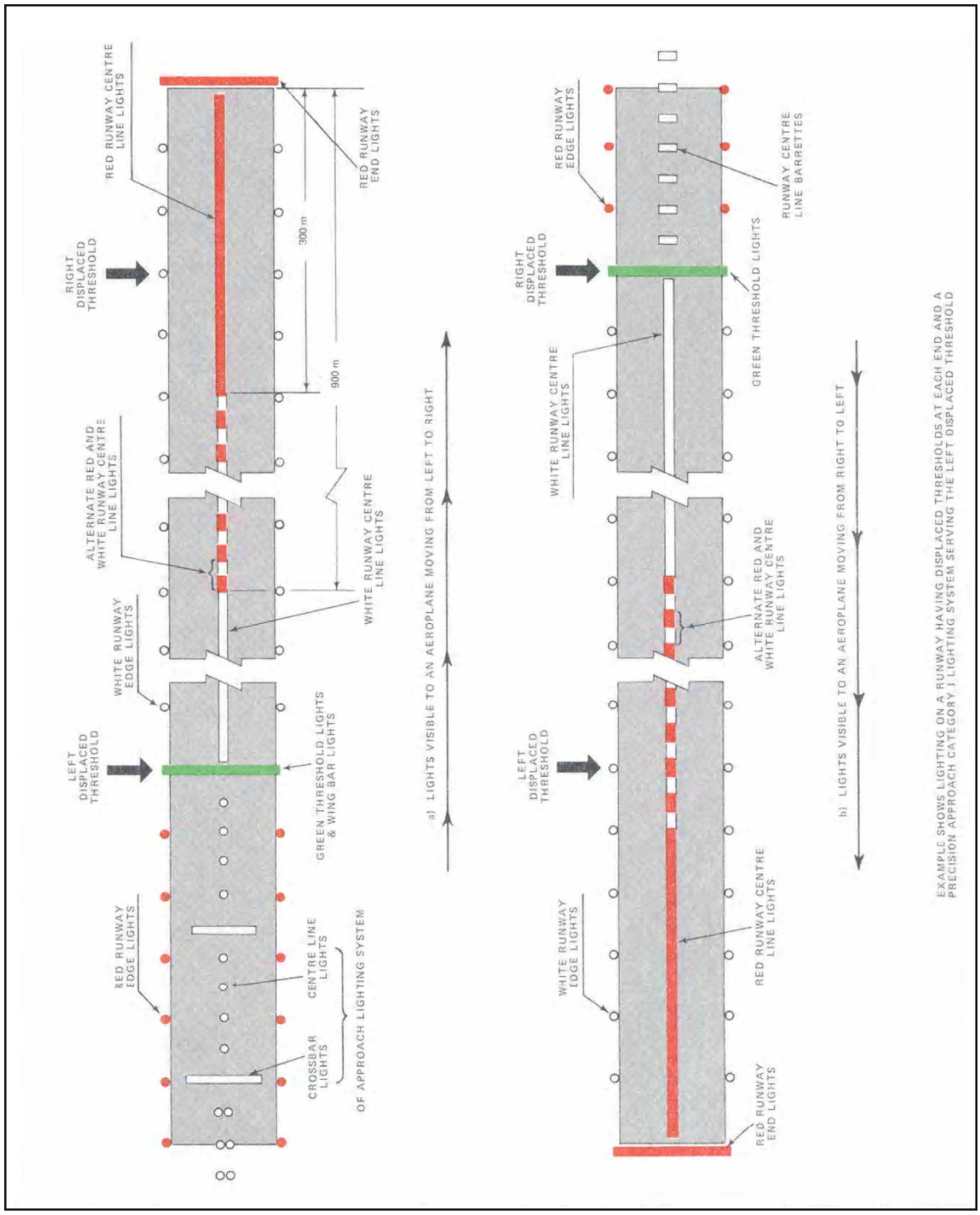


Figure 5-22. Example of approach and runway lighting for runway with displaced thresholds

5.3.12.2 Runway centre line lights shall be provided on a precision approach runway category I, particularly 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.

5.3.12.3 Runway centre line lights shall be provided on a runway intended to be used for take-off with an operating minimum below an RVR of the order of 400 m.

5.3.12.4 Runway centre line lights shall 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 airplanes with a very high take-off speed, particularly where the width between the runway edge lights is greater than 50 m.

Location

5.3.12.5 Runway centre line lights shall be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The lights shall be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in 10.4.7 or 10.4.11, as appropriate, can be demonstrated and the runway is intended for use in runway visual range conditions of 350 m or greater, the longitudinal spacing may be approximately 30 m.

Note – Existing centre line lighting where lights are spaced at 7.5 m need not be replaced.

5.3.12.6 Centre line guidance for take-off from the beginning of a runway to a displaced threshold shall be provided by:
a) an approach lighting system if its characteristics and intensity settings afford the guidance required during take-off and it does not dazzle the pilot of an aircraft taking off; or
b) runway centre line lights; or
c) barrettes of at least 3 m length and spaced at uniform intervals of 30 m, as shown in Figure 5-22, designed so that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an aircraft taking off.

Where necessary, provision shall be made to extinguish those centre line lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case shall only the single source runway centre line lights show from the beginning of the runway to a displaced threshold when the runway is being used for landing.

Characteristics

5.3.12.7 Runway centre line lights shall be fixed lights showing variable white from the threshold to the point 900 m from the runway end; alternate red and variable white from 900 m to 300 m from the runway end; and red from 300 m to the runway end, except that for runways less than 1800 m in length, the alternate red and variable white lights shall extend from the mid-point of the runway usable for landing to 300 m from the runway end.

Note – Care is required in the design of the electrical system to ensure that failure of part of the electrical system will not result in a false indication of the runway distance remaining.

5.3.12.8 Runway centre line lights shall be in accordance with the specifications of Appendix 2, Figure A2-6 or A2-7.

5.3.13 Runway touchdown zone lights

Application

5.3.13.1 Touchdown zone lights shall be provided in the touchdown zone of a precision approach runway category II or III.

Location

5.3.13.2 Touchdown zone lights shall extend from the threshold for a longitudinal distance of 900 m, except that, on runways less than 1800 m in length, the system shall be shortened so that it does not extend beyond the midpoint of the runway. The pattern shall be formed by pairs of barrettes symmetrically located about the runway centre line. The lateral spacing between the innermost lights of a pair of barrettes shall be equal to the lateral spacing selected for the touchdown zone marking. The longitudinal spacing between pairs of barrettes shall be either 30 m or 60 m.

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

Characteristics

5.3.13.3 A barrette shall be composed of at least three lights with a spacing between the lights of not more than 1.5 m.

5.3.13.4 A barrette shall be not less than 3 m nor more than 4.5 m in length.

5.3.13.5 Touchdown zone lights shall be fixed unidirectional lights showing variable white.

5.3.13.6 Touchdown zone lights shall be in accordance with the specifications of Appendix 2, Figure A2-5.

5.3.14 Rapid exit taxiway indicator lights

Note – The purpose of rapid exit taxiway indicator lights (RETILs) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with runway(s) displaying rapid exit taxiway indicator lights be familiar with the purpose of these lights.

Application

5.3.14.1 Rapid exit taxiway indicator lights shall be provided on a runway intended for use in runway visual range conditions less than a value of 350 m and/or where the traffic density is heavy.

Note – See Attachment A, Section 14.

5.3.14.2 Rapid exit taxiway indicator lights shall not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure 5-23, in full.

Location

5.3.14.3 A set of rapid exit taxiway indicator lights shall be located on the runway on the same side of the runway centre line as the associated rapid exit taxiway, in the configuration shown in Figure 5-23. In each set, the lights shall be located 2 m apart and the light nearest to the runway centre line shall be displaced 2 m from the runway centre line.

5.3.14.4 Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit shall not overlap when displayed.

Characteristics

5.3.14.5 Rapid exit taxiway indicator lights shall be fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing airplane in the direction of approach to the runway.

5.3.14.6 Rapid exit taxiway indicator lights shall be in accordance with the specifications in Appendix 2, Figure A2-6 or Figure A2-7, as appropriate.

5.3.14.7 Rapid exit taxiway indicator lights shall be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

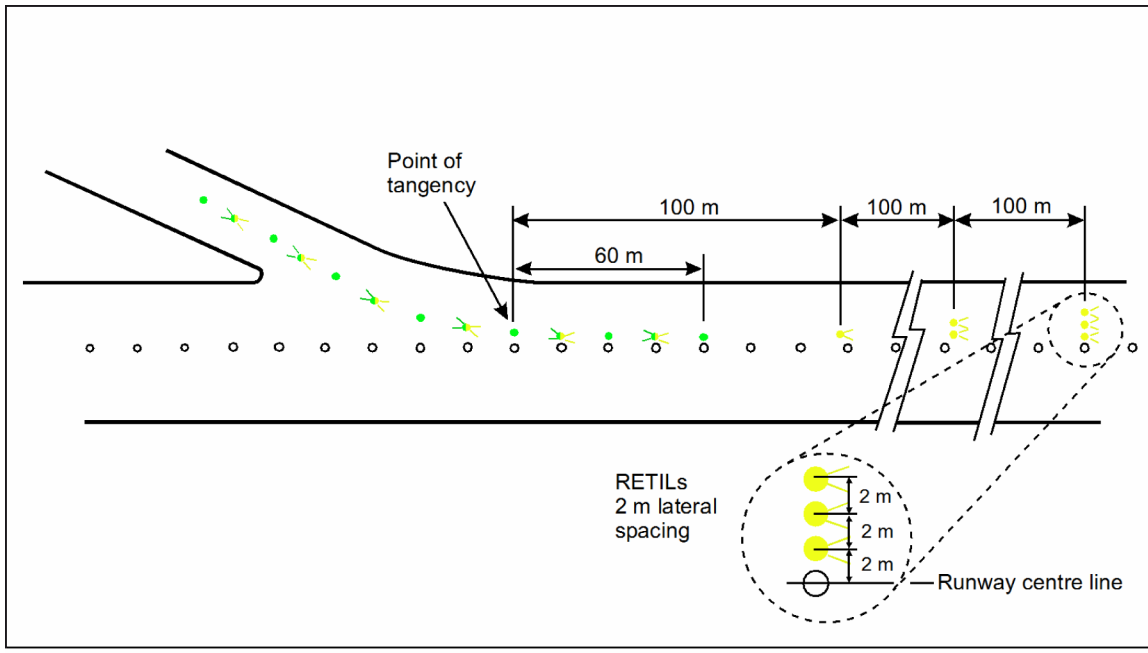


Figure 5-23. Rapid exit taxiway indicator lights (RETILS)

5.3.15 Stopway lights

Application

5.3.15.1 Stopway lights shall be provided for a stopway intended for use at night.

Location

5.3.15.2 Stopway lights shall be placed along the full length of the stopway and shall be in two parallel rows that are equidistant from the centre line and coincident with the rows of the runway edge lights. Stopway lights shall also be pro-vided across the end of a stopway on a line at right angles to the stopway axis as near to the end of the stopway as possible and, in any case, not more than 3 m outside the end.

Characteristics

5.3.15.3 Stopway lights shall be fixed unidirectional lights showing red in the direction of the runway.

5.3.16 Taxiway centre line lights

Application

5.3.16.1 Taxiway centre line lights shall be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron intended for use in runway visual range conditions less than a value of 350 m in such a manner as to provide continuous guidance between the runway centre line and aircraft stands, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

5.3.16.2 Taxiway centre line lights shall be provided on a taxiway intended for use at night in runway visual range conditions of 350 m or greater, and particularly on complex taxiway intersections and exit taxiways, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

Note – Where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway, narrow taxiway or in snow conditions, this may be done with taxiway edge lights or markers.

5.3.16.3 Taxiway centre line lights shall be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the runway centre line and aircraft stands.

5.3.16.4 Taxiway centre line lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

Note – See 8.2.3 for provisions concerning the interlocking of runway and taxiway lighting systems.

5.3.16.5 Taxiway centre line lights shall be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

5.3.16.6 Taxiway centre line lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-route shall be fixed lights showing green with beam dimensions such that the light is visible only from airplanes on or in the vicinity of the taxiway.

5.3.16.7 Taxiway centre line lights on an exit taxiway shall be fixed lights. Alternate taxiway centre line lights shall show green and yellow from their beginning near the runway centre line to the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway; and thereafter all lights shall show green (Figure 5-24). The light nearest to the perimeter shall always show yellow. Where aircraft may follow the same centre line in both directions, all the centre line lights shall show green to aircraft approaching the runway.

Note 1 – Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2 – For yellow filter characteristics see Appendix 1, 2.2.

Note 3 – The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS/MLS and other factors. Guidance is provided in Part 10, Volume I, Attachments C and G.

Note 4 – See 5.4.3 for specifications on runway vacated signs.

5.3.16.8 Taxiway centre line lights shall be in accordance with the specifications of:
a) Appendix 2, Figure A2-12, A2-13, or A2-14 for taxiways intended for use in runway visual range conditions of less than a value of 350 m; and
b) Appendix 2, Figure A2-15 or A2-16 for other taxiways.

5.3.16.9 Where higher intensities are required, from an operational point of view, taxiway centre line lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of 350 m shall be in accordance with the specifications of Appendix 2, Figure A2-12. The number of levels of brilliancy settings for these lights shall be the same as that for the runway centre line lights.

5.3.16.10 Where taxiway centre line lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centre line lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

Note – High-intensity centre line lights shall only be used in case of an absolute necessity and following a specific study.

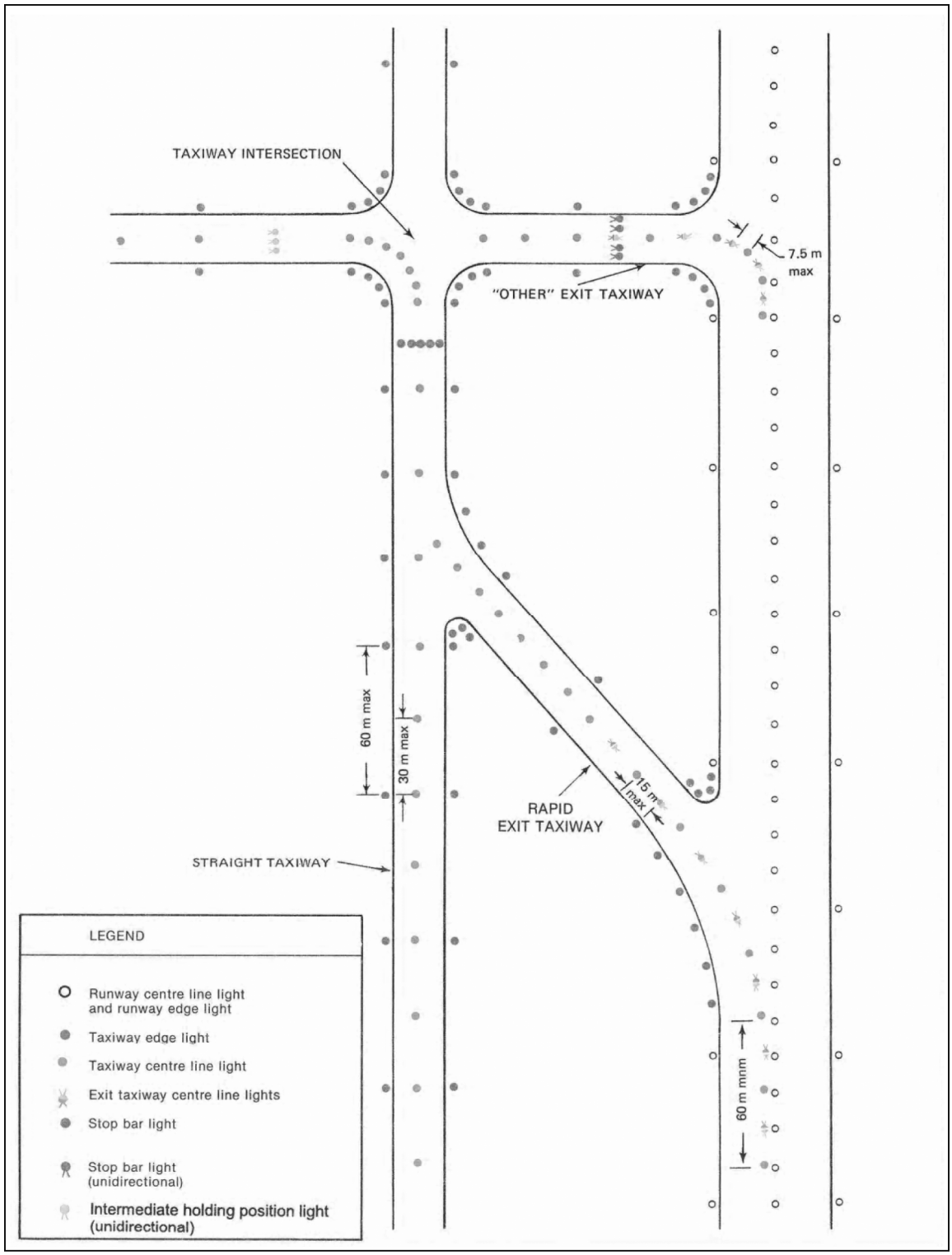


Figure 5-24. Taxiway lighting

Location

5.3.16.11 Taxiway centre line lights should normally be located on the taxiway centre line marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

Taxiway centre line lights on taxiways

Location

5.3.16.12 Taxiway centre line lights on a straight section of a taxiway shall be spaced at longitudinal intervals of not more than 30 m, except that:

a) larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;

b) intervals less than 30 m shall be provided on short straight sections; and

c) on a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing shall not exceed 15 m.

5.3.16.13 Taxiway centre line lights on a taxiway curve shall continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights shall be spaced at intervals such that a clear indication of the curve is provided.

5.3.16.14 On a taxiway intended for use in RVR conditions of less than a value of 350 m, the lights on a curve shall not exceed a spacing of 15 m and on a curve of less than 400 m radius the lights shall be spaced at intervals of not greater than 7.5 m. This spacing shall extend for 60 m before and after the curve.

Note 1 – Spacing on curves that have been found suitable for a taxiway intended for use in RVR conditions of 350 m or greater are:

Curve radius	Light spacing
up to 400 m	7.5 m
401 m to 899 m	15 m
900 m or greater	30 m

Note 2 – See 3.9.6 and Figure 3-2.

Taxiway centre line lights on rapid exit taxiways

Location

5.3.16.15 Taxiway centre line lights on a rapid exit taxiway shall commence at a point at least 60 m before the beginning of the taxiway centre line curve and continue beyond the end of the curve to a point on the centre line of the taxiway where an airplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line shall always be at least 60 cm from any row of runway centre line lights, as shown in Figure 5-25.

5.3.16.16 The lights shall be spaced at longitudinal intervals of not more than 15 m, except that, where runway centre line lights are not provided, a greater interval not exceeding 30 m may be used.

Taxiway centre line lights on other exit taxiways

Location

5.3.16.17 Taxiway centre line lights on exit taxiways other than rapid exit taxiways shall commence at the point where the taxiway centre line marking begins to curve from the runway centre line, and follow the curved taxiway centre line marking at least to the point where the marking leaves the runway. The first light shall be at least 60 cm from any row of runway centre line lights, as shown in Figure 5-25.

5.3.16.18 The lights shall be spaced at longitudinal intervals of not more than 7.5 m.

Taxiway centre line lights on runways

Location

5.3.16.19 Taxiway centre line lights on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m shall be spaced at longitudinal intervals not exceeding 15 m.

5.3.17 Taxiway edge lights

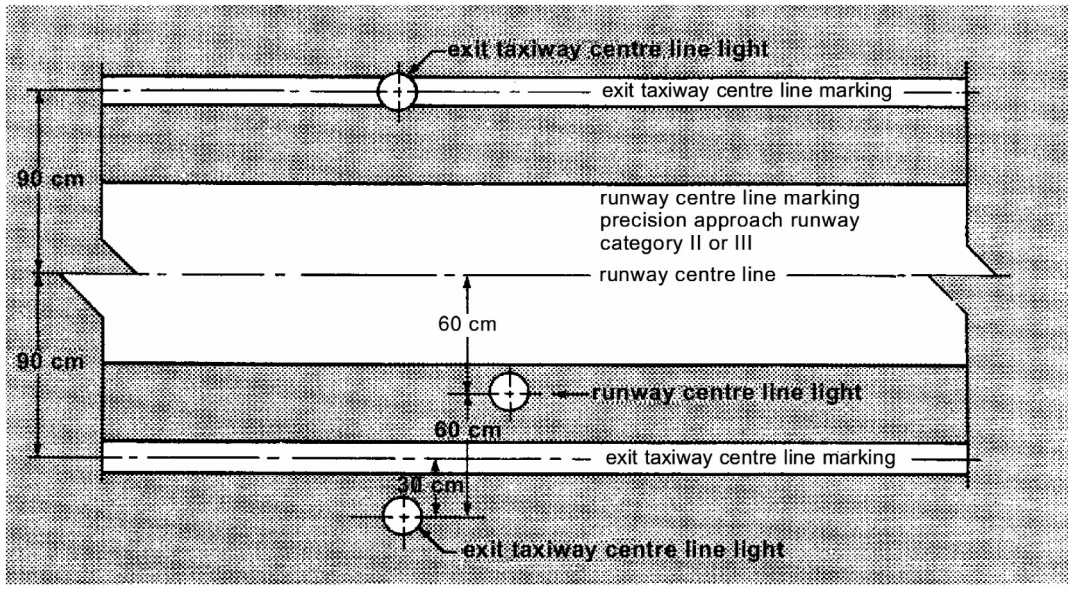
Application

5.3.17.1 Taxiway edge lights shall be provided at the edges of a runway turn pad, holding bay, de-icing/anti-icing facility, apron, etc. intended for use at night and on a taxiway not provided with taxiway centre line lights and intended for use at night, except that taxiway edge lights need not be provided where, considering the nature of the operations, adequate guidance can be achieved by surface illumination or other means.

Note – See 5.5.5 for taxiway edge markers.

5.3.17.2 Taxiway edge lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing at night where the runway is not provided with taxiway centre line lights.

Note – See 8.2.3 for provisions concerning the inter-locking of runway and taxiway lighting systems.



Tolerances for offset runway centre line lights and
taxiway centre line lights to maintain 60 cm separation.

Figure 5-25. Offset runway and taxiway centre line lights

Location

5.3.17.3 Taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi-route shall be spaced at uniform longitudinal intervals of not more than 60 m. The lights on a curve shall be spaced at intervals less than 60 m so that a clear indication of the curve is provided.

Note – Guidance on the spacing of taxiway edge lights on curves is given in the Aerodrome Design Manual, Part 4.

5.3.17.4 Taxiway edge lights on a holding bay, de-icing/anti-icing facility, apron, etc. shall be spaced at uniform longitudinal intervals of not more than 60 m.

5.3.17.5 Taxiway edge lights on a runway turn pad shall be spaced at uniform longitudinal intervals of not more than 30 m.

5.3.17.6 The lights shall be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, de-icing/anti-icing facility, apron or runway, etc. or outside the edges at a distance of not more than 3 m.

Characteristics

5.3.17.7 Taxiway edge lights shall be fixed lights showing blue. The lights shall show up to at least 30° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction. At an intersection, exit or curve the lights shall be shielded as far as practicable so that they cannot be seen in angles of azimuth in which they may be confused with other lights.

5.3.18 Runway turn pad lights

Application

5.3.18.1 Runway turn pad lights shall be provided for continuous guidance on a runway turn pad intended for use in runway visual range conditions less than a value of 350 m, to enable an airplane to complete a 180-degree turn and align with the runway centre line.

5.3.18.2 Runway turn pad lights shall be provided on a runway turn pad intended for use at night.

Location

5.3.18.3 Runway turn pad lights shall normally be located on the runway turn pad marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

5.3.18.4 Runway turn pad lights on a straight section of the runway turn pad marking shall be spaced at longitudinal intervals of not more than 15 m.

5.3.18.5 Runway turn pad lights on a curved section of the runway turn pad marking shall not exceed a spacing of 7.5 m.

Characteristics

5.3.18.6 Runway turn pad lights shall be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from airplanes on or approaching the runway turn pad.

5.3.18.7 Runway turn pad lights shall be in accordance with the specifications of Appendix 2, Figure A2-13, A2-14 or A2-15, as appropriate.

5.3.19 Stop bars

Application

Note 1 – The provision of stop bars requires their control either manually or automatically by air traffic services.

Note 2 – Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway holding positions and their use at night and in visibility conditions greater than 550 m runway visual range can form part of effective runway incursion prevention measures.

5.3.19.1 A stop bar shall be provided at every runway-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m, except where:
a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles onto the runway; or
b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:
1) aircraft on the maneuvering area to one at a time; and
2) vehicles on the maneuvering area to the essential minimum.

5.3.19.2 A stop bar shall be provided at every runway-holding position, serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m,

except where:
a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles onto the runway; or
b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:
1) aircraft on the maneuvering area to one at a time; and
2) vehicles on the maneuvering area to the essential minimum.

5.3.19.3 A stop bar shall be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

5.3.19.4 Where the normal 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, then a pair of elevated lights shall be added to each end of the stop bar.

Location

5.3.19.5 Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 5.3.19.4 are provided, these lights shall be located not less than 3 m from the taxiway edge.

Characteristics

5.3.19.6 Stop bars shall consist of lights spaced at intervals of 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

5.3.19.7 Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

5.3.19.8 Where the additional lights specified in 5.3.19.4 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

5.3.19.9 Selectively switchable stop bars shall be installed in conjunction with at least three taxiway centre line lights (extending for a distance of at least 90 m from the stop bar) in the direction that it is intended for an aircraft to proceed from the stop bar.

Note – See 5.3.16.12 for provisions concerning the spacing of taxiway centre line lights.

5.3.19.10 The intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.19.11 Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

Note – High-intensity stop bars shall only be used in case of an absolute necessity and following a specific study.

5.3.19.12 Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.

5.3.19.13 The lighting circuit shall be designed so that:
a) stop bars located across entrance taxiways are selectively switchable;
b) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;
c) when a stop bar is illuminated, any taxiway centre line lights installed beyond the stop bar shall be extinguished for a distance of at least 90 m; and
d) stop bars shall be interlocked with the taxiway centre line lights so that when the centre line lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

Note 1 – A stop bar is switched on to indicate that traffic stop and switched off to indicate that traffic proceed.

Note 2 – Care is required in the design of the electrical system to ensure that all of the lights of a stop bar will not fail at the same time. Guidance on this issue is given in the Aerodrome Design Manual, Part 5.

5.3.20 Intermediate holding position lights

Note – See 5.2.11 for specifications on intermediate holding position marking.

Application

5.3.20.1 Except where a stop bar has been installed, intermediate holding position lights shall be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of 350 m.

5.3.20.2 Intermediate holding position lights shall be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

Location

5.3.20.3 Intermediate holding position lights shall be located along the intermediate holding position marking at a distance of 0.3 m prior to the marking.

Characteristics

5.3.20.4 Intermediate holding position lights shall consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights if provided. The lights shall be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5 m apart.

5.3.21 Open

5.3.22 Runway guard lights

Note – The purpose of runway guard lights is to warn pilots, and drivers of vehicles when they are operating on taxiways, that they are about to enter an active runway. There are two standard configurations of runway guard lights as illustrated in Figure 5-27.

Application

5.3.22.1 Runway guard lights, Configuration A, shall be provided at each taxiway/runway intersection associated with a runway intended for use in:
a) runway visual range conditions less than a value of 550 m where a stop bar is not installed; and
b) runway visual range conditions of values between 550 m and 1200 m where the traffic density is heavy.

5.3.22.2 Runway guard lights, Configuration A, shall be provided at each taxiway/runway intersection associated with a runway intended for use in:
a) runway visual range conditions of values less than a value of 550 m where a stop bar is installed; and
b) runway visual range conditions of values between 550 m and 1200 m where the traffic density is medium or light.

5.3.22.3 Runway guard lights, Configuration A or Configuration B or both, shall be provided at each taxiway/runway intersection where enhanced conspicuity of the taxiway/runway intersection is needed, such as on a wide-throat taxiway, except that Configuration B shall not be collocated with a stop bar.

Location

5.3.22.4 Runway guard lights, Configuration A, shall be located at each side of the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table 3-2.

5.3.22.5 Runway guard lights, Configuration B, shall be located across the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table 3-2.

Characteristics

5.3.22.6 Runway guard lights, Configuration A, shall consist of two pairs of yellow lights.

5.3.22.7 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 shall be located above each lamp.

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

5.3.22.8 Runway guard lights, Configuration B, shall consist of yellow lights spaced at intervals of 3 m across the taxiway.

5.3.22.9 The light beam shall be unidirectional and aligned so as to be visible to the pilot of an airplane taxiing to the holding position.

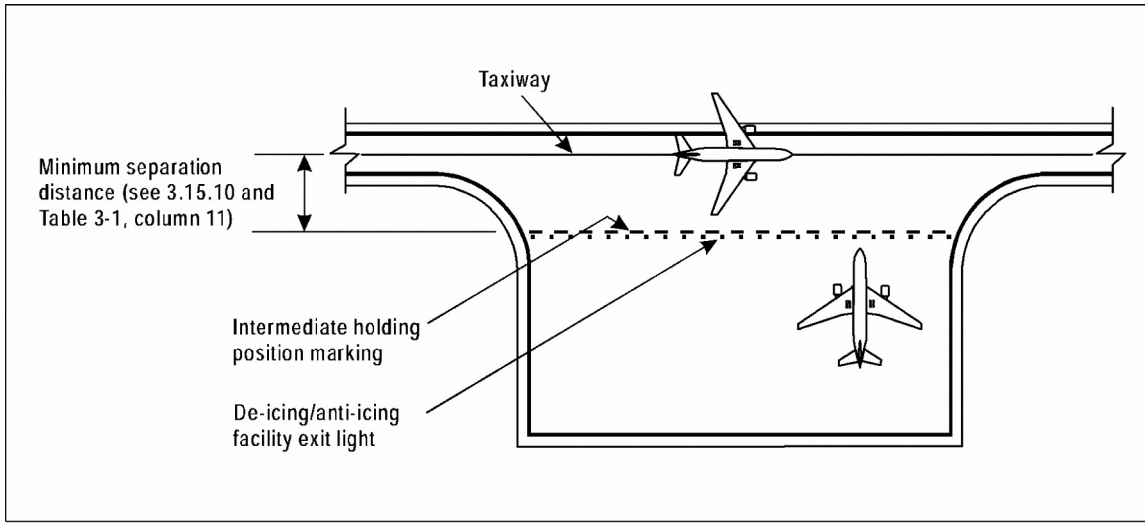


Figure 5-26. Typical remote de-icing/anti-icing facility

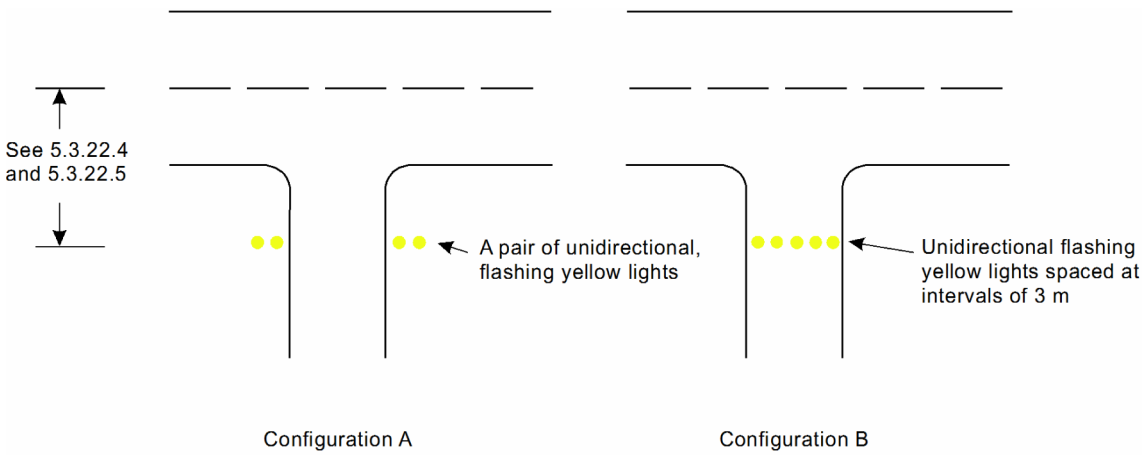


Figure 5-27. Runway guard lights

5.3.22.10 The intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-24.

5.3.22.11 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-25.

5.3.22.12 Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-25.

Note – Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities.

5.3.22.13 The intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-12.

5.3.22.14 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.22.15 Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.22.16 The lights in each unit of Configuration A shall be illuminated alternately.

5.3.22.17 For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.

5.3.22.18 The lights shall be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods shall be equal and opposite in each light.

Note – 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.

5.3.23 Apron floodlighting (see also 5.3.16.1 and 5.3.17.1)

Application

5.3.23.1 Apron floodlighting shall be provided on an apron and on a designated isolated aircraft parking position intended to be used at night.

Note 1 – The designation of an isolated aircraft parking position is specified in 3.14.

Note 2 – Guidance on apron floodlighting is given in the Aerodrome Design Manual, Part 4.

Location

5.3.23.2 Apron floodlights shall be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights shall be such that an aircraft stand receives light from two or more directions to minimize shadows.

Characteristics

5.3.23.3 The spectral distribution of apron floodlights shall be such that the colors used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

5.3.23.4 The average luminance shall be at least the following:

Aircraft stand:
– horizontal luminance – 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
– vertical luminance – 20 lux at a height of 2 m above the apron in relevant directions.

Other apron areas:
– horizontal luminance – 50 per cent of the average luminance on the aircraft stands with a uniformity ratio (average to minimum) of not more than 4 to 1.

5.3.24 Visual docking guidance system

Application

5.3.24.1 A visual docking guidance system shall be provided when it is intended to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand and other alternative means, such as marshallers, are not practicable.

Note – The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for maneuvering into the parking position due to aircraft servicing installation, passenger loading bridges, etc. See the Aerodrome Design Manual, Part 4 – Visual Aids for guidance on the selection of suitable systems.

5.3.24.2 The provisions of 5.3.24.3 to 5.3.24.7, 5.3.24.9, 5.3.24.10, 5.3.24.12 to 5.3.24.15, 5.3.24.17, 5.3.24.18 and 5.3.24.20 shall not require the replacement of existing installations before 1 January 2005.

Characteristics

5.3.24.3 The system shall provide both azimuth and stopping guidance.

5.3.24.4 The azimuth guidance unit and the stopping position indicator shall be adequate for use in all weather, visibility, background lighting and pavement conditions for which the system is intended both by day and night, but shall not dazzle the pilot.

Note – Care is required in both the design and on-site installation of the system to ensure that reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

5.3.24.5 The azimuth guidance unit and the stopping position indicator shall be of a design such that:
a) a clear indication of malfunction of either or both is available to the pilot; and
b) they can be turned off.

5.3.24.6 The azimuth guidance unit and the stopping position indicator shall be located in such a way that there is continuity of guidance between the aircraft stand markings, the aircraft stand maneuvering guidance lights, if present, and the visual docking guidance system.

5.3.24.7 The accuracy of the system shall be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

5.3.24.8 The system shall be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.

5.3.24.9 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system shall provide an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly.

Azimuth guidance unit

Location

5.3.24.10 The azimuth guidance unit shall be located on or close to the extension of the stand centre line ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking maneuver and aligned for use at least by the pilot occupying the left seat.

5.3.24.11 The azimuth guidance unit shall be aligned for use by the pilots occupying both the left and right seats.

Characteristics

5.3.24.12 The azimuth guidance unit shall provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over controlling.

5.3.24.13 When azimuth guidance is indicated by color change, green shall be used to identify the centre line and red for deviations from the centre line.

Stopping position indicator

Location

5.3.24.14 The stopping position indicator shall be located in conjunction with, or sufficiently close to, the azimuth guidance unit so that a pilot can observe both the azimuth and stop signals without turning the head.

5.3.24.15 The stopping position indicator shall be usable at least by the pilot occupying the left seat.

5.3.24.16 The stopping position indicator shall be usable by the pilots occupying both the left and right seats.

Characteristics

5.3.24.17 The stopping position information provided by the indicator for a particular aircraft type shall account for the anticipated range of variations in pilot eye height and/or viewing angle.

5.3.24.18 The stopping position indicator shall show the stopping position for the aircraft for which guidance is being provided, and shall provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

5.3.24.19 The stopping position indicator shall provide closing rate information over a distance of at least 10 m.

5.3.24.20 When stopping guidance is indicated by color change, green shall be used to show that the aircraft can proceed and red to show that the stop point has been reached except that for a short distance prior to the stop point a third color may be used to warn that the stopping point is close.

5.3.25 Aircraft stand maneuvering guidance lights

Application

5.3.25.1 Aircraft stand maneuvering guidance lights shall be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron intended for use in poor visibility conditions, unless adequate guidance is provided by other means.

Location

5.3.25.2 Aircraft stand maneuvering guidance lights shall be collocated with the aircraft stand markings.

Characteristics

5.3.25.3 Aircraft stand maneuvering guidance lights, other than those indicating a stop position, shall be fixed yellow lights, visible throughout the segments within which they are intended to provide guidance.

5.3.25.4 The lights used to delineate lead-in, turning and lead-out lines shall be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.

5.3.25.5 The lights indicating a stop position shall be fixed, unidirectional lights, showing red.

5.3.25.6 The intensity of the lights shall be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.

5.3.25.7 The lighting circuit shall be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.

5.3.26 Road-holding position light

Application

5.3.26.1 A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m.

5.3.26.2 A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m.

Location

5.3.26.3 A road-holding position light shall be located adjacent to the holding position marking 1.5 m (± 0.5 m) from one edge of the road, i.e. left or right as appropriate to the local traffic regulations.

Note – See 9.9 for the mass and height limitations and frangibility requirements of navigation aids located on runway strips.

Characteristics

5.3.26.4 The road-holding position light shall comprise:
a) a controllable red (stop)/green (go) traffic light; or
b) a flashing-red light.

Note – It is intended that the lights specified in sub-paragraph a) be controlled by the air traffic services.

5.3.26.5 The road-holding position light beam shall be unidirectional and aligned so as to be visible to the driver of a vehicle approaching the holding position.

5.3.26.6 The intensity of the light beam shall be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended, but shall not dazzle the driver.

Note – The commonly used traffic lights are likely to meet the requirements in 5.3.26.5 and 5.3.26.6.

5.3.26.7 The flash frequency of the flashing-red light shall be between 30 and 60 per minute.

5.4 Signs

5.4.1 General

Note – Signs shall be either fixed message signs or variable message signs. Guidance on signs is contained in the Aerodrome Design Manual, Part 4.

Application

5.4.1.1 Signs shall be provided to convey a mandatory instruction, information on a specific location or destination on a movement area or to provide other information to meet the requirements of 9.8.1.

Note – See 5.2.17 for specifications on information marking.

Table 5-4. Location distances for taxiing guidance signs including runway exit signs

Sign height (mm)				Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	400	700	5-11 m	3-10 m
1 or 2	300	600	900	5-11 m	3-10 m
3 or 4	300	600	900	11-21 m	8-15 m
3 or 4	400	800	1 100	11-21 m	8-15 m

5.4.1.2 A variable message sign shall be provided where:
a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or
b) there is a need for variable pre-determined information to be displayed on the sign to meet the requirements of 9.8.1.

Characteristics

5.4.1.3 Signs shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. The installed height of the sign shall not exceed the dimension shown in the appropriate column of Table 5-4.

5.4.1.4 Signs shall be rectangular, as shown in Figures 5-28 and 5-29 with the longer side horizontal.

5.4.1.5 The only signs on the movement area utilizing red shall be mandatory instruction signs.

5.4.1.6 The inscriptions on a sign shall be in accordance with the provisions of Appendix 4.

5.4.1.7 Signs shall be illuminated in accordance with the provisions of Appendix 4 when intended for use:
a) in runway visual range conditions less than a value of 800 m; or
b) at night in association with instrument runways; or
c) at night in association with non-instrument runways where the code number is 3 or 4.

5.4.1.8 Signs shall be retro reflective and/or illuminated in accordance with the provisions of Appendix 4 when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

5.4.1.9 A variable message sign shall show a blank face when not in use.

5.4.1.10 In case of failure, a variable message sign shall not provide information that could lead to unsafe action from a pilot or a vehicle driver.

5.4.1.11 The time interval to change from one message to another on a variable message sign shall be as short as practicable and shall not exceed 5 seconds.

5.4.2 Mandatory instruction signs

Note – See Figure 5-28 for pictorial representation of mandatory instruction signs and Figure 5-30 for examples of locating signs at taxiway/runway intersections.

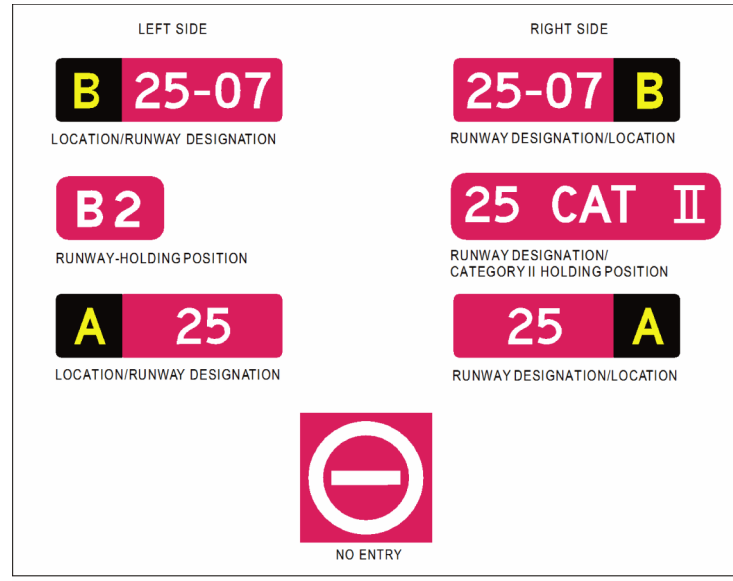


Figure 5-28. Mandatory instruction signs

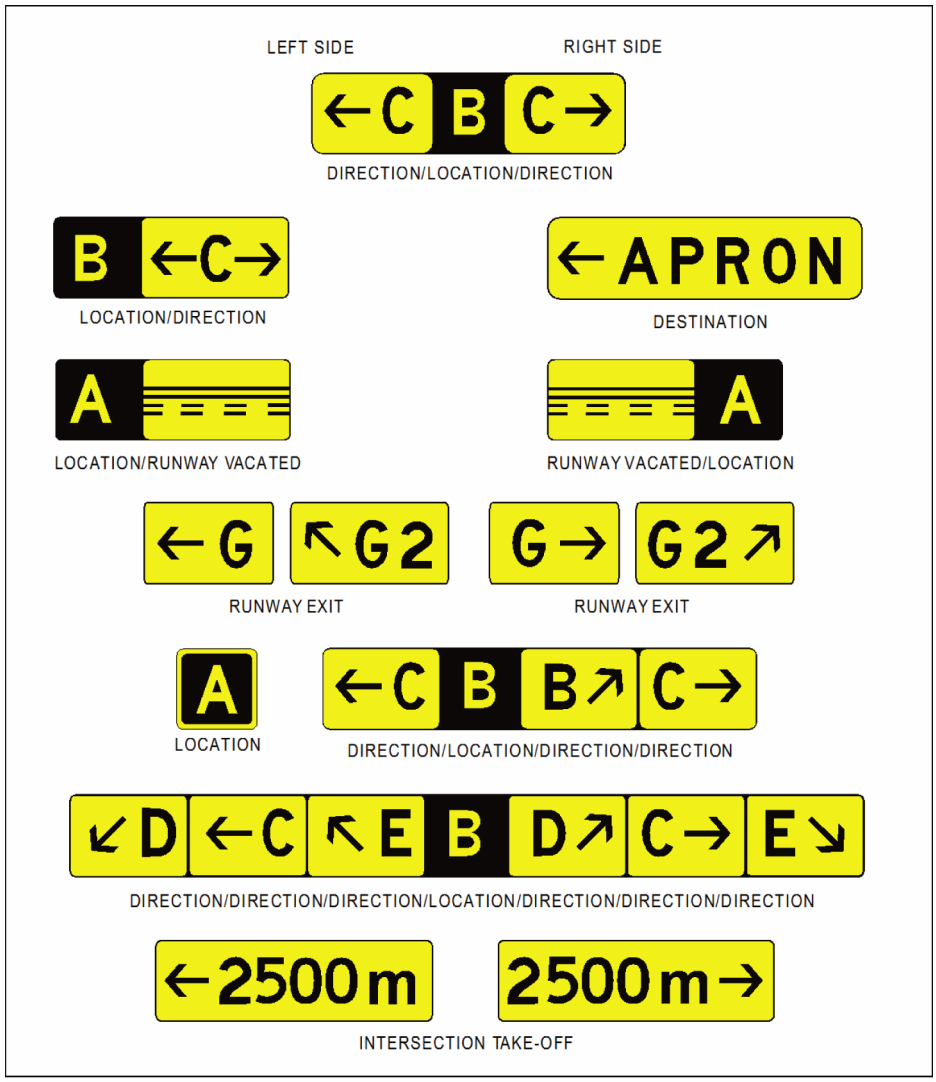
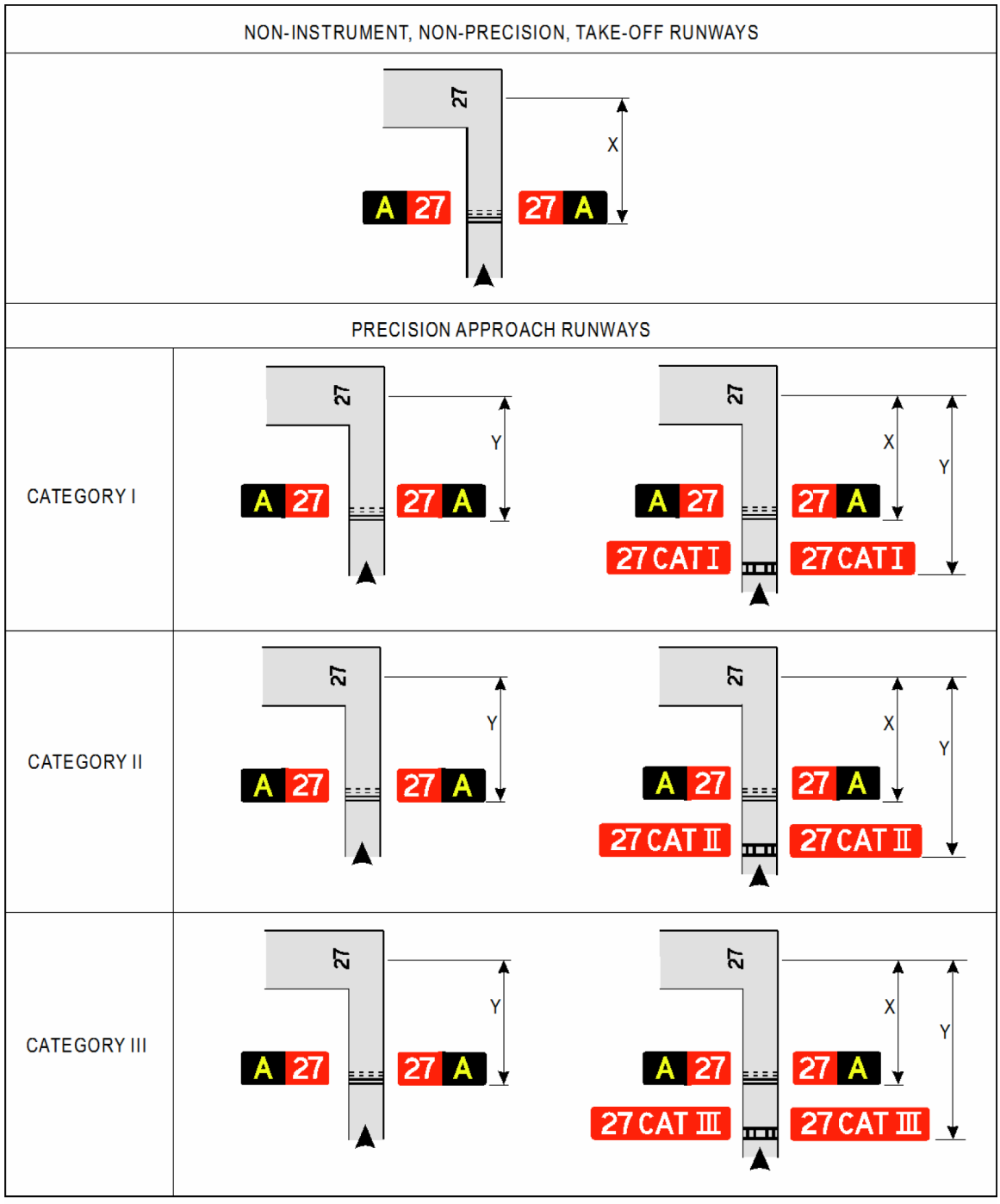


Figure 5-29. Information signs



Note: Distance X is established in accordance with Table 3-2. Distance Y is established at the edge of the ILS/MLS critical/sensitive area.

Figure 5-30. Examples of sign positions at taxiway/runway intersections

Application

5.4.2.1 A mandatory instruction sign shall be provided to identify a location beyond which an aircraft taxiing or vehicle shall not proceed unless authorized by the aerodrome control tower.

5.4.2.2 Mandatory instruction signs shall include runway designation signs, category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs.

Note – See 5.4.7 for specifications on road-holding position signs.

5.4.2.3 A pattern «A» runway-holding position marking shall be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.

5.4.2.4 A pattern «B» runway-holding position marking shall be supplemented with a category I, II or III holding position sign.

5.4.2.5 A pattern «A» runway-holding position marking at a runway-holding position established in accordance with 3.12.3 shall be supplemented with a runway-holding position sign.

Note – See 5.2.10 for specifications on runway-holding position marking.

5.4.2.6 A runway designation sign at a taxiway/runway intersection shall be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

Note – See 5.4.3 for characteristics of location signs.

5.4.2.7 A NO ENTRY sign shall be provided when entry into an area is prohibited.

Location

5.4.2.8 A runway designation sign at a taxiway/runway intersection or a runway/runway intersection shall be located on each side of the runway-holding position marking facing the direction of approach to the runway.

5.4.2.9 A category I, II or III holding position sign shall be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.

5.4.2.10 A NO ENTRY sign shall be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.

5.4.2.11 A runway-holding position sign shall be located on each side of the runway-holding position established in accordance with 3.12.3, facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.

Characteristics

5.4.2.12 A mandatory instruction sign shall consist of an inscription in white on a red background.

5.4.2.13 The inscription on a runway designation sign shall consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.

5.4.2.14 The inscription on a category I, II, III or joint II/III holding position sign shall consist of the runway designator followed by CAT I, CAT II, CAT III or CAT II/III, as appropriate.

5.4.2.15 The inscription on a NO ENTRY sign shall be in accordance with Figure 5-28.

5.4.2.16 The inscription on a runway-holding position sign at a runway-holding position established in accordance with 3.12.3 shall consist of the taxiway designation and a number.

5.4.2.17 Where appropriate, the following inscriptions/symbol shall be used:

Inscription/ symbol	Use
Runway designation of a runway extremity OR	To indicate a runway-holding position at a runway extremity
Runway designation of both extremities of a runway	To indicate a runway-holding position located at other taxiway/runway intersections or runway/runway intersections
25 CAT I (Example)	To indicate a category I runway holding position at the threshold of runway 25
25 CAT II (Example)	To indicate a category II runway holding position at the threshold of runway 25
25 CAT III To indicate a category III runway (Example) holding position at the threshold of runway 25	
25 CAT II/III To indicate a joint (Example) category II/III runway-holding position at the threshold of runway 25	
NO ENTRY To indicate that entry to an area symbol is prohibited	
B2 To indicate a runway-holding (Example) position established in accordance with 3.12.3	

5.4.3 Information signs

Note – See Figure 5-29 for pictorial representations of information signs.

Application

5.4.3.1 An information sign shall be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.

5.4.3.2 Information signs shall include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.

5.4.3.3 A runway exit sign shall be provided where there is an operational need to identify a runway exit.

5.4.3.4 A runway vacated sign shall be provided where the exit taxiway is not provided with taxiway centre line lights and there is a need to indicate to a pilot leaving a runway the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface whichever is farther from the runway centre line.

Note – See 5.3.16 for specifications on color coding taxiway centre line lights.

5.4.3.5 An intersection take-off sign shall be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.

5.4.3.6 Where necessary, a destination sign shall be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.

5.4.3.7 A combined location and direction sign shall be provided when it is intended to indicate routing information prior to a taxiway intersection.

5.4.3.8 A direction sign shall be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.

5.4.3.9 A location sign shall be provided at an intermediate holding position.

5.4.3.10 A location sign shall be provided in conjunction with a runway designation sign except at a runway/runway intersection.

5.4.3.11 A location sign shall be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

5.4.3.12 Where necessary, a location sign shall be provided to identify taxiways exiting an apron or taxiways beyond an intersection.

5.4.3.13 Where a taxiway ends at an intersection such as a ''T'' and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid shall be used.

Location

5.4.3.14 Except as specified in 5.4.3.16 and 5.4.3.24 information signs shall, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table 5-4.

5.4.3.15 At a taxiway intersection, information signs shall be located prior to the intersection and in line with the taxiway intersection marking. Where there is no taxiway intersection marking, the signs shall be installed at least 60 m from the centre line of the intersecting taxiway where the code number is 3 or 4 and at least 40 m where the code number is 1 or 2.

Note – A location sign installed beyond a taxiway intersection may be installed on either side of a taxiway.

5.4.3.16 A runway exit sign shall be located on the same side of the runway as the exit is located (i.e. left or right) and positioned in accordance with Table 5-4.

5.4.3.17 A runway exit sign shall be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.

5.4.3.18 A runway vacated sign shall be located at least on one side of the taxiway. The distance between the sign and the centre line of a runway shall be not less than the greater of the following:
a) the distance between the centre line of the runway and the perimeter of the ILS/MLS critical/sensitive area; or
b) the distance between the centre line of the runway and the lower edge of the inner transitional surface.

5.4.3.19 Where provided in conjunction with a runway vacated sign, the taxiway location sign shall be positioned outboard of the runway vacated sign.

5.4.3.20 An intersection take-off sign shall be located at the left-hand side of the entry taxiway. The distance between the sign and the centre line of the runway shall be not less than 60 m where the code number is 3 or 4 and not less than 45 m where the code number is 1 or 2.

5.4.3.21 A taxiway location sign installed in conjunction with a runway designation sign shall be positioned outboard of the runway designation sign.

5.4.3.22 A destination sign shall not normally be collocated with a location or direction sign.

5.4.3.23 An information sign other than a location sign shall not be collocated with a mandatory instruction sign.

5.4.3.24 A direction sign, barricade and/or other appropriate visual aid used to identify a ''T'' intersection shall be located on the opposite side of the intersection facing the taxiway.

Characteristics

5.4.3.25 An information sign other than a location sign shall consist of an inscription in black on a yellow background.

5.4.3.26 A location sign shall consist of an inscription in yellow on a black background and where it is a stand-alone sign shall have a yellow border.

5.4.3.27 The inscription on a runway exit sign shall consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

5.4.3.28 The inscription on a runway vacated sign shall depict the pattern A runway-holding position marking as shown in Figure 5-29.

5.4.3.29 The inscription on an intersection take-off sign shall consist of a numerical message indicating the remaining take-off run available in meters plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in Figure 5-29.

5.4.3.30 The inscription on a destination sign shall comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure 5-29.

5.4.3.31 The inscription on a direction sign shall comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure 5-29.

5.4.3.32 The inscription on a location sign shall comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and shall not contain arrows.

5.4.3.33 Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign shall consist of the taxiway designation and a number.

5.4.3.34 Where a location sign and direction signs are used in combination:
a) all direction signs related to left turns shall be placed on the left side of the location sign and all direction signs related to right turns shall be placed on the right side of the location sign, except that where the junction consists of one intersecting taxiway, the location sign may alternatively be placed on the left hand side;
b) the direction signs shall be placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;
c) an appropriate direction sign shall be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and
d) adjacent direction signs shall be delineated by a vertical black line as shown in Figure 5-29.

5.4.3.35 A taxiway shall be identified by a designator comprising a letter, letters or a combination of a letter or letters followed by a number.

5.4.3.36 When designating taxiways, the use of the letters I, O or X and the use of words such as inner and outer shall be avoided wherever possible to avoid confusion with the numerals 1, 0 and closed marking.

5.4.3.37 The use of numbers alone on the maneuvering area shall be reserved for the designation of runways.

5.4.4 VOR aerodrome check-point sign

Application

5.4.4.1 When a VOR aerodrome check-point is established, it shall be indicated by a VOR aerodrome check-point marking and sign.

Note – See 5.2.12 for VOR aerodrome check-point marking.

Location

5.4.4.2 A VOR aerodrome check-point sign shall be located as near as possible to the check-point and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome check-point marking.

Characteristics

5.4.4.3 A VOR aerodrome check-point sign shall consist of an inscription in black on a yellow background.

5.4.4.4 The inscriptions on a VOR check-point sign shall be in accordance with one of the alternatives shown in Figure 5-31 in which:

VOR	is an abbreviation identifying this as a VOR check-point;
116.3	is an example of the radio frequency of the VOR concerned;
147°	is an example of the VOR bearing, to the nearest degree, which shall be indicated at the VORcheck-point; and
4.3 NM	is an example of the distance in nautical miles to a DME collocated with the VOR concerned.

Note – Tolerances for the bearing value shown on the sign are given in Part 10, Volume I, Attachment E. It will be noted that a check-point can only be used operationally when periodic checks show it to be consistently within ± 2 degrees of the stated bearing.

5.4.5 Aerodrome identification sign

Application

5.4.5.1 An aerodrome identification sign shall be provided at an aerodrome where there is insufficient alternative means of visual identification.

Location

5.4.5.2 The aerodrome identification sign shall be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.

Characteristics

5.4.5.3 The aerodrome identification sign shall consist of the name of the aerodrome.

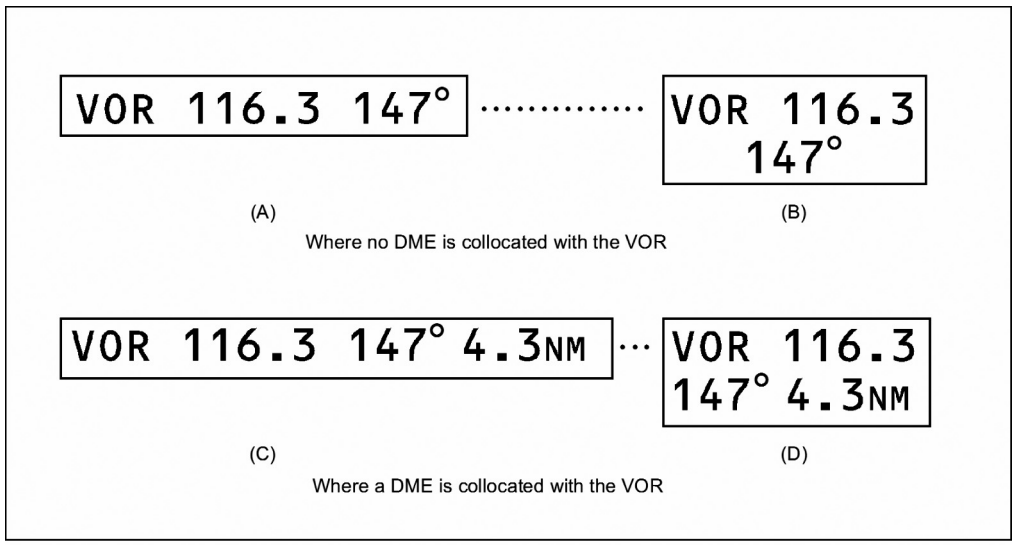


Figure 5-31. VOR aerodrome check-point sign

5.4.5.4 The color selected for the sign shall give adequate conspicuity when viewed against its background.

5.4.5.5 The characters shall have a height of not less than 3 m.

5.4.6 Aircraft stand identification signs

Application

5.4.6.1 An aircraft stand identification marking shall be supplemented with an aircraft stand identification sign where feasible.

Location

5.4.6.2 An aircraft stand identification sign shall be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

Characteristics

5.4.6.3 An aircraft stand identification sign shall consist of an inscription in black on a yellow background.

5.4.7 Road-holding position sign

5.4.7.1 A road-holding position sign shall be provided at all road entrances to a runway.

Location

5.4.7.2 The road-holding position sign shall be located 1.5 m from one edge of the road (left or right as appropriate to the local traffic regulations) at the holding position.

Characteristics

5.4.7.3 A road-holding position sign shall consist of an inscription in white on a red background.

5.4.7.4 The inscription on a road-holding position sign shall be in the national language, be in conformity with the local traffic regulations and include the following:

a) a requirement to stop; and

b) where appropriate:

1) a requirement to obtain ATC clearance; and

2) location designator.

Note – Examples of road-holding position signs are contained in the Aerodrome Design Manual, Part 4.

5.4.7.5 A road-holding position sign intended for night use shall be retro reflective or illuminated.

5.5 Markers

5.5.1 General

Markers shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

Note 1 – Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.

Note 2 – Guidance on frangibility of markers is given in the Aerodrome Design Manual, Part 6 (in preparation).

5.5.2 Unpaved runway edge markers

Application

5.5.2.1 Markers shall be pro-vided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.

Location

5.5.2.2 Where runway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape shall be placed so as to delimit the runway clearly.

Characteristics

5.5.2.3 The flat rectangular markers shall have a minimum size of 1 m by 3 m and shall be placed with their long dimension parallel to the runway centre line. The conical markers shall have a height not exceeding 50 cm.

5.5.3 Stopway edge markers

Application

5.5.3.1 Stopway edge markers shall be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

Characteristics

5.5.3.2 The stopway edge markers shall be sufficiently different from any runway edge markers used to ensure that the two types of markers cannot be confused.

Note – Markers consisting of small vertical boards camouflaged on the reverse side, as viewed from the runway, have proved operationally acceptable.

5.5.4 Open.

5.5.5 Taxiway edge markers

Application

5.5.5.1 Taxiway edge markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway centre line markers are not provided.

Location

5.5.5.2 Taxiway edge markers shall be installed at least at the same locations as would the taxiway edge lights had they been used.

Characteristics

5.5.5.3 A taxiway edge marker shall be retro reflective blue.

5.5.5.4 The marked surface as viewed by the pilot shall be a rectangle and shall have a minimum viewing area of 150 cm2 .

5.5.5.5 Taxiway edge markers shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

5.5.6 Taxiway centre line markers

Application

5.5.6.1 Taxiway centre line markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway edge markers are not provided.

5.5.6.2 Taxiway centre line markers shall be provided on a taxiway where the code number is 3 or 4 and taxiway centre line lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.

Location

5.5.6.3 Taxiway centre line markers shall be installed at least at the same location as would taxiway centre line lights had they been used.

Note – See 5.3.16.12 for the spacing of taxiway centre line lights.

5.5.6.4 Taxiway centre line markers shall normally be located on the taxiway centre line marking except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

Characteristics

5.5.6.5 A taxiway centre line marker shall be retro-reflective green.

5.5.6.6 The marked surface as viewed by the pilot shall be a rectangle and shall have a minimum viewing area of 20 cm2 .

5.5.6.7 Taxiway centre line markers shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

5.5.7 Unpaved taxiway edge markers

Application

5.5.7.1 Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers shall be provided.

Location

5.5.7.2 Where taxiway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of conical shape shall be placed so as to delimit the taxiway clearly.

5.5.8 Boundary markers

Application

5.5.8.1 Boundary markers shall be provided at an aerodrome where the landing area has no runway.

Location

5.5.8.2 Boundary markers shall be spaced along the boundary of the landing area at intervals of not more than 200 m, if the type shown in Figure 5-32 is used, or approximately 90 m, if the conical type is used with a marker at any corner.

Characteristics

5.5.8.3 Boundary markers shall be of a form similar to that shown in Figure 5-32, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers shall be colored to contrast with the background against which they will be seen. A single color, orange or red, or two contrasting colors, orange and white or alternatively red and white, shall be used, except where such colors merge with the background.

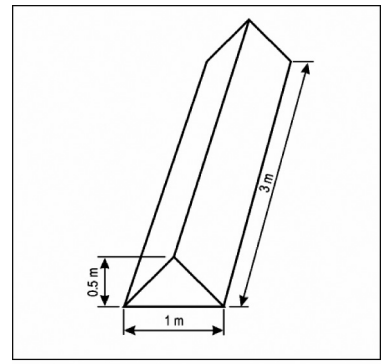


Figure 5-32. Boundary markers

CHAPTER 6. VISUAL AIDS FOR DENOTING OBSTACLES

6.1 Objects to be marked and/or lighted

Note – 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.

6.1.1 A fixed obstacle that extends above a take-off climb surface within 3000 m of the inner edge of the take-off climb surface shall be marked and, if the runway is used at night, lighted, except that:

a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.2 fixed object, other than an obstacle, adjacent to a take-off climb surface shall be marked and, if the runway is used at night, lighted if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:

a) the object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or

b) the object is lighted by high-intensity obstacle lights by day.

6.1.3 A fixed obstacle that extends above an approach or transitional surface within 3000 m of the inner edge of the approach surface shall be marked and, if the runway is used at night, lighted, except that:

a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.4 A fixed obstacle above a horizontal surface shall be marked and, if the aerodrome is used at night, lighted except that:

a) such marking and lighting may be omitted when:

1) the obstacle is shielded by another fixed obstacle; or

2) for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or

3) an aeronautical study shows the obstacle not to be of operational significance;

b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.5 A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

Note – See 5.3.5 for information on the obstacle protection surface.

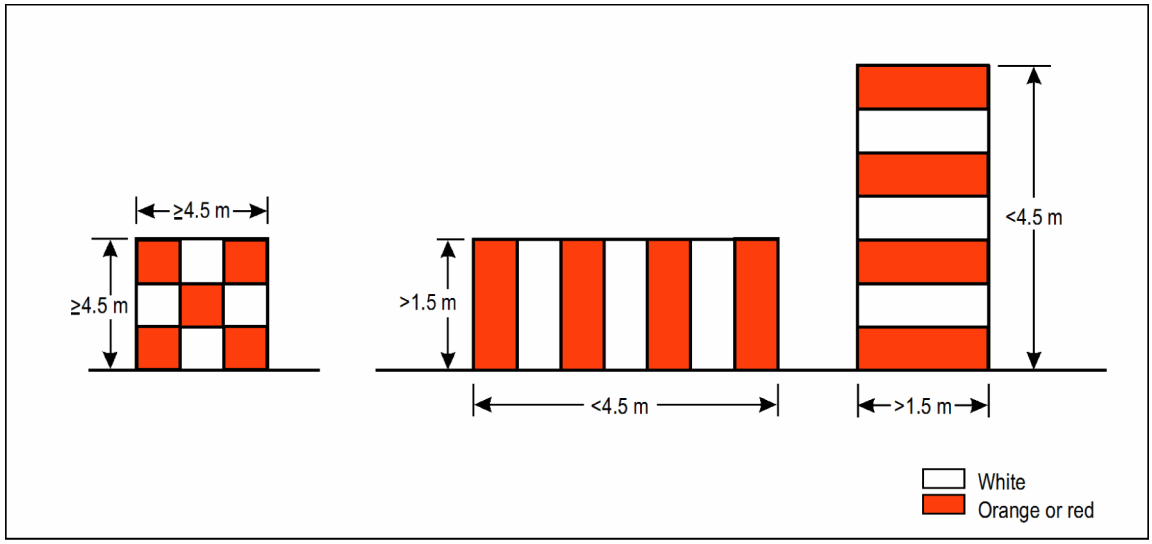


Figure 6-1. Basic marking patterns

6.1.6 Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and shall be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.

6.1.7 Elevated aeronautical ground lights within the movement area shall be marked so as to be conspicuous by day. Obstacle lights shall not be installed on elevated ground lights or signs in the movement area.

6.1.8 All obstacles within the distance specified in Table 3-1, column 11 or 12, from the centre line of a taxiway, an apron taxiway or aircraft stand taxi lane shall be marked and, if the taxiway, apron taxiway or aircraft stand taxi lane is used at night, lighted.

6.1.9 Obstacles in accordance with 4.3.2 shall be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

6.1.10 Overhead wires, cables, etc., crossing a river, valley or highway shall be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

6.1.11 When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, shall be provided on their supporting towers.

6.2 Marking of objects

General

6.2.1 Fixed objects, temporary and permanent, which extend above the obstacle limitation surfaces but are permitted to remain; or objects which are present on the movement area, are regarded as obstacles, and must be marked. The aerodrome operator must submit details of such obstacles to DCANA, for hazard assessment and particular requirements for marking and lighting.
This information must be included in the Aerodrome Manual.

All fixed objects to be marked shall, whenever practicable, be colored, but if this is not practicable, markers or flags shall be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or color need not be otherwise marked.

6.2.2 All mobile objects to be marked shall be colored or display flags.

Use of colors

6.2.3 An object shall be colored to show a checkered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5 m in both dimensions. The pattern shall consist of rectangles of not less than 1.5 m and not more than 3 m on a side, the corners being of the darker color. The colors of the pattern shall contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colors merge with the background. (See Figure 6-1.)

6.2.4 An object shall be colored to show alternating contrasting bands if:
a) it has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5 m, and the other dimension, horizontal or vertical, less than 4.5 m; or
b) it is of skeletal type with either a vertical or a horizontal dimension greater than 1.5 m.

The bands shall be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. The colors of the bands shall contrast with the background against which they will be seen. Orange and white shall be used, except where such colors are not conspicuous when viewed against the background. The bands on the extremities of the object shall be of the darker color. (See Figures 6-1 and 6-2.)

Note – Table 6-1 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker color.

6.2.5 An object shall be colored in a single conspicuous color if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red shall be used, except where such colors merge with the background.

Note – Against some backgrounds it may be found necessary to use a different color from orange or red to obtain sufficient contrast.

6.2.6 When mobile objects are marked by color, a single conspicuous color, preferably red or yellowish green for emergency vehicles and yellow for service vehicles shall be used.

Table 6-1. Marking band widths

Longest dimension		
Greater than	Not exceeding	Band width
1.5 m	210 m	1/7 of longest dimension
210 m	270 m	1/9 ” ” ”
270 m	330 m	1/11 ” ” ”
330 m	390 m	1/13 ” ” ”
390 m	450 m	1/15 ” ” ”
450 m	510 m	1/17 ” ” ”
510 m	570 m	1/19 ” ” ”
570 m	630 m	1/21 ” ” ”

Use of markers

6.2.7 Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

6.2.8 A marker displayed on an overhead wire, cable, etc., shall be spherical and have a diameter of not less than 60 cm.

6.2.9 The spacing between two consecutive markers or between a marker and a supporting tower shall be appropriate to the diameter of the marker, but in no case shall the spacing exceed:

a) 30 m where the marker diameter is 60 cm progressively increasing with the diameter of the marker to

b) 35 m where the marker diameter is 80 cm and further progressively increasing to a maximum of

c) 40 m where the marker diameter is of at least 130 cm.

Where multiple wires, cables, etc. are involved, a marker shall be located not lower than the level of the highest wire at the point marked.

6.2.10 A marker shall be of one color. When installed, white and red, or white and orange markers shall be displayed alternately. The color selected shall contrast with the background against which it will be seen.

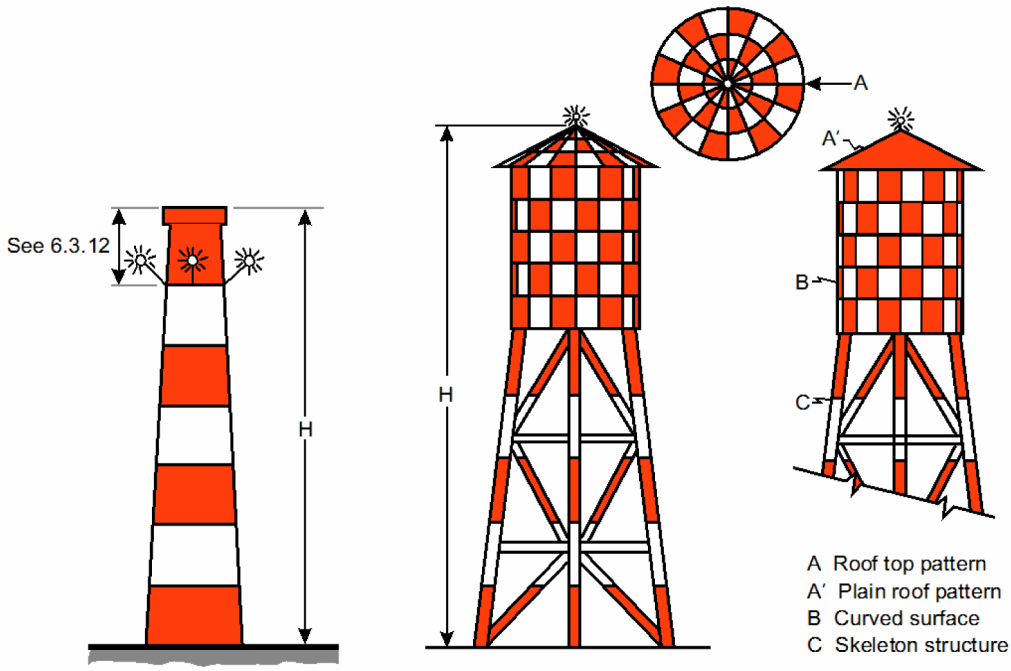
Use of flags

6.2.11 Flags used to mark objects shall be displayed around, on top of, or around the highest edge of, the object. When flags are used to mark extensive objects or groups of closely spaced objects, they shall be displayed at least every 15 m. Flags shall not increase the hazard presented by the object they mark.

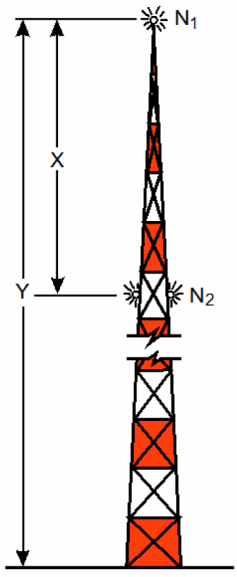
6.2.12 Flags used to mark fixed objects shall not be less than 0.6 m square and flags used to mark mobile objects, not less than 0.9 m square.

6.2.13 Flags used to mark fixed objects shall be orange in color or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colors merge with the background, other conspicuous colors shall be used.

6.2.14 Flags used to mark mobile objects shall consist of a checkered pattern, each square having sides of not less than 0.3 m. The colors of the pattern shall contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colors merge with the background.



Note.— H is less the 45 m for the examples shown above.
For greater heights intermediate lights must be added as shown below.



Light spacing (X) in accordance with Appendix 6

Number of levels of lights = N = $\frac{\text{Y (metres)}}{\text{X (metres)}}$

Figure 6-2. Examples of marking and lighting of tall structures

6.3 Lighting of objects

Use of obstacle lights

6.3.1 The presence of objects which must be lighted, as specified in 6.1, shall be indicated by low-, medium-or high-intensity obstacle lights, or a combination of such lights.

Note – High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, location and operation of high-intensity obstacle lights is given in the Aerodrome Design Manual, Part 4.

6.3.2 Low-intensity obstacle lights, Type A or B, shall be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.

6.3.3 Where the use of low-intensity obstacle lights, Type A or B, would be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights shall be used.

6.3.4 Low-intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

6.3.5 Low-intensity obstacle lights, Type D, shall be displayed on follow-me vehicles.

6.3.6 Low-intensity obstacle lights, Type B, shall be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with 6.3.7.

6.3.7 Medium-intensity obstacle lights, Type A, B or C, shall be used where the object is an extensive one or its height above the level of the surrounding ground is greater than 45 m. Medium-intensity obstacle lights, Types A and C, shall be used alone, whereas medium-intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

Note – A group of trees or buildings is regarded as an extensive object.

6.3.8 High-intensity obstacle lights, Type A, shall be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150 m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.

6.3.9 High-intensity obstacle lights, Type B, shall be used to indicate the presence of a tower supporting overhead wires, cables, etc., where:
a) an aeronautical study indicates such lights to be essential for the recognition of the presence of wires, cables, etc.; or
b) it has not been found practicable to install markers on the wires, cables, etc.

6.3.10 Where, in the opinion of the DCA NA, the use of high-intensity obstacle lights, Type A or B, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10000 m radius) or cause significant environmental concerns, a dual obstacle lighting system shall be provided. This system shall be composed of high-intensity obstacle lights, Type A or B, or medium-

intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use.

Location of obstacle lights

Note – Recommendations on how a combination of low-, medium-, and/or high-intensity lights on obstacles shall be displayed are given in Appendix 6.

6.3.11 One or more low-, medium-or high-intensity obstacle lights shall be located as close as practicable to the top of the object. The top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface.

6.3.12 In the case of chimney or other structure of like function, the top lights shall be placed sufficiently below the top so as to minimize contamination by smoke etc. (see Figures 6-2 and 6-3).

6.3.13 In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance, such as a rod or an antenna, greater than 12 m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light shall be located at the highest practicable point and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.

6.3.14 In the case of an extensive object or of a group of closely spaced objects, top lights shall be displayed at least on the points or edges of the objects highest in relation to the obstacle limitation surface, so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area shall be marked. Where low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m. Where medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

6.3.15 When the obstacle limitation surface concerned is sloping and the highest point above the obstacle limitation surface is not the highest point of the object, additional obstacle lights shall be placed on the highest point of the object.

6.3.16 Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m (see 6.3.7).

6.3.17 Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.3.18 Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.3.19 Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 6.3.11 except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

6.3.20 Where high-intensity obstacle lights, Type B, are used, they shall be located at three levels:
– at the top of the tower;
– at the lowest level of the catenary of the wires or cables; and
– at approximately midway between these two levels.

Note – In some cases, this may require locating the lights off the tower.

6.3.21 The installation setting angles for high-intensity obstacle lights, Types A and B, shall be in accordance with Table 6-2.

6.3.22 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that object in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

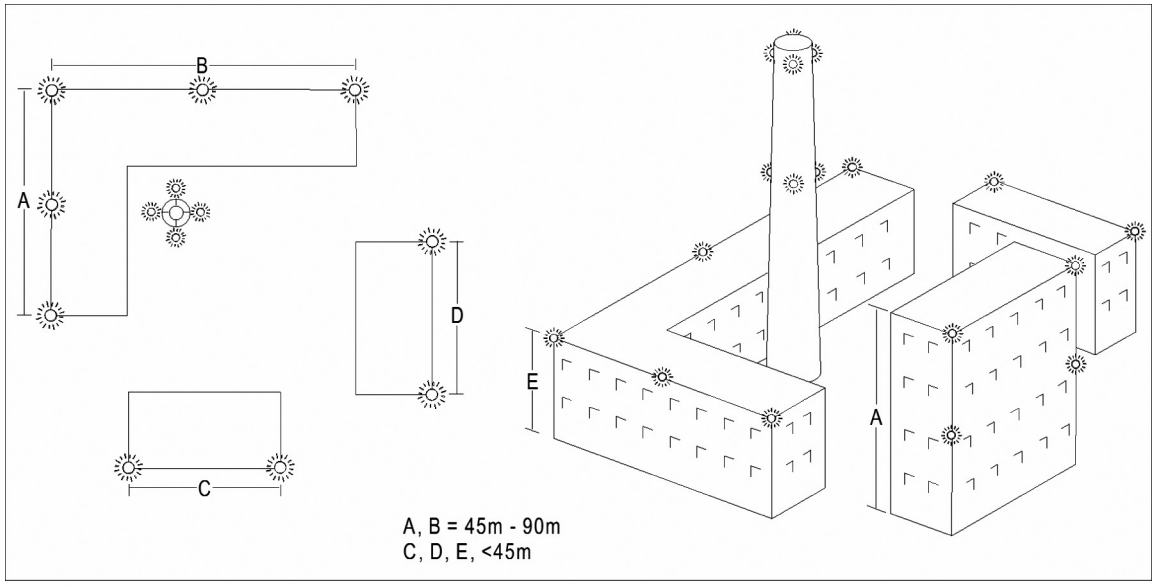


Figure 6-3. Lighting of buildings

Table 6-2. Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain	*Angle of the peak of the beam above the horizontal*
greater than 151 m AGL	0°
122 m to 151 m AGL	1°
92 m to 122 m AGL	2°
less than 92 m AGL	3°

Low-intensity obstacle light – Characteristics

6.3.23 Low-intensity obstacle lights on fixed objects, Types A and B, shall be fixed-red lights.

6.3.24 Low-intensity obstacle lights, Types A and B, shall be in accordance with the specifications in Table 6-3.

6.3.25 Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security shall be flashing-blue and those displayed on other vehicles shall be flashing-yellow.

6.3.26 Low-intensity obstacle lights, Type D, displayed on follow-me vehicles shall be flashing-yellow.

6.3.27 Low-intensity obstacle lights, Types C and D, shall be in accordance with the specifications in Table 6-3.

6.3.28 Low-intensity obstacle lights on objects with limited mobility such as aerobridges shall be fixed-red. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

Note – See Part 2 for lights to be displayed by aircraft.

6.3.29 Low-intensity obstacle lights on objects with limited mobility shall as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table 6-3.

Medium-intensity obstacle light – Characteristics

6.3.30 Medium-intensity obstacle lights, Type A, shall be flashing-white lights, Type B shall be flashing-red lights and Type C shall be fixed-red lights. 6.3.31 Medium-intensity obstacle lights, Types A, B and C, shall be in accordance with the specifications in Table 6-3. 6.3.32 Medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.

High-intensity obstacle light – Characteristics

6.3.33 High-intensity obstacle lights, Types A and B, shall be flashing-white lights.

6.3.34 High-intensity obstacle lights, Types A and B, shall be in accordance with the specifications in Table 6-3.

6.3.35 High-intensity obstacle lights, Type A, located on an object shall flash simultaneously.

6.3.36 High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., shall flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights shall approximate the following ratios:

Flash interval between	Ratio of cycle time
middle and top light	1/13
top and bottom light	2/13
bottom and middle light	10/13.

Table 6-3. Characteristics of obstacle lights

1	2	3	4	5	6	7	8	9	10	11	12
			Peak intensity (cd) at given Background Luminance			Vertical Beam	Intensity (cd) at given Elevation Angles when the light unit is levelled (d)				
Light Type	Colour	Signal type/ (flash rate)	Above 500 cd/m^2	50-500 cd/m^2	Below 50 cd/m^2	Spread (c)	−10° (e)	−1° (f)	±0° (f)	16°	10°
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	10 mnm	10 mnm	10°	—	—	—	10 mnm (g)	10 mnm (g)
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	32 mnm	32 mnm	10°	—	—	—	32 mnm (g)	32 mnm (g)
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40 mnm (b) 400 max	40 mnm (b) 400 max	12° (h)					
Low-intensity, Type D Follow-me Vehicle	Yellow	Flashing (60-90 fpm)	N/A	200 mnm (b) 400 max	200 mnm (b) 400 max	12° (i)					
Medium-intensity, Type A	White	Flashing (20-60 fpm)	20 000 (b) − 25%	20 000 (b) − 25%	2 000 (b) + 25%	3° mnm	3% max	50% mnm 75% max	100% mnm	—	—
Medium-intensity, Type B	Red	Flashing (20-60 fpm)	N/A	N/A	2 000 (b) + 25%	3° mnm	—	50% mnm 75% max	100% mnm	—	—
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2 000 (b) ± 25%	3° mnm	—	50% mnm 75% max	100% mnm	—	—
High-intensity, Type A	White	Flashing (40-60 fpm)	200 000 (b) − 25%	20 000 (b) − 25%	2 000 (b) + 25%	3°-7°	3% max	50% mnm 75% max	100% mnm	—	—
High-intensity, Type B	White	Flashing (40-60 fpm)	100 000 (b) − 25%	20 000 (b) − 25%	2 000 (b) + 25%	3°-7°	3% max	50% mnm 75% max	100% mnm	—	—

Note. This table does not include recommended horizontal beam spreads. 6.3.22 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) See 6.3.25
b) Effective intensity, as determined in accordance with the *Aerodrome Design Manual*, Part 4.
c) Beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the intensity shown in columns 4, 5 and 6. The beam pattern is not necessarily symmetrical about the elevation angle at which the peak intensity occurs.
d) Elevation (vertical) angles are referenced to the horizontal.
e) Intensity at any specified horizontal radial as a percentage of the actual peak intensity at the same radial when operated at each of the intensities shown in columns 4, 5 and 6.
f) Intensity at any specified horizontal radial as a percentage of the lower tolerance value of the intensity shown in columns 4, 5 and 6.
g) In addition to specified values, lights shall have sufficient intensity to ensure conspicuity at elevation angles between ± 0° and 50°.
h) Peak intensity should be located at approximately 2.5° vertical.
i) Peak intensity should be located at approximately 17° vertical.

fpm — flashes per minute; N/A — not applicable

CHAPTER 7. VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

7.1 Closed runways and taxiways, or parts thereof

Application

7.1.1 A closed marking shall be displayed on a runway or taxiway, or portion thereof, which is permanently closed to the use of all aircraft.

7.1.2 A closed marking shall be displayed on a temporarily closed runway or taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.

Location

7.1.3 On a runway a closed marking shall be placed at each end of the runway, or portion thereof, declared closed, and additional markings shall be so placed that the maximum interval between markings does not exceed 300 m. On a taxi-way a closed marking shall be placed at least at each end of the taxiway or portion thereof closed.

Characteristics

7.1.4 The closed marking shall be of the form and proportions as detailed in Figure 7-1, Illustration a), when displayed on a runway, and shall be of the form and proportions as detailed in Figure 7-1, Illustration b), when displayed on a taxiway. The marking shall be white when displayed on a runway and shall be yellow when displayed on a taxiway.

Note – When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

7.1.5 When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings shall be obliterated.

7.1.6 Lighting on a closed runway or taxiway or portion thereof shall not be operated, except as required for maintenance purposes.

7.1.7 In addition to closed markings, when the runway or taxiway or portion thereof closed is intercepted by a usable runway or taxiway which is used at night, unserviceability lights shall be placed across the entrance to the closed area at intervals not exceeding 3 m (see 7.4.4).

7.2 Non-load-bearing surfaces

Application

7.2.1 Shoulders for taxiways, runway turn pads, holding bays and aprons and other non-load bearing surfaces which cannot readily be distinguished from load-bearing surfaces and which, if used by aircraft, might result in damage to the aircraft shall have the boundary between such areas and the load-bearing surface marked by a taxi side stripe marking.

Note – The marking of runway sides is specified in 5.2.7.

Location

7.2.2 A taxi side stripe marking shall be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

Characteristics

7.2.3 A taxi side stripe marking shall consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same color as the taxiway centre line marking.

Note – Guidance on providing additional transverse stripes at an intersection or a small area on the apron is given in the Aerodrome Design Manual, Part 4.

7.3 Pre-threshold area

Application

7.3.1 When the surface before a threshold is paved and exceeds 60 m in length and is not suitable for normal use by aircraft, the entire length before the threshold shall be marked with a chevron marking.

Location

7.3.2 A chevron marking shall point in the direction of the runway and be placed as shown in Figure 7-2.

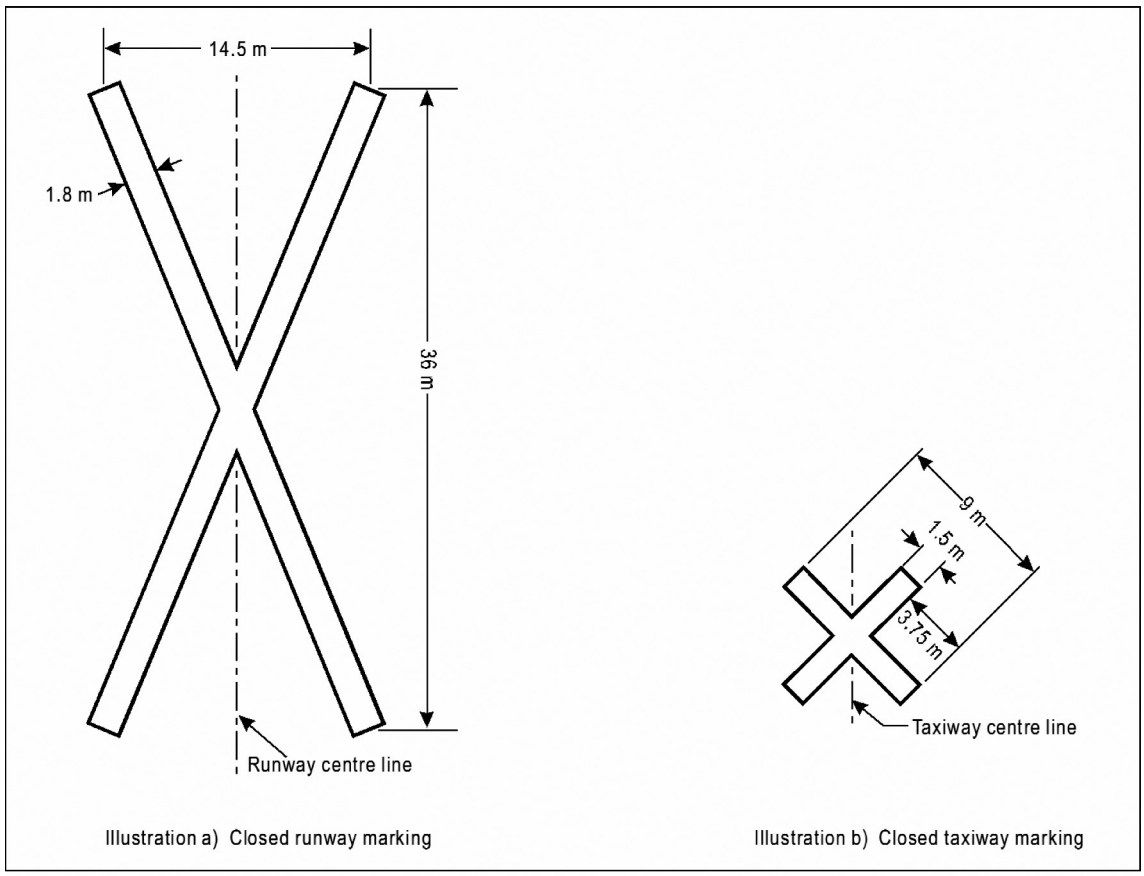


Figure 7-1. Closed runway and taxiway markings

Characteristics

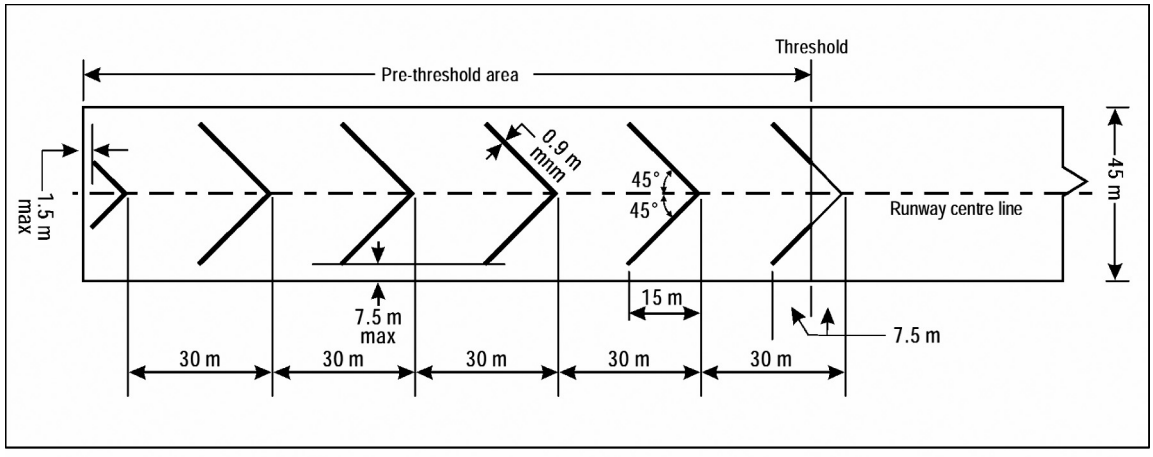


Figure 7-2. Pre-threshold marking

7.3.3 A chevron marking shall be of conspicuous color and contrast with the color used for the runway markings; it shall preferably be yellow. It shall have an overall width of at least 0.9 m.

7.4 Unserviceable areas

Application

7.4.1 Unserviceability markers shall be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely. On a movement area used at night, unserviceability lights shall be used.

Note – 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.

Location

7.4.2 Unserviceability markers and lights shall be placed at intervals sufficiently close so as to delineate the unserviceable area.

Note – Guidance on the location of unserviceability lights is given in Attachment A, Section 13.

Characteristics of unserviceability markers

7.4.3 Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones or marker boards.

Characteristics of unserviceability lights

7.4.4 An unserviceability light shall consist of a red fixed light. The light shall have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case shall the intensity be less than 10 cd of red light.

Characteristics of unserviceability cones

7.4.5 An unserviceability cone shall be at least 0.5 m in height and red, orange or yellow or any one of these colors in combination with white.

Characteristics of unserviceability flags

7.4.6 An unserviceability flag shall be at least 0.5 m square and red, orange or yellow or any one of these colors in combination with white.

Characteristics of unserviceability marker boards

7.4.7 An unserviceability marker board shall be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.

CHAPTER 8. ELECTRICAL SYSTEMS

8.1 Electrical power supply systems for air navigation facilities

Note – 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.

8.1.1 Adequate primary power supply shall be available at aerodromes for the safe functioning of air navigation facilities.

8.1.2 The design and provision of electrical power systems for aerodrome visual and radio navigation aids shall be such that an equipment failure will not leave the pilot with inadequate visual and non-visual guidance or misleading information.

Note – The design and installation of the electrical systems need to take into consideration factors that can lead to malfunction, such as electro-magnetic disturbances, line losses, power quality, etc. Additional guidance is given in the Aerodrome Design Manual, Part 5.

8.1.3 Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.4 The time interval between failure of the primary source of power and the complete restoration of the services required by 8.1.10 shall be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 8-1 for maximum switch-over times shall apply.

Note – A definition of switch-over time is given in Chapter 1.

8.1.5 The provision of a definition of switch-over time shall not require the replacement of an existing secondary power supply before 1 January 2010. However, for a secondary power supply installed after 4 November 1999, the electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are capable of meeting the requirements of Table 8-1 for maximum switch-over times as defined in Chapter 1.

Visual aids

Application

8.1.6 For a precision approach runway, a secondary power supply capable of meeting the requirements of Table 8-1 for the appropriate category of precision approach runway shall be provided. Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.7 For a runway meant for take-off in runway visual range conditions less than a value of 800 m, a secondary power supply capable of meeting the relevant requirements of Table 8-1 shall be provided.

8.1.8 At an aerodrome where the primary runway is a non-precision approach runway, a secondary power supply capable of meeting the requirements of Table 8-1 shall be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.

8.1.9 At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of 8.1.4 shall be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system in accordance with the specification of 5.3.2 is provided and capable of being deployed in 15 minutes.

8.1.10 The following aerodrome facilities shall be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:

a) the signaling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

Note – The requirement for minimum lighting may be met by other than electrical means.

b) all obstacle lights which, in the opinion of the appropriate authority, are essential to ensure the safe operation of aircraft;

c) approach, runway and taxiway lighting as specified in 8.1.6 to 8.1.9;

d) meteorological equipment;

e) essential security lighting, if provided in accordance with 9.11;

f) essential equipment and facilities for the aerodrome responding emergency agencies;

g) floodlighting on a designated isolated aircraft parking position if provided in accordance with 5.3.23.1; and

h) illumination of apron areas over which passengers may walk.

Note – Specifications for secondary power supply for radio navigation aids and ground elements of communications systems are given in Part 10, Volume I, Chapter 2.

8.1.11 Requirements for a secondary power supply shall be met by either of the following:

– 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

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

Note – Guidance on electrical systems is included in the Aerodrome Design Manual, Part 5.

8.2 System design

8.2.1 For a runway meant for use in runway visual range conditions less than a value of 550 m, the electrical systems for the power supply, lighting and control of the lighting systems included in Table 8-1 shall be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information.

Note – Guidance on means of providing this protection is given in the Aerodrome Design Manual, Part 5.

8.2.2 Where the secondary power supply of an aerodrome is provided by the use of duplicate feeders, such supplies shall be physically and electrically separate so as to ensure the required level of availability and independence.

8.2.3 Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems shall be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.

8.3 Monitoring

Note – Guidance on this subject is given in the Aerodrome Design Manual, Part 5.

8.3.1 A system of monitoring shall be employed to indicate the operational status of the lighting systems.

8.3.2 Where lighting systems are used for aircraft control purposes, such systems shall be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information shall be automatically relayed to the air traffic service unit.

8.3.3 Where a change in the operational status of lights has occurred, an indication shall be provided within two seconds for a stop bar at a runway-holding position and within five seconds for all other types of visual aids.

8.3.4 For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 shall be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in 10.4.7 to 10.4.11, as appropriate. This information shall be automatically relayed to the maintenance crew.

8.3.5 For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 shall be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified by the appropriate authority below which operations shall not continue. This information shall be automatically relayed to the air traffic services unit and displayed in a prominent position.

Note – Guidance on air traffic control interface and visual aids monitoring is included in the Aerodrome Design Manual, Part 5.

Table 8-1. Secondary power supply requirements
(see 8.1.4)

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators[a]	See
	Runway edge[b]	8.1.4 and
	Runway threshold[b]	8.1.9
	Runway end[b]	
	Obstacle[a]	
Non-precision approach	Approach lighting system	15 seconds
	Visual approach slope indicators[a, d]	15 seconds
	Runway edge[d]	15 seconds
	Runway threshold[d]	15 seconds
	Runway end	15 seconds
	Obstacle[a]	15 seconds
Precision approach category I	Approach lighting system	15 seconds
	Runway edge[d]	15 seconds
	Visual approach slope indicators[a, d]	15 seconds
	Runway threshold[d]	15 seconds
	Runway end	15 seconds
	Essential taxiway[a]	15 seconds
	Obstacle[a]	15 seconds
Precision approach category II/III	Inner 300 m of the approach lighting system	1 second
	Other parts of the approach lighting system	15 seconds
	Obstacle[a]	15 seconds
	Runway edge	15 seconds
	Runway threshold	1 second
	Runway end	1 second
	Runway centre line	1 second
	Runway touchdown zone	1 second
	All stop bars	1 second
	Essential taxiway	15 seconds
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Runway edge	15 seconds[c]
	Runway end	1 second
	Runway centre line	1 second
	All stop bars	1 second
	Essential taxiway[a]	15 seconds
	Obstacle[a]	15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.
b. See Chapter 5, 5.3.2 regarding the use of emergency lighting.
c. One second where no runway centre line lights are provided.
d. One second where approaches are over hazardous or precipitous terrain.

CHAPTER 9. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

9.1 Aerodrome emergency planning

General

Note – Aerodrome emergency planning is the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in its vicinity. The objective of aerodrome emergency planning is to minimize the effects of an emergency, particularly in respect of saving lives and maintaining aircraft operations. The aerodrome emergency plan sets forth the procedures for coordinating the response of different aerodrome agencies (or services) and of those agencies in the surrounding community that could be of assistance in responding to the emergency. Guidance material to assist the appropriate authority in

establishing aerodrome emergency planning is given in the Airport Services Manual, Part 7.

9.1.1 An aerodrome emergency plan shall be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome.

9.1.2 The aerodrome emergency plan shall provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.

Note – Examples of emergencies are: aircraft emergencies, sabotage including bomb threats, unlawfully seized aircraft, dangerous goods occurrences, building fires and natural disasters.

9.1.3 The plan shall coordinate the response or participation of all existing agencies which, in the opinion of the appropriate authority, could be of assistance in responding to an emergency.

Note – Examples of agencies are:
– on the aerodrome: air traffic control unit, rescue and fire fighting services, aerodrome administration, medical and ambulance services, aircraft operators, security services, and police;
– off the aerodrome: fire departments, police, medical and ambulance services, hospitals, military, and harbor patrol or coast guard.

9.1.4 The plan shall provide for cooperation and coordination with the rescue coordination centre, as necessary.

9.1.5 The aerodrome emergency plan document shall include at least the following:
a) types of emergencies planned for;
b) agencies involved in the plan;
c) responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;
d) information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and
e) a grid map of the aerodrome and its immediate vicinity.

9.1.6 The plan shall observe Human Factors principles to ensure optimum response by all existing agencies participating in emergency operations.

Note – Guidance material on Human Factors principles can be found in the Human Factors Training Manual.

Emergency operations centre and command post

9.1.7 A fixed emergency operations centre and a mobile command post shall be available for use during an emergency.

9.1.8 The emergency operations centre shall be a part of the aerodrome facilities and shall be responsible for the overall coordination and general direction of the response to an emergency.

9.1.9 The command post shall be a facility capable of being moved rapidly to the site of an emergency, when required, and shall undertake the local coordination of those agencies responding to the emergency.

9.1.10 A person shall be assigned to assume control of the emergency operations centre and, when appropriate, another person the command post.

Communication system

9.1.11 Adequate communication systems linking the command post and the emergency operations centre with each other and with the participating agencies shall be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

Aerodrome emergency exercise

9.1.12 The plan shall contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness.

Note – The plan includes all participating agencies and associated equipment.

9.1.13 The plan shall be tested by conducting:
a) a full-scale aerodrome emergency exercise at intervals not exceeding two years; and
b) partial emergency exercises in the intervening year to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected; and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

Note – The purpose of a full-scale exercise is to ensure the adequacy of the plan to cope with different types of emergencies. The purpose of a partial exercise is to ensure the adequacy of the response to individual participating agencies and components of the plan, such as the communications system.

Emergencies in difficult environments

9.1.14 The plan shall include the ready availability of and coordination with appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas.

9.1.15 At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan shall include the establishment, testing and assessment at regular intervals of a pre-determined response for the specialist rescue services.

9.2 Rescue and fire fighting

General

Note – The principal objective of a rescue and fire fighting service is to save lives. For this reason, the provision of means of dealing with an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome assumes primary importance because it is within this area that there are the greatest opportunities of saving lives. This must assume at all times the possibility of, and need for, extinguishing a fire which may occur either immediately following an aircraft accident or incident, or at any time during rescue operations.

The most important factors bearing on effective rescue in a survivable aircraft accident are: the training received, the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and fire fighting purposes can be put into use.

Requirements to combat building and fuel farm fires, or to deal with foaming of runways, are not taken into account.

Application

9.2.1 Rescue and fire fighting equipment and services shall be provided at an aerodrome.

Note – Public or private organizations, suitably located and equipped, may be designated to provide the rescue and fire fighting service. It is intended that the fire station housing these organizations be normally located on the aerodrome, although an off-aerodrome location is not precluded provided the response time can be met.

9.2.2 Where an aerodrome is located close to water/ swampy areas, or difficult terrain, and where a significant portion of approach or departure operations takes place over these areas, specialist rescue services and fire fighting equipment appropriate to the hazard and risk shall be available.

Note 1 – Special fire fighting equipment need not be provided for water areas; this does not prevent the provision of such equipment if it would be of practical use, such as when the areas concerned include reefs or islands.

Note 2 – The objective is to plan and deploy the necessary life-saving flotation equipment as expeditiously as possible in a number commensurate with the largest airplane normally using the aerodrome.

Note 3 – Additional guidance is available in Chapter 13 of the Airport Services Manual, Part 1.

Level of protection to be provided

9.2.3 The level of protection provided at an aerodrome for rescue and fire fighting shall be appropriate to the aerodrome category determined using the principles in 9.2.5 and 9.2.6, except that, where the number of movements of the airplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months, the level of protection provided shall be not less than one category below the determined category.

Note – Either a take-off or a landing constitutes a movement.

9.2.4 The level of protection provided at an aerodrome for rescue and fire fighting shall be equal to the aerodrome category determined using the principles in 9.2.5 and 9.2.6.

9.2.5 The aerodrome category shall be determined from Table 9-1 and shall be based on the longest airplanes normally using the aerodrome and their fuselage width.

Note – To categorize the airplanes using the aerodrome, first evaluate their overall length and second, their fuselage width.

9.2.6 If, after selecting the category appropriate to the longest airplane's overall length, that airplane's fuselage width is greater than the maximum width in Table 9-1, column 3 for that category, then the category for that airplane shall actually be one category higher.

Note – Guidance on categorizing aerodromes for rescue and fire fighting purposes and on providing rescue and fire fighting equipment and services is given in Attachment A, Section 17 and in the Airport Services Manual, Part 1.

9.2.7 During anticipated periods of reduced activity, the level of protection available shall be no less than that needed for the highest category of airplane planned to use the aerodrome during that time irrespective of the number of movements.

Extinguishing agents

9.2.8 Both principal and complementary agents shall normally be provided at an aerodrome.

Note – Descriptions of the agents may be found in the Airport Services Manual, Part 1.

9.2.9 The principal extinguishing agent shall be:
a) a foam meeting the minimum performance level A; or
b) a foam meeting the minimum performance level B; or
c) a combination of these agents;
except that the principal extinguishing agent for aerodromes in categories 1 to 3 shall preferably meet the minimum performance level B.

Note – Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance level A or B rating is given in the Airport Services Manual, Part 1.

9.2.10 The complementary extinguishing agent shall be a dry chemical powder suitable for extinguishing hydrocarbon fires.

Note 1 – When selecting dry chemical powders for use with foam, care must be exercised to ensure compatibility.

Note 2 – Alternate complementary agents having equivalent fire fighting capability may be utilized. Additional information on extinguishing agents is given in the Airport Services Manual, Part 1.

9.2.11 The amounts of water for foam production and the complementary agents to be provided on the rescue and fire fighting vehicles shall be in accordance with the aerodrome category determined under 9.2.3, 9.2.4, 9.2.5, 9.2.6 and Table 9-2, except that these amounts may be modified as follows:
a) for aerodrome categories 1 and 2 up to 100 per cent of the water may be replaced by complementary agent; or
b) for aerodrome categories 3 to 10 when a foam meeting performance level A is used, up to 30 per cent of the water may be replaced by complementary agent.

For the purpose of agent substitution, the following equivalents shall be used:
1 kg complementary agent = 1.0 L water for production of a foam meeting performance level A

1 kg complementary agent = 0.66 L water for production of a foam meeting performance level B

Note 1 – The amounts of water specified for foam production are predicated on an application rate of 8.2 L/min/m2 for a foam meeting performance level A, and 5.5 L/min/m2 for a foam meeting performance level B.

Note 2 – When any other complementary agent is used, the substitution ratios need to be checked.

9.2.12 The quantity of foam concentrates separately provided on vehicles for foam production shall be in proportion to the quantity of water provided and the foam concentrate selected.

9.2.13 The amount of foam concentrate provided on a vehicle shall be sufficient to produce at least two loads of foam solution.

9.2.14 Supplementary water supplies, for the expeditious replenishment of rescue and fire fighting vehicles at the scene of an aircraft accident, shall be provided.

9.2.15 When both a foam meeting performance level A and a foam meeting performance level B are to be used, the total amount of water to be provided for foam production shall first be based on the quantity which would be required if only a foam meeting performance level A were used, and then reduced by 3 L for each 2 L of water provided for the foam meeting performance level B.

9.2.16 The discharge rate of the foam solution shall not be less than the rates shown in Table 9-2.

9.2.17 The complementary agents shall comply with the appropriate specifications of the International Organization for Standardization (ISO).*

9.2.18 The discharge rate of complementary agents shall be selected for optimum effectiveness of the agent.

9.2.19 A reserve supply of foam concentrate and complementary agent, equivalent to 200 per cent of the quantities of these agents to be provided in the rescue and fire fighting vehicles, shall be maintained on the aerodrome for vehicle replenishment purposes. Where a major delay in the replenishment of this supply is anticipated, the amount of reserve supply shall be increased.

Table 9-1. Aerodrome category for rescue and fire fighting

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

Table 9-2. Minimum usable amounts of extinguishing agents

	Foam meeting performance level A		Foam meeting performance level B		Complementary agents
Aerodrome category	Water[1] (L)	Discharge rate foam solution/ minute (L)	Water[1] (L)	Discharge rate foam solution/ minute (L)	Dry[2] chemical powders (kg)
(1)	(2)	(3)	(4)	(5)	(6)
1	350	350	230	230	45
2	1 000	800	670	550	90
3	1 800	1 300	1 200	900	135
4	3 600	2 600	2 400	1 800	135
5	8 100	4 500	5 400	3 000	180
6	11 800	6 000	7 900	4 000	225
7	18 200	7 900	12 100	5 300	225
8	27 300	10 800	18 200	7 200	450
9	36 400	13 500	24 300	9 000	450
10	48 200	16 600	32 300	11 200	450

Note 1.— The quantities of water shown in columns 2 and 4 are based on the average overall length of aeroplanes in a given category. Where operations of an aeroplane larger than the average size are expected, the quantities of water would need to be recalculated. See the Airport Services Manual, *Part 1 for additional guidance.*

Note 2.— Any other complementary agent having equivalent fire fighting capability may be used.

Rescue equipment

9.2.20 Rescue equipment commensurate with the level of aircraft operations shall be provided on the rescue and fire fighting vehicle(s).

Note – Guidance on the rescue equipment to be provided at an aerodrome is given in the Airport Services Manual, Part 1.

Response time

9.2.21 The operational objective of the rescue and fire fighting service shall be to achieve a response time not exceeding three minutes to any point of each operational runway, in optimum visibility and surface conditions.

9.2.22 The operational objective of the rescue and fire fighting service shall be to achieve a response time not exceeding two minutes to any point of each operational runway, in optimum visibility and surface conditions.

9.2.23 The operational objective of the rescue and fire fighting service shall be to achieve a response time not exceeding three minutes to any other part of the movement area in optimum visibility and surface conditions.

Note 1 – Response time is considered to be the time between the initial call to the rescue and fire fighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 9-2.

Note 2 – To meet the operational objective as nearly as possible in less than optimum conditions of visibility, it may be necessary to provide suitable guidance and/or procedures for rescue and fire fighting vehicles.

Note 3 – Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination e.g. water, ice or snow.

9.2.24 Any other vehicles required to deliver the amounts of extinguishing agents specified in Table 9-2 shall arrive no more than one minute after the first responding vehicle(s) so as to provide continuous agent application.

9.2.25 A system of preventive maintenance of rescue and fire fighting vehicles shall be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.

Emergency access roads

9.2.26 Emergency access roads shall be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention shall be given to the provision of ready access to approach areas up to 1000 m from the threshold, or at least within the aerodrome boundary. Where a fence is provided, the need for convenient access to outside areas shall be taken into account.

Note – Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.

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

9.2.28 When the surface of the road is indistinguishable from the surrounding area, edge markers shall be placed at intervals of about 10 m.

Fire stations

9.2.29 All rescue and fire fighting vehicles shall normally be housed in a fire station. Satellite fire stations shall be provided whenever the response time cannot be achieved from a single fire station.

9.2.30 The fire station shall be located so that the access for rescue and fire fighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.

Communication and alerting systems

9.2.31 A discrete communication system shall be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and fire fighting vehicles.

9.2.32 An alerting system for rescue and fire fighting personnel, capable of being operated from that station, shall be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.

Number of rescue and fire fighting vehicles

9.2.33 The minimum number of rescue and fire fighting vehicles provided at an aerodrome shall be in accordance with the following tabulation:

Aerodrome category	Rescue and fire fighting vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Note – Guidance on minimum characteristics of rescue and fire fighting vehicles is given in the Airport Services Manual, Part 1.

Personnel

9.2.34 All rescue and fire fighting personnel shall be properly trained to perform their duties in an efficient manner and shall participate in live fire drills commensurate with the types of aircraft and type of rescue and fire fighting equipment in use at the aerodrome, including pressure-fed fuel fires.

Note 1 – Guidance to assist the DCA NA in providing proper training is given in Attachment A, Section 17; Airport Services Manual, Part 1; and Training Manual, Part E-2.

Note 2 – Fires associated with fuel discharged under very high pressure from a ruptured fuel tank are known as «pressure-fed fuel fires».

9.2.35 The rescue and fire fighting personnel training program shall include training in human performance, including team coordination.

Note – Guidance material to design training programs on human performance and team coordination can be found in the Human Factors Training Manual.

9.2.36 During flight operations, sufficient trained personnel shall be detailed and be readily available to ride the rescue and fire fighting vehicles and to operate the equipment at maximum capacity. These trained personnel shall be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. Consideration shall also be given for personnel to use hand lines, ladders and other rescue and fire fighting equipment normally associated with aircraft rescue and fire fighting operations.

9.2.37 In determining the number of personnel required to provide for rescue, consideration shall be given to the types of aircraft using the aerodrome.

9.2.38 All responding rescue and fire fighting personnel shall be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.

9.3 Disabled aircraft removal

Note – Guidance on removal of a disabled aircraft, including recovery equipment, is given in the Airport Services Manual, Part 5. See also Part 13 concerning protection of evidence, custody and removal of aircraft.

9.3.1 A plan for the removal of an aircraft disabled on, or adjacent to, the movement area shall be established for an aerodrome, and a coordinator designated to implement the plan, when necessary.

9.3.2 The disabled aircraft removal plan shall be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:
a) a list of equipment and personnel on, or in the vicinity of, the aerodrome which would be available for such purpose; and
b) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes.

9.4 Bird hazard reduction

9.4.1 The bird strike hazard on, or in the vicinity of, an aerodrome shall be assessed through:
a) the establishment of a national procedure for recording and reporting bird strikes to aircraft; and
b) the collection of information from aircraft operators, airport personnel, etc. on the presence of birds on or around the aerodrome constituting a potential hazard to aircraft operations.

Note – See Annex 15, Chapter 8.

9.4.2 Bird strike reports shall be collected and forwarded to ICAO for inclusion in the ICAO Bird Strike Information System (IBIS) database.

Note – The IBIS is designed to collect and disseminate information on bird strikes to aircraft. Information on the system is included in the Manual on the ICAO Bird Strike Information System (IBIS).

9.4.3 When a bird strike hazard is identified at an aerodrome, the appropriate authority shall take action to decrease the number of birds constituting a potential hazard to aircraft operations by adopting measures for discouraging their presence on, or in the vicinity of, an aerodrome.

Note – Guidance on effective measures for establishing whether or not birds, on or near an aerodrome, constitute a potential hazard to aircraft operations, and on methods for discouraging their presence, is given in the Airport Services Manual, Part 3.

9.4.4 The appropriate aerodrome authority shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any such other source attracting bird activity on, or in the vicinity of, an aerodrome unless an appropriate aeronautical study indicates that they are unlikely to create conditions conducive to a bird hazard problem.

Note – Due consideration needs to be given to airport operators' concerns related to land developments close to the airport boundary that may attract birds/wildlife.

9.5 Apron management service

9.5.1 When warranted by the volume of traffic and operating conditions, an appropriate apron management service shall be provided on an apron by an aerodrome ATS unit, by another aerodrome operating authority, or by a cooperative combination of these, in order to:
a) regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;
b) regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and
c) ensure safe and expeditious movement of vehicles and appropriate regulation of other activities.

9.5.2 When the aerodrome control tower does not participate in the apron management service, procedures shall be established to facilitate the orderly transition of aircraft between the apron management unit and the aerodrome control tower.

Note – Guidance on an apron management service is given in the Airport Services Manual, Part 8 and in the Manual of Surface Movement Guidance and Control Systems (SMGCS).

9.5.3 An apron management service shall be provided with radiotelephony communications facilities.

9.5.4 Where low visibility procedures are in effect, persons and vehicles operating on an apron shall be restricted to the essential minimum.

Note – Guidance on related special procedures is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS).

9.5.5 An emergency vehicle responding to an emergency shall be given priority over all other surface movement traffic.

9.5.6 A vehicle operating on an apron shall:

a) give way to an emergency vehicle; an aircraft taxiing, about to taxi, or being pushed or towed; and
b) give way to other vehicles in accordance with local regulations.

9.5.7 An aircraft stand shall be visually monitored to ensure that the recommended clearance distances are provided to an aircraft using the stand.

9.6 Ground servicing of aircraft

9.6.1 Fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire and personnel trained in its use shall be readily available during the ground servicing of an aircraft, and there shall be a means of quickly summoning the rescue and fire fighting service in the event of a fire or major fuel spill.

9.6.2 When aircraft refueling operations take place while passengers are embarking, on board or disembarking, ground equipment shall be positioned so as to allow:
a) the use of a sufficient number of exits for expeditious evacuation; and
b) a ready escape route from each of the exits to be used in an emergency.

9.7 Aerodrome vehicle operations

Note 1 – Guidance on aerodrome vehicle operations is contained in Attachment A, Section 18 and on traffic rules and regulations for vehicles in the Manual of Surface Movement Guidance and Control Systems (SMGCS).

Note 2 – It is intended that roads located on the movement area be restricted to the exclusive use of aerodrome personnel and other authorized persons, and that access to the public buildings by an unauthorized person will not require use of such roads.

9.7.1 A vehicle shall be operated:
a) on a maneuvering area only as authorized by the aerodrome control tower; and
b) on an apron only as authorized by the appropriate designated authority.

9.7.2 The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by markings and signs unless otherwise authorized by:
a) the aerodrome control tower when on the maneuvering area; or
b) the appropriate designated authority when on the apron.

9.7.3 The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by lights.

9.7.4 The driver of a vehicle on the movement area shall be appropriately trained for the tasks to be performed and shall comply with the instructions issued by:
a) the aerodrome control tower, when on the maneuvering area; and
b) the appropriate designated authority, when on the apron.

9.7.5 The driver of a radio-equipped vehicle shall establish satisfactory two-way radio communication with the aerodrome control tower before entering the maneuvering area and with the appropriate designated

authority before entering the apron. The driver shall maintain a continuous listening watch on the assigned frequency when on the movement area.

9.8 Surface movement guidance and control systems

Application

9.8.1 It is desirable to provide a surface movement guidance and control system at an aerodrome.

Note – Guidance on surface movement guidance and control systems is contained in the Manual of Surface Movement Guidance and Control Systems (SMGCS).

Characteristics

9.8.2 The design of a surface movement guidance and control system shall take into account:
a) the density of air traffic;
b) the visibility conditions under which operations are intended;
c) the need for pilot orientation;
d) the complexity of the aerodrome layout; and
e) movements of vehicles.

9.8.3 The visual aid components of a surface movement guidance and control system, i.e. markings, lights and signs shall be designed to conform with the relevant specifications in 5.2, 5.3 and 5.4, respectively.

9.8.4 A surface movement guidance and control system shall be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.

9.8.5 The system shall be designed to assist in the prevention of collisions between aircraft, and between aircraft and vehicles or objects, on any part of the movement area.

Note – Guidance on control of stop bars through induction loops and on a visual taxiing guidance and control system is contained in the Aerodrome Design Manual, Part 4.

9.8.6 Where a surface movement guidance and control system is provided by selective switching of stop bars and taxiway centre line lights, the following requirements shall be met:
a) taxiway routes which are indicated by illuminated taxiway centre line lights shall be capable of being terminated by an illuminated stop bar;
b) the control circuits shall be so arranged that when a stop bar located ahead of an aircraft is illuminated, the appropriate section of taxiway centre line lights beyond it is suppressed; and
c) the taxiway centre line lights are activated ahead of an aircraft when the stop bar is suppressed.
Note 1 – See Sections 5.3.16 and 5.3.19 for specifications on taxiway centre line lights and stop bars, respectively.

Note 2 – Guidance on installation of stop bars and taxiway centre line lights in surface movement guidance and control systems is given in the Aerodrome Design Manual, Part 4.

9.8.7 Surface movement radar for the maneuvering area shall be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m.

9.8.8 Surface movement radar for the maneuvering area shall be provided at an aerodrome other than that in 9.8.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

Note – Guidance on the use of surface movement radar is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) and in the Air Traffic Services Planning Manual (Doc 9426).

9.9 Siting of equipment and installations on operational areas

Note 1 – Requirements for obstacle limitation surfaces are specified in 4.2.

Note 2 – The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs, and markers, is specified in 5.3.1, 5.3.5, 5.4.1 and 5.5.1, respectively. Guidance on the frangible design of visual and non-visual aids for navigation is given in the Aerodrome Design Manual, Part 6 (in preparation).

9.9.1 Unless its function requires it to be there for air navigation purposes, no equipment or installation shall be:
a) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in Table 3-1, column 11, if it would endanger an aircraft; or
b) on a clearway if it would endanger an aircraft in the air.

9.9.2 Any equipment or installation required for air navigation purposes which must be located:
a) on that portion of a runway strip within: 1) 75 m of the runway centre line where the code number is 3 or 4; or 2) 45 m of the runway centre line where the code number is 1 or 2; or
b) on a runway end safety area, a taxiway strip or within the distances specified in Table 3-1; or c) on a clearway and which would endanger an aircraft in the air; shall be frangible and mounted as low as possible.

9.9.3 Existing non-visual aids need not meet the requirement of 9.9.2 until 1 January 2010.

9.9.4 Any equipment or installation required for air navigation purposes which must be located on the non-graded portion of a runway strip shall be regarded as an obstacle and shall be frangible and mounted as low as possible.

Note – Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual, Part 6 (in preparation).

9.9.5 Unless its function requires it to be there for air navigation purposes, no equipment or installation shall be located within 240 m from the end of the strip and within:
a) 60 m of the extended centre line where the code number is 3 or 4; or
b) 45 m of the extended centre line where the code number is 1 or 2; of a precision approach runway category I, II or III.

9.9.6 Any equipment or installation required for air navigation purposes which must be located on or near a strip of a precision approach runway

category I, II or III and which:

a) is situated on that portion of the strip within 77.5 m of the runway centre line where the code number is 4 and the code letter is F; or

b) is situated within 240 m from the end of the strip and within:

1) 60 m of the extended runway centre line where the code number is 3 or 4; or

2) 45 m of the extended runway centre line where the code number is 1 or 2; or

c) penetrates the inner approach surface, the inner transitional surface or the balked landing surface;

shall be frangible and mounted as low as possible.

9.9.7 Existing non-visual aids need not meet the requirement of 9.9.6 b) until 1 January 2010.

Note – See 5.3.1.5 for the protection date for existing elevated approach lights.

9.9.8 Any equipment or installation required for air navigation purposes which is an obstacle of operational significance in accordance with 4.2.4, 4.2.11, 4.2.20 or 4.2.27 shall be frangible and mounted as low as possible.

9.10 Fencing

Application

9.10.1 A fence or other suitable barrier shall be provided on an aerodrome to prevent the entrance to the movement area of animals large enough to be a hazard to aircraft.

9.10.2 Open.

9.10.3 A fence or other suitable barrier shall be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome.

Note 1 – This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.

Note 2 – Special measures may be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

9.10.4 Open.

Note 1 – This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.

Note 2 – Special measures may be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

9.10.5 Suitable means of protection shall be provided to deter the inadvertent or premeditated access of unauthorized persons into ground installations and facilities essential for the safety of civil aviation located off the aerodrome.

9.10.6 Open.

Location

9.10.7 The fence or barrier shall be located so as to separate the movement area and other facilities or zones on the aerodrome vital to the safe operation of aircraft from areas open to public access.

9.10.8 Open.

9.10.9 When greater security is thought necessary, a cleared area shall be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult. Consideration shall be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

9.11 Security lighting

At an aerodrome where it is deemed desirable for security reasons, a fence or other barrier provided for the protection of international civil aviation and its facilities shall be illuminated at a minimum essential level. Consideration shall be given to locating lights so that the ground area on both sides of the fence or barrier, particularly at access points, is illuminated.

CHAPTER 10. AERODROME MAINTENANCE

10.1 General

10.1.1 A maintenance program, including preventive maintenance where appropriate, shall be established at an aerodrome to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation.

Note 1 – Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities.

Note 2 – «Facilities» are intended to include such items as pavements, visual aids, fencing, drainage systems and buildings.

10.1.2 The design and application of the maintenance program shall observe Human Factors principles.

Note – Guidance material on Human Factors principles can be found in the Human Factors Training Manual.

10.2 Pavements

10.2.1 The surface of pavements (runways, taxiways, aprons and adjacent areas) shall be kept clear of any loose stones or other objects that might cause damage to aircraft structures or engines, or impair the operation of aircraft systems.

Note – Guidance on precautions to be taken in regard to the surface of shoulders is given in Attachment A, Section 8, and the Aerodrome Design Manual, Part 2.

10.2.2 The surface of a runway shall be maintained in a condition such as to prevent formation of harmful irregularities.

Note – See Attachment A, Section 5.

10.2.3 Measurements of the friction characteristics of a runway surface shall be made periodically with a continuous friction measuring device using self-wetting features.

Note – Guidance on evaluating the friction characteristics of a runway is provided in Attachment A, Section 7. Additional guidance is included in the Airport Services Manual, Part 2.

10.2.4 Corrective maintenance action shall be taken when the friction characteristics for either the entire runway or a portion thereof are below a minimum friction level specified by the State.

Note – A portion of runway in the order of 100 m long may be considered significant for maintenance or reporting action.

10.2.5 Corrective maintenance action shall be considered when the friction characteristics for either the entire runway or a portion thereof are below a maintenance planning level specified by the DCA NA.

10.2.6 When there is reason to believe that the drainage characteristics of a runway, or portions thereof, are poor due to slopes or depressions, then the runway friction characteristics shall be assessed under natural or simulated conditions that are representative of local rain and corrective maintenance action shall be taken as necessary.

10.2.7 When a taxiway is used by turbine-engined airplanes, the surface of the taxiway shoulders shall be maintained so as to be free of any loose stones or other objects that could be ingested by the airplane engines.

Note – Guidance on this subject is given in the Aerodrome Design Manual, Part 2.

10.2.8 The surface of a paved runway shall be maintained in a condition so as to provide good friction characteristics and low rolling resistance. Snow, slush, ice, standing water, mud, dust, sand, oil, rubber deposits and other contaminants shall be removed as rapidly and completely as possible to minimize accumulation.

Note – The Airport Services Manual, Part 2, contains further information on this subject, on improving friction characteristics and on clearing of runways.

10.2.9 A taxiway shall be kept clear of snow, slush, ice, etc., to the extent necessary to enable aircraft to be taxied to and from an operational runway.

10.2.10 Aprons shall be kept clear of snow, slush, ice, etc., to the extent necessary to enable aircraft to maneuver safely or, where appropriate, to be towed or pushed.

10.2.11 Open

10.2.12 Open.

Note – Guidance on the use of chemicals for aerodrome pavements is given in the Airport Services Manual, Part 2.

10.2.13 Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, shall not be used.

10.3 Runway pavement overlays

Note – The following specifications are intended for runway pavement overlay projects when the runway is to be returned to an operational status before overlay of the entire runway is complete thus normally necessitating a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the Aerodrome Design Manual, Part 3.

10.3.1 The longitudinal slope of the temporary ramp, measured with reference to the existing runway surface or previous overlay course, shall be:

a) 0.5 to 1.0 per cent for overlays up to and including 5 cm in thickness; and

b) not more than 0.5 per cent for overlays more than 5 cm in thickness.

10.3.2 Overlaying shall proceed from one end of the runway toward the other end so that based on runway utilization most aircraft operations will experience a down ramp.

10.3.3 The entire width of the runway shall be overlaid during each work session.

10.3.4 Before a runway being overlaid is returned to a temporary operational status, a runway centre line marking conforming to the specifications in Section 5.2.3 shall be provided. Additionally, the location of any temporary threshold shall be identified by a 3.6 m wide transverse stripe.

10.4 Visual aids

Note – These specifications are intended to define the maintenance performance level objectives. They are not intended to define whether the lighting system is operationally out of service.

10.4.1 A light shall be deemed to be unserviceable when the main beam average intensity is less than 50 per cent of the value specified in the appropriate figure in Appendix 2. For light units where the designed main beam average intensity is above the value shown in Appendix 2, the 50 per cent value shall be related to that design value.

10.4.2 A system of preventive maintenance of visual aids shall be employed to ensure lighting and marking system reliability.

Note – Guidance on preventive maintenance of visual aids is given in the Airport Services Manual, Part 9.

10.4.3 The system of preventive maintenance employed for a precision approach runway category II or III shall include at least the following checks:

a) visual inspection and in-field measurement of the intensity, beam spread and orientation of lights included in the approach and runway lighting systems;

b) control and measurement of the electrical characteristics of each circuitry included in the approach and runway lighting systems; and

c) control of the correct functioning of light intensity settings used by air traffic control.

10.4.4 In-field measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specification of Appendix 2.

10.4.5 Measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken using a mobile measuring unit of sufficient accuracy to analyze the characteristics of the individual lights.

10.4.6 The frequency of measurement of lights for a precision approach runway category II or III shall be based on traffic density, the local pollution level, the reliability of the installed lighting equipment and the continuous assessment of the results of the in-field measurements but in any event shall not be less than twice a year for in-pavement lights and not less than once a year for other lights.

10.4.7 The system of preventive maintenance employed for a precision approach runway category II or III shall have as its objective that, during any period of category II or III operations, all approach and runway lights are serviceable, and that in any event at least:

a) 95 per cent of the lights are serviceable in each of the following particular significant elements:

1) precision approach category II and III lighting system, the inner 450 m;

2) runway centre line lights;

3) runway threshold lights; and

4) runway edge lights;

b) 90 per cent of the lights are serviceable in the touchdown zone lights;

c) 85 per cent of the lights are serviceable in the approach lighting system beyond 450 m; and

d) 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, the allowable percentage of unserviceable lights shall not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally, an unserviceable light shall not be permitted adjacent to another unserviceable light, except in a barrette or a crossbar where two adjacent unserviceable lights may be permitted.

Note – With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

– laterally: in the same barrette or crossbar; or

– longitudinally: in the same row of edge lights or barrettes.

10.4.8 The system of preventive maintenance employed for a stop bar provided at a runway-holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of 350 m shall have the following objectives:

a) no more than two lights will remain unserviceable; and

b) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.

10.4.9 The system of preventive maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of 350 m shall have as its objective that no two adjacent taxiway centre line lights be unserviceable.

10.4.10 The system of preventive maintenance employed for a precision approach runway category I shall have as its objective that, during any period of category I operations, all approach and runway lights are serviceable, and that in any event at least 85 per cent of the lights are serviceable in each of the following:

a) precision approach category I lighting system;
b) runway threshold lights;
c) runway edge lights; and
d) runway end lights.

In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.

Note – In barrettes and crossbars, guidance is not lost by having two adjacent unserviceable lights.

10.4.11 The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions less than a value of 550 m shall have as its objective that, during any period of operations, all runway lights are serviceable and that in any event:

a) at least 95 per cent of the lights are serviceable in the runway centre line lights (where provided) and in the runway edge lights; and
b) at least 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.4.12 The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions of a value of 550 m or greater shall have as its objective that, during any period of operations, all runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.4.13 During low visibility procedures the appropriate authority shall restrict construction or maintenance activities in the proximity of aerodrome electrical systems.

APPENDIX 1. COLOURS FOR AERONAUTICAL GROUND LIGHTS, MARKINGS, SIGNS AND PANELS

1. General

Note – The following specifications define the chromaticity limits of colors to be used for aeronautical ground lights, markings, signs and panels. The specifications are in accord with the 1983 specifications of the International Commission on Illumination (CIE). It is not possible to establish specifications for colors such that there is no possibility of confusion. For reasonably certain recognition, it is important that the eye illumination be well above the threshold of perception, that the color not be greatly modified by selective atmospheric attenuations and that the observer's color vision be adequate. There is also a risk of confusion of color at an extremely high level of eye illumination such as may be obtained from a high-intensity source at very close range. Experience indicates that satisfactory recognition can be achieved if due attention is given to these factors.

*The chromaticities are expressed in terms of the standard observer and coordinate system adopted by the International Commission on Illumination (CIE) at its Eighth Session at Cambridge, England, in 1931.**

2. Colors for aeronautical ground lights

2.1 Chromaticities

2.1.1 The chromaticities of aeronautical ground lights shall be within the following boundaries:

CIE Equations (see Figure A1-1):

a) Red		
	Purple boundary	y = 0.980 – x
	Yellow boundary	y = 0.335
b) Yellow		
	Red boundary	y = 0.382
	White boundary	y = 0.790 – 0.667x
	Green boundary	y = x – 0.120
c) Green		
	Yellow boundary	x = 0.360 – 0.080y
	White boundary	x = 0.650y
	Blue boundary	y = 0.390 – 0.171x
d) Blue		
	Green boundary	y = 0.805x + 0.065
	White boundary	y = 0.400 – x
	Purple boundary	x = 0.600y + 0.133
e) White		
	Yellow boundary	x = 0.500
	Blue boundary	x = 0.285
	Green boundary	y = 0.440 and y = 0.150 + 0.640x
	Purple boundary	y = 0.050 + 0.750x and y = 0.382
f) Variable white		
	Yellow boundary	x = 0.255 + 0.750y and x = 1.185 – 1.500 y
	Blue boundary	x = 0.285
	Green boundary	y = 0.440 and y = 0.150 + 0.640x
	Purple boundary	y = 0.050 + 0.750x and y = 0.382

Note – Guidance on chromaticity changes resulting from the effect of temperature on filtering elements is given in the Aerodrome Design Manual, Part 4.

2.1.2 Where dimming is not required, or where observers with defective color vision must be able to determine the color of the light, green signals shall be within the following boundaries:

Yellow boundary	y = 0.726 – 0.726x
White boundary	x = 0.650y
Blue boundary	y = 0.390 – 0.171x

2.1.3 Where increased certainty of recognition is more important than maximum visual range, green signals shall be within the following boundaries:

Yellow boundary	y = 0.726 – 0.726x
White boundary	x = 0.625y – 0.041
Blue boundary	y = 0.390 – 0.171x

2.2 Discrimination between lights

2.2.1 If there is a requirement to discriminate yellow and white from each other, they shall be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

2.2.2 If there is a requirement to discriminate yellow from green and/or white, as for example on exit taxiway centre line lights, the y coordinates of the yellow light shall not exceed a value of 0.40.

Note – The limits of white have been based on the assumption that they will be used in situations in which the characteristics (color temperature) of the light source will be substantially constant.

2.2.3 The color variable white is intended to be used only for lights that are to be varied in intensity, e.g. to avoid dazzling. If this color is to be discriminated from yellow, the lights shall be so designed and operated that:

a) the x coordinate of the yellow is at least 0.050 greater than the x coordinate of the white; and

b) the disposition of the lights will be such that the yellow lights are displayed simultaneously and in close proximity to the white lights.

2.2.4 The color of aeronautical ground lights shall be verified as being within the boundaries specified in Figure A1-1 by measurement at five points within the area limited by the innermost isocandela curve (isocandela diagrams in Appendix 2 refer), with operation at rated current or voltage. In the case of elliptical or circular isocandela curves, the color measurements shall be taken at the centre and at the horizontal and vertical limits. In the case of rectangular isocandela curves, the color measurements shall be taken at the centre and the limits of the diagonals (corners). In addition, the color of the light shall be checked at the outermost isocandela curve to ensure that there is no color shift that might cause signal confusion to the pilot.

Note 1 – For the outermost isocandela curve, a measurement of color coordinates shall be made and recorded for review and judgment of acceptability by the appropriate authority.

Note 2 – Certain light units may have application so that they may be viewed and used by pilots from directions beyond that of the outermost isocandela curve (e.g. stop bar lights at significantly wide runway-holding positions). In such instances, the appropriate authority shall assess the actual application and if necessary require a check of color shift at angular ranges beyond the outermost curve.

2.2.5 In the case of visual approach slope indicators and other light units having a color transition sector, the color shall be measured at points in accordance with 2.2.4, except that the color areas shall be treated separately and no point shall be within 0.5 degrees of the transition sector.

3. Colors for markings, signs and panels

Note 1 – The specifications of surface colors given below apply only to freshly colored surfaces. Colors used for markings, signs and panels usually change with time and therefore require renewal.
Note 2 – Guidance on surface colors is contained in the CIE document entitled Recommendations for Surface Colors for Visual Signaling – Publication No. 39-2 (TC-106) 1983.

Note 3 – The specifications recommended in 3.4 below for trans-illuminated panels are interim in nature and are based on the CIE specifications for trans-illuminated signs. It is intended that these specifications will be reviewed and updated as and when CIE develops specifications for trans-illuminated panels.

3.1 The chromaticities and luminance factors of ordinary colors, colors of retro-reflective materials and colors of trans-illuminated (internally illuminated) signs and panels shall be determined under the following standard conditions:
a) angle of illumination: 45°;
b) direction of view: perpendicular to surface; and
c) illuminant: CIE standard illuminant D65.

3.2 The chromaticity and luminance factors of ordinary colors for markings and externally illuminated signs and panels shall be within the following boundaries when determined under standard conditions.

CIE Equations (see Figure A1-2):

a) Red		
	Purple boundary	y = 0.345 – 0.051x
	White boundary	y = 0.910 – x
	Orange boundary	y = 0.314 + 0.047x
	Luminance factor	ß = 0.07 (mnm)
b) Orange		
	Red boundary	y = 0.285 + 0.100x
	White boundary	y = 0.940 – x
	Yellow boundary	y = 0.250 + 0.220x
	Luminance factor	ß = 0.20 (mnm)
c) Yellow		
	Orange boundary	y = 0.108 + 0.707x
	White boundary	y = 0.910 – x
	Green boundary	y = 1.35x – 0.093
	Luminance factor	ß = 0.45 (mnm)
d) White		
	Purple boundary	y = 0.010 + x
	Blue boundary	y = 0.610 – x
	Green boundary	y = 0.030 + x
	Yellow boundary	y = 0.710 – x
	Luminance factor	ß = 0.75 (mnm)
e) Black		
	Purple boundary	y = x – 0.030
	Blue boundary	y = 0.570 – x
	Green boundary	y = 0.050 + x
	Yellow boundary	y = 0.740 – x
	Luminance factor	ß = 0.03 (max)
f) Yellowish green		
	Green boundary	y = 1.317x + 0.4
	White boundary	y = 0.910 – x
	Yellow boundary	y = 0.867x + 0.4

Note – The small separation between surface red and surface orange is not sufficient to ensure the distinction of these colors when seen separately.

3.3 The chromaticity and luminance factors of colors of retro-reflective materials for markings, signs and panels shall be within the following boundaries when determined under standard conditions.

CIE Equations (see Figure A1-3):

a) Red		
	Purple boundary	y = 0.345 – 0.051x
	White boundary	y = 0.910 – x
	Orange boundary	y = 0.314 + 0.047x
	Luminance factor	ß = 0.03 (mnm)
b) Orange		
	Red boundary	y = 0.265 + 0.205x
	White boundary	y = 0.910 – x
	Yellow boundary	y = 0.207 + 0.390x
	Luminance factor	ß = 0.14 (mnm)
c) Yellow		
	Orange boundary	y = 0.160 + 0.540x
	White boundary	y = 0.910 – x
	Green boundary	y = 1.35x – 0.093
	Luminance factor	ß = 0.16 (mnm)
d) White		
	Purple boundary	y = x
	Blue boundary	y = 0.610 – x
	Green boundary	y = 0.040 + x
	Yellow boundary	y = 0.710 – x
	Luminance factor	ß = 0.27 (mnm)
e) Blue		
	Green boundary	y = 0.118 + 0.675x
	White boundary	y = 0.370 – x
	Purple boundary	y = 1.65x – 0.187
	Luminance factor	ß = 0.01 (mnm)
f)	Green	
	Yellow boundary	y = 0.711 – 1.22x
	White boundary	y = 0.243 + 0.670x
	Blue boundary	y = 0.405 – 0.243x
	Luminance factor	ß = 0.03 (mnm)

3.4 The chromaticity and luminance factors of colors for trans-illuminated (internally illuminated) signs and panels shall be within the following boundaries when determined under standard conditions.

CIE Equations (see Figure A1-4):

a) Red		
	Purple boundary	y = 0.345 – 0.051x
	White boundary	y = 0.910 – x
	Orange boundary	y = 0.314 + 0.047x
	Luminance factor (day condition)	ß = 0.07 (mnm)
	Relative luminance	5% (mnm)
	To white (night condition)	20% (max)
b) Yellow		
	Orange boundary	y = 0.108 + 0.707x
	White boundary	y = 0.910 – x
	Green boundary	y = 1.35x – 0.093
	Luminance factor (day condition)	ß = 0.45 (mnm)
	Relative luminance	30% (mnm)
	to white (night condition)	80% (max)

c) White		
	Purple boundary	y = 0.010 + x
	Blue boundary	y = 0.610 – x
	Green boundary	y = 0.030 + x
	Yellow boundary	y = 0.710 – x
	Luminance factor (day condition)	ß = 0.75 (mnm)
	Relative luminance to white (night condition)	100%
d) Black		
	Purple boundary	y = x – 0.030
	Blue boundary	y = 0.570 – x
	Green boundary	y = 0.050 + x
	Yellow boundary	y = 0.740 – x
	Luminance factor (day condition)	ß = 0.03 (max)
	Relative luminance to white (night condition)	0% (mnm) 2% (max)

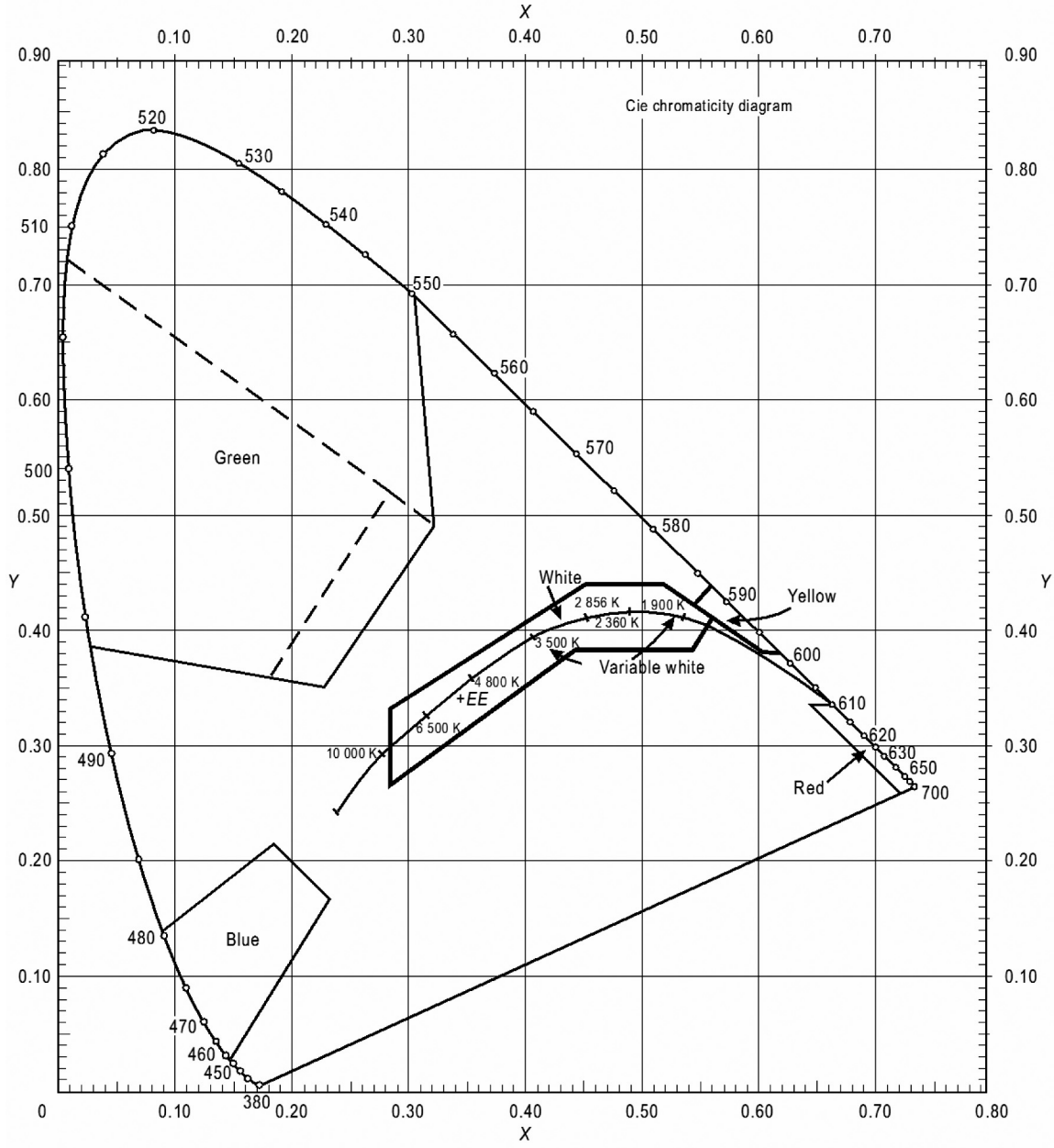


Figure A1-1. Colours for aeronautical ground lights

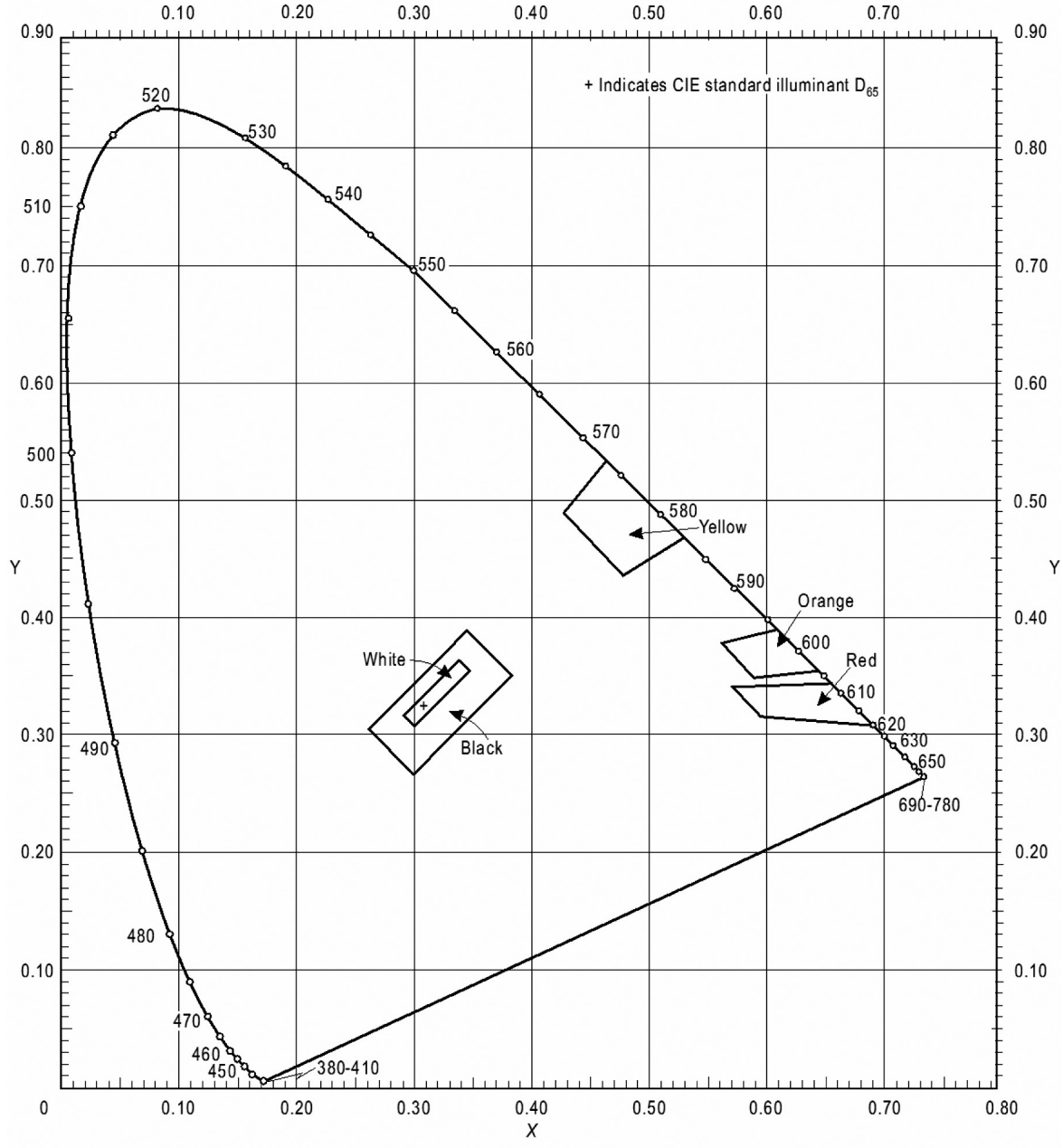


Figure A1-2. Ordinary colours for markings and externally illuminated signs and panels

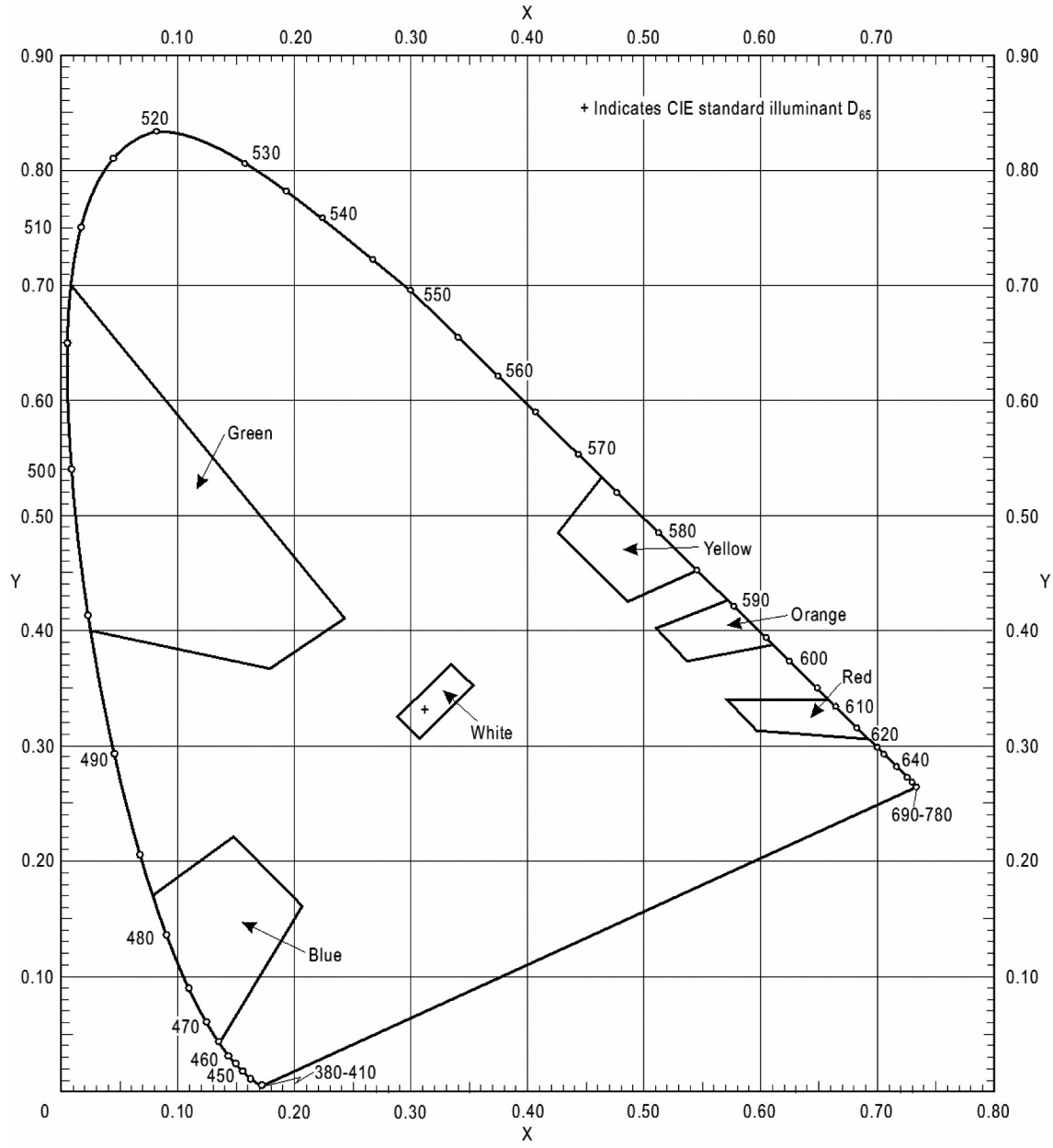


Figure A1-3. Colours of retro-reflective materials for markings, signs and panels

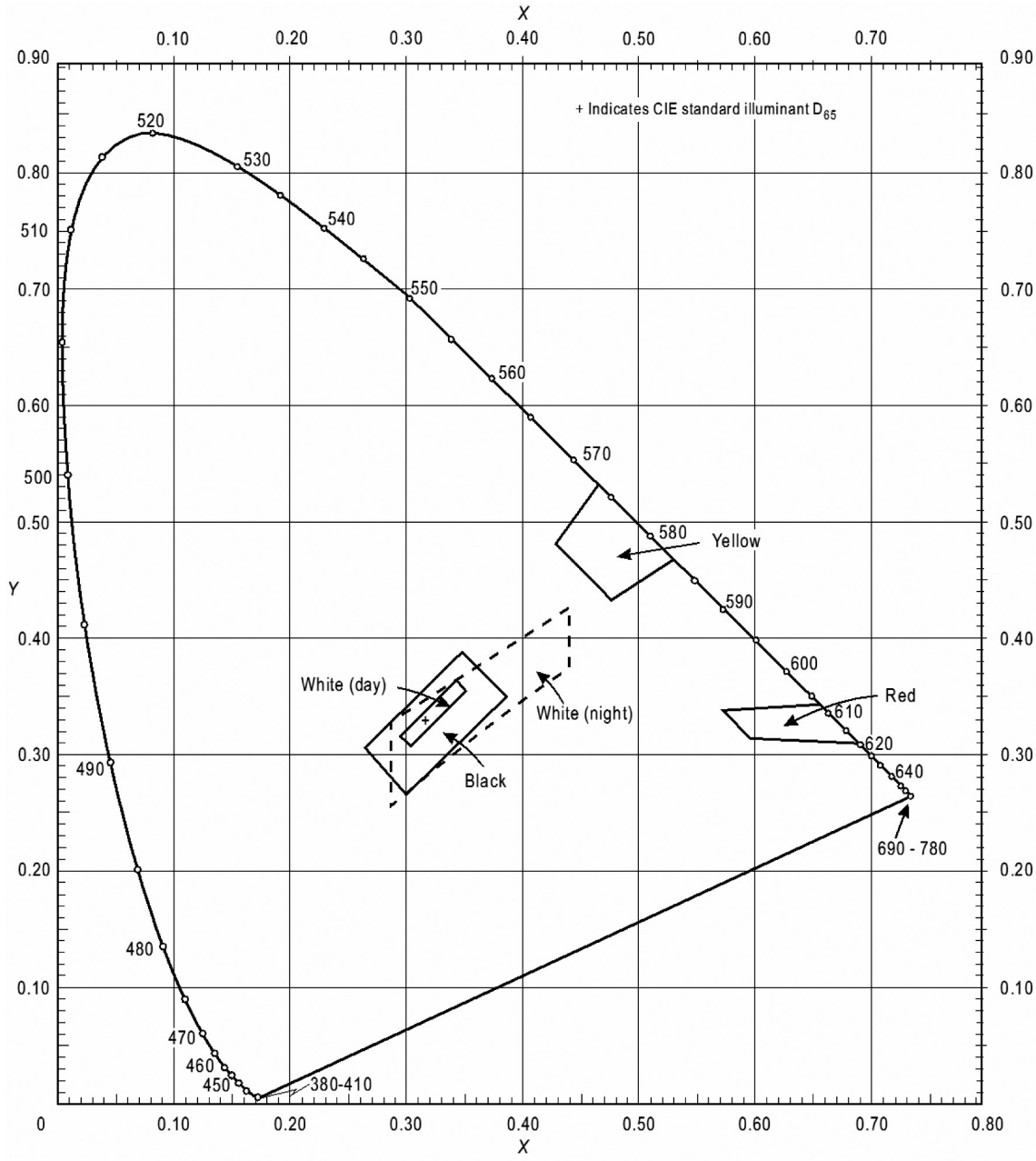
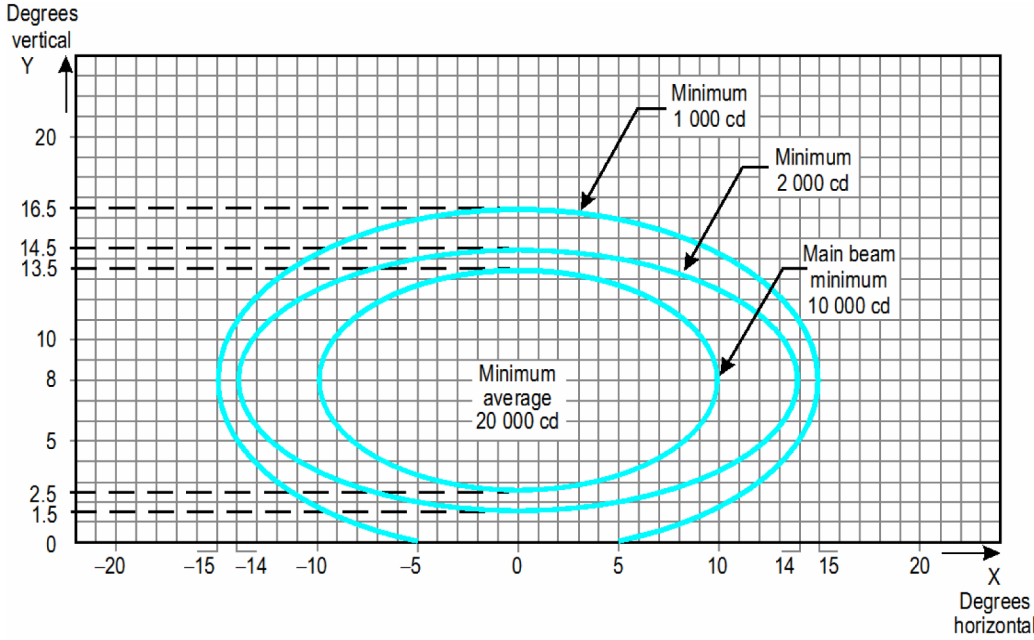


Figure A1-4. Colours of transilluminated (internally illuminated) signs and panels



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	10	14	15
b	5.5	6.5	8.5

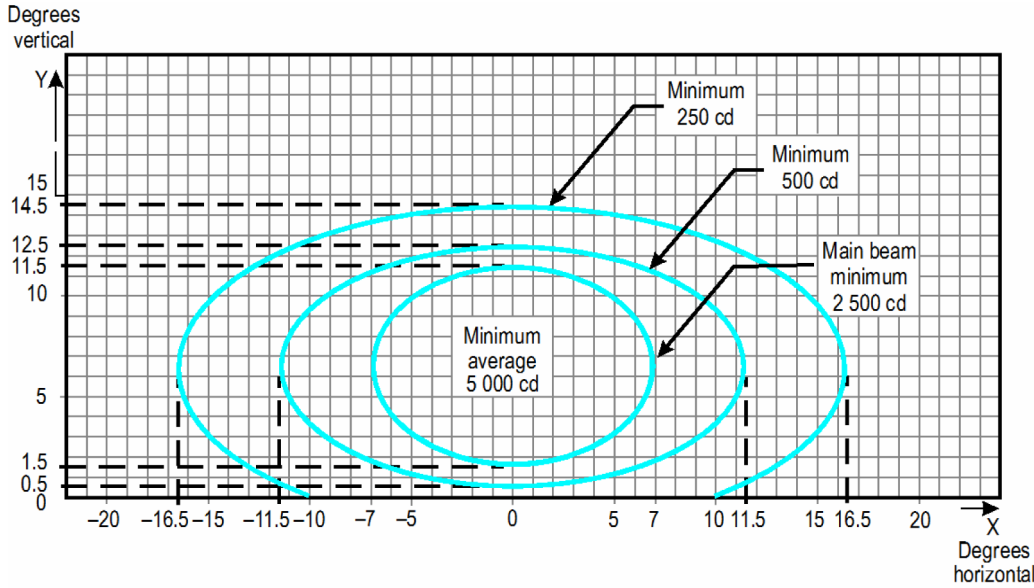
2. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 315 m	0° — 11°
316 m to 475 m	0.5° — 11.5°
476 m to 640 m	1.5° — 12.5°
641 m and beyond	2.5° — 13.5° (as illustrated above)

3. Lights in crossbars beyond 22.5 m from the centre line shall be toed-in 2 degrees. All other lights shall be aligned parallel to the centre line of the runway.

4. See collective notes for Figures A2-1 to A2-11.

Figure A2-1. Isocandela diagram for approach centre line light and crossbars (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

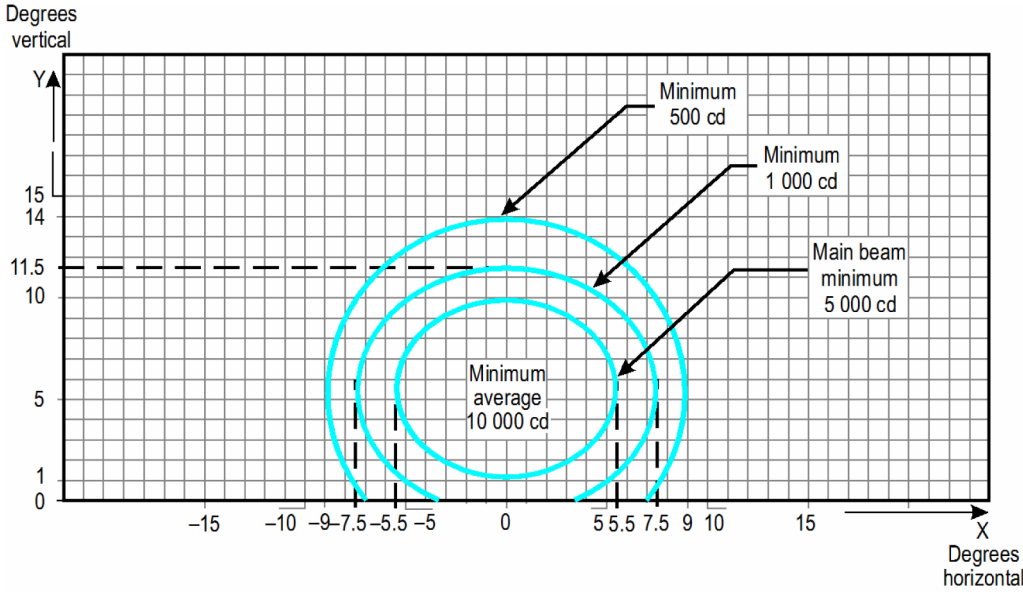
2. Toe-in 2 degrees

3. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 115 m	0.5° — 10.5°
116 m to 215 m	1° — 11°
216 m and beyond	1.5° — 11.5° (as illustrated above)

4. See collective notes for Figures A2-1 to A2-11.

Figure A2-2. Isocandela diagram for approach side row light (red light)



Notes:

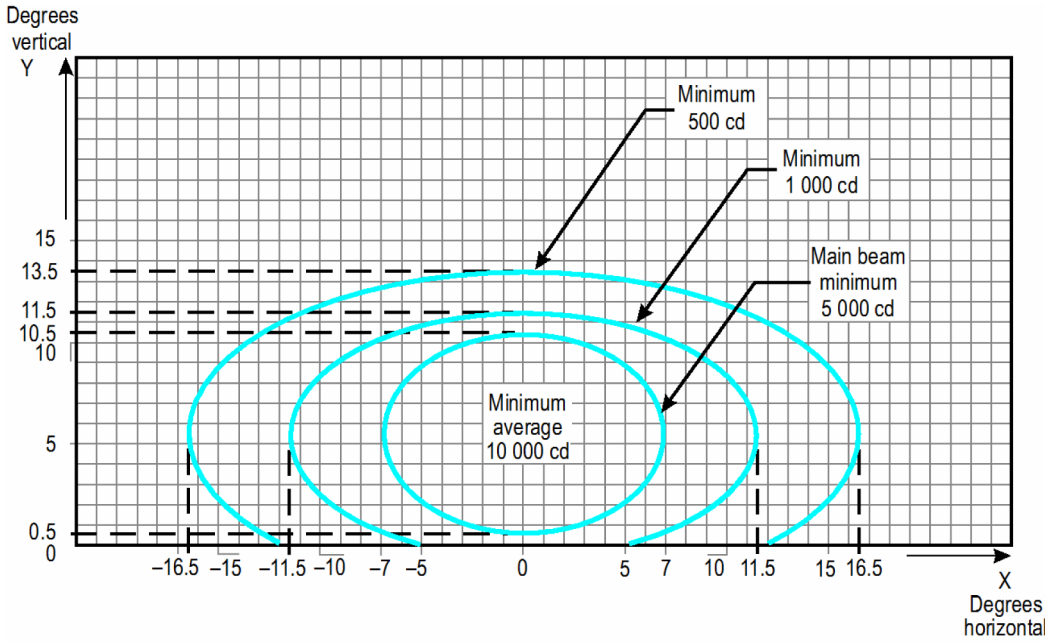
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	4.5	6.0	8.5

2. Toe-in 3.5 degrees

3. See collective notes for Figures A2-1 to A2-11.

Figure A2-3. Isocandela diagram for threshold light (green light)



Notes:

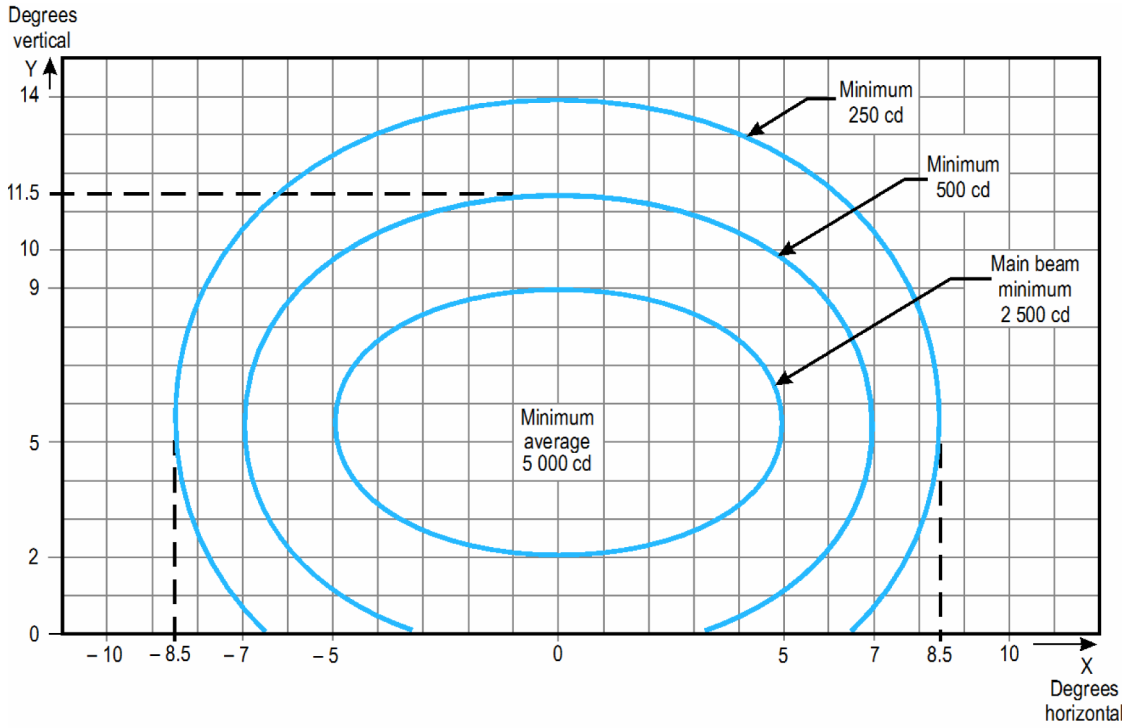
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

2. Toe-in 2 degrees

3. See collective notes for Figures A2-1 to A2-11.

Figure A2-4. Isocandela diagram for threshold wing bar light (green light)



Notes:

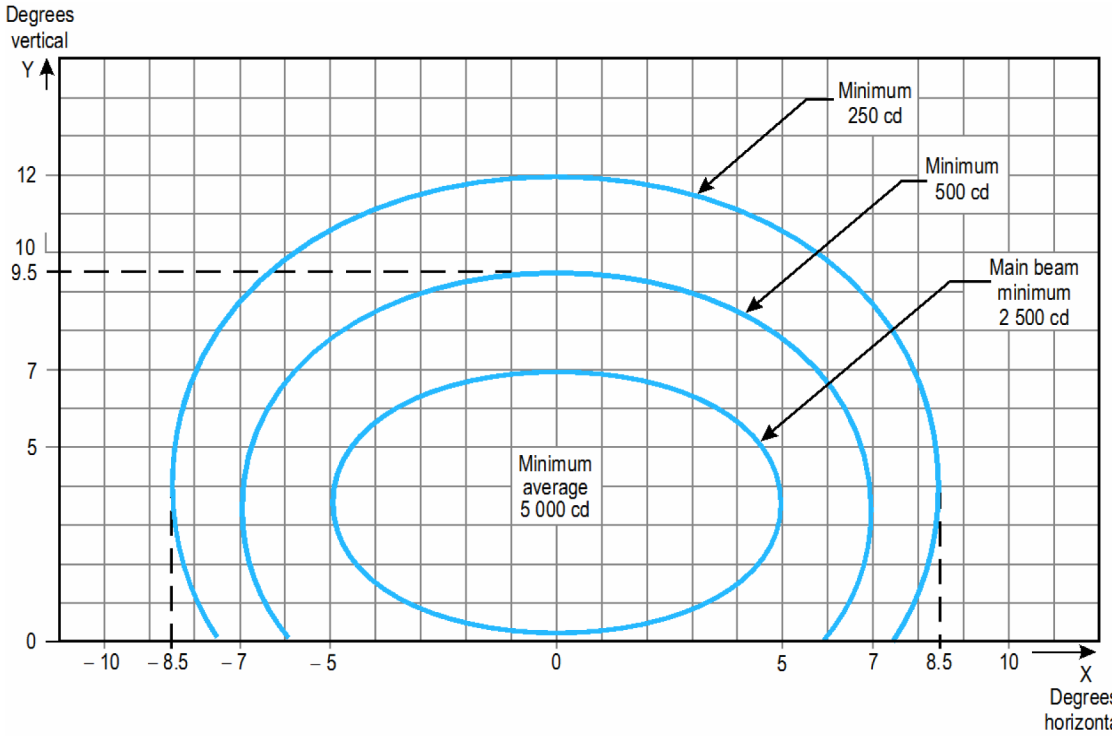
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Toe-in 4 degrees

3. See collective notes for Figures A2-1 to A2-11.

Figure A2-5. Isocandela diagram for touchdown zone light (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

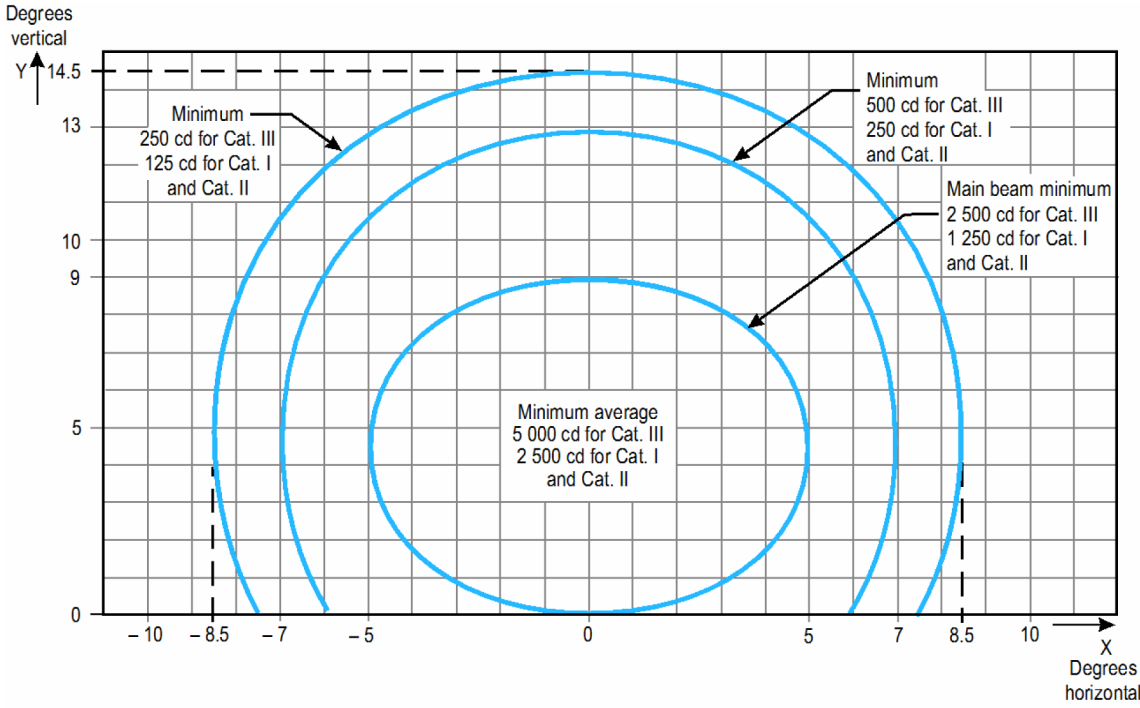
a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures A2-1 to A2-11.

Figure A2-6. Isocandela diagram for runway centre line light with 30 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

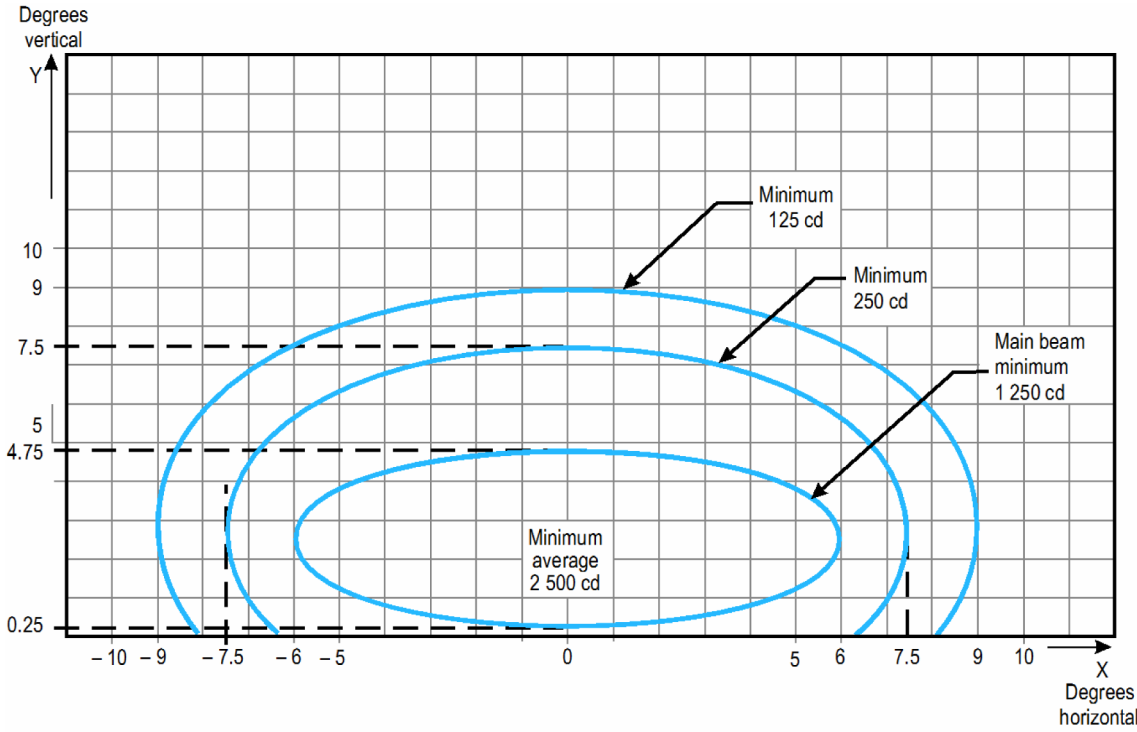
a	5.0	7.0	8.5
b	4.5	8.5	10

2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures A2-1 to A2-11.

Figure A2-7. Isocandela diagram for runway centre line light with 15 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)



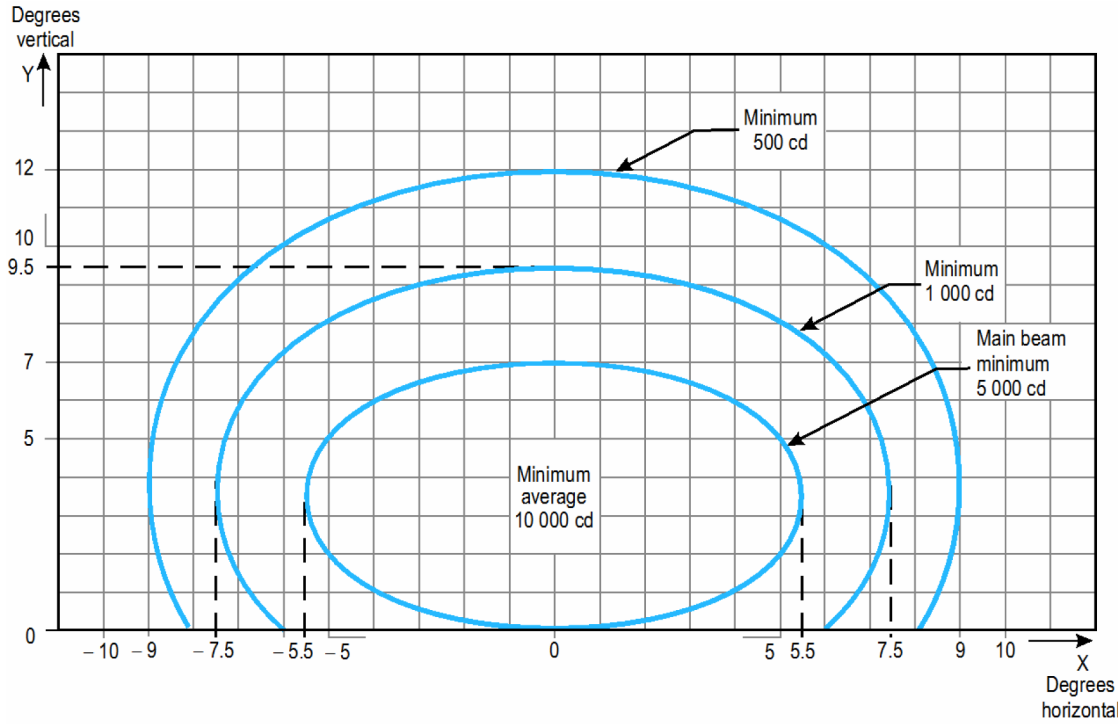
Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. See collective notes for Figures A2-1 to A2-11.

Figure A2-8. Isocandela diagram for runway end light (red light)



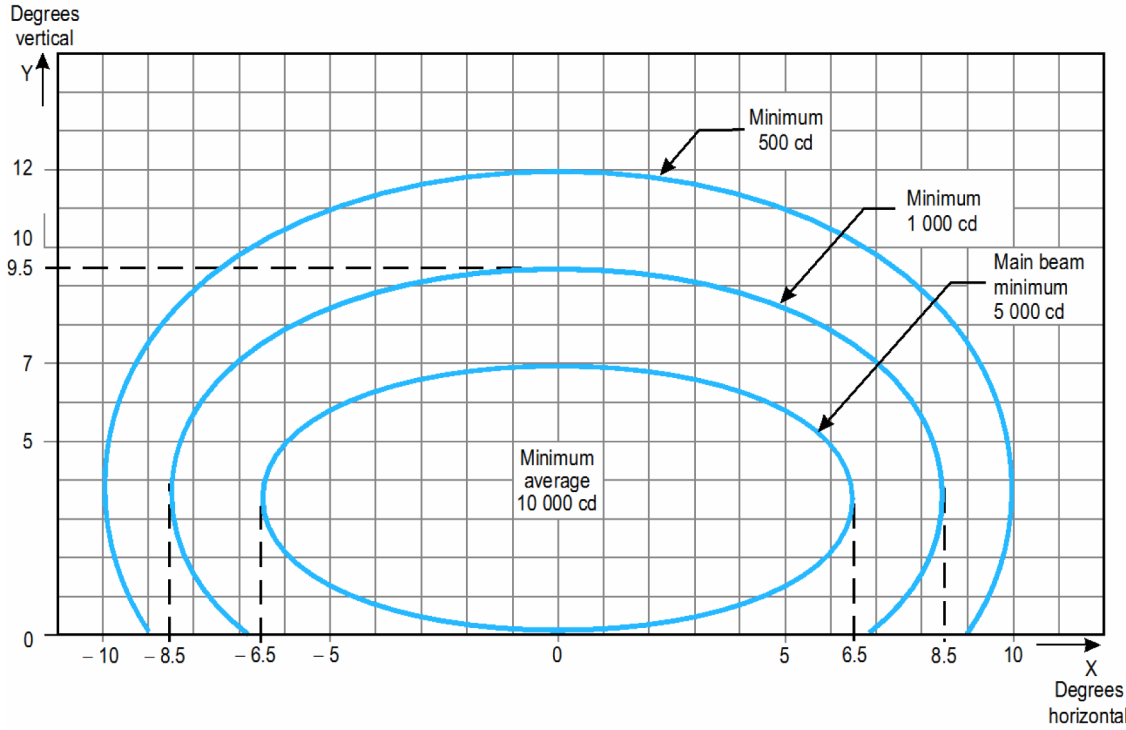
Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	3.5	6.0	8.5

2. Toe-in 3.5 degrees
3. For yellow light, multiply values by 0.40.
4. See collective notes for Figures A2-1 to A2-11.

Figure A2-9. Isocandela diagram for runway edge light where width of runway is 45 m (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Toe-in 4.5 degrees
3. For yellow light, multiply values by 0.40.
4. See collective notes for Figures A2-1 to A2-11.

Figure A2-10. Isocandela diagram for runway edge light where width of runway is 60 m (white light)

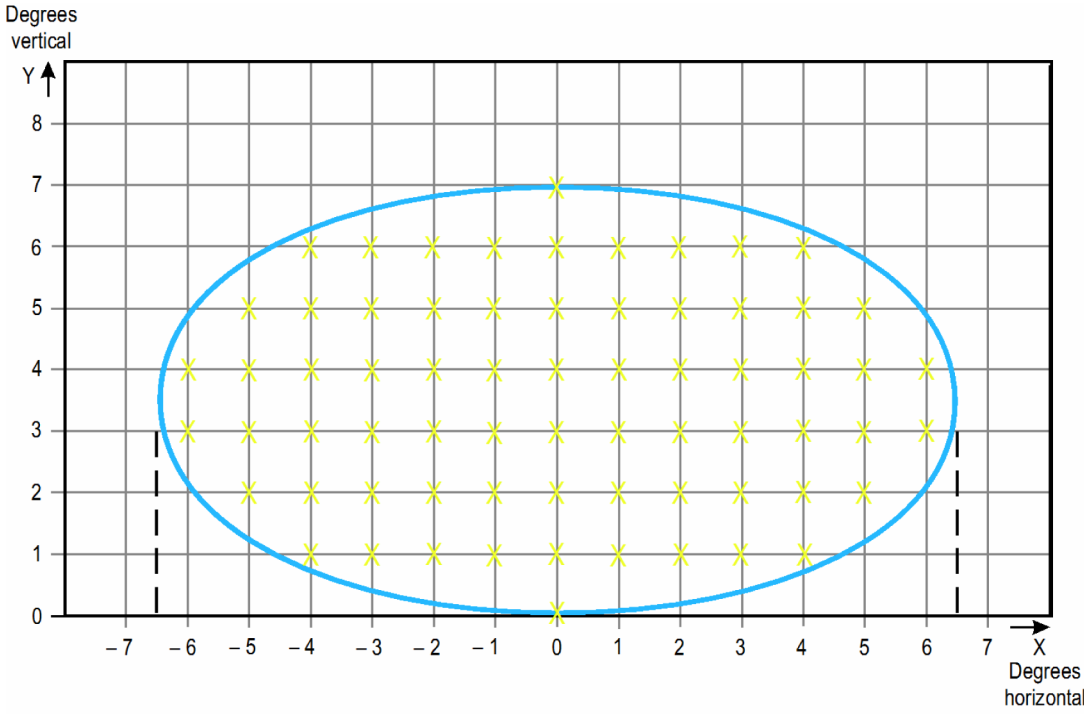


Figure A2-11. Grid points to be used for the calculation of average intensity of approach and runway lights

Collective notes to Figures A2-1 to A2-11

1. The ellipses in each figure are symmetrical about the common vertical and horizontal axes.

2. Figures A2-1 to A2-10 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure A2-11 and using the intensity values measures at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

3. No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.

4. Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average light intensity of the main beam of a new runway edge light shall be as follows:

Figure A2-1	Approach centre line and crossbars	1.5 to 2.0 (white light)
Figure A2-2	Approach side row	0.5 to 1.0 (red light)
Figure A2-3	Threshold	1.0 to 1.5 (green light)
Figure A2-4	Threshold wing bar	1.0 to 1.5 (green light)
Figure A2-5	Touchdown zone	0.5 to 1.0 (white light)
Figure A2-6	Runway centre line (longitudinal spacing 30 m)	0.5 to 1.0 (white light)

Figure A2-7	Runway centre line (longitudinal spacing 15 m)	0.5 to 1.0 for CAT III (white light) 0.25 to 0.5 for CAT I, II (white light)
Figure A2-8	Runway end	0.25 to 0.5 (red light)
Figure A2-9	Runway edge (45 m runway width)	1.0 (white light)
Figure A2-10	Runway edge (60 m runway width)	1.0 (white light)

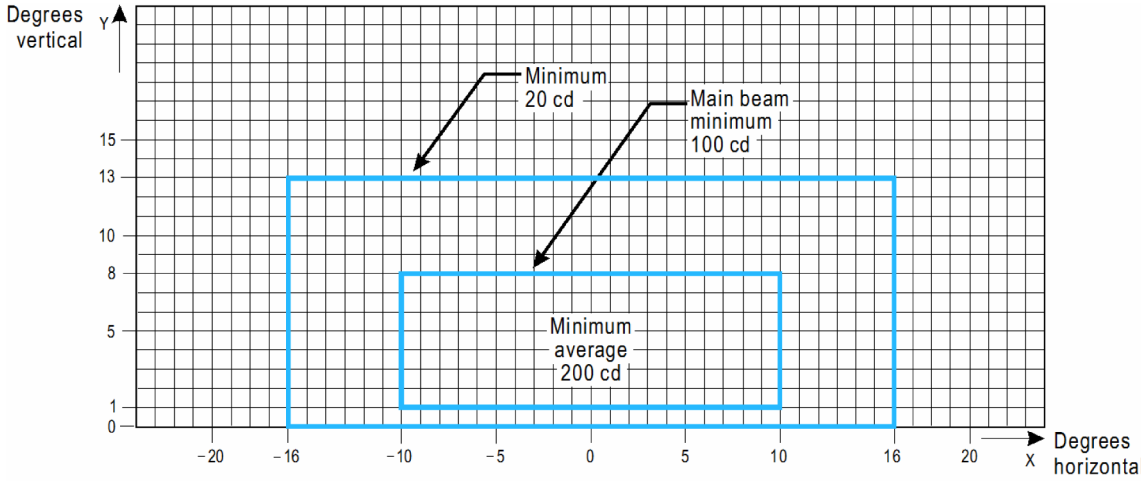
5. The beam coverage in the figures provide the necessary guidance for approaches down to an RVR of the order of 150 m and take-offs down to an RVR of the order of 100 m.

6. Horizontal angles are measured with respect to the vertical plane through the runway centre line. For lights other than centre line lights, the direction towards the runway centre line is considered positive. Vertical angles are measured with respect to the horizontal plane.

7. Where, for approach centre line lights and crossbars and for approach side row lights, inset lights are used in lieu of elevated lights, e.g. on a runway with a displaced threshold, the intensity requirements can be met by installing two or three fittings (lower intensity) at each position.

8. The importance of adequate maintenance cannot be over-emphasized. The average intensity shall never fall to a value less than 50 per cent of the value shown in the figures and it shall be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.

9. The light unit shall be installed so that the main beam is aligned within one-half degree of the specified requirement.



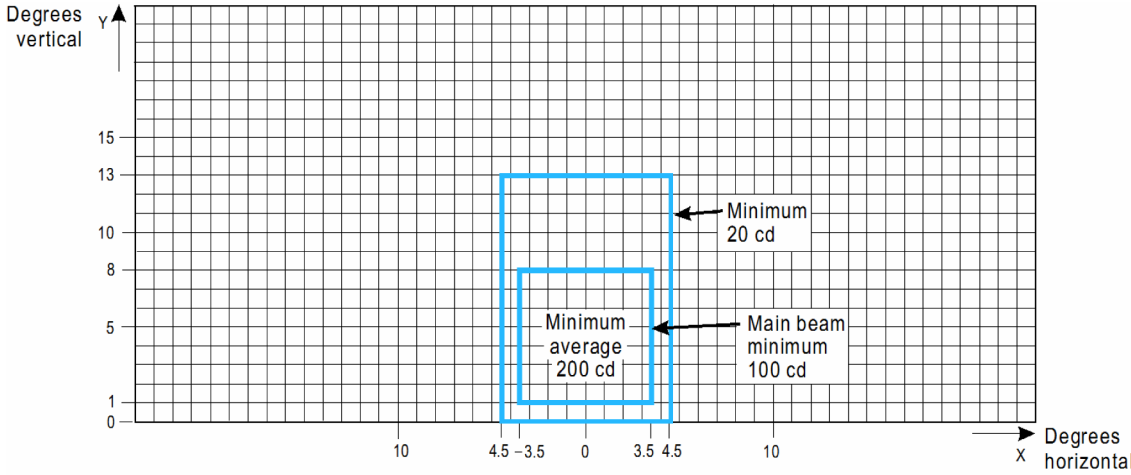
Notes:

1. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m and are intended for use before and after curves.

2. See collective notes for Figures A2-12 to A2-21.

3. Increased intensities for enhanced rapid exit taxiway centre line lights as recommended in 5.3.16.9 are four times the respective intensities in the figure (i.e. 800 cd for minimum average main beam).

Figure A2-12. Isocandela diagram for taxiway centre line (15 m spacing) and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m where large offsets can occur and for low-intensity runway guard lights, Configuration B

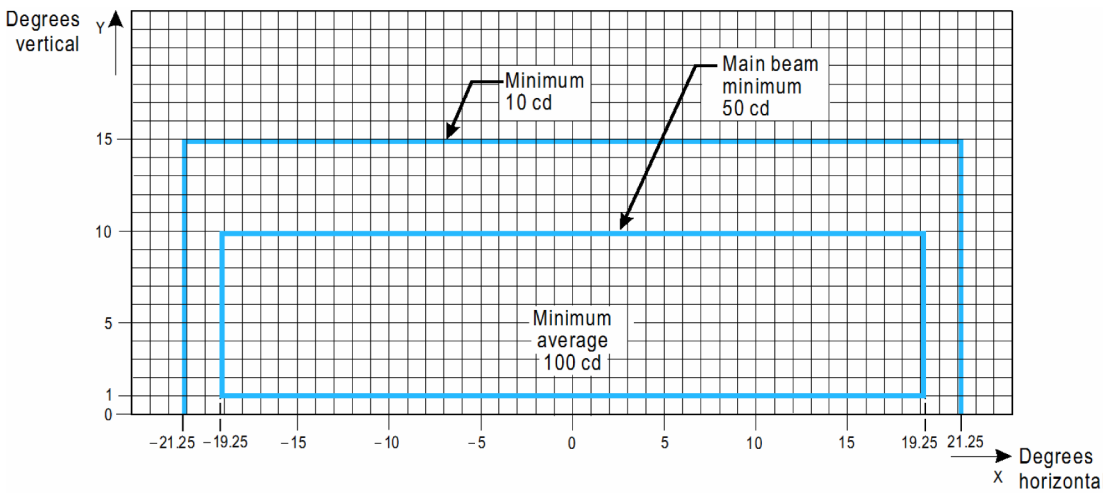


Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit from the centre line of approximately 3 m.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-13. Isocandela diagram for taxiway centre line (15 m spacing) and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m

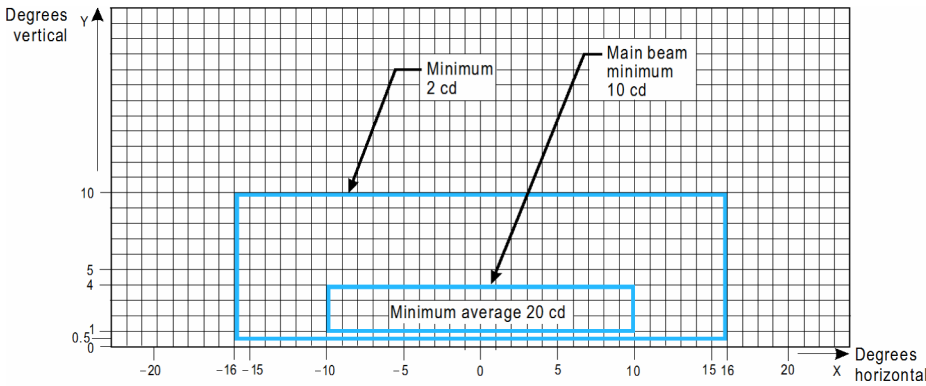


Notes:

1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.

2. See collective notes for Figures A2-12 to A2-21.

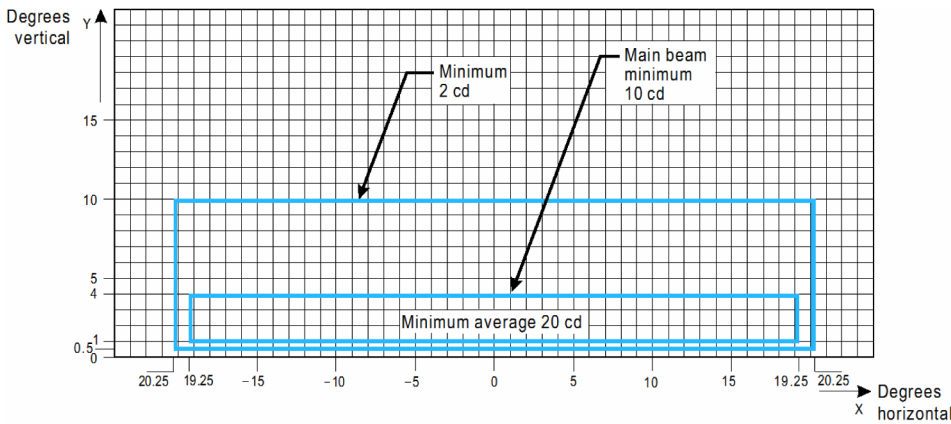
Figure A2-14. Isocandela diagram for taxiway centre line (7.5 m spacing) and stop bar lights in curved sections intended for use in runway visual range conditions of less than a value of 350 m



Notes:

1. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5.
2. Where omnidirectional lights are used they shall comply with the vertical beam requirements in this figure.
3. See collective notes for Figures A2-12 to A2-21.

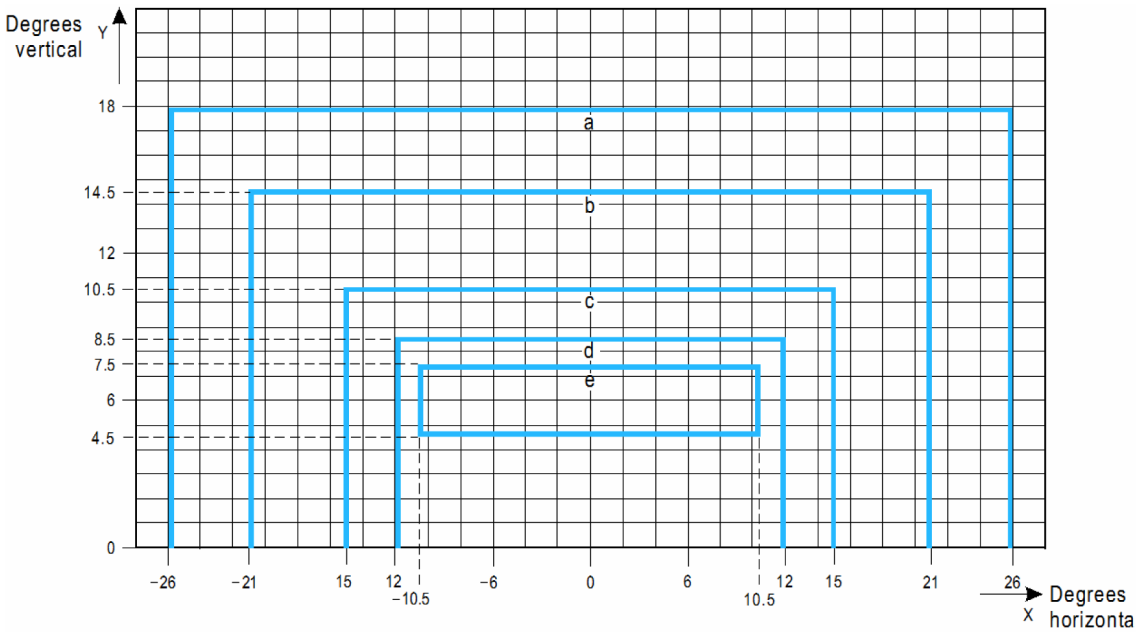
Figure A2-15. Isocandela diagram for taxiway centre line (30 m, 60 m spacing) and stop bar lights in straight sections intended for use in runway visual range conditions of 350 m or greater



Notes:

1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.
2. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5.
3. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m as could occur at the end of curves.
4. See collective notes for Figures A2-12 to A2-21.

Figure A2-16. Isocandela diagram for taxiway centre line (7.5 m, 15 m, 30 m spacing) and stop bar lights in curved sections intended for use in runway visual range conditions of 350 m or greater



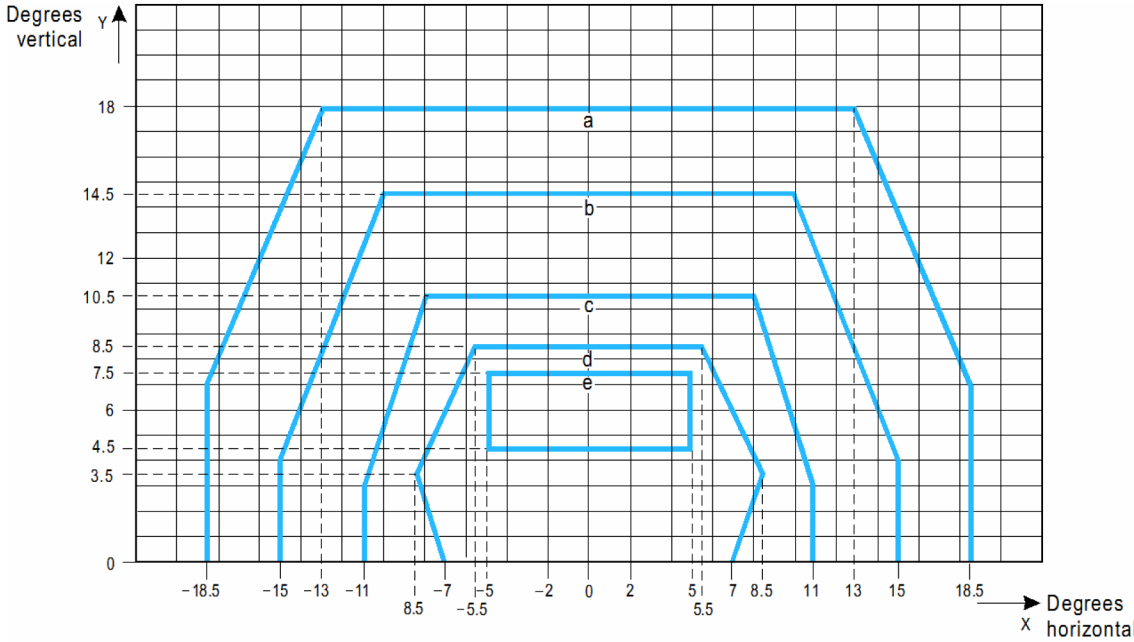
Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Notes:

1. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m and are intended for use before and after curves.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-17. Isocandela diagram for high-intensity taxiway centre line (15 m spacing) and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required and where large offsets can occur



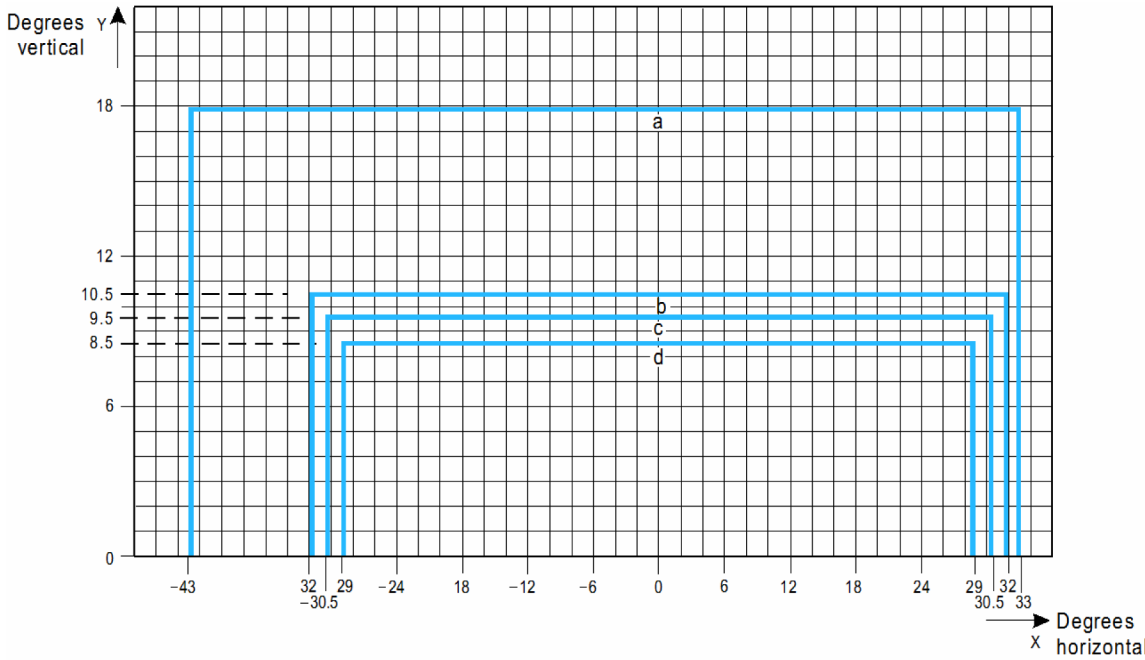
Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit corresponding to the outer main gear wheel on the taxiway edge.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-18. Isocandela diagram for high-intensity taxiway centre line (15 m spacing) and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required

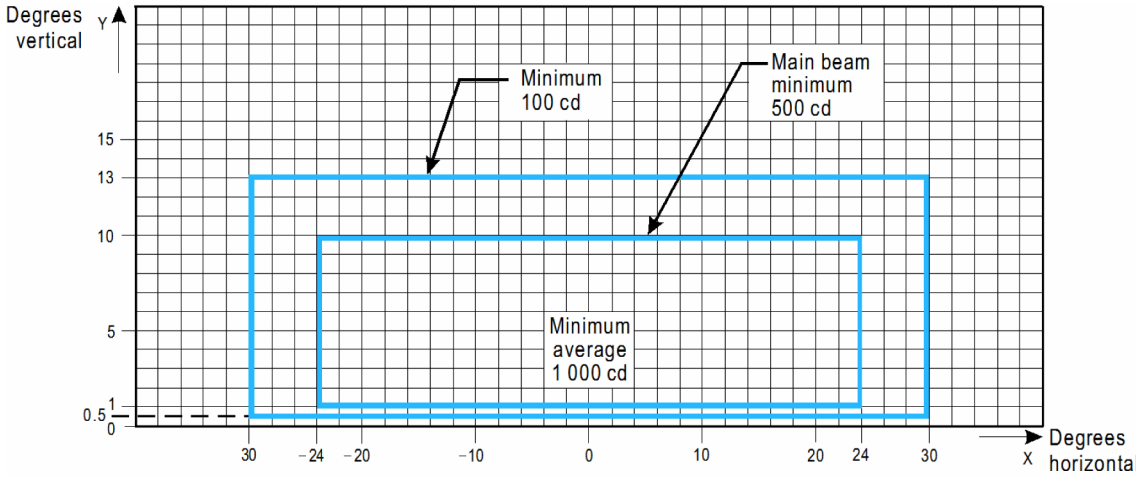


Curve	a	b	c	d
Intensity (cd)	8	100	200	400

Notes:

1. Lights on curves to be toed-in 17 degrees with respect to the tangent of the curve.
2. See collective notes for Figures A2-12 to A2-21.

Figure A2-19. Isocandela diagram for high-intensity taxiway centre line (7.5 m spacing) and stop bar lights in curved sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required



Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-20. Isocandela diagram for high-intensity runway guard lights, Configuration B

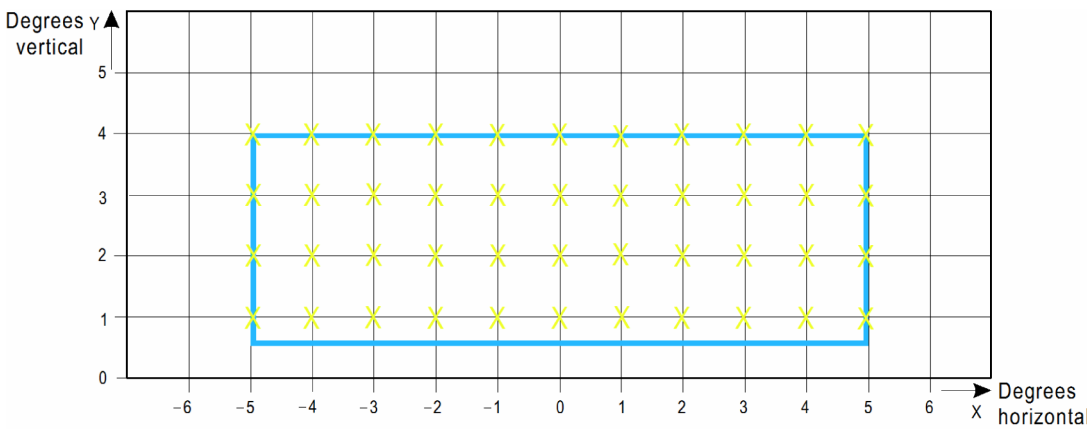


Figure A2-21. Grid points to be used for calculation of average intensity of taxiway centre line and stop bar lights

Collective notes to Figures A2-12 to A2-21

1. The intensities specified in Figures A2-12 to A2-20 are in green and yellow light for taxiway centre line lights, yellow light for runway guard lights and red light for stop bar lights.

2. Figures A2-12 to A2-20 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure A2-21 and using the intensity values measured

at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of the light intensities measured at all considered grid points.

3. No deviations are acceptable in the main beam or in the innermost beam, as applicable, when the lighting fixture is properly aimed.

4. Horizontal angles are measured with respect to the vertical plane through the taxiway centre line except on curves where they are measured with respect to the tangent to the curve.

5. Vertical angles are measured from the longitudinal slope of the taxiway surface.

6. The importance of adequate maintenance cannot be over-emphasized. The intensity, either average where applicable or as specified on the corresponding isocandela curves, shall never fall to a value less than 50 per cent of the value shown in the figures, and it shall be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.

7. The light unit shall be installed so that the main beam or the innermost beam, as applicable, is aligned within one-half degree of the specified requirement.

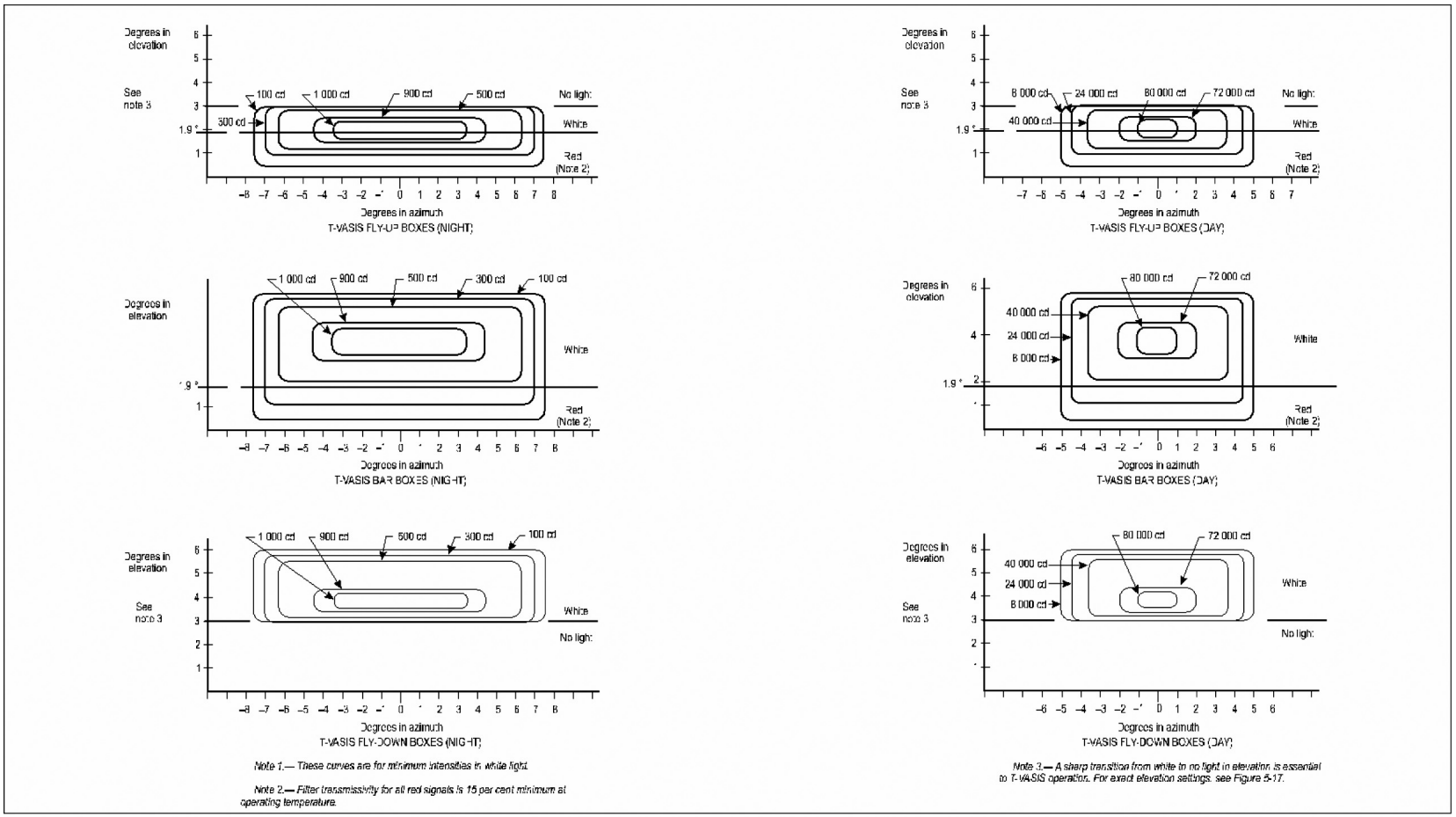
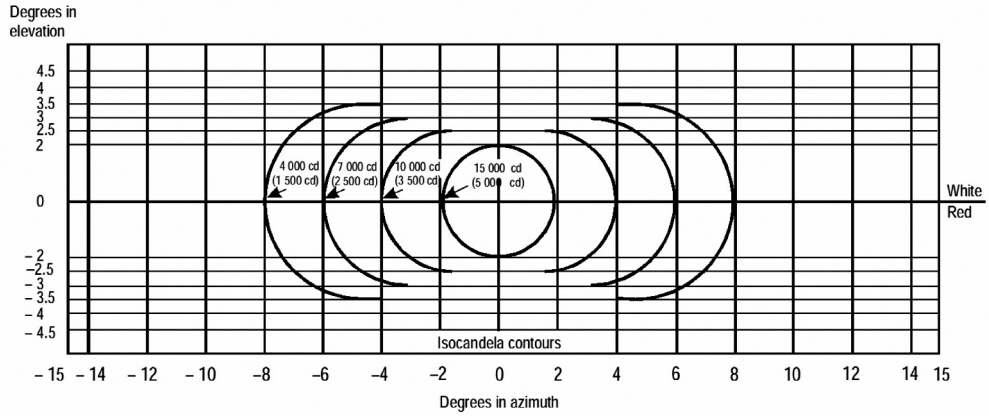


Figure A2-22. Light intensity distribution of T-VASIS and AT-VASIS

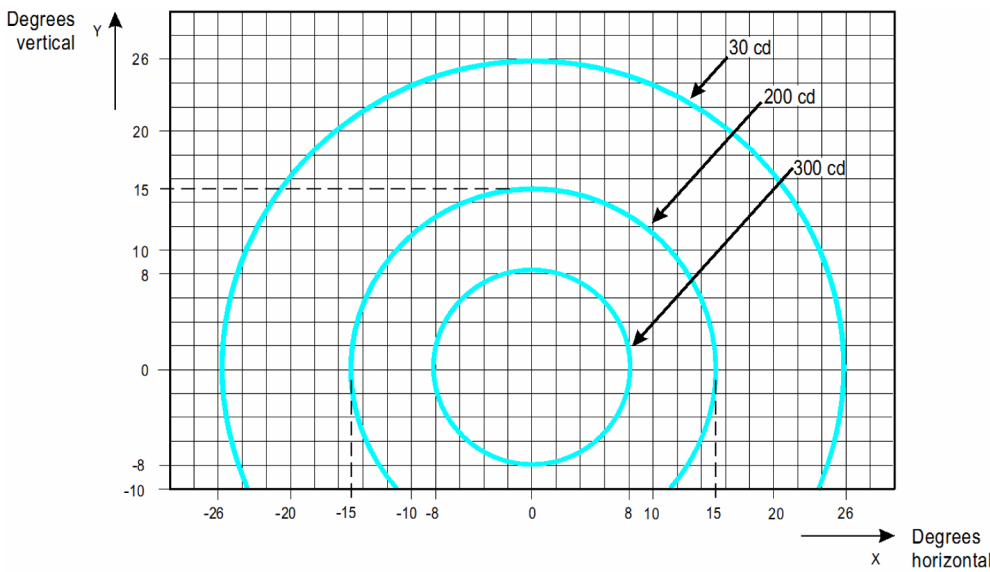


Note 1.— These curves are for minimum intensities in red light.

Note 2.— The intensity value in the white sector of the beam is no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.

Note 3.— The intensity values shown in brackets are for APAPI.

Figure A2-23. Light intensity distribution of PAPI and APAPI

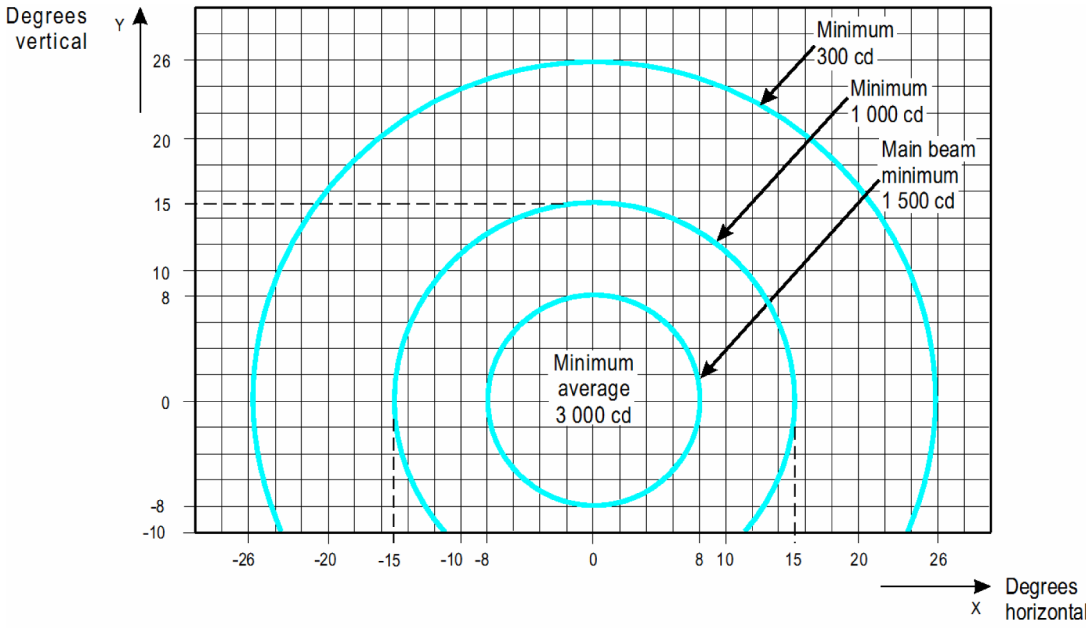


Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. The intensities specified are in yellow light.

Figure A2-24. Isocandela diagram for each light in low-intensity runway guard lights, Configuration A



Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

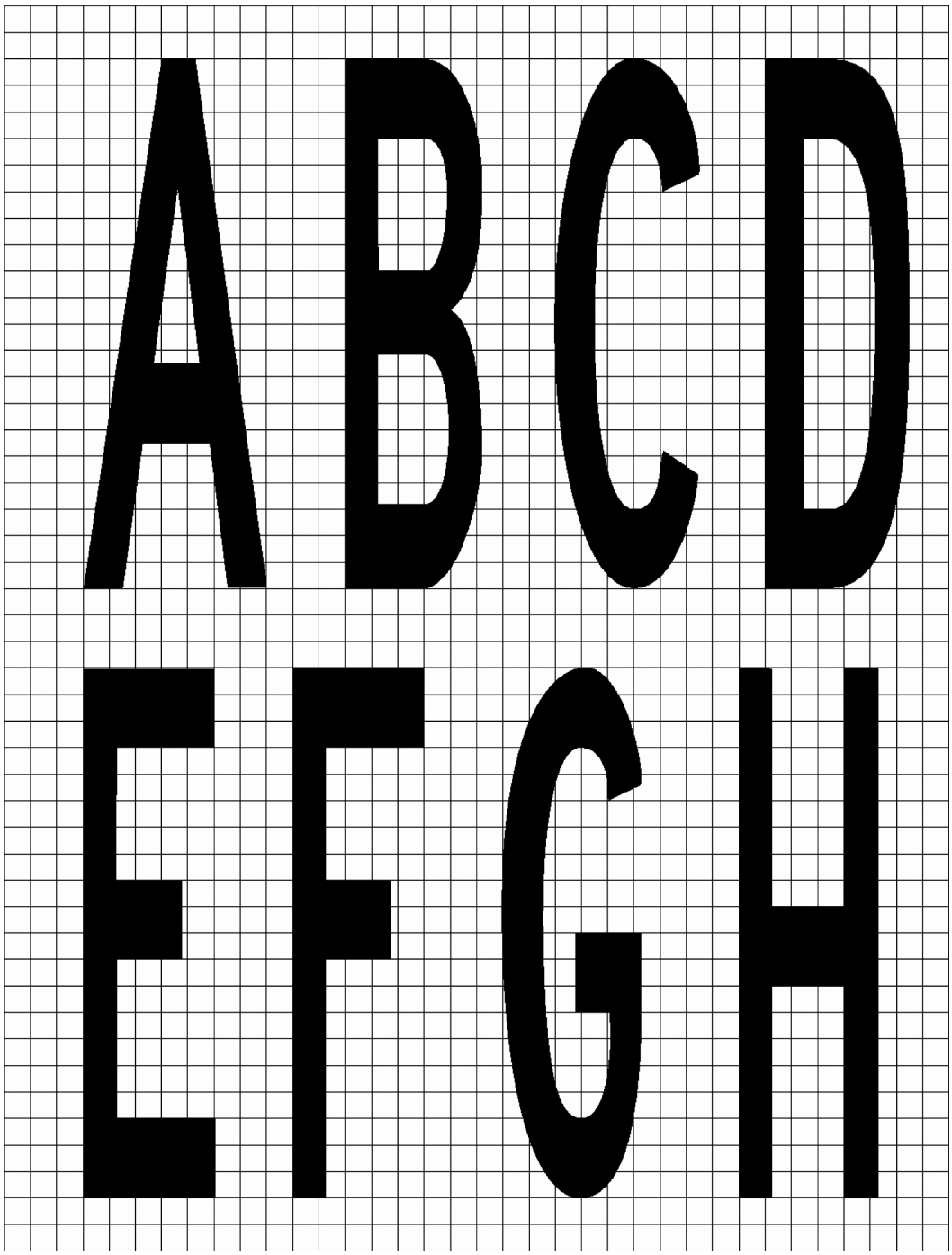
2. The intensities specified are in yellow light.

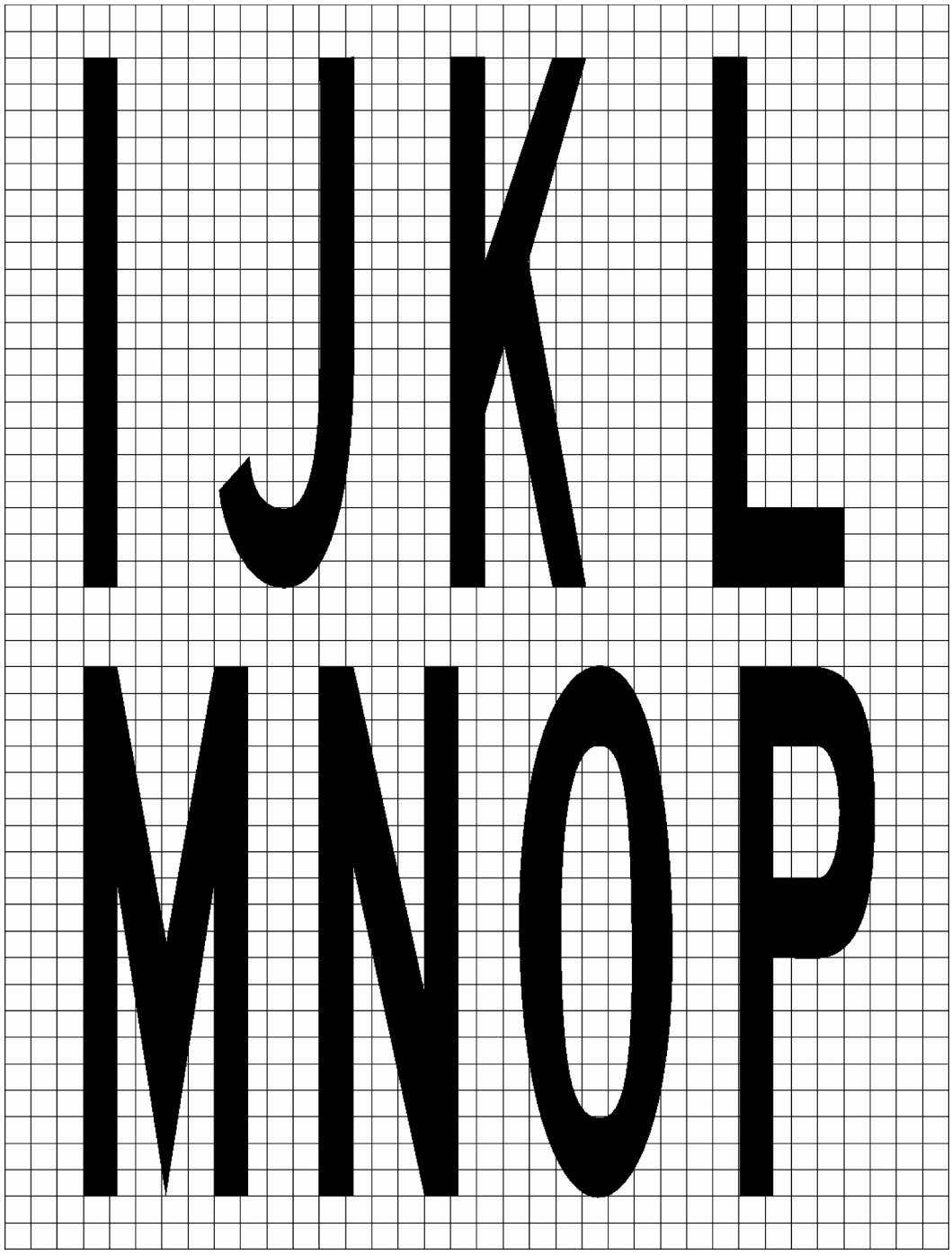
Figure A2-25. Isocandela diagram for each light in high-intensity runway guard lights, Configuration A

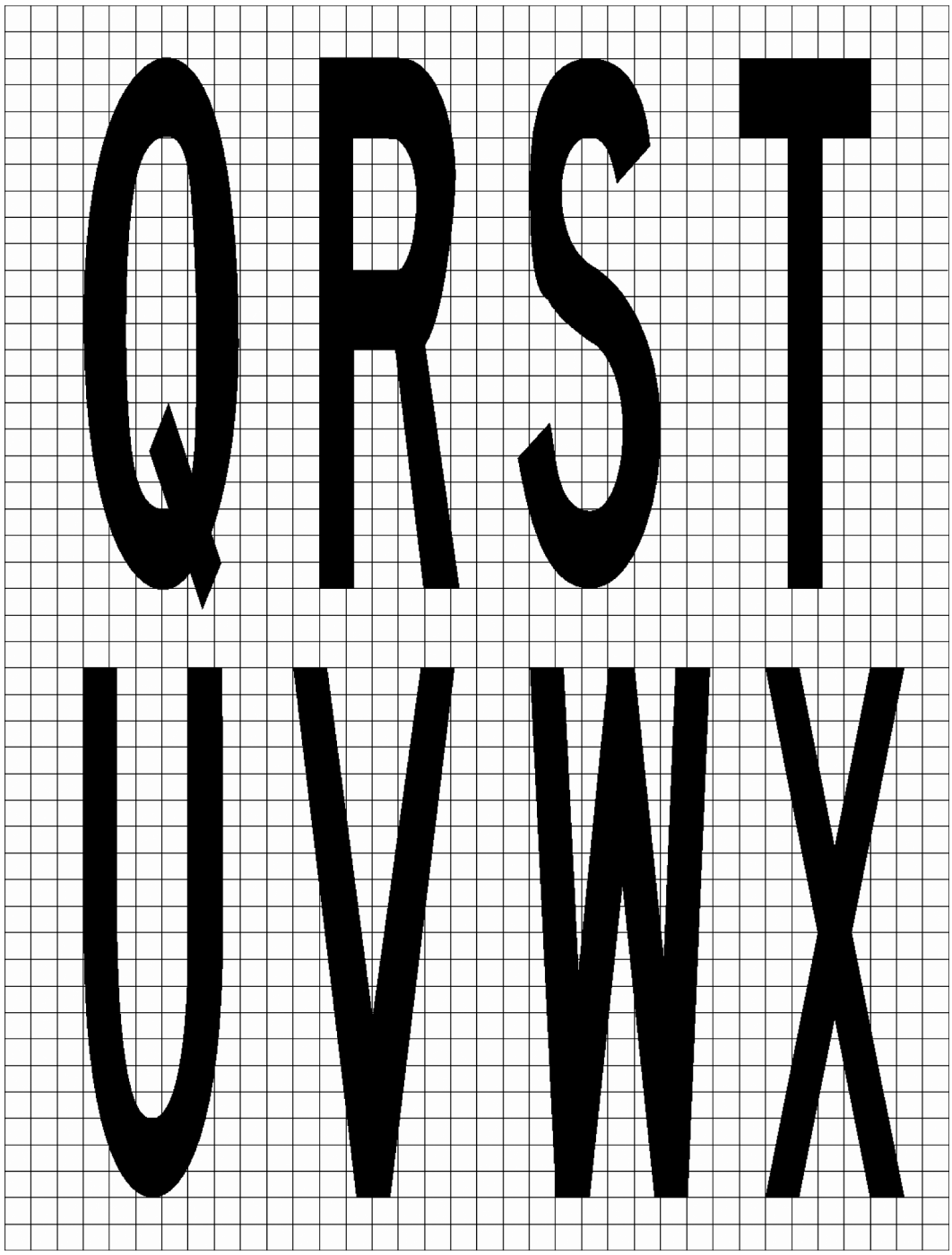
APPENDIX 3. MANDATORY INSTRUCTION MARKINGS AND INFORMATION MARKINGS

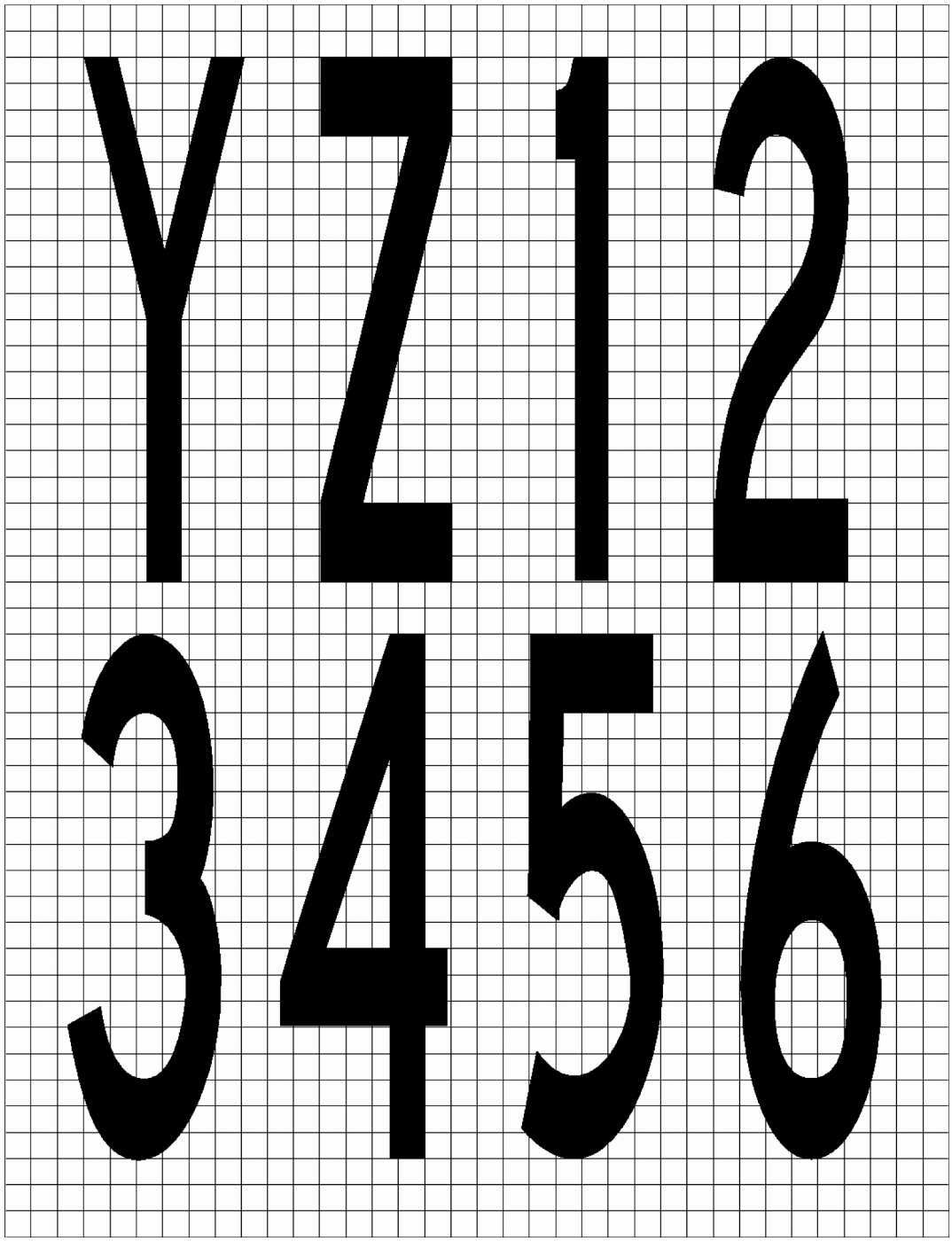
Note 1 – See Chapter 5, Sections 5.2.16 and 5.2.17 for specifications on the application, location and characteristics of mandatory instruction markings and information markings.

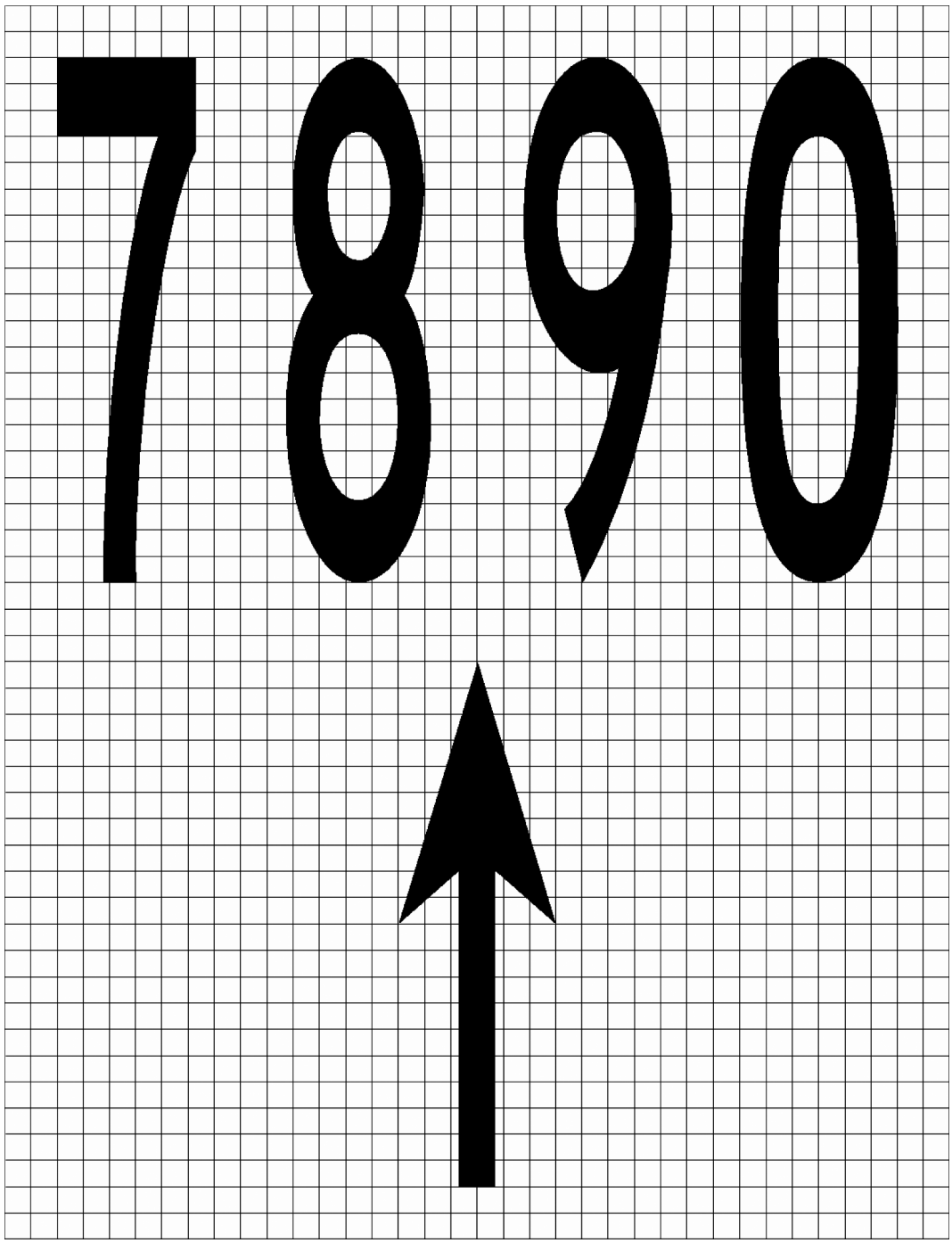
Note 2 – This appendix details the form and proportions of the letters, numbers and symbols of mandatory instruction markings and information markings on a 20 cm grid.




IJKL
MNOP


QRST
UVWX


Y712
3456



APPENDIX 4. REQUIREMENTS CONCERNING DESIGN OF TAXIING GUIDANCE SIGNS

Note – See Chapter 5, Section 5.4 for specifications on the application, location and characteristics of signs.

1. Inscription heights shall conform to the following tabulation.

Runway code number	Minimum character height		
	Mandatory instruction sign	Information sign	
		Runway exit and runway vacated signs	Other signs
1 or 2	300 mm	300 mm	200 mm
3 or 4	400 mm	400 mm	300 mm

Note – Where a taxiway location sign is installed in conjunction with a runway designation sign (see 5.4.3.22), the character size shall be that specified for mandatory instruction signs.

2. Arrow dimensions shall be as follows:

Legend height	Stroke
200 mm	32 mm
300 mm	48 mm
400 mm	64 mm

3. Stroke width for single letter shall be as follows:

Legend height	Stroke
200 mm	32 mm
300 mm	48 mm
400 mm	64 mm

4. Sign luminance shall be as follows:

a) Where operations are conducted in runway visual range conditions less than a value of 800 m, average sign luminance shall be at least:

Red	30 cd/m^2
Yellow	150 cd/m^2
White	300 cd/m^2

b) Where operations are conducted in accordance with 5.4.1.7 b) and c) and 5.4.1.8, average sign luminance shall be at least:

Red	10 cd/m^2
Yellow	50 cd/m^2
White	100 cd/m^2

Note – In runway visual range conditions less than a value of 400 m, there will be some degradation in the performance of signs.

5. The luminance ratio between red and white elements of a mandatory sign shall be between 1:5 and 1:10.

6. The average luminance of the sign is calculated by establishing grid points as shown in Figure A4-1 and using the luminance values measured at all grid points located within the rectangle representing the sign.

7. The average value is the arithmetic average of the luminance values measured at all considered grid points.

Note – Guidance on measuring the average luminance of a sign is contained in the Aerodrome Design Manual, Part 4.

8. The ratio between luminance values of adjacent grid points shall not exceed 1.5:1. For areas on the sign face where the grid spacing is 7.5 cm, the ratio between luminance values of adjacent grid points shall not exceed 1.25:1. The ratio between the maximum and minimum luminance value over the whole sign face shall not exceed 5:1.

9. The forms of characters, i.e. letters, numbers, arrows and symbols, shall conform to those shown in Figure A4-2. The width of characters and the space between individual characters shall be determined as indicated in Table A4-1.

10. The face height of signs shall be as follows:

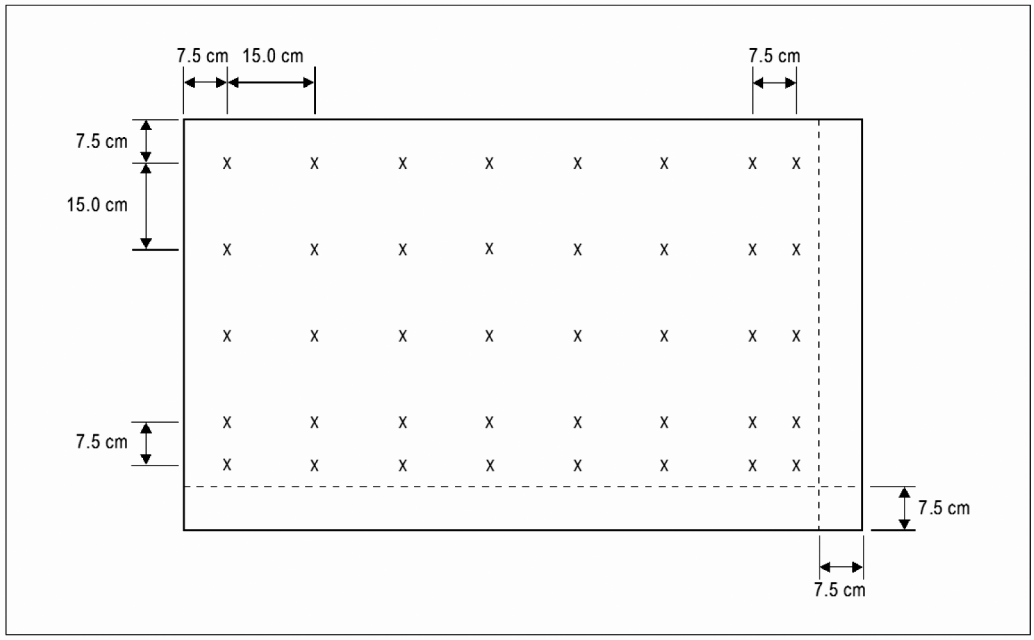
Legend height	Face height (min)
200 mm	400 mm
300 mm	600 mm
400 mm	800 mm

11. The face width of signs shall be determined using Figure A4-3 except that, where a mandatory instruction sign is provided on one side of a taxiway only, the face width shall not be less than:
a) 1.94 m where the code number is 3 or 4; and
b) 1.46 m where the code number is 1 or 2.

Note – Additional guidance on determining the face width of a sign is contained in the Aerodrome Design Manual, Part 4.

12. Borders
a) The black vertical delineator between adjacent direction signs shall have a width of approximately 0.7 of the stroke width.
b) The yellow border on a stand-alone location sign shall be approximately 0.5 stroke width.

13. The colors of signs shall be in accordance with the appropriate specifications in Appendix 1.



Note 1.— The average luminance of a sign is calculated by establishing grid points on a sign face showing typical inscriptions and a background of the appropriate colour (red for mandatory instruction signs and yellow for direction and destination signs) as follows:

a) Starting at the top left corner of the sign face, establish a reference grid point at 7.5 cm from the left edge and the top of the sign face.

b) Create a grid of 15 cm spacing horizontally and vertically from the reference grid point. Grid points within 7.5 cm of the edge of the sign face shall be excluded.

c) Where the last point in a row/column of grid points is located between 22.5 cm and 15 cm from the edge of the sign face (but not inclusive), an additional point shall be added 7.5 cm from this point.

d) Where a grid point falls on the boundary of a character and the background, the grid point shall be slightly shifted to be completely outside the character.

Note 2.— Additional grid points may be required to ensure that each character includes at least five evenly spaced grid points.

Note 3.— Where one unit includes two types of signs, a separate grid shall be established for each type.

Figure A4-1. Grid points for calculating average luminance of a sign

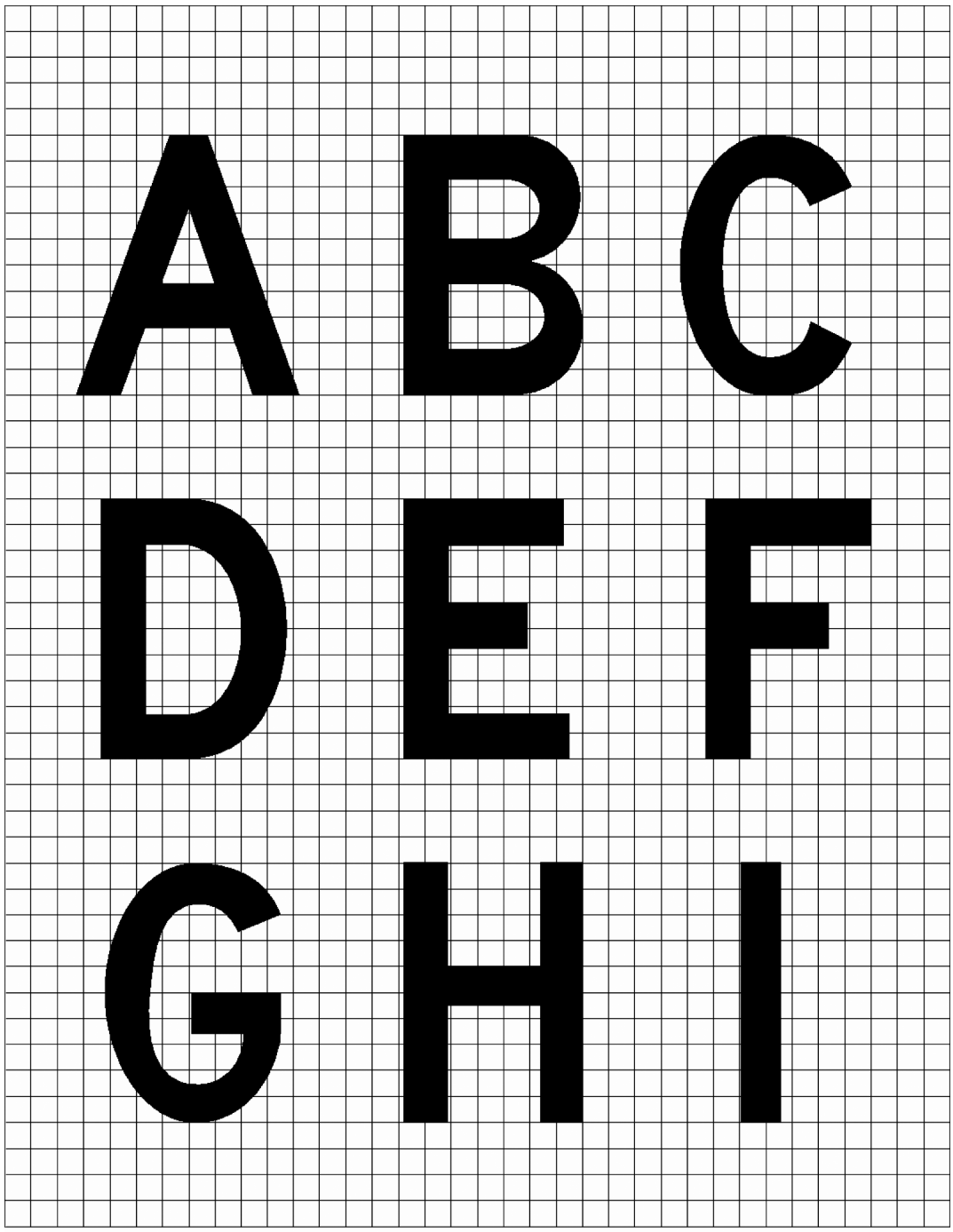


Figure A4-2. Forms of characters

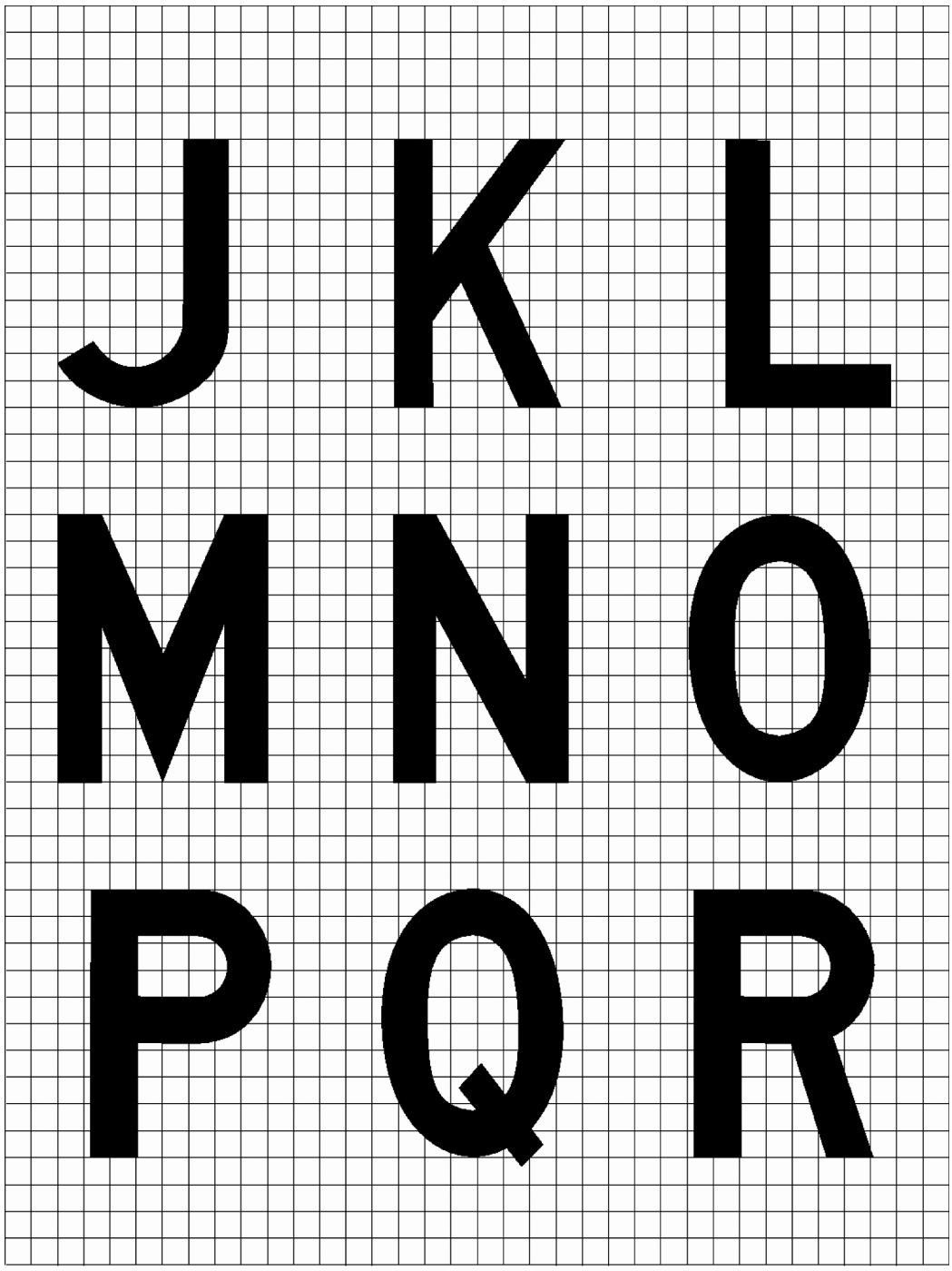


Figure A4-2. (cont.)

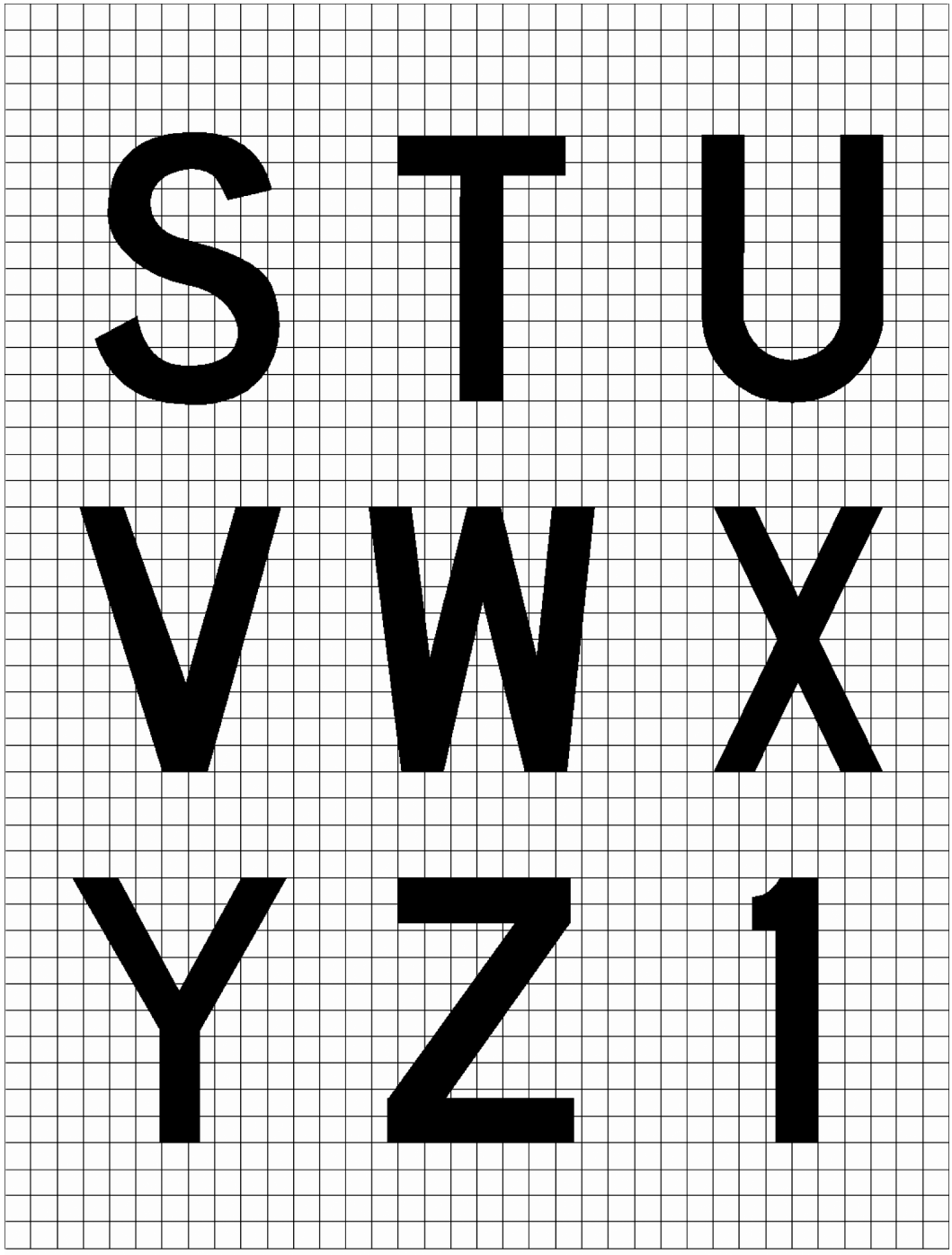


Figure A4-2. (cont.)

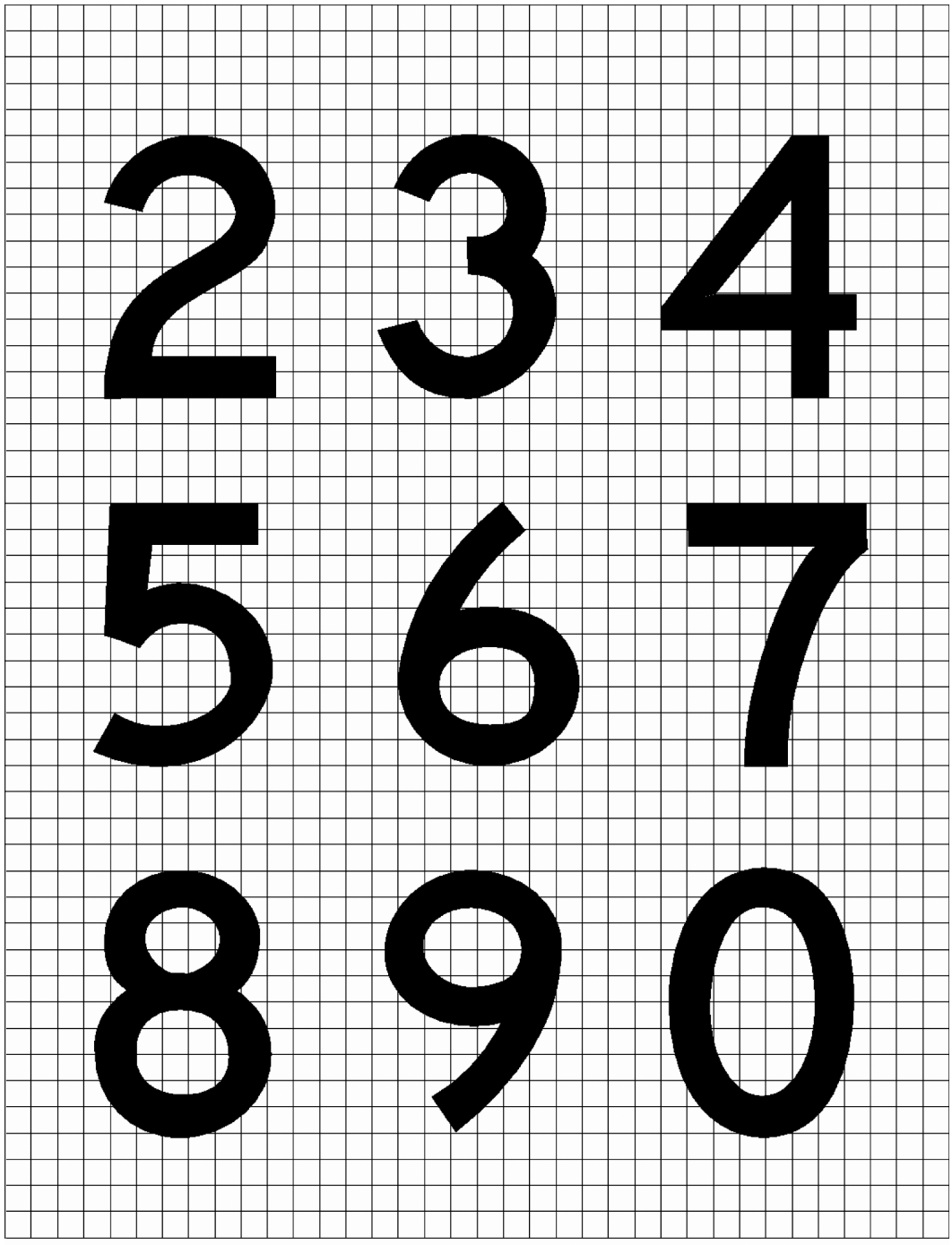


Figure A4-2. (cont.)

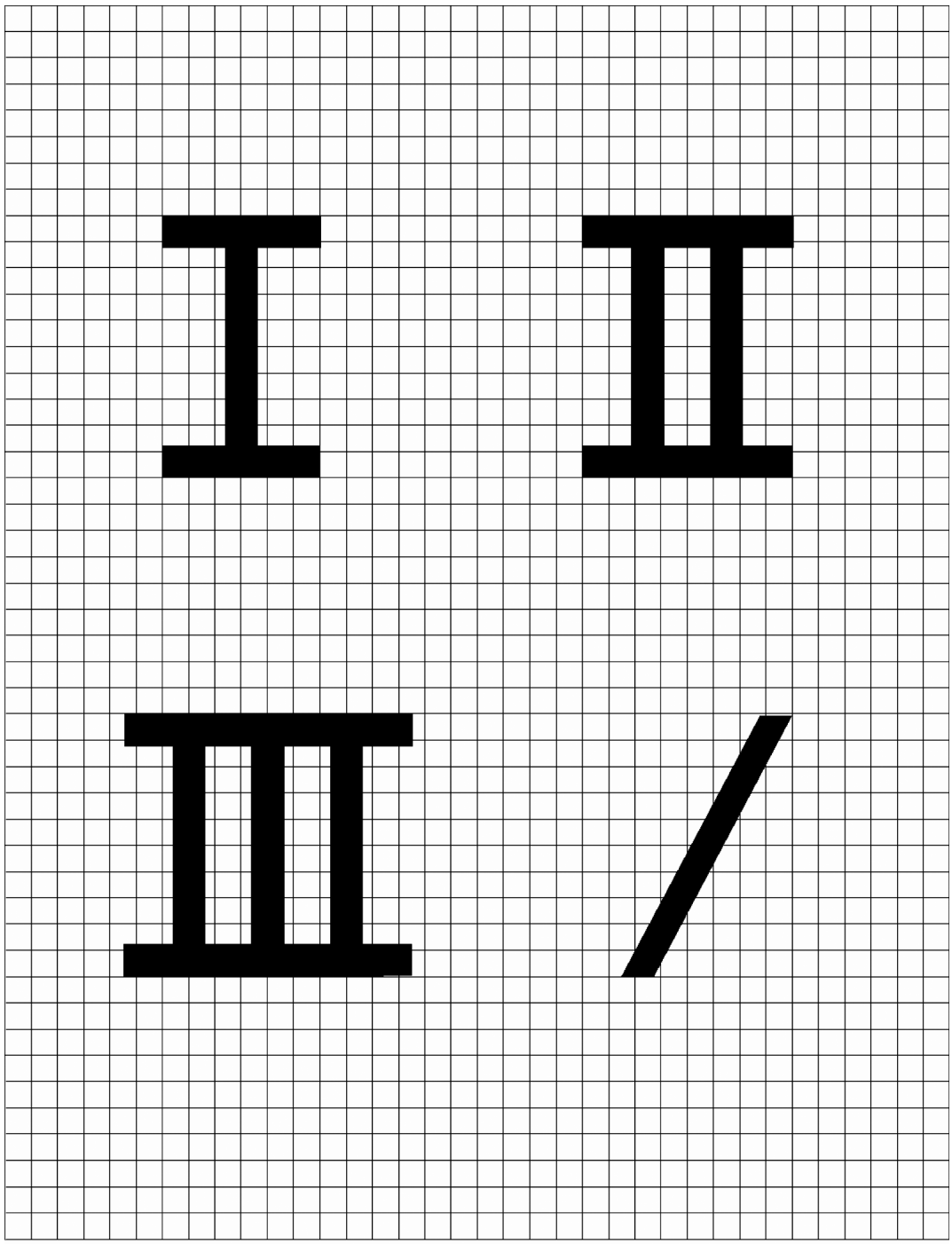
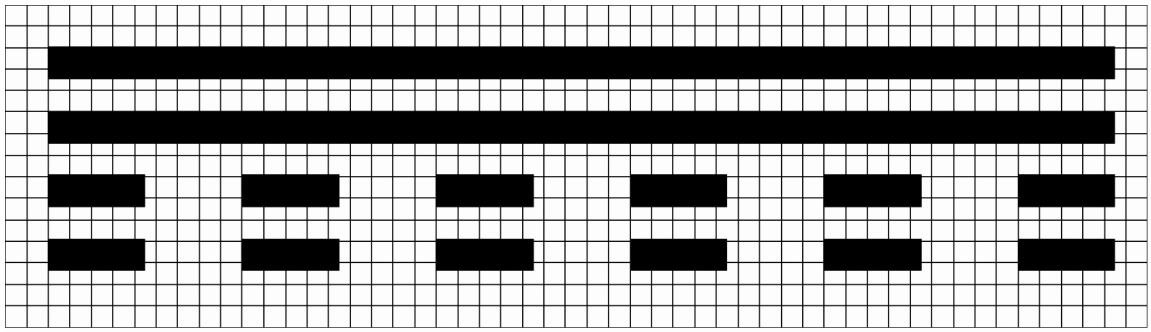
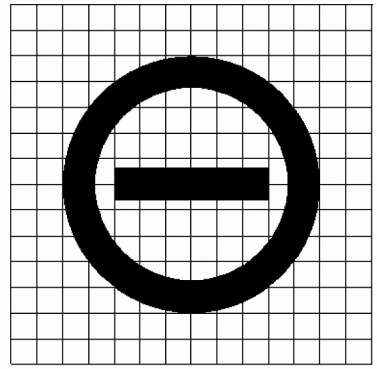


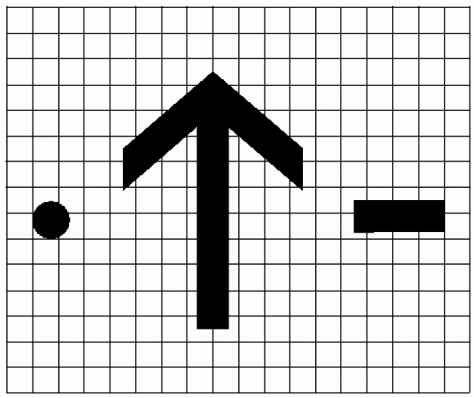
Figure A4-2. (cont.)



Runway vacated sign



NO ENTRY sign



Arrow, dot and dash

Note 1.— The arrow stroke width, diameter of the dot, and both width and length of the dash shall be proportioned to the character stroke widths.

Note 2.— The dimensions of the arrow shall remain constant for a particular sign size, regardless of orientation.

Figure A4-2. (cont.)

Table A4-1. Letter and numeral widths and space between letters or numerals

a) Letter to letter code number			
Preceding Letter	Following Letter		
	B, D, E, F, H, I, K, L, M, N, P, R, U	C, G, O, Q, S, X, Z	A, J, T, V, W, Y
	Code number		
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	2	3
G	1	2	2
H	1	1	2
I	1	1	2
J	1	1	2
K	2	2	3
L	2	2	4
M	1	1	2
N	1	1	2
O	1	2	2
P	1	2	2
Q	1	2	2
R	1	2	2
S	1	2	2
T	2	2	4
U	1	1	2
V	2	2	4
W	2	2	4
X	2	2	3
Y	2	2	4
Z	2	2	3

b) Numeral to numeral code number			
Preceding Numeral	Following number		
	1, 5	2, 3, 6, 8, 9, 0	4, 7
	Code number		
1	1	1	2
2	1	2	2
3	1	2	2
4	2	2	4
5	1	2	2
6	1	2	2
7	2	2	4
8	1	2	2
9	1	2	2
0	1	2	2

c) Space between characters			
Code No.	Letter Height (mm)		
	200	300	400
	Space (mm)		
1	48	71	96
2	38	57	76
3	25	38	50
4	13	19	26

d) Width of letter			
Letter	Letter height (mm)		
	200	300	400
	Width (mm)		
A	170	255	340
B	137	205	274
C	137	205	274
D	137	205	274
E	124	186	248
F	124	186	248
G	137	205	274
H	137	205	274
I	32	48	64
J	127	190	254
K	140	210	280
L	124	186	248
M	157	236	314
N	137	205	274
O	143	214	286
P	137	205	274
Q	143	214	286
R	137	205	274
S	137	205	274
T	124	186	248
U	137	205	274
V	152	229	304
W	178	267	356
X	137	205	274
Y	171	257	342
Z	137	205	274

e) Width of numeral			
Letter	Numeral height (mm)		
	200	300	400
	Width (mm)		
1	50	74	98
2	137	205	274
3	137	205	274
4	149	224	298
5	137	205	274
6	137	205	274
7	137	205	274
8	137	205	274
9	137	205	274
0	143	214	286

INSTRUCTIONS

1. To determine the proper SPACE between letters or numerals, obtain the code number from table a or b and enter table c for that code number to the desired letter or numeral height.
2. The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single character such as 'A →', the space may be reduced to not less than one quarter of the height of the character in order to provide a good visual balance.
3. Where the numeral follows a letter or vice versa use Code 1.
4. Where a hyphen, dot, or diagonal stroke follows a character or vice versa use Code 1.

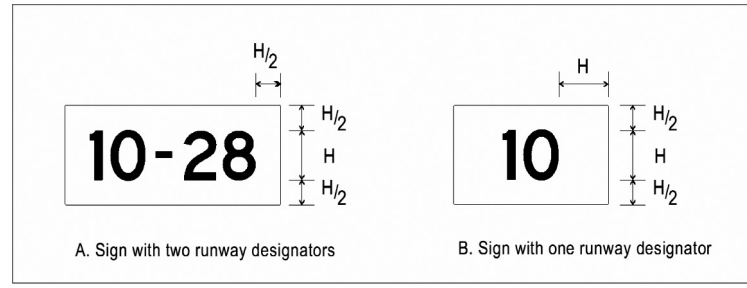


Figure A4-3. Sign dimensions

APPENDIX 5. AERONAUTICAL DATA QUALITY REQUIREMENTS

Table A5-1. Latitude and longitude

Latitude and longitude	Accuracy Data type	Integrity Classification
Aerodrome reference point	30 m surveyed/calculated	1×10^{-3} routine
Navaids located at the aerodrome	3 m surveyed	1×10^{-5} essential
Obstacles in Area 3	0.5 m surveyed	1×10^{-5} essential
Obstacles in Area 2 (the part within the aerodrome boundary)	5 m surveyed	1×10^{-5} essential
Runway thresholds	1 m surveyed	1×10^{-8} critical
Runway end (flight path alignment point)	1 m surveyed	1×10^{-8} critical
Runway centre line points	1 m surveyed	1×10^{-8} critical
Runway holding position	0.5 m surveyed	1×10^{-8} critical
Taxiway centre line/parking guidance line points	0.5 m surveyed	1×10^{-5} essential
Taxiway intersection marking line	0.5 m surveyed	1×10^{-5} essential
Exit guidance line	0.5 m surveyed	1×10^{-5} essential
Apron boundaries (polygon)	1 m surveyed	1×10^{-3} routine
De-icing/anti-icing facility (polygon)	1 m surveyed	1×10^{-3} routine
Aircraft stand points/INS checkpoints	0.5 m surveyed	1×10^{-3} routine

Note 1.— See Annex 15, Appendix 8, for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

Note 2.— Implementation of Annex 15 provision 10.6.1.2 concerning the availability, as of 18 November 2010, of obstacle data according to Area 2 and Area 3 specifications would be facilitated by appropriate advanced planning for the collection and processing of such data.

Table A5-2. Elevation/altitude/height

Elevatioln/altitude/height	Accuracy Data type	Integrity Classification
Aerodrome elevation	0.5 m surveyed	1×10^{-5} essential
WGS-84 geoid undulation at aerodrome elevation position	0.5 m surveyed	1×10^{-5} essential
Runway threshold, non-precision approaches	0.5 m surveyed	1×10^{-5} essential
WGS-84 geoid undulation at runway threshold, non-precision approaches	0.5 m surveyed	1×10^{-5} essential
Runway threshold, precision approaches	0.25 m surveyed	1×10^{-8} critical
WGS-84 geoid undulation at runway threshold, precision approaches	0.25 m surveyed	1×10^{-8} critical
Runway centre line points	0.25 m surveyed	1×10^{-8} critical
Taxiway centre line/parking guidance line points	1 m surveyed	1×10^{-5} essential
Obstacles in Area 2 (the part within the aerodrome boundary)	3 m surveyed	1×10^{-5} essential
Obstacles in Area 3	0.5 m surveyed	1×10^{-5} essential
Distance measuring equipment/precision (DME/P)	3 m surveyed	1×10^{-5} essential

Note 1.— See Annex 15, Appendix 8, for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

Note 2.— Implementation of Annex 15 provision 10.6.1.2 concerning the availability, as of 18 November 2010, of obstacle data according to Area 2 and Area 3 specifications would be facilitated by appropriate advanced planning for the collection and processing of such data.

Table A5-3. Declination and magnetic variation

Declination/variation	Accuracy Data type	Integrity Classification
Aerodrome magnetic variation	1 degree surveyed	1×10^{-5} essential
ILS localizer antenna magnetic variation	1 degree surveyed	1×10^{-5} essential
MLS azimuth antenna magnetic variation	1 degree surveyed	1×10^{-5} essential

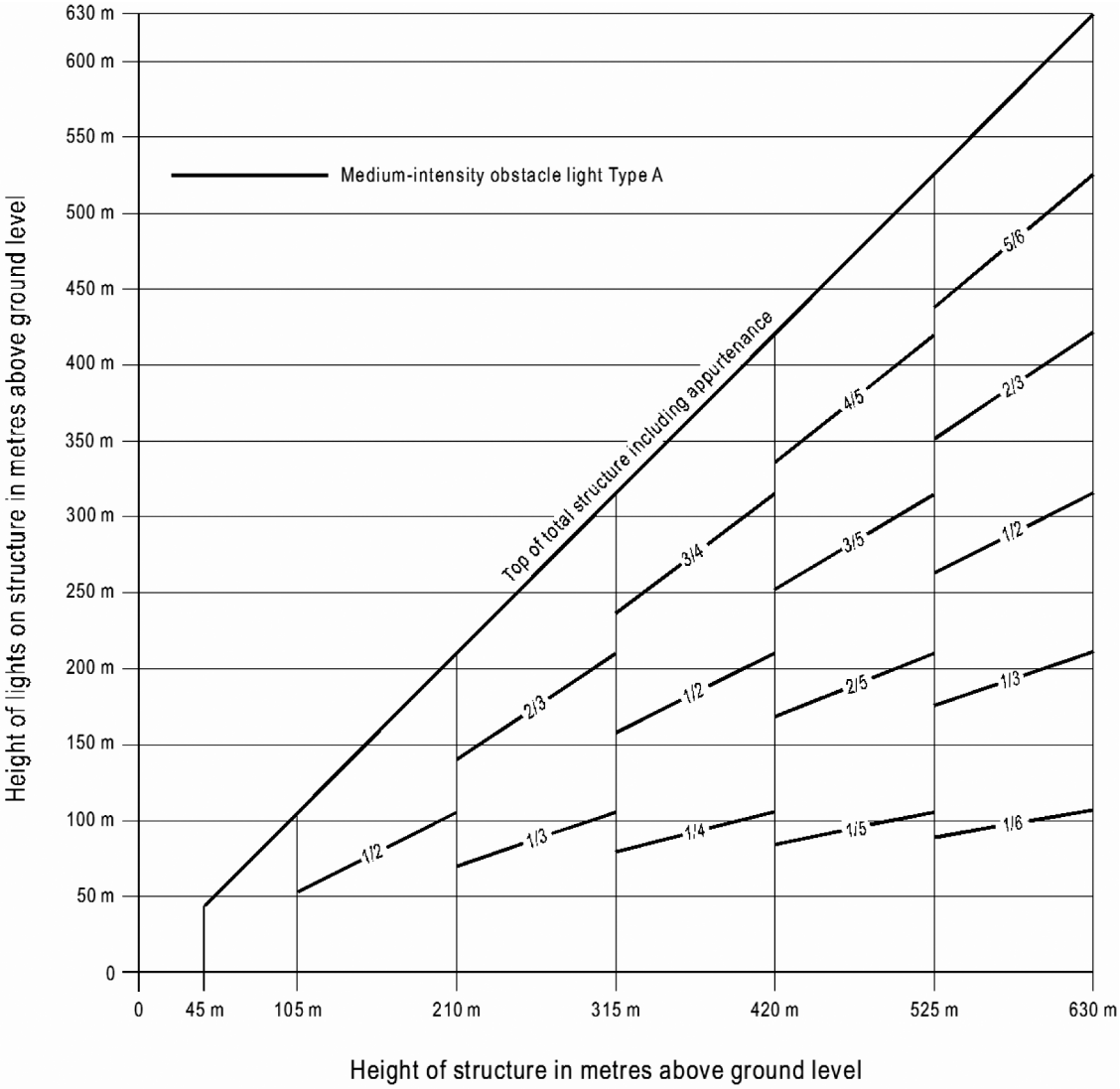
Table A5-4. Bearing

Bearing	Accuracy Data type	Integrity Classification
ILS localizer alignment	1/100 degree surveyed	1×10^{-5} essential
MLS zero azimuth alignment	1/100 degree surveyed	1×10^{-5} essential
Runway bearing (True)	1/100 degree surveyed	1×10^{-3} routine

Table A5-5. Length/Distance/Dimension

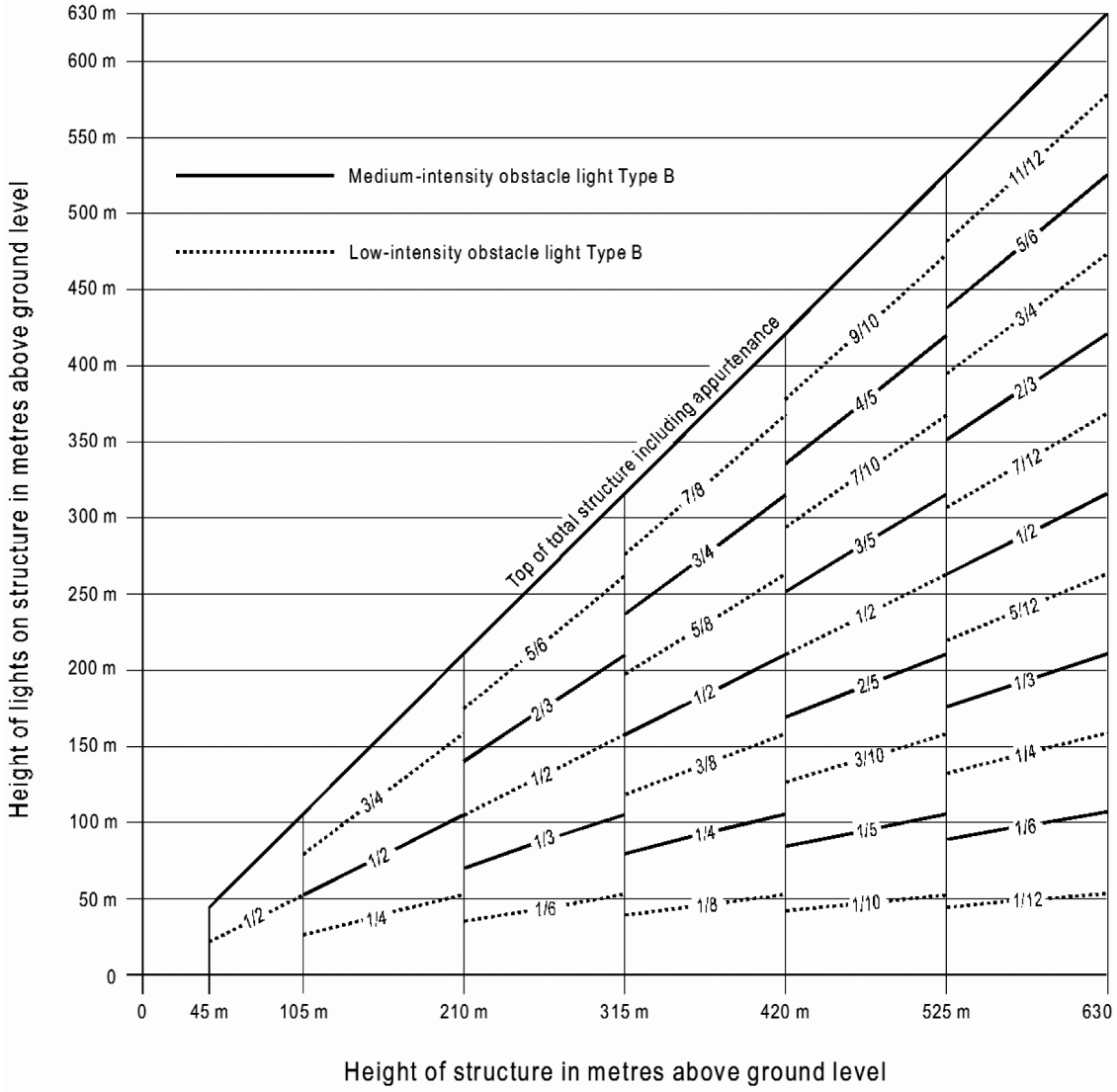
Length/distance/dimension	Accuracy Data type	Integrity Classification
Runway length	1 m surveyed	1×10^{-8} critical
Runway width	1 m surveyed	1×10^{-5} essential
Displaced threshold distance	1 m surveyed	1×10^{-3} routine
Stopway length and width	1 m surveyed	1×10^{-8} critical
Clearway length and width	1 m surveyed	1×10^{-5} essential
Landing distance available	1 m surveyed	1×10^{-8} critical
Take-off run available	1 m surveyed	1×10^{-8} critical
Take-off distance available	1 m surveyed	1×10^{-8} critical
Accelerate-stop distance available	1 m surveyed	1×10^{-8} critical
Runway shoulder width	1 m surveyed	1×10^{-5} essential
Taxiway width	1 m surveyed	1×10^{-5} essential
Taxiway shoulder width	1 m surveyed	1×10^{-5} essential
ILS localizer antenna-runway end, distance	3 m calculated	1×10^{-3} routine
ILS glide slope antenna-threshold, distance along centre line	3 m calculated	1×10^{-3} routine
ILS marker-threshold distance	3 m calculated	1×10^{-5} essential
ILS DME antenna-threshold, distance along centre line	3 m calculated	1×10^{-5} essential
MLS azimuth antenna-runway end, distance	3 m calculated	1×10^{-3} routine
MLS elevation antenna-threshold, distance along centre line	3 m calculated	1×10^{-3} routine
MLS DME/P antenna-threshold, distance along centre line	3 m calculated	1×10^{-5} essential

APPENDIX 6. LOCATION OF LIGHTS ON OBSTACLES



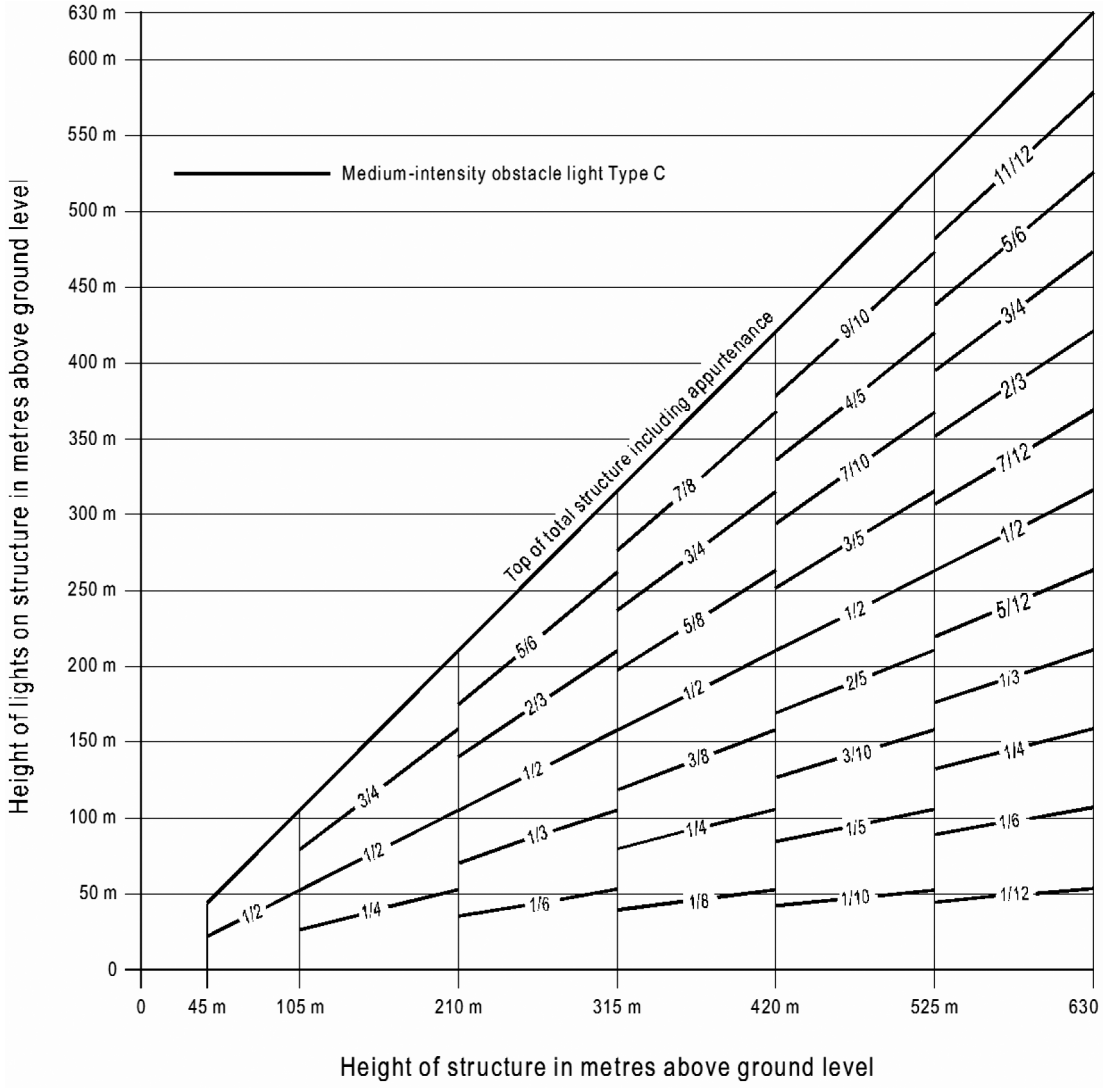
Note.— High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A6-1. Medium-intensity flashing-white obstacle lighting system, Type A



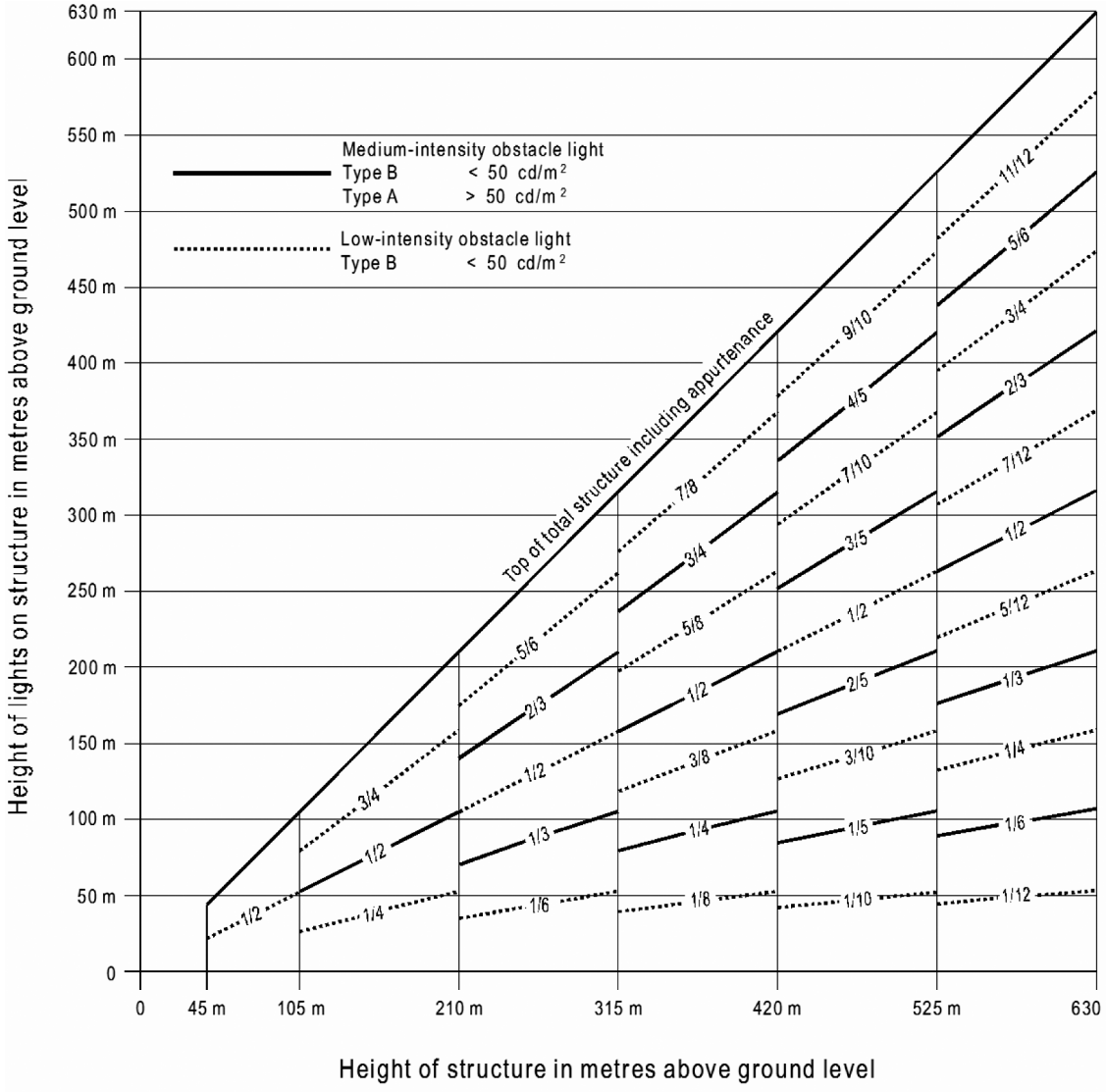
Note.— For night-time use only.

Figure A6-2. Medium-intensity flashing-red obstacle lighting system, Type B



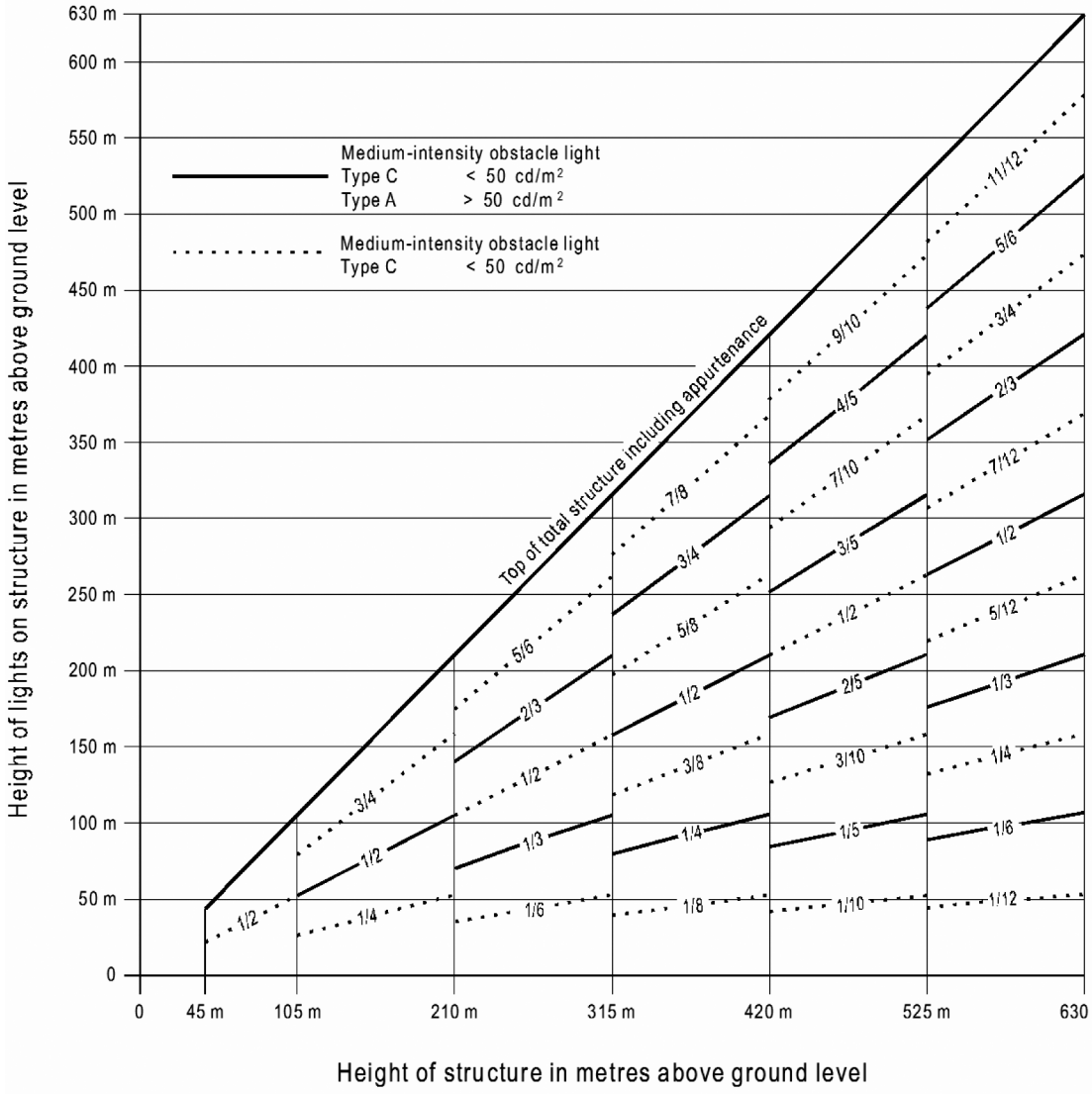
Note.— For night-time use only.

Figure A6-3. Medium-intensity fixed-red obstacle lighting system, Type C



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

Figure A6-4. Medium-intensity dual obstacle lighting system, Type A/Type B



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

Figure A6-5. Medium-intensity dual obstacle lighting system, Type A/Type C

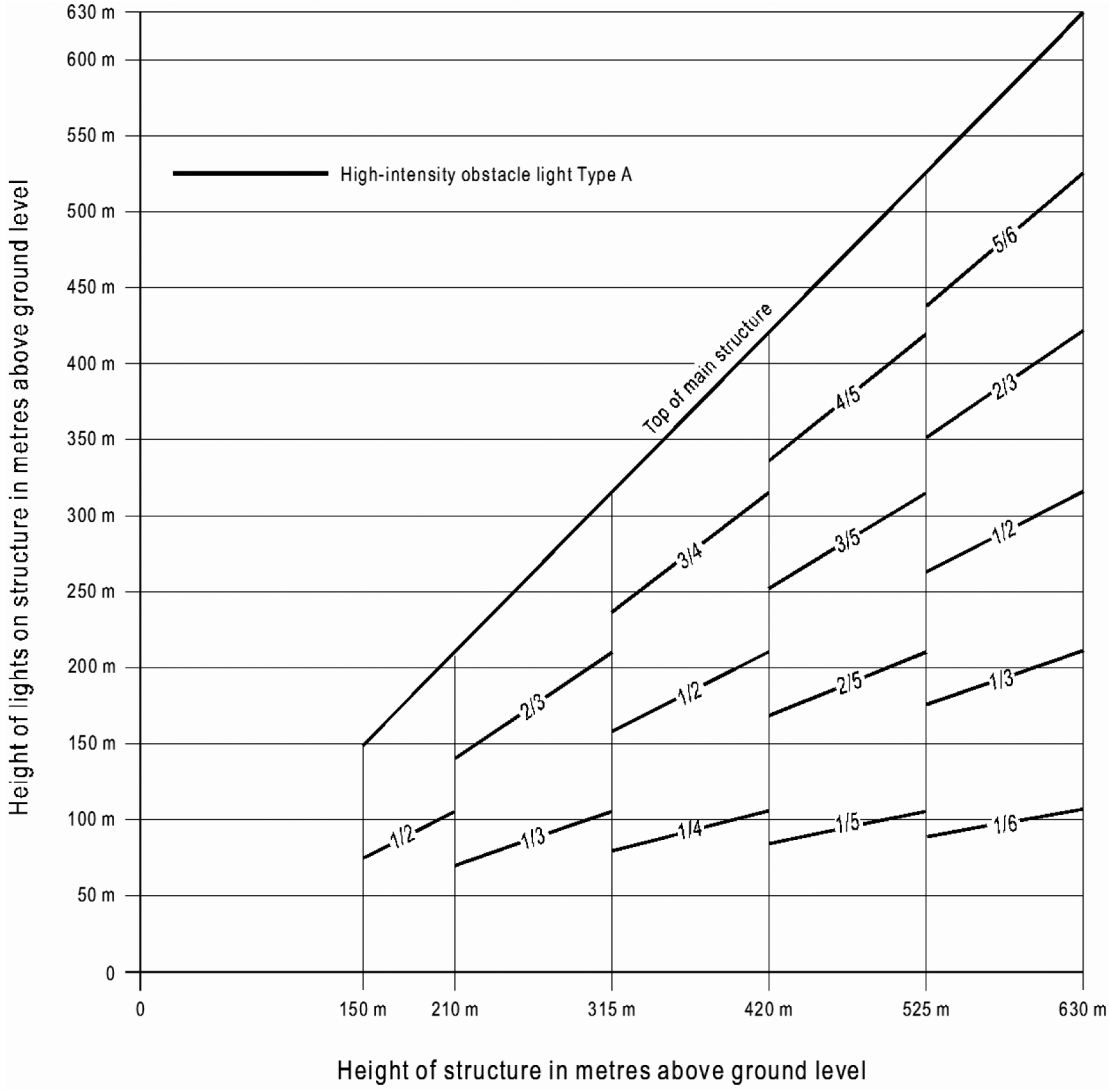


Figure A6-6. High-intensity flashing-white obstacle lighting system, Type A

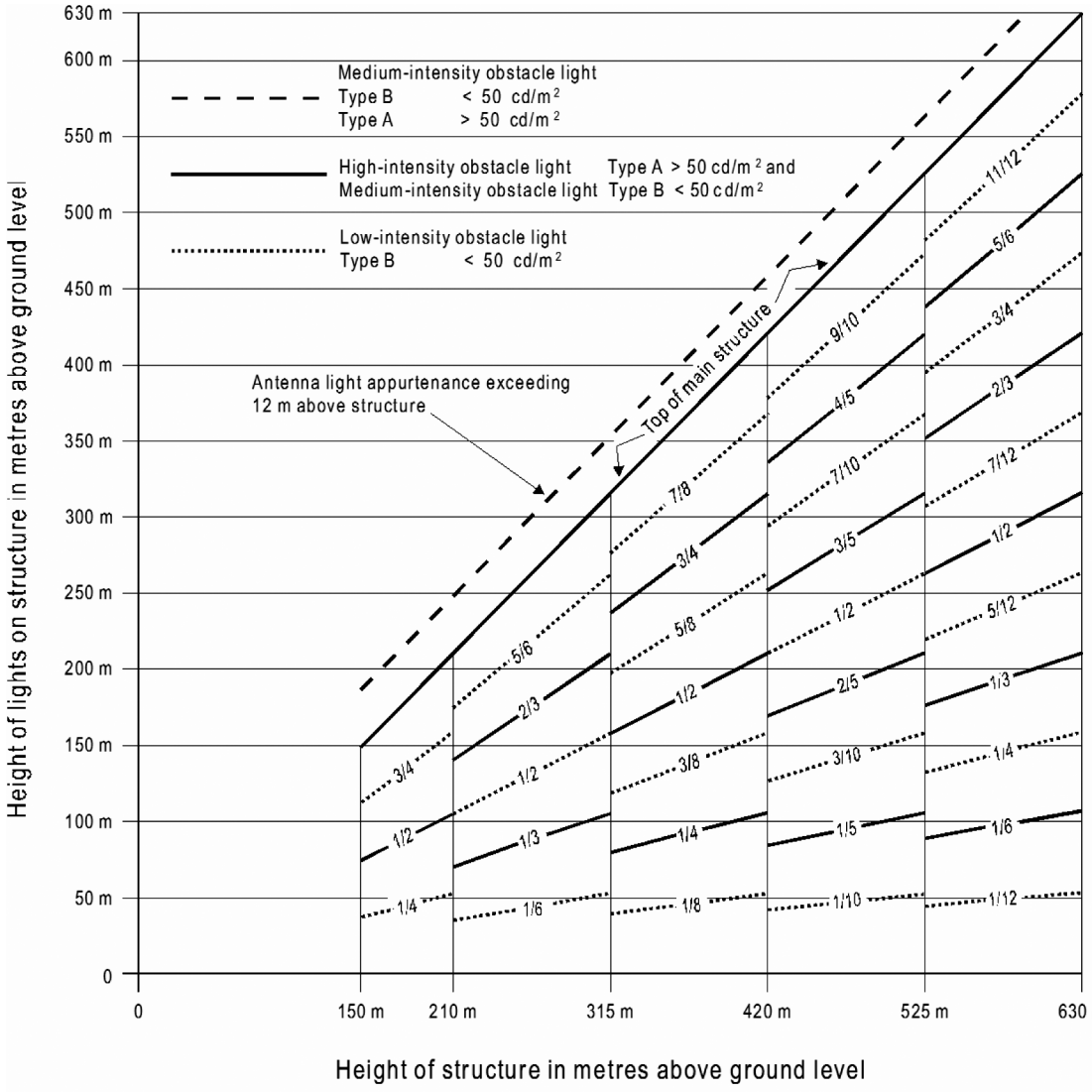


Figure A6-7. High-/medium-intensity dual obstacle lighting system, Type A/Type B

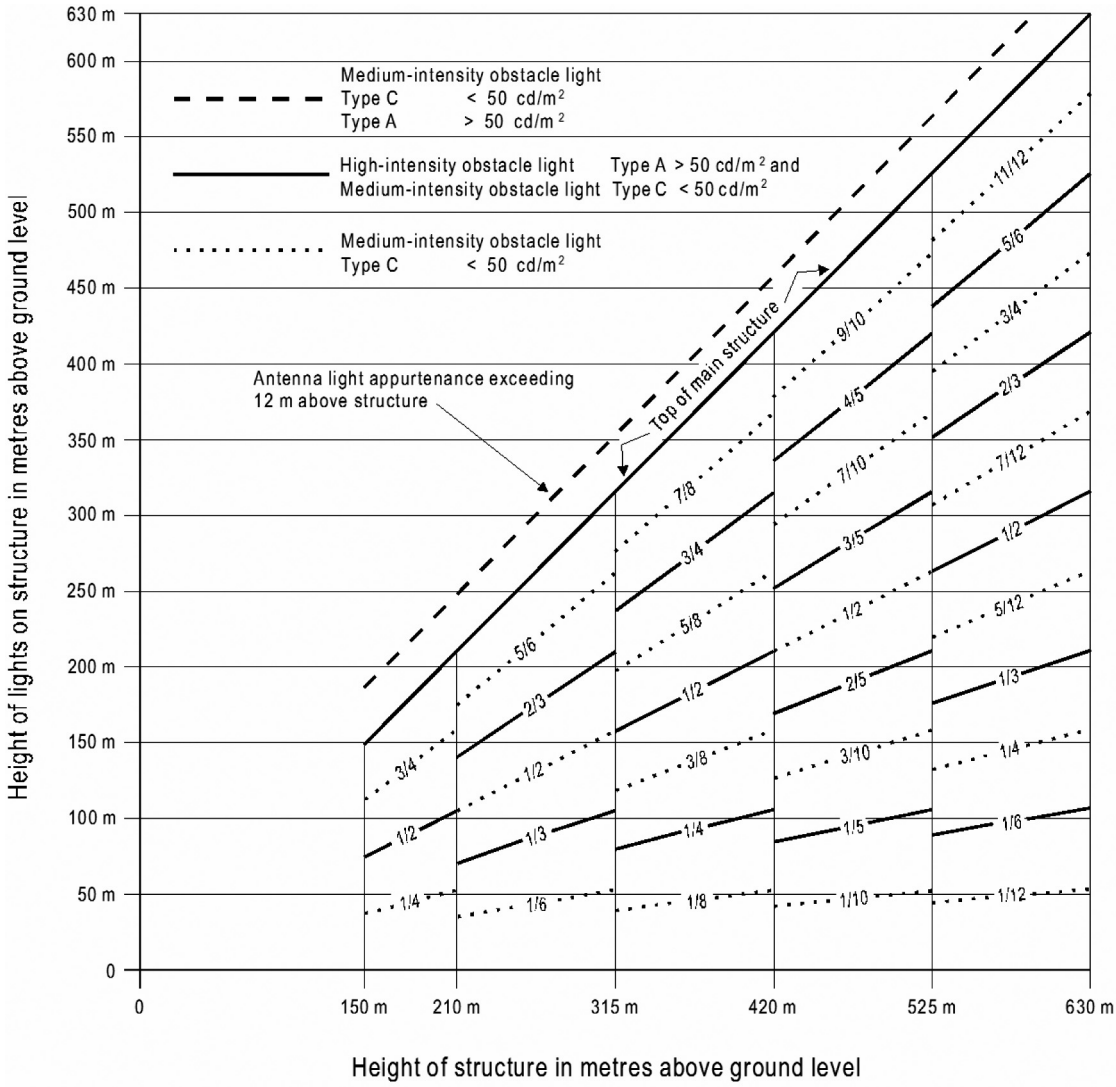


Figure A6-8. High-/medium-intensity dual obstacle lighting system, Type A/Type C

ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO THE NETHERLANDS ANTILLES CIVIL AVIATION REGULATIONS PART 14, VOLUME I

1. Number, siting and orientation of runways

Siting and orientation of runways

1.1 Many factors shall be taken into account in the determination of the siting and orientation of runways. Without attempting to provide an exhaustive list of these factors nor an analysis of their effects, it appears useful to indicate those which most frequently require study. These factors may be classified under four headings:

1.1.1 Type of operation. Attention shall 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.

1.1.2 Climatological conditions. A study of the wind distribution shall be made to determine the usability factor. In this regard, the following comments shall be taken into account:

a) Wind statistics used for the calculation of the usability factor are normally available in ranges of speed and direction, and the accuracy of the results obtained depends, to a large extent, on the assumed distribution of observations within these ranges. In the absence of any sure information as to the true distribution, it is usual to assume a uniform distribution since, in relation to the most favorable runway orientations, this generally results in a slightly conservative for the usability factor.

b) The maximum mean cross-wind components given in Chapter 3, 3.1.3 refer to normal circumstances. There are some factors which may require that a reduction of those maximum values be taken into account at a particular aerodrome. These include:

1) the wide variations which may exist, in handling characteristics and maximum permissible cross-wind components, among diverse types of airplanes (including future types) within each of the three groups given in 3.1.3;

2) prevalence and nature of gusts;

3) prevalence and nature of turbulence;

4) the availability of a secondary runway;

5) the width of runways;

6) the runway surface conditions – water, snow and ice on the runway materially reduce the allowable crosswind component; and

7) the strength of the wind associated with the limiting cross-wind component.

A study shall also be made of the occurrence of poor visibility and/or low cloud base. Account shall be taken of their frequency as well as the accompanying wind direction and speed.

1.1.3 Topography of the aerodrome site, its approaches, and surroundings, particularly:

a) compliance with the obstacle limitation surfaces;

b) current and future land use. The orientation and layout shall be selected so as to protect as far as possible the particularly sensitive areas such as residential, school and hospital zones from the discomfort caused by aircraft noise. Detailed information on this topic is provided in the Airport Planning Manual, Part 2, and in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829);

c) current and future runway lengths to be provided;

d) construction costs; and
e) possibility of installing suitable non-visual and visual aids for approach-to-land.

1.1.4 Air traffic in the vicinity of the aerodrome, particularly:
a) proximity of other aerodromes or ATS routes;
b) traffic density; and
c) air traffic control and missed approach procedures.

Number of runways in each direction

1.2 The number of runways to be provided in each direction depends on the number of aircraft movements to be catered to.

2. Clearways and stopways

2.1 The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway will depend on the physical characteristics of the area beyond the runway end, and on the operating performance requirements of the prospective airplanes. The runway, stopway and clearway lengths to be provided are determined by the airplane take-off performance, but a check shall also be made of the landing distance required by the airplanes 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.

2.2 The airplane performance operating limitations require a length which is enough to ensure that the airplane 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 airplane 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 must be abandoned if an engine fails, while above it the take-off must 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.

2.3 On the other hand, if an engine fails after the decision speed is reached, the airplane will have sufficient speed and power available to complete the take-off safely in the remaining take-off distance available. However, because of the high speed, there would be difficulty in stopping the airplane in the remaining accelerate-stop distance available.

2.4 The decision speed is not a fixed speed for any airplane, but can be selected by the pilot within limits to suit the accelerate-stop and take-off distance available, airplane 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.

2.5 A variety of combinations of accelerate-stop distances required and take-off distances required can be obtained to accommodate a particular airplane, taking into account the airplane take-off mass, runway characte-

ristics, and ambient atmospheric conditions. Each combination requires its particular length of take-off run.

2.6 The most familiar case is where the decision speed is such that the take-off distance required is equal to the accelerate-stop distance required; this value is known as the balanced field length. Where stopway and clearway are not provided, these distances are both equal to the runway length. However, if landing distance is for the moment ignored, runway is not essential for the whole of the balanced field length, as the take-off run required is, of course, less than the balanced field length. The balanced field length can, therefore, be provided by a runway supplemented by an equal length of clearway and stopway, instead of wholly as a runway. If the runway is used for take-off in both directions, an equal length of clearway and stopway has to be provided at each runway end. The saving in runway length is, therefore, bought at the cost of a greater overall length.

2.7 In case economic considerations preclude the provision of stopway and, as a result, only runway and clearway are to be provided, the runway length (neglecting landing requirements) shall be equal to the accelerate-stop distance required or the take-off run required, whichever is the greater. The take-off distance available will be the length of the runway plus the length of clearway.

2.8 The minimum runway length and the maximum stop-way or clearway length to be provided may be determined as follows, from the data in the airplane flight manual for the airplane considered to be critical from the viewpoint of runway length requirements:
a) if a stopway is economically possible, the lengths to be provided are those for the balanced field length. The runway length is the take-off run required or the landing distance required, whichever is the greater. If the accelerate-stop distance required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway. In addition, a clearway of the same length as the stopway must also be provided;
b) 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.

2.9 In addition to the above consideration, the concept of clearways in certain circumstances can be applied to a situation where the take-off distance required for all engines operating exceeds that required for the engine failure case.

2.10 The economy of a stopway can be entirely lost if, after each usage, it must be re-graded and compacted. Therefore, it shall be designed to withstand at least a certain number of loadings of the airplane which the stopway is intended to serve without inducing structural damage to the airplane.

3. Calculation of declared distances

3.1 The declared distances to be calculated for each runway direction comprise: the take-off run available (TORA), take-off distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available (LDA).

3.2 Where a runway is not provided with a stopway or clearway and the threshold is located at the extremity of the runway, the four declared distances shall normally be equal to the length of the runway, as shown in Figure A-1 (A).

3.3 Where a runway is provided with a clearway (CWY), then the TODA will include the length of clearway, as shown in Figure A-1 (B).

3.4 Where a runway is provided with a stopway (SWY), then the ASDA will include the length of stopway, as shown in Figure A-1 (C).

3.5 Where a runway has a displaced threshold, then the LDA will be reduced by the distance the threshold is displaced, as shown in Figure A-1 (D). A displaced threshold affects only the LDA for approaches made to that threshold; all declared distances for operations in the reciprocal direction are unaffected.

3.6 Figures A-1 (B) through A-1 (D) illustrate a runway provided with a clearway or a stopway or having a displaced threshold. Where more than one of these features exist, then more than one of the declared distances will be modified – but the modification will follow the same principle illustrated. An example showing a situation where all these features exist is shown in Figure A-1 (E).

3.7 A suggested format for providing information on declared distances is given in Figure A-1 (F). If a runway direction cannot be used for take-off or landing, or both, because it is operationally forbidden, then this shall be declared and the words «not usable» or the abbreviation «NU» entered.

4. Slopes on a runway

4.1 Distance between slope changes

The following example illustrates how the distance between slope changes is to be determined (see Figure A-2):
D for a runway where the code number is 3 shall 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 shall be not less than:

15 000 (0.015 + 0.01) m,
that is, 15 000 ’ 0.025 = 375 m

4.2 Consideration of longitudinal and transverse slopes

When a runway is planned that will combine the extreme values for the slopes and changes in slope permitted under Chapter 3, 3.1.13 to 3.1.19, a study shall be made to ensure that the resulting surface profile will not hamper the operation of airplanes.

4.3 Radio altimeter operating area

In order to accommodate airplanes 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 shall 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 an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft. This is desirable because these airplanes are equipped with a radio altimeter for final height and flare guidance, and when the airplane is above the terrain immediately prior to the threshold, the radio altimeter will begin to provide information to the automatic pilot for auto-flare. Where slope changes cannot be avoided, the rate of change between two consecutive slopes shall not exceed 2 per cent per 30 m.

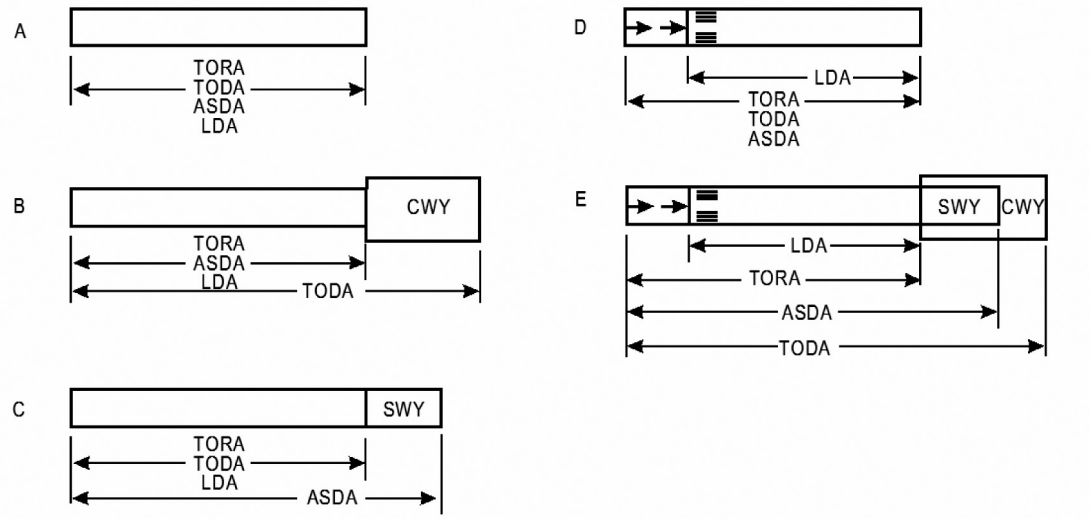
5. Runway surface evenness

5.1 In adopting tolerances for runway surface irregularities, the following standard of construction is achievable for short distances of 3 m and conforms to good engineering practice:

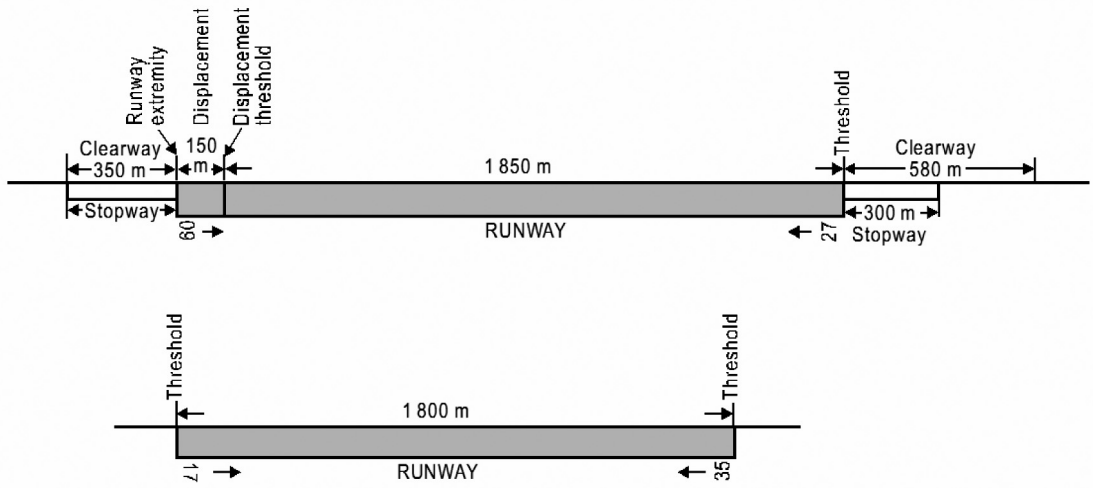
Except across the crown of a camber or across drainage channels, the finished surface of the wearing course is to be of such regularity that, when tested with a 3 m straight-edge placed anywhere in any direction on the surface, there is no deviation greater than 3 mm between the bottom of the straight-edge and the surface of the pavement anywhere along the straight edge.

5.2 Caution shall also be exercised when inserting runway lights or drainage grilles in runway surfaces to ensure that adequate smoothness of the surface is maintained.

5.3 The operation of aircraft and differential settlement of surface foundations will eventually lead to increases in surface irregularities. Small deviations in the above tolerances will not seriously hamper aircraft operations. In general, isolated irregularities of the order of 2.5 cm to 3 cm over a 45 m distance are tolerable. Exact information of the maximum acceptable deviation cannot be given, as it varies with the type and speed of an aircraft.



Note.— All declared distances are illustrated for operations from left to right.



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 A-1. Illustration of declared distances

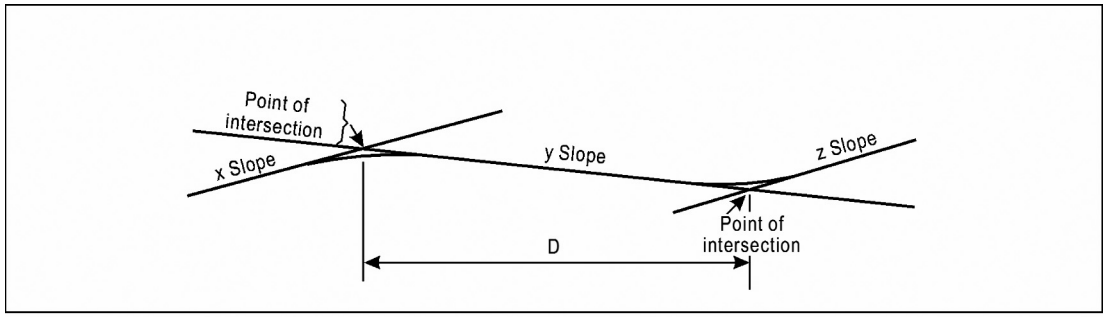


Figure A-2. Profile on centre line of runway

5.4 Deformation of the runway with time may also increase the possibility of the formation of water pools. Pools as shallow as approximately 3 mm in depth, particularly if they are located where they are likely to be encountered at high speed by landing airplanes, can induce aquaplaning, which can then be sustained on a wet runway by a much shallower depth of water. Improved guidance regarding the significant length and depth of pools relative to aquaplaning is the subject of further research. It is, of course, especially necessary to prevent pools from forming whenever there is a possibility that they might become frozen.

6. Determining and expressing the friction characteristics of snow- and ice-covered paved surfaces

6.1 There is an operational need for reliable and uniform information concerning the friction characteristics of ice- and snow-covered runways. Accurate and reliable indications of surface friction characteristics can be obtained by friction measuring devices; however, further experience is required to correlate the results obtained by such equipment with aircraft performance, owing to the many variables involved, such as:

aircraft mass, speed, braking mechanism, tire and under-carriage characteristics.

6.2 The friction coefficient shall be measured if a runway is covered wholly or partly by snow or ice and repeated as conditions change. Friction measurements and/or braking action assessments on surfaces other than runways shall be made when an unsatisfactory friction condition can be expected on such surfaces.

6.3 The measurement of the friction coefficient provides the best basis for determining surface friction conditions. The value of surface friction shall be the maximum value which occurs when a wheel is slipping but still rolling. Various friction measuring devices may be used. As there is an operational need for uniformity in the method of assessing and reporting runway friction conditions, the measurements shall preferably be made with equipment which provides continuous measuring of the maximum friction along the entire runway. Measuring techniques and information on limitations of the various friction measuring devices and precautions to be observed are given in the Airport Services Manual, Part 2.

6.4 A chart, based on results of tests conducted on selected ice- or snow-covered surfaces, showing the correlation between certain friction measuring devices on ice- or snow-covered surfaces is presented in the Airport Services Manual, Part 2.

6.5 The friction conditions of a runway shall be expressed as «braking action information» in terms of the measured friction coefficient μ or estimated braking action. Specific numerical μ values are necessarily related to the design and construction of each friction measuring device as well as to the surface being measured and the speed employed.

6.6 The table below with associated descriptive terms was developed from friction data collected only in compacted snow and ice and shall not therefore be taken to be absolute values applicable in all conditions. If the surface is affected by snow or ice and the braking action is reported as «good», pilots shall not expect to find conditions as good as on a clean dry runway (where the available friction may well be greater than that needed in any case). The value «good» is a comparative value and is intended to mean that airplanes shall not experience directional control or braking difficulties, especially when landing.

Measured coefficient	Estimated braking action	Code
0.40 and above	Good	5
0.39 to 0.36	Medium to good	4
0.35 to 0.30	Medium	3
0.29 to 0.26	Medium to poor	2
0.25 and below	Poor	1

6.7 It has been found necessary to provide surface friction information for each third of a runway. The thirds are called A, B and C. For the purpose of reporting information to aeronautical service units, section A is always the section associated with the lower runway designation number. When giving landing information to a pilot before landing, the sections are however referred to as first, second or third part of the runway. The first part always means the first third of the runway as seen in the direction of landing. Friction measurements are made along two lines parallel to the runway, i.e. along a line on each side of the centre line approximately 3 m or that distance from the centre line at which most operations take place. The objective of the tests is to determine the mean friction value for sections A, B and C. In cases where a continuous friction measuring device is used, the mean values are obtained from the friction values recorded for each section.

The distance between each test point shall be approximately 10 per cent of the usable length of the runway. If it is decided that a single test line on one side of the runway centre line gives adequate coverage of the runway, then it follows that each third of the runway shall have three tests carried out on it. Test results and calculated mean friction values are entered in a special form (see Airport Services Manual, Part 2).

Note – Where applicable, figures for stopway friction value shall also be made available on request.

6.8 A continuous friction measuring device (e.g. Skiddometer, Surface Friction Tester, Mu-meter, Runway Friction Tester or Grip Tester), can be used for measuring the friction values for compacted snow-and ice-covered runways. A decelerometer (e.g. Tapley Meter or Brakemeter – Dynometer) may be used on certain surface conditions, e.g. compacted snow, ice and very thin layers of dry snow. Other friction measuring devices can be used, provided they have been correlated with at least one of the types mentioned above. A decelerometer shall not be used in loose snow or slush, as it can give misleading friction values. Other friction measuring devices can also give misleading friction values under certain combinations of contaminants and air/pavement temperature.

6.9 The Airport Services Manual, Part 2 provides guidance on the uniform use of test equipment to achieve compatible test results and other information on removal of surface contamination and improvement of friction conditions.

7. Determination of friction characteristics of wet paved runways

7.1 The friction of a wet paved runway shall be measured to:
a) verify the friction characteristics of new or resurfaced paved runways when wet (Chapter 3, 3.1.24);
b) assess periodically the slipperiness of paved runways when wet (Chapter 10, 10.2.3);
c) determine the effect on friction when drainage characteristics are poor (Chapter 10, 10.2.6); and
d) determine the friction of paved runways that become slippery under unusual conditions (Chapter 2, 2.9.8).

7.2 Runways shall be evaluated when first constructed or after resurfacing to determine the wet runway surface friction characteristics. Although it is recognized that friction reduces with use, this value will represent the friction of the relatively long central portion of the runway that is uncontaminated by rubber deposits from aircraft operations and is therefore of operational value. Evaluation tests shall be made on clean surfaces. If it is not possible to clean a surface before testing, then for purposes of preparing an initial report a test could be made on a portion of clean surface in the central part of the runway.

7.3 Friction tests of existing surface conditions shall be taken periodically in order to identify runways with low friction when wet. A State shall define what minimum friction level it considers acceptable before a runway is classified as slippery when wet and publish this value in the State's aeronautical information publication (AIP). When the friction of a runway is found to be below this reported value, then such information shall be promulgated by NOTAM.

The State shall also establish a maintenance planning level, below which, appropriate corrective maintenance action shall be initiated to improve the friction. However, when the friction characteristics for either the entire runway or a portion thereof are below the minimum friction level, corrective maintenance action must be taken without delay. Friction measurements shall be taken at intervals that will ensure identification of runways in need of maintenance or special surface treatment before the condition becomes serious. The time interval between measurements will depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and pavement service and maintenance requirements.

7.4 For uniformity and to permit comparison with other runways, friction tests of existing, new or resurfaced runways shall be made with a continuous friction measuring device provided with a smooth tread tire. The device shall have a capability of using self-wetting features to enable measurements of the friction characteristics of the surface to be made at a water depth of at least 1 mm.

7.5 When it is suspected that the friction characteristics of a runway may be reduced because of poor drainage, owing to inadequate slopes or depressions, then an additional test shall be made, but this time under natural conditions representative of a local rain. This test differs from the previous one in that water depths in the poorly cleared areas are normally greater in a local rain condition. The test results are thus more apt to

identify problem areas having low friction values that could induce aquaplaning than the previous test. If circumstances do not permit tests to be conducted during natural conditions representative of a rain, then this condition may be simulated.

7.6 Even when the friction has been found to be above the level set by the State to define a slippery runway, it may be known that under unusual conditions, such as after a long dry period, the runway may have become slippery. When such a condition is known to exist, then a friction measurement shall be made as soon as it is suspected that the runway may have become slippery.

7.7 When the results of any of the measurements identified in 7.3 through 7.6 indicate that only a particular portion of a runway surface is slippery, then action to promulgate this information and, if appropriate, take corrective action is equally important.

7.8 When conducting friction tests on wet runways, it is important to note that, unlike compacted snow and ice conditions, in which there is very limited variation of the friction coefficient with speed, a wet runway produces a drop in friction with an increase in speed. However, as the speed increases, the rate at which the friction is reduced becomes less. Among the factors affecting the friction coefficient between the tire and the runway surface, texture is particularly important. If the runway has a good macro-texture allowing the water to escape beneath the tire, then the friction value will be less affected by speed. Conversely, a low macro-texture surface will produce a larger drop in friction with increase in speed. Accordingly, when testing runways to determine their friction characteristics and whether maintenance action is necessary to improve it, a speed high enough to reveal these friction/speed variations shall be used.

7.9 Part 14, Volume I requires States to specify two friction levels as follows:

a) a maintenance friction level below which corrective maintenance action shall be initiated; and

b) a minimum friction level below which information that a runway may be slippery when wet shall be made available.

Furthermore, States shall establish criteria for the friction characteristics of new or resurfaced runway surfaces. Table A-1 provides guidance on establishing the design objective for new runway surfaces and maintenance planning and minimum friction levels for runway surfaces in use.

7.10 The friction values given above are absolute values and are intended to be applied without any tolerance. These values were developed from a research study conducted in a State. The two friction measuring tires mounted on the Mu-meter were smooth tread and had a special rubber formulation, i.e. Type A. The tires were tested at a 15 degree included angle of alignment along the longitudinal axis of the trailer. The single friction measuring tires mounted on the Skiddometer, Surface Friction Tester, Runway Friction Tester and TATRA were smooth tread and used the same rubber formulation, i.e. Type B. The GRIPTESTER was tested with a single smooth tread tire having the same rubber formulation as Type B but the size was smaller, i.e. Type C. The specifications of these tires (i.e. Types A, B and C) are contained in the Airport Services Manual, Part 2. Friction measuring devices using rubber formulation, tire tread/groove patterns, water depth, tire pressures, or test speeds different from those used in the program described above, cannot be directly equated with the friction values given in the table. The values

in columns (5), (6) and (7) are averaged values representative of the runway or significant portion thereof. It is considered desirable to test the friction characteristics of a paved runway at more than one speed.

7.11 Other friction measuring devices can be used, provided they have been correlated with at least one test equipment mentioned above. The Airport Services Manual, Part 2 provides guidance on the methodology for determining the friction values corresponding to the design objective, maintenance planning level and minimum friction level for a friction tester not identified in the above table.

Table A-1.

Test equipment	Test tire		Test speed (km/h)	Test water depth (mm)	Design objective for new surface	Maintenance planning level	Minimum friction level
	Type	Pressure (kPa)					
(1)	(2)		(3)	(4)	(5)	(6)	(7)
Mu-meter Trailer	A	70	65	1.0	0.72	0.52	0.42
	A	70	95	1.0	0.66	0.38	0.26
Skiddometer Trailer	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.47	0.34
Surface Friction Tester Vehicle	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.47	0.34
Runway Friction Tester Vehicle	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.54	0.41
TATRA Friction Tester Vehicle	B	210	65	1.0	0.76	0.57	0.48
	B	210	95	1.0	0.67	0.52	0.42
GRIPTESTER Trailer	C	140	65	1.0	0.74	0.53	0.43
	C	140	95	1.0	0.64	0.36	0.24

8. Strips

8.1 Shoulders

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

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

8.1.3 Attention shall also be paid when designing shoulders to prevent the ingestion of stones or other objects by turbine engines. Similar considerations apply here to those which are discussed for the margins of taxiways in the Aerodrome Design Manual, Part 2, both as to the special measures which may be necessary and as to the distance over which such special measures, if required, shall be taken.

8.1.4 Where shoulders have been treated specially, either to provide the required bearing strength or to prevent the presence of stones or debris, difficulties may arise because of a lack of visual contrast between the runway surface and that of the adjacent strip. This difficulty can be overcome either by providing a good visual contrast in the surfacing of the runway or strip, or by providing a runway side stripe marking.

8.2 Objects on strips

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

8.3 Grading of a strip for precision approach runways Chapter 3, 3.4.8 recommends that the portion of a strip of an instrument runway within at least 75 m from the centre line shall be graded where the code number is 3 or 4. For a precision approach runway, it may be desirable to adopt a greater width where the code number is 3 or 4. Figure A-3 shows the shape and dimensions of a wider strip that may be considered for such a runway. This strip has been designed using information on aircraft running off runways. The portion to be graded extends to a distance of 105 m from the 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.

9. Runway end safety areas

9.1 Where a runway end safety area is provided in accordance with Chapter 3, consideration shall be given to providing an area long enough to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localizer is normally the first upstanding obstacle, and the runway end safety area shall extend up to this facility. In other circumstances and on a non-precision approach or non-instrument runway, the first upstanding obstacle may be a road, a railroad or other constructed or natural feature. In such circumstances, the runway end safety area shall extend as far as the obstacle.

9.2 Where provision of a runway end safety area may involve encroachment in areas where it would be particularly prohibitive to implement, and the appropriate authority considers a runway end safety area essential, consideration may have to be given to reducing some of the declared distances.

10. Location of threshold

10.1 General

10.1.1 The threshold is normally located at the extremity of a runway, if there are no obstacles penetrating above the approach surface. In some cases, however, due to local conditions it may be desirable to displace the threshold permanently (see below). When studying the location of a threshold, consideration shall 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 Part 10, Volume I.)

10.1.2 In determining that no obstacle penetrate above the approach surface, account shall be taken of mobile objects (vehicles on roads, trains, etc.) at least within that portion of the approach area within 1200 m longitudinally from the threshold and of an overall width of not less than 150 m.

10.2 Displaced threshold

10.2.1 If an object extends above the approach surface and the object cannot be removed, consideration shall be given to displacing the threshold permanently.

10.2.2 To meet the obstacle limitation objectives of Chapter 4, the threshold shall ideally be displaced down the runway for the distance necessary to provide that the approach surface is cleared of obstacles.

10.2.3 However, displacement of the threshold from the runway extremity will inevitably cause reduction of the landing distance available, and this may be of greater operational significance than penetration of the approach surface by marked and lighted obstacles. A decision to displace the threshold, and the extent of such displacement, shall therefore have regard to an optimum balance between the considerations of clear approach surfaces and adequate landing distance. In deciding this question, account will need to be taken of the types of airplanes which the runway is intended to serve, the limiting visibility and cloud base conditions under which the runway will be used, the position of the obstacles in relation to the threshold and extended centre line and, in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.

10.2.4 Notwithstanding the consideration of landing distance available, the selected position for the threshold shall not be such that the obstacle-free surface to the threshold is steeper than 3.3 per cent where the code number is 4 or steeper than 5 per cent where the code number is 3.

10.2.5 In the event of a threshold being located according to the criteria for obstacle-free surfaces in the preceding paragraph, the obstacle marking requirements of Chapter 6 shall continue to be met in relation to the displaced threshold.

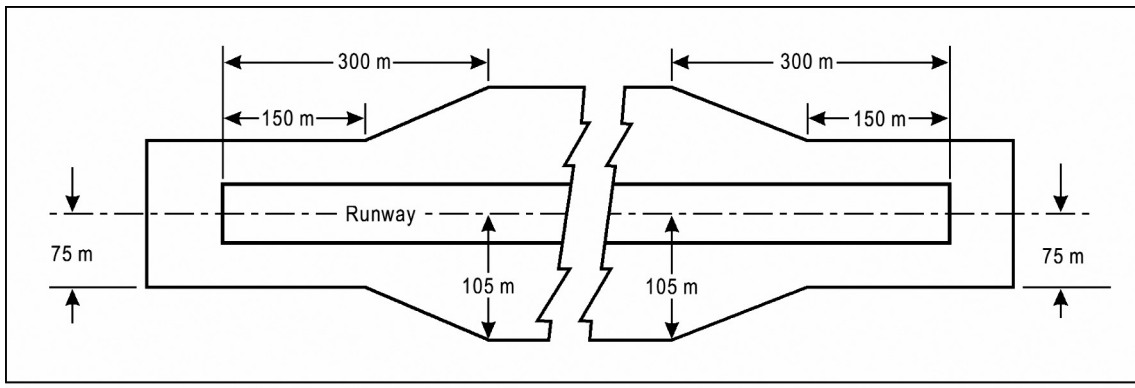


Figure A-3. Graded portion of a strip including a precision approach runway where the code number is 3 or 4

11. Approach lighting systems

11.1 Types and characteristics

11.1.1 The specifications in this regulation provide for the basic characteristics for simple and precision approach lighting systems. For certain aspects of these systems, some latitude is permitted, for example, in the spacing between centre line lights and crossbars. The approach lighting patterns that have been generally adopted are shown in Figures A-5 and A-6. A diagram of the inner 300 m of the precision approach category II and III lighting system is shown in Figure 5-13.

11.1.2 The approach lighting configuration is to be provided irrespective of the location of the threshold, i.e. whether the threshold is at the extremity of the runway or displaced from the runway extremity. In both cases, the approach lighting system shall 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 Chapter 5, 5.3.1.9, and the photometric requirements specified in Appendix 2, Figure A2-1 or A2-2.

11.1.3 Flight path envelopes to be used in designing the lighting are shown in Figure A-4.

11.2 Installation tolerances

Horizontal

11.2.1 The dimensional tolerances are shown in Figure A-6.

11.2.2 The centre line of an approach lighting system shall be as coincident as possible with the extended centre line of the runway with a maximum tolerance of ± 15'.

11.2.3 The longitudinal spacing of the centre line lights shall 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 cross-bars or a crossbar and a threshold.

11.2.4 The crossbars and barrettes shall be at right angles to the centre line of the approach lighting system with a tolerance of ± 30', if the pattern in Figure A-6 (A) is adopted or ± 2°, if Figure A-6 (B) is adopted.

11.2.5 When a crossbar has to be displaced from its standard position, any adjacent crossbar shall, where possible, be displaced by appropriate amounts in order to reduce the differences in the crossbar spacing.

11.2.6 When a crossbar in the system shown in Figure A-6 (A) is displaced from its standard position, its overall length shall 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 shall be kept symmetrical about the centre line of the approach lighting.

Vertical

11.2.7 The ideal arrangement is to mount all the approach lights in the horizontal plane passing through the threshold (see Figure A-7), and this shall be the general aim as far as local conditions permit. However, buildings, trees, etc., shall 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.

11.2.8 Within a stopway or clearway, and within 150 m of the end of a runway, the lights shall be mounted as near to the ground as local conditions permit in order to minimize risk of damage to airplanes 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.

11.2.9 It is desirable that the lights be mounted so that, as far as possible, no object within a distance of 60 m on each side of the 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.

11.2.10 In order to avoid giving a misleading impression of the plane of the ground, the lights shall 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.

11.2.11 Centre line. The gradients of the centre line in any section (including a stopway or clearway) shall be as small as practicable, and the changes in gradients shall be as few and small as can be arranged and shall 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.

11.2.12 Crossbars. The crossbar lights shall be so arranged as to lie on a straight line passing through the associated centre line lights, and wherever possible this line shall 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.

11.3 Clearance of obstacles

11.3.1 An area, hereinafter referred to as the light plane, has been established for obstacle clearance purposes, and all lights of the system are in this plane. This plane is rectangular in shape and symmetrically located about the approach lighting system's centre line. It starts at the threshold and extends 60 m beyond the approach end of the system, and is 120 m wide.

11.3.2 No objects are permitted to exist within the boundaries of the light plane which are higher than the light plane except as designated herein. All roads and highways are considered as obstacles extending 4.8 m above the crown of the road, except aerodrome service roads where all vehicular traffic is under control of the aerodrome authorities and coordinated with the aerodrome traffic control tower. Railroads, regardless of the amount of traffic, are considered as obstacles extending 5.4 m above the top of the rails.

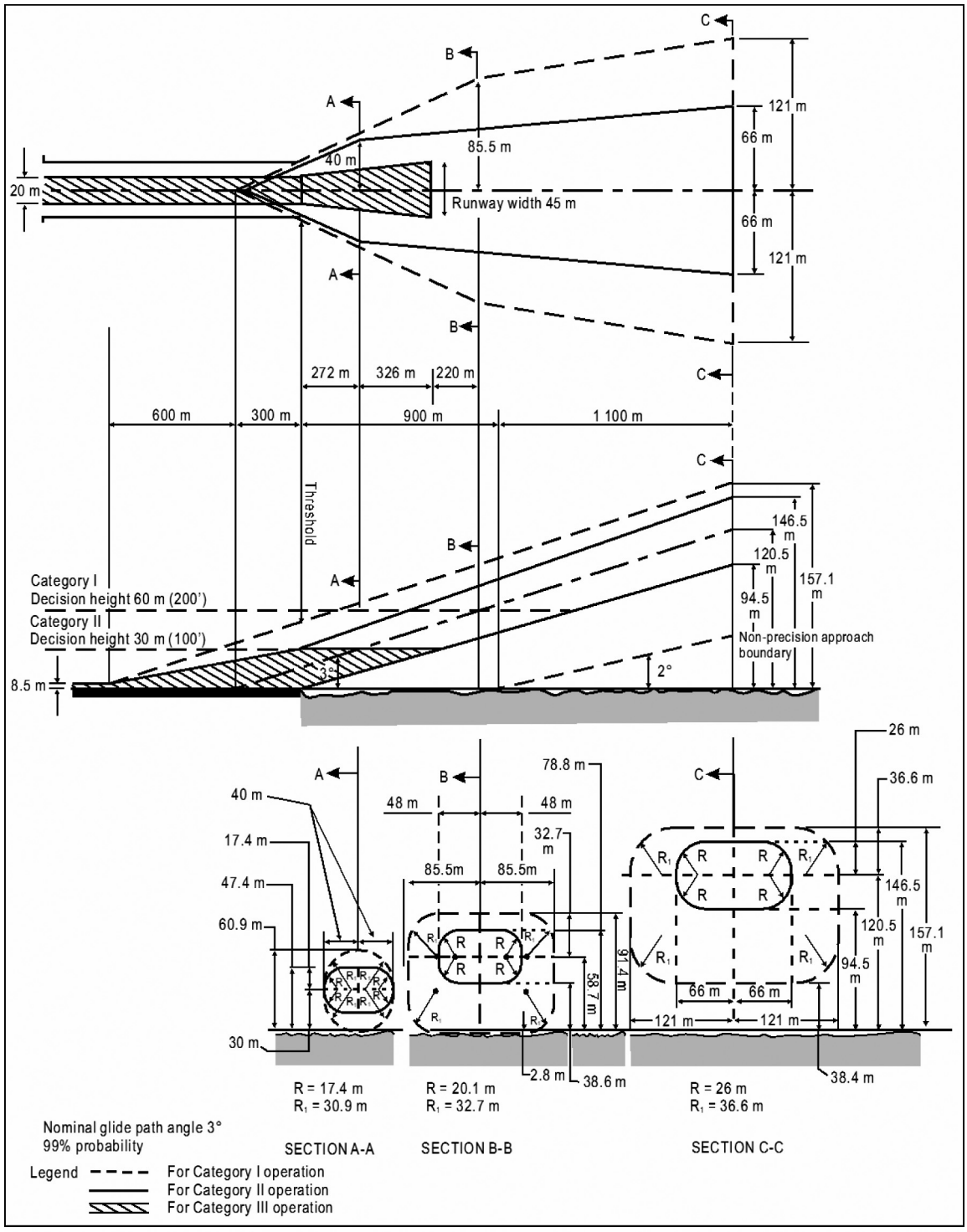


Figure A-4. Flight path envelopes to be used for lighting design for category I, II and III operations

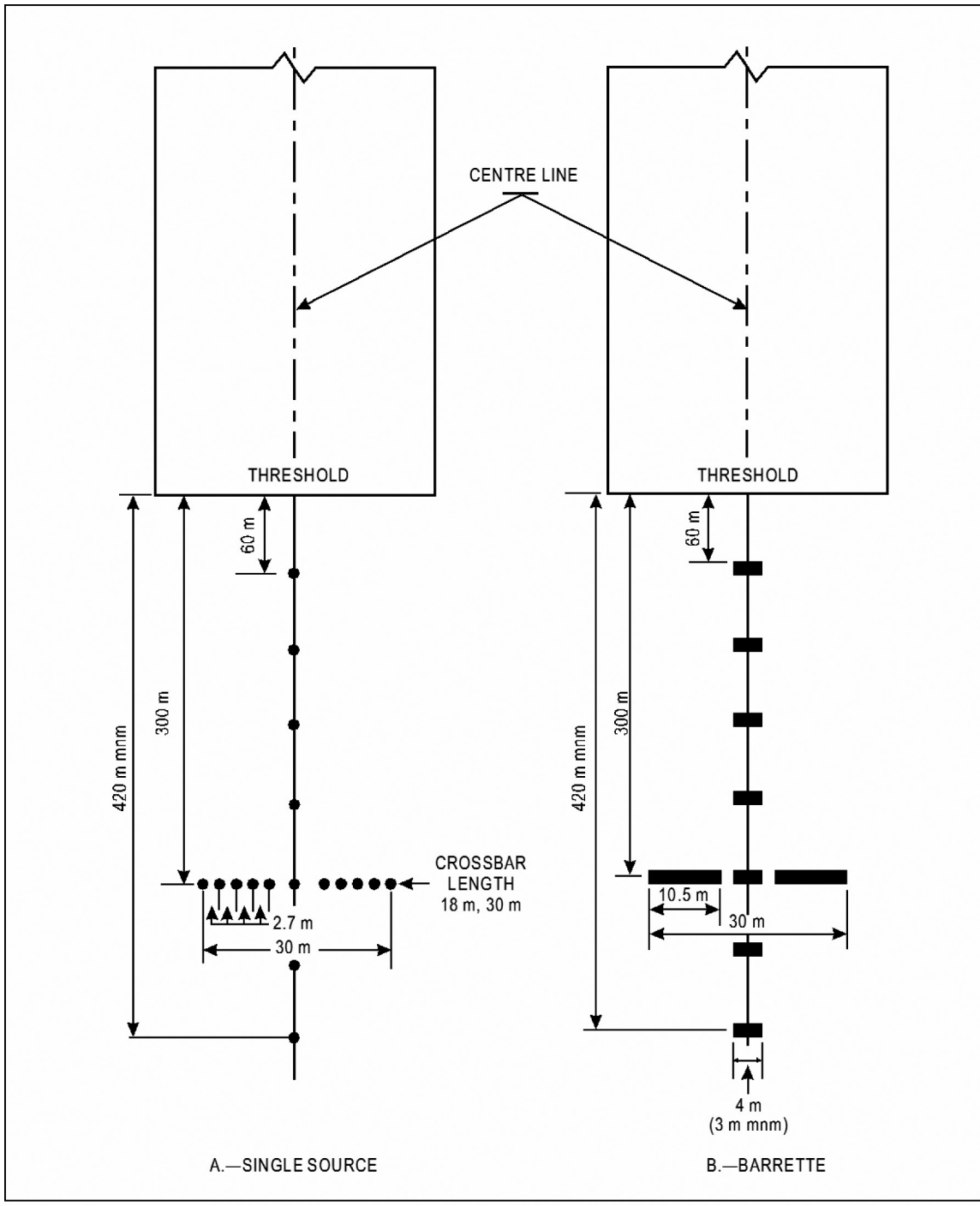


Figure A-5. Simple approach lighting systems

Figure A-6. Precision approach category I lighting systems

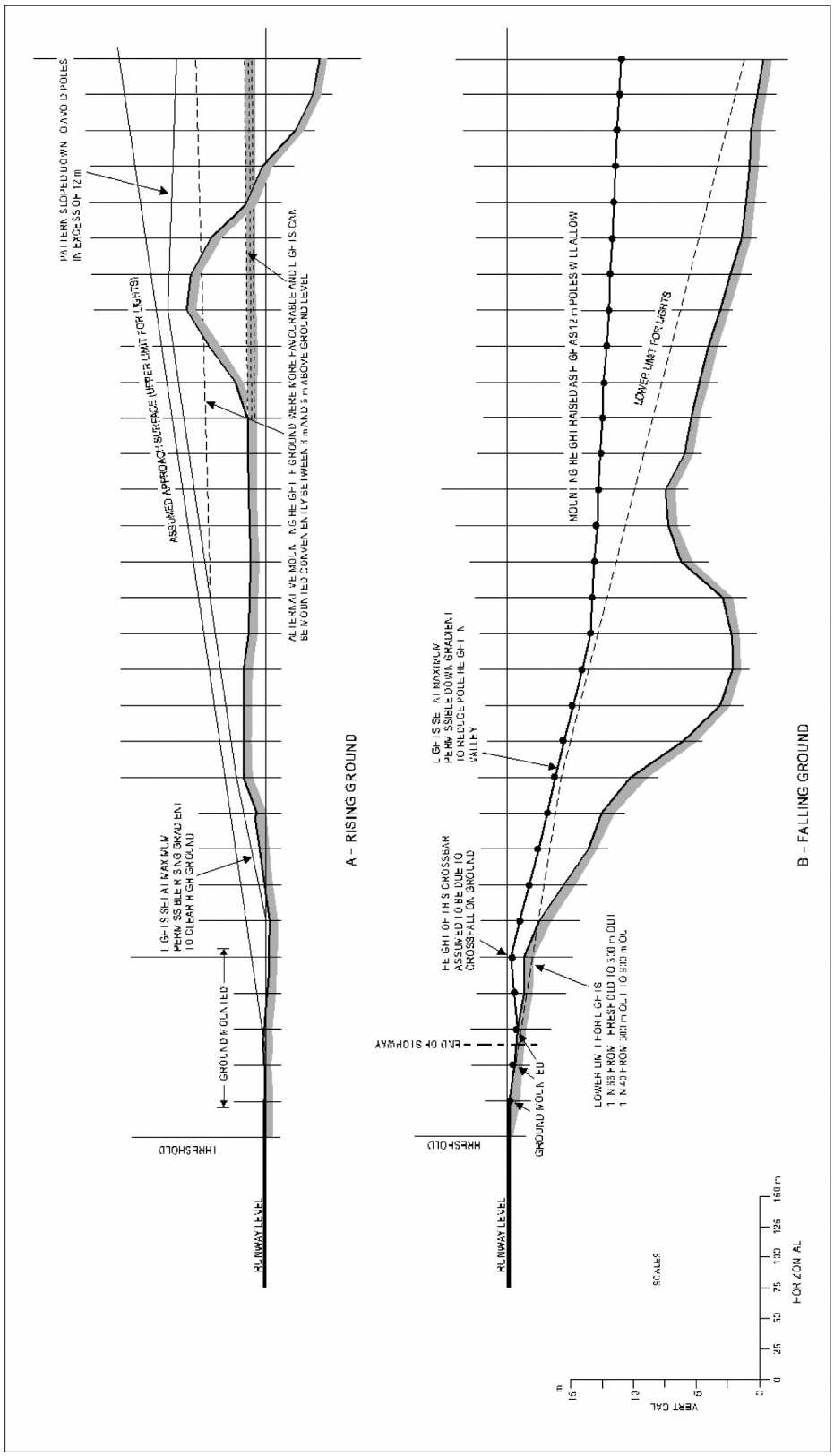


Figure A-1. Vertical installation tolerances

11.3.3 It is recognized that some components of electronic landing aids systems, such as reflectors, antennas, monitors, etc., must be installed above the light plane. Every effort shall 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.

11.3.4 Where an ILS localizer is installed within the light plane boundaries, it is recognized that the localizer, or screen if used, must extend above the light plane. In such cases the height of these structures shall be held to a minimum and they shall be located as far from the threshold as possible. In general the rule regarding permissible heights is 15 cm for each 30 m the structure is located from the threshold. As an example, if the localizer is located 300 m from the threshold, the screen will be permitted to extend above the plane of the approach lighting system by 10 × 15 = 150 cm maximum, but preferably shall be kept as low as possible consistent with proper operation of the ILS.

11.3.5 In locating an MLS azimuth antenna the guidance contained in Part 10, Volume I, Attachment G shall be followed. This material, which also provides guidance on collocating an MLS azimuth antenna with an ILS localizer 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 shall 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 shall 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.)

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 shall 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.

11.3.6 Objects existing within the boundaries of the light plane, requiring the light plane to be raised in order to meet the criteria contained herein, shall be removed, lowered or relocated where this can be accomplished more economically than raising the light plane.

11.3.7 In some instances objects may exist which cannot be removed, lowered or relocated economically. These objects may be located so close to the threshold that they cannot be cleared by the 2 per cent slope. Where such conditions exist and no alternative is possible, the 2 per cent slope may be exceeded or a «stair step» resorted to in order to keep the approach lights above the objects. Such «step» or increased gradients shall be resorted to only when it is impracticable to follow standard slope criteria, and they shall be held to the absolute minimum. Under this criterion no negative slope is permitted in the outermost portion of the system.

11.4 Consideration of the effects of reduced lengths

11.4.1 The need for an adequate approach lighting system to support precision approaches where the pilot is required to acquire visual references prior to landing, cannot be stressed too strongly. The safety and regularity of such operations is dependent on this visual acquisition. The height above runway threshold at which the pilot decides there are sufficient visual cues to continue the precision approach and land will vary, depending on the type of approach being conducted and other factors such as meteorological conditions, ground and airborne equipment, etc. The required length of approach lighting system which will support all the variations of such approaches is 900 m, and this shall always be provided whenever possible.

11.4.2 However, there are some runway locations where it is impossible to provide the 900 m length of approach lighting system to support precision approaches.

11.4.3 In such cases, every effort shall be made to provide as much approach lighting system as possible. The appropriate authority may impose restrictions on operations to runways equipped with reduced lengths of lighting. There are many factors which determine at what height the pilot must have decided to continue the approach to land or execute a missed approach. It must be understood that the pilot does not make an instantaneous judgment upon reaching a specified height. The actual decision to continue the approach and landing sequence is an accumulative process which is only concluded at the specified height. Unless lights are available prior to reaching the decision point, the visual assessment process is impaired and the likelihood of missed approaches will increase substantially. There are many operational considerations which must be taken into account by the appropriate authorities in deciding if any restrictions are necessary to any precision approach and these are detailed in Part 6.

12. Priority of installation of visual approach slope indicator systems

12.1 It has been found impracticable to develop guidance material that will permit a completely objective analysis to be made of which runway on an aerodrome shall receive first priority for the installation of a visual approach slope indicator system. However, factors that must be considered when making such a decision are:

a) frequency of use;
b) seriousness of the hazard;
c) presence of other visual and non-visual aids;
d) type of airplanes using the runway; and
e) frequency and type of adverse weather conditions under which the runway will be used.

12.2 With respect to the seriousness of the hazard, the order given in the application specifications for a visual approach slope indicator system, 5.3.5.1 b) to e) of Chapter 5 may be used as a general guide. These may be summarized as:

a) inadequate visual guidance because of:
1) approaches over water or featureless terrain, or absence of sufficient extraneous light in the approach area by night;
2) deceptive surrounding terrain;
b) serious hazard in approach;
c) serious hazard if airplanes undershoot or overrun; and
d) unusual turbulence.

12.3 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 must be remembered, though, that visual approach slope indicator systems are visual approach aids in their own right and can supplement electronic aids. When serious hazards exist and/or a substantial number of airplanes not equipped for ILS or MLS use a runway, priority might be given to installing a visual approach slope indicator on this runway.

12.4 Priority shall be given to runways used by turbo-jet airplanes.

13. Lighting of unserviceable areas

Where a temporarily unserviceable area exists, it may be marked with fixed-red lights. These lights shall mark the most potentially dangerous extremities of the area. A minimum of four such lights shall be used, except where the area is triangular in shape where a minimum of three lights may be employed. The number of lights shall be increased when the area is large or of unusual configuration. At least one light shall be installed for each 7.5 m of peripheral distance of the area. If the lights are directional, they shall be orientated so that as far as possible their beams are aligned in the direction from which aircraft or vehicles will approach. Where aircraft or vehicles will normally approach from several directions, consideration shall be given to adding extra lights or using omnidirectional lights to show the area from these directions. Unserviceable area lights shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for engine pods of jet aircraft.

14. Rapid exit taxiway indicator lights

14.1 Rapid exit taxiway indicator lights (RETILs) comprise a set of yellow unidirectional lights installed in the runway adjacent to the centre line. The lights are positioned in a 3-2-1 sequence at 100 m intervals prior to the point of tangency of the rapid exit taxiway centre line. They are intended to give an indication to pilots of the location of the next available rapid exit taxiway.

14.2 In low visibility conditions, RETILs provide useful situational awareness cues while allowing the pilot to concentrate on keeping the aircraft on the runway centre line.

14.3 Following a landing, runway occupancy time has a significant effect on achievable runway capacity. RETILs allow pilots to maintain a good roll-out speed until it is necessary to decelerate to an appropriate speed for the turn into a rapid exit turn-off. A roll-out speed of 60 knots until the first RETIL (three-light barrette) is reached is seen as the optimum.

15. Intensity control of approach and runway lights

15.1 The conspicuity of a light depends on the impression received of contrast between the light and its background. If a light is to be useful to a pilot by day when on approach, it must have an intensity of at least 2 000 or 3000 cd, and in the case of approach lights an intensity of the order of 20000 cd is desirable. In conditions of very bright daylight fog it may not be possible to provide lights of sufficient intensity to be effective. On the other hand, in clear weather on a dark night, an intensity of the order of 100 cd for approach lights and 50 cd for the runway edge lights may be found suitable. Even then, owing to the closer range at which they are

viewed, pilots have sometimes complained that the runway edge lights seemed unduly bright.

15.2 In fog the amount of light scattered is high. At night this scattered light increases the brightness of the fog over the approach area and runway to the extent that little increase in the visual range of the lights can be obtained by increasing their intensity beyond 2000 or 3000 cd. In an endeavor to increase the range at which lights would first be sighted at night, their intensity must not be raised to an extent that a pilot might find excessively dazzling at diminished range.

15.3 From the foregoing will be evident the importance of adjusting the intensity of the lights of an aerodrome lighting system according to the prevailing conditions, so as to obtain the best results without excessive dazzle that would disconcert the pilot. The appropriate intensity setting on any particular occasion will depend both on the conditions of background brightness and the visibility. Detailed guidance material on selecting intensity setting for different conditions is given in the Aerodrome Design Manual, Part 4.

16. Signal area

A signal area need be provided only when it is intended to use visual ground signals to communicate with aircraft in flight. Such signals may be needed when the aerodrome does not have an aerodrome control tower or an aerodrome flight information service unit, or when the aerodrome is used by airplanes not equipped with radio. Visual ground signals may also be useful in the case of failure of two-way radio communication with aircraft. It shall be recognized, however, that the type of information which may be conveyed by visual ground signals shall normally be available in AIPs or NOTAM. The potential need for visual ground signals shall therefore be evaluated before deciding to provide a signal area.

17. Rescue and fire fighting services

17.1 Administration

17.1.1 The rescue and fire fighting service at an aerodrome shall be under the administrative control of the aerodrome management, which shall also be responsible for ensuring that the service provided is organized, equipped, staffed, trained and operated in such a manner as to fulfill its proper functions.

17.1.2 In drawing up the detailed plan for the conduct of search and rescue operations in accordance with 4.2.1 of Part 12, the aerodrome management shall coordinate its plans with the relevant rescue coordination centers to ensure that the respective limits of their responsibilities for an aircraft accident within the vicinity of an aerodrome are clearly delineated.

17.1.3 Coordination between the rescue and fire fighting service at an aerodrome and public protective agencies, such as local fire brigade, police force, coast guard and hospitals, shall be achieved by prior agreement for assistance in dealing with an aircraft accident.

17.1.4 A grid map of the aerodrome and its immediate vicinity shall be provided for the use of the aerodrome services concerned. Information concerning topography, access roads and location of water supplies shall be indicated. This map shall be conspicuously posted in the control tower and fire station, and available on the rescue and fire fighting vehicles and

such other supporting vehicles required to respond to an aircraft accident or incident. Copies shall also be distributed to public protective agencies as desirable.

17.1.5 Coordinated instructions shall be drawn up detailing the responsibilities of all concerned and the action to be taken in dealing with emergencies. The appropriate authority shall ensure that such instructions are promulgated and observed.

17.2 Training

The training curriculum shall include initial and recurrent instruction in at least the following areas:
a) airport familiarization;
b) aircraft familiarization;
c) rescue and fire fighting personnel safety;
d) emergency communications systems on the aerodrome, including aircraft fire related alarms;
e) use of the fire hoses, nozzles, turrets and other appliances required for compliance with Chapter 9, 9.2;
f) application of the types of extinguishing agents required for compliance with Chapter 9, 9.2;
g) emergency aircraft evacuation assistance;
h) fire fighting operations;
i) adaptation and use of structural rescue and fire fighting equipment for aircraft rescue and fire fighting;
j) dangerous goods;
k) familiarization with fire fighters' duties under the aerodrome emergency plan; and
l) protective clothing and respiratory protection.

17.3 Level of protection to be provided

17.3.1 In accordance with Chapter 9, 9.2 aerodromes shall be categorized for rescue and fire fighting purposes and the level of protection provided shall be appropriate to the aerodrome category.

17.3.2 However, Chapter 9, 9.2.3 permits a lower level of protection to be provided for a limited period where the number of movements of the airplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months. It is important to note that the concession included in 9.2.3 is applicable only where there is a wide range of difference between the dimensions of the airplanes included in reaching 700 movements.

17.4 Rescue equipment for difficult environments

17.4.1 Suitable rescue equipment and services shall be available at an aerodrome where the area to be covered by the service includes water, swampy areas or other difficult environment that cannot be fully served by conventional wheeled vehicles. This is particularly important where a significant portion of approach/departure operations takes place over these areas.

17.4.2 The rescue equipment shall be carried on boats or other vehicles such as helicopters and amphibious or air cushion vehicles, capable of operating in the area concerned. The vehicles shall be so located that they can be brought into action quickly to respond to the areas covered by the service.

17.4.3 At an aerodrome bordering the water, the boats or other vehicles shall preferably be located on the aerodrome, and convenient launching or docking sites provided. If these vehicles are located off the aerodrome, they shall preferably be under the control of the aerodrome rescue and fire fighting service or, if this is not practicable, under the control of another competent public or private organization working in close coordination with the aerodrome rescue and fire fighting service (such as police, military services, harbor patrol or coast guard).

17.4.4 Boats or other vehicles shall have as high a speed as practicable so as to reach an accident site in minimum time. To reduce the possibility of injury during rescue operations, water jet-driven boats are preferred to water propeller-driven boats unless the propellers of the latter boats are ducted. Shall the water areas to be covered by the service be frozen for a significant period of the year, the equipment shall be selected accordingly. Vehicles used in this service shall be equipped with life rafts and life preservers related to the requirements of the larger aircraft normally using the aerodrome, with two-way radio communication, and with floodlights for night operations. If aircraft operations during periods of low visibility are expected, it may be necessary to provide guidance for the responding emergency vehicles.

17.4.5 The personnel designated to operate the equipment shall be adequately trained and drilled for rescue services in the appropriate environment.

17.5 Facilities

17.5.1 The provision of special telephone, two-way radio communication and general alarm systems for the rescue and fire fighting service is desirable to ensure the dependable transmission of essential emergency and routine information. Consistent with the individual requirements of each aerodrome, these facilities serve the following purposes:

a) direct communication between the activating authority and the aerodrome fire station in order to ensure the prompt alerting and dispatch of rescue and fire fighting vehicles and personnel in the event of an aircraft accident or incident;

b) emergency signals to ensure the immediate summoning of designated personnel not on standby duty;

c) as necessary, summoning essential related services on or off the aerodrome; and

d) maintaining communication by means of two-way radio with the rescue and fire fighting vehicles in attendance at an aircraft accident or incident.

17.5.2 The availability of ambulance and medical facilities for the removal and after-care of casualties arising from an aircraft accident shall receive the careful consideration of the appropriate authority and shall form part of the overall emergency plan established to deal with such emergencies.

18. Operators of vehicles

18.1 The authorities responsible for the operation of vehicles on the movement area shall ensure that the operators are properly qualified. This may include, as appropriate to the driver's function, knowledge of:

a) the geography of the aerodrome;

b) aerodrome signs, markings and lights;

c) radiotelephone operating procedures;

d) terms and phrases used in aerodrome control including the ICAO spelling alphabet;
e) rules of air traffic services as they relate to ground operations;
f) airport rules and procedures; and
g) specialist functions as required, for example, in rescue and fire fighting.

18.2 The operator shall be able to demonstrate competency, as appropriate, in:
a) the operation or use of vehicle transmit/receive equipment;
b) understanding and complying with air traffic control and local procedures;
c) vehicle navigation on the aerodrome; and
d) special skills required for the particular function.
In addition, as required for any specialist function, the operator shall be the holder of a State driver's license, a State radio operator's license or other licenses.

18.3 The above shall be applied as is appropriate to the function to be performed by the operator and it is not necessary that all operators be trained to the same level, for example, operators whose functions are restricted to the apron.

18.4 If special procedures apply for operations in low visibility conditions, it is desirable to verify an operator's knowledge of the procedures through periodic checks.

19. The ACN-PCN method of reporting pavement strength

19.1 Overload operations

19.1.1 Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behavior are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behavior is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor over-loading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:
a) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10 per cent above the reported PCN shall not adversely affect the pavement;
b) for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5 per cent above the reported PCN shall not adversely affect the pavement;
c) if the pavement structure is unknown, the 5 per cent limitation shall apply; and
d) the annual number of overload movements shall not exceed approximately 5 per cent of the total annual aircraft movements.

19.1.2 Such overload movements shall not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading shall be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its sub-grade could

be weakened by water. Where overload operations are conducted, the appropriate authority shall review the relevant pavement condition regularly, and shall also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

19.2 ACNs for several aircraft types For convenience, several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four sub-grade strength categories in Chapter 2, 2.6.6 b) and the results tabulated in the Aerodrome Design Manual, Part 3.

ATTACHMENT B. OBSTACLE LIMITATION SURFACES

OBSTACLE LIMITATION SURFACES
Note.— The figure shows the obstacle limitation surfaces at an aerodrome with two runways, an instrument runway and a non-instrument runway. Both are also take-off runways.
Take-off climb surface
15 000 m
3.4
Slope 2%
Inner horizontal surface
Instrument runways
4 000 m 3 500 m
3,4 1,2
Conical surface
Slope 5%
Transitional surface
Slope 14,3% 3,4
20% 1,2
Take-off climb surface
15 000 m 3,4
2 500 m 2
1 600 m 1
Slope 2% 3,4
4% 2
5% 1
Approach surface
Non-instrument runway
3 000 m 3,4
2 500 m 2
1 600 m 1
Slope
2,5% 4
3,33 % 3
4% 2
5% 1
3 000 m 3,4
Slope 2%
Approach surface – Instrument runway
3 600 m
Slope 2,5%
8 400 m
Horizontal section
45 m

Figure B-1