



WORKING PAPER

AIR NAVIGATION COMMISSION

AN Programme No. A1-SMP-ACT: Manage hazards and risks
AN Programme No. D1-ANS-ADO: Aerodrome design and operations

**REVIEW OF THE REPORT OF THE SECOND MEETING OF THE AERODROMES PANEL
(AP/2) AND PRELIMINARY REVIEW OF PROPOSED AMENDMENTS TO ANNEX 14,
VOLUMES I AND II, ANNEX 15 AND PANS-ATM
(Item No. 18601)**

(Presented by the Chairman of the ANC Working Group of the Whole on AN
Work Programme Deliverables Production)

SUMMARY The report of the second meeting of the Aerodromes Panel (AP/2) is presented for review by the Air Navigation Commission. Action by the Air Navigation Commission is in paragraph 3.
COORDINATION All ANB Sections
REFERENCES AN-WP/8385 AN Min. 184-5 Annex 14, Volumes I and II Annex 15 Doc. 4444 PANS-ATM * Report of the AP/2 Meeting (https://portal.icao.int/Panel/Reports) *Principal reference

1. INTRODUCTION

1.1 The second meeting of the Aerodromes Panel (AP/2) was held in Montréal from 12 to 15 October 2010. The meeting was attended by fifty members, advisors and observers nominated by sixteen Member States and eight international organizations.

1.2 The meeting considered all seven agenda items and formulated nine recommendations. Proposed action by the Commission on those recommendations is contained in the appendix to this paper in the form of a supplement to the report.

2. SUMMARY OF THE WORK OF THE MEETING AND SECRETARIAT'S COMMENTS.

2.1 Agenda Item 1: Aerodrome design specifications including RESA and associated mitigating measures

2.1.1 Under this agenda item, the meeting developed amendment proposals for incorporation into Annex 14 — *Aerodromes*, Volume I — *Aerodrome Design and Operations*, concerning runway end safety areas (RESA) and associated mitigating measures, runway shoulders and blast pads on runway ends (Recommendation 1/1 refers).

2.1.2 The meeting also discussed some other aerodrome design topics, including code letter F specifications, a comprehensive review of Annex 14, Volume I, Chapter 3 on physical characteristics for all code letters and taxiway naming convention. There were no amendments proposed on these topics. The meeting agreed: that the panel had completed the review of the code letter F specifications, insofar as they could be completed without the wider Annex 14, Volume I, Chapter 3 review; that given the large nature of the Chapter 3 review, the results of the work could only be submitted to the next panel meeting; and that taxiway naming convention should be included in the future work programme.

Secretariat's comments

2.1.3 The Secretariat supports Recommendation 1/1. It should be noted that the requirement for RESA is strengthened in the amendment proposal, as all runways are required to be provided with RESA, including non-instrument runways with code numbers 1 and 2. The introduction of arresting systems in relation to the provision of RESA offers additional mitigating measures to address runway overruning, a serious occurrence of runway excursion that has resulted in a number of fatal accidents in recent years.

2.1.4 It should also be noted that the panel has made good progress on the comprehensive review of Annex 14, Volume I, Chapter 3, which has evolved to cover an extensive scope of work, including the review of aerodrome reference code (ARC).

2.2 Agenda Item 2: Visual aids for navigation

2.2.1 Under this agenda item, the meeting developed amendment proposals for incorporation into Annex 14, Volume I concerning the marking and lighting of visual aids for navigation.

2.2.2 The amendment proposals relate to a wide range of topics in the areas of: the enhanced taxiway centre line marking; the limitation of runway holding positions (RHPs) to a maximum of two at any single runway/taxiway intersection; alternating green and yellow taxiway centre line lights to denote proximity to a runway; enhancing the conspicuity of stop bars; runway guard lights; runway status lights (RWSLs); no entry bars; the use of light emitting diode (LED) technology in visual aids; defining LED white boundaries; intermixing of multiple-source aerodrome lighting technologies; simple touchdown zone lights to assist the prevention of runway excursions; application for visual approach slope indicator systems; and proposed changes to Annex 14, Chapter 6, Visual Aids for Denoting Obstacles (Recommendation 2/1 refers).

2.2.3 The principle of limiting the number of RHPs at any single runway/taxiway intersection to a maximum of two was accepted by the meeting as an appropriate runway incursion prevention measure; however, the meeting noted that the introduction of this provision in Annex 14, Volume I, Chapter 5 would conflict with Annex 14, Volume I, Chapter 3. The meeting left it to the Secretariat to study the issue, to determine whether or not the limitation belonged in Chapter 3 rather than in Chapter 5, and to make any changes needed.

2.2.4 The proposals regarding stop bars introduce a limitation of a single illuminated stop bar at any given time and a requirement for ATC clearance in addition to the extinguishing of an illuminated stop bar before a flight crew could proceed.

2.2.5 The proposals for runway guard lights (RGLs) involve a recommendation for their operation during all visibility conditions and not only on runways operated in certain visibility conditions.

2.2.6 A new section is proposed for the introduction of runway status lights (RWSLs). The goal of the meeting was to ensure that an internationally consistent visual signal is provided to flight crews when RWSLs are to be used. The application of RWSLs is introduced as a Recommendation in the body of Annex 14, Volume I and RWSL characteristics are introduced into the supplementary guidance material in Attachment A. The focus is on the displayed visual signal of the RWSL system for the sake of an internationally consistent pattern for flight crews and no restriction to national or regional development of different underlying RWSL system technology is introduced.

2.2.7 A new section is proposed for Annex 14, Volume I for the recommendation of simple touchdown zone lights when high approach angles and short runways coincide and standard runway touchdown zone lights have not been installed. The installation of these lights on active runways by member States has been shown to drastically reduce the number of runway excursions in such situations.

2.2.8 The proposed changes to Annex 14, Volume I, Chapter 6 reflect three separate categories: the first is the restructuring of Chapter 6 to make it more readable and user friendly for the target audience of obstacle owners/operators; the second is the content of the SARPs; and the third is the revision of Table 6-3 to also make it more readable.

Secretariat's comments

2.2.9 The Secretariat agrees in principle to the proposal to limit the number of RHPs to a maximum of two. With regard to the Secretariat conducting further study on the subject, the Secretariat considers that the provision limiting the number of RHPs belongs in Chapter 3 as opposed to Chapter 5 as proposed by the Panel. The Secretariat also believes that the proposed limitation to a maximum of two RHPs involves more than the introduction of a note or a slight change of words. It requires further examination by the working groups of the Aerodromes Panel to consider any unintended consequences. Thus, the Secretariat recommends that the proposed change to Annex 14, Volume I, paragraph 5.2.10.3 be referred back to the panel for further study.

2.2.10 The Secretariat notes that the original intent of the Visual Aids Working Group (VAWG) for the proposed changes to Annex 14, Volume I, paragraph 5.3.22.2 was to recommend that RGLs be used at all taxiway/runway intersections in all weather conditions during day and night. This runway incursion prevention measure had been discussed and developed over several meetings. While the Secretariat notes that the meeting agreed to weaken the recommendation at the intervention of a member, it continues to support the guiding principle of the original proposal of a strong

recommendation for the enhancement of runway incursion prevention measures. Noting that the aviation community as a whole seeks measures to combat the continuing occurrence of runway incursions, the Secretariat recommends that the original proposal be retained, as follows:

5.3.22.2 Recommendation. - *As part of runway incursion prevention measures, Runway guard lights, Configuration A or B, should be provided at each taxiway/runway intersection and used under all weather conditions during day and night. ~~associated with a runway intended for use in:~~*

2.2.18 Consequential to the proposed amendment to Note 1 of paragraph 5.3.19.13 of Annex 14, Volume I regarding a requirement for an ATC clearance in addition to the extinguishing of an illuminated stop bar prior to a flight crew proceeding, internal Secretariat coordination following the meeting determined the need for an amendment to paragraph 3.2.2.7.3 of Annex 2 — *Rules of the Air*, and paragraph 7.15.7 of the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444). This coordination also determined the need to add the word “explicit” to the proposed amendment to Note 1 of paragraph 5.3.19.13. The amendments are proposed by the Secretariat as follows:

Annex 14, Volume I, 5.3.19.13, *Note 1.* – *A stop bar is switched on to indicate that traffic stop and switched off to indicate that traffic ~~may~~ proceed in conjunction with an explicit ATC clearance.*

Annex 2, 3.2.2.7.3, An aircraft taxiing on the manoeuvring area shall stop and hold at all lighted stop bars and may proceed further when the lights are switched off *in conjunction with an explicit ATC clearance.*

PANS-ATM (Doc 4444), 7.15.7 Stop bars, Stop bars shall be switched on to indicate that all traffic shall stop and switched off to indicate that traffic may proceed *in conjunction with an explicit ATC clearance.*

2.3 **Agenda Item 3: Rescue and fire fighting**

2.3.1 Under this agenda item, the meeting developed amendment proposals for incorporation into Annex 14, Volume I and Volume II — *Heliports*, concerning rescue and fire fighting.

2.3.2 The amendment proposals relate to a wide range of topics in the areas of aerodrome emergency planning, emergencies in difficult environments, performance level “C” foam, minimum staffing levels for rescue and fire fighting service and response time for heliports (Recommendation 3/1 refers).

2.3.3 With regard to the modular approach to aerodrome emergency planning, the new system, while providing additional flexibility, was also expected to alleviate problems in situations where the aerodrome operator finds it difficult to find mutual aid agencies to participate during the emergency exercises.

2.3.4 Concerning the proposed amendment introducing a new generation of extinguishing agent for fire fighting, the new performance level “C” foam was seen to be, on average, 52 per cent and 20 per cent more efficient than current performance level “A” and “B” foams, respectively, based on the revised quantities of water required. It was recognized that the use of the new foam should result in either a reduction in the size of new fire vehicles or an increase in fire fighting capabilities in existing vehicles.

2.3.5 The revised minimum usable amounts of extinguishing agents in the proposed Table 9-3 was based on the largest overall length of aeroplanes in a given category as opposed to the median aeroplane in the existing Table 9-2. Apart from category 1 where a 100 per cent increase in quantities of water across the three performance level foams has resulted, it is noted that a recalculation using the largest overall length of aeroplane resulted in, on average, an 18 per cent increase in quantities of water required for performance level “A” and “B” foams and a 14 percent increase for performance level “C” foam, as compared to when using the median aeroplane. With regard to the 100 per cent increase in water quantities for category 1 aerodromes, the increase in cost could be mitigated in two ways: a) by using the more efficient performance level “C” foam which requires only 320 litres of water (Table 9-3) compared to 350 litres (performance level “A”) and 230 litres (performance level “B”) in Table 9-2; or b) replacing up to 100 per cent of the quantities of water by complementary agents.

Secretariat’s comments

2.3.6 The performance level “C” foam was expected to initially cost more than the performance level “A” and “B” foams; however, with economies of scale, the cost was expected to decrease. Due to improved performance and potential savings on vehicle costs since less water and foam would need to be carried, a net cost savings arising from the use of the level “C” foam was envisaged. It could, therefore, be reasonably inferred that the use of the performance level “C” foam could be a way to upgrade the RFF capabilities of existing aerodromes without expending considerable resources. The amendment proposal is strongly supported.

2.3.7 Concerning the applicability date for the full implementation of Table 9-3 as a Standard in 9.2.11A based on the largest overall length of aeroplanes, the Secretariat agreed with the proposed date of 2022. This would provide a realistic time frame for aerodrome operators and RFF service providers to prepare for increases in the amount of extinguishing agents to be carried on the basis that rescue and fire vehicles normally had their half life re-fit after ten years.

2.4 Agenda Item 4: Aerodrome operations and services

2.4.1 Under this agenda item, the meeting developed amendment proposals for incorporation into Annex 14, Volume I, Annex 15 — *Aeronautical Information Services* and PANS-ATM relating to runway surface friction measurement and reporting. The meeting also developed a proposal to amend Annex 14, Volume I regarding revised limits to the maximum allowable tire pressure category used in the Aircraft Classification Number/Pavement Classification Number (ACN/PCN) system (Recommendations 4/1, 4/2 and 4/3 refer).

2.4.2 The proposed amendments to Annex 14, Volume I, Annex 15 and PANS-ATM on runway surface friction measurement and reporting were developed by the Friction Task Force (FTF). The meeting was cognizant that the issue of runway surface friction, including the larger remit of surface condition assessment, measurement and reporting for the prevention of runway excursion was an extremely complex subject, often involving a variety of disciplines. The task requires expertise in, *inter alia*, pavement engineering, airport and flight operations, aircraft manufacturing, air traffic management, aeronautical information and aviation meteorology. The meeting also recognized that the amendment currently proposed under this agenda item represented the progress achieved during phase one of the FTF’s work and there remain significant and important activities to be undertaken during phase two. This included, but was not limited to, a global reporting format, development of common taxonomy and a study into rainfall rate, drainage, texture and aircraft performance.

Secretariat's comments

2.4.3 The Secretariat agrees with the recommendation of the meeting.

2.5 **Agenda Item 5: Heliport design**

2.5.1 Under this agenda item, the meeting developed amendment proposals for incorporation into Annex 14, Volume II. These proposals are tranche 2 of the comprehensive update to the content of the entire volume. Tranche 1 amendments became applicable as of 19 November 2009.

2.5.2 The amendment proposals relate primarily to physical characteristics (Chapter 3), Obstacle environment (Chapter 4), and Visual aids (Chapter 5) for onshore surface-level and elevated heliports, offshore helidecks, and shipboard heliports (Recommendation 5/1 refers).

2.5.3 Criteria for instrument heliports are removed from the main body of Annex 14, Volume II and relocated to a new Appendix 2. This reflects actual operational practices of helicopter operations continuing to land following a PinS approach only when visual meteorological conditions (VMC) exist. As reported by the helicopter experts of the panel, no instrument heliports actually exist and approaches to land from a PinS are conducted under VMC only. As a result, all references to instrument heliports were proposed for deletion. As true instrument heliports were reported to currently be under study and development in member States, it was determined that existing information should be preserved in the new Appendix 2 for possible use as a basis for instrument heliport provisions in the future, pending completion of the aforementioned studies.

2.5.4 The airspace requirements currently within Annex 14, Volume II assume that a helicopter always requires a continuous flat surface for horizontal acceleration before it transitions to vertical flight. Helicopters, however, can have a variety of flight departure and arrival profiles (including vertical profiles) and can operate in one or more performance classes. Proposed amendments in this regard seek to provide more flexibility for heliport operations.

2.5.5 For surface-level and elevated heliports two new sub-sections are proposed recommending the use of the flight path alignment guidance marking and lighting system.

Secretariat's comments

2.5.6 The Secretariat agrees with the recommendations of the meeting. As indicated, this work along with tranche 1, which became applicable 19 November 2009, represents a large amount of effort in the accomplishment of this comprehensive amendment to Annex 14, Volume II. The Secretariat acknowledges both the achievements made by the panel and the magnitude of the continuing work programme.

2.6 **Agenda Item 6: Future work**

2.6.1 Under this agenda item, the meeting reviewed the proposals from all the working groups on future work in the areas of aerodrome design, visual aids for navigation, aerodrome operations and services, rescue and fire fighting and heliport design. As a result, the meeting developed a new work programme for the panel (Recommendation 6/1 refers).

Secretariat's comments

2.6.2 The AP has completed most of the work items in its existing work programme. Several items remain as work is still ongoing. A few new items were proposed to be added to the work programme. Most of the proposals for future work were based on a template provided to the Panel by the Secretariat, which included sections for a task description, rationale, expected deliverables, expected date of completion for the deliverables, a statement of safety implications if the task were not addressed, a financial impact statement and an environmental impact statement. Therefore, the Secretariat supports in principle Recommendation 6/1 pending the Commission's review.

2.7 Agenda Item 7: Any other business

2.7.1 Under this agenda item the meeting was briefed on the current status of the Aerodrome Mapping Database (AMDB) effort and coordination with the AP was discussed. The meeting was also briefed on the current status of the work of the joint-AP/IFPP task force. The Secretariat presented the meeting with several editorial changes to be made with the current amendment. The meeting concurred with the editorial nature of the changes (Recommendation 7/1 refers).

3. WG/PDP REVIEW

3.1 On 1 February 2011, 7 March 2011, and 15 March 2011 the ANC Working Group of the Whole on AN Work Programme Deliverables Production (AN-WG/PDP) conducted a preliminary review of the first version of this paper.

3.2 The main outcome of the review is reflected in the Appendices to this PDP version of the paper, in the "Preliminary review by WG/PDP" and "Recommendation" text boxes. The content of the text boxes is intended to present proposals from the AN-WG/PDP for consideration by the ANC.

3.3 The WG/PDP suggested that:

- a) the review of the report and the future work programme be separated from the review of the proposed amendments and be conducted under a separate effort; and
- b) the State letter be prepared in two separate letters each addressing the proposed amendments for Annex 14, Volume I (including the consequential amendments to Annex 15 and PANS-ATM) and Annex 14, Volume II, respectively.

3.4 On 15 March 2011 the eighth meeting of the 186th Session of the ANC (ANC 186-8) took the first version of this paper. As the WG/PDP had not completed a full review of the entire paper the meeting only considered the proposed amendments of Agenda Item 5, Heliport design which are relevant to Annex 14, Volume II. ANC 186-8 approved the Annex 14, Volume II proposed amendments as submitted by the panel for forwarding to States for comment. The proposed amendments for Annex 14, Volume II were forwarded to States via State letter AN 4/1.1.51-11/31, dated 20 April 2011. The attachments for Agenda Item 5 that were originally a part of AN-WP/8545 have therefore been removed from this version of AN-WP/8545.PDP.

4. ACTION BY THE AIR NAVIGATION COMMISSION

4.1 The Air Navigation Commission is invited to:

- a) note the report of the AP/2 Meeting;
- b) take action on the recommendations of the aforementioned meeting as indicated in the appendix;
- c) agree that the report of AP/2 should not be published as a saleable document; and
- d) agree that a memorandum recording the action by the Commission on the report of AP/2 should be transmitted to the President of the Council by the President of the Air Navigation Commission.

D. Behrens
Chairman
AN-WG/PDP

INTERNATIONAL CIVIL AVIATION ORGANIZATION
SECOND MEETING OF THE AERODROMES PANEL (AP/2)

Montréal, 12 to 15 October 2010

SUPPLEMENT NO. 1

1. The Air Navigation Commission, at the meeting of its Session on 2011, under the authority delegated by the Council, took action on the recommendations of the second meeting of the Aerodromes Panel (AP/2), as indicated hereunder.

2. **RECOMMENDATIONS FOR AMENDMENT OF STANDARDS AND RECOMMENDED PRACTICES AND PROCEDURES (RSPP)**

2.1 Recommendation 1/1
Recommendation 2/1
Recommendation 3/1
Recommendation 4/1
Recommendation 4/2
Recommendation 4/3
Recommendation 5/1
Recommendation 7/1

2.2 The Air Navigation Commission made a preliminary review of the above recommendations, and agreed that, with the exception of;

- a) the proposed new recommendation of Annex 14, Volume I, paragraph 3.2.6 in regard to runway shoulders (which has been referred back to the panel);
- b) the proposed amendment to Annex 14, Volume I, paragraph 5.2.10.3 in regard to a restriction of runway holding positions to a maximum of two at any single taxiway/runway intersection (which has been referred back to the panel);
- c) the proposed amendment to Annex 14, Volume I, Note 1 to paragraph 5.3.19.13 (which was superseded by the deletion of the note entirely);
- d) the proposed new sections in Annex 14, Volume I, Chapter 5 and Attachment A in regard to Runway Status Lights (which has been referred back to the panel for inclusion in the development of a new Circular);
- e) the proposed new section in Annex 14, Volume I, Chapter 5 in regard to a No-Entry Bar (which was merged into the existing paragraph 5.3.19 Stop bars as a new paragraph in the Application section);

- f) the proposed amendments to Annex 14, Volume I, paragraph 5.3.5 Visual approach slope indicator systems; and
- g) the proposed amendments to Annex 14, Volume II, Chapter 6 Heliport services (which has been referred back to the panel),

the recommendations should be referred for comments to Contracting States and appropriate international organizations, together with the Commission's own comments and proposals thereon. Following receipt of comments, the Commission will conduct a detailed review and will then present its recommendation for action by the Council.

3. RECOMMENDATIONS OTHER THAN FOR STANDARDS AND RECOMMENDED PRACTICES AND PROCEDURES

3.1 The Secretary General will arrange for any follow-up action in respect of all approved recommendations as indicated in the action taken hereunder.

Report Reference		Action by Council (C) or Air Navigation Commission (ANC)	Recommendation Title and Action Taken
Recommendation No.	Page No.		
6/1	6-4	ANC	Future Work Programme To be reviewed under a separate ANC effort.

APPENDIX A

TEXT OF PROPOSED AMENDMENT TO THE

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

AERODROME DESIGN AND OPERATIONS

ANNEX 14, VOLUME I

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT TO ANNEX 14, VOLUME I

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

1. ~~Text to be deleted is shown with a line through it.~~ text to be deleted
2. **New text to be inserted is highlighted with grey shading.** new text to be inserted
3. ~~Text to be deleted is shown with a line through it.~~ followed by the replacement text which is **highlighted with grey shading.** new text to replace existing text

CHAPTER 1. GENERAL

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1.1 Definitions

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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 aeroplane undershooting or overrunning the runway, and also to allow an aeroplane overrunning to decelerate and an aeroplane undershooting to continue.

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CHAPTER 2. AERODROME DATA

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2.6 Strength of pavements

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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:

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c) *Maximum allowable tire pressure category:*

Code

~~High~~ **Unlimited**: no pressure limit

W

~~Medium~~ **High**: pressure limited to 4.50 **1.75** MPa

X

~~Low~~ **Medium**: pressure limited to 4.00 **1.25** MPa

Y

~~Very Low~~ **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 behaviour 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 1.25 MPa, then the reported information would be:

PCN 50 / F / A / Y / U

Note.— Composite construction

Example 3.— If the bearing strength of a flexible pavement, 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.

Origin:	Rationale:
AOSWGs/5 to 8 AP-WG/WHL-5 and 6	In 1978, ICAO initiated the adoption of a single means for airports to express the load bearing capacity of airfield pavement, and at the same time, created a means by which the aircraft manufacturers could indicate the pavement loading intensity of their aircraft. The method is now used worldwide, and is referred to as the

	ACN/PCN System. There are five attributes to the ACN/PCN system: pavement type, subgrade code, allowable tire pressure, description of the method by which the pavement rating was developed and numerical PCN (and ACN) value. From the advent of this system, the tire pressure element was and remains only loosely defined, having no ICAO prescribed methodology. The dilemma that is facing both airports and aircraft manufacturers is that commercial aircraft tire pressures have gradually increased, and yet few if any known pavement failures have come to light, therefore indicating that the tire pressure limits that have been part of the ACN/PCN system ever since its inception could possibly be increased somewhat without putting airfield pavements or aircraft at risk. This has been substantiated by the results of two series of full-scale testing in France and in the United States and by the analysis of a survey by ACI. The proposed amendment is intended to facilitate the use of aircraft with higher tyre pressure which would have a beneficial impact on costs, environment and to a lesser degree, safety of operations.
Preliminary review by WG/PDP	The WG/PDP agrees with the proposed amendment but was concerned that allowing higher tire pressure may have an adverse effect on the pavement especially around the runway lights, an issue which is not covered by the base study. This concern has an impact on maintenance in Annex 14, Volume I, Chapter 10. PDP recommends adding a new Note in Annex 14, Volume I, paragraph 10.1.1 cross-referenced with a new corresponding Note at 2.6.6 (c) that points out the need for particular attention to be given to the integrity of light fittings in pavement and joints where the pavement is used by large aircraft or aircraft with high tire pressures.
Recommendation	Insert a note to paragraph 2.6.6(c) as follows: <i>Note.— See Note 2 to 10.1.1 where the pavement is used by aircraft with high tire pressures.</i>

CHAPTER 2. AERODROME DATA

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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 appropriate aeronautical information services units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date and changes in conditions reported without delay.

Note.— Nature, format and conditions of the information to be provided are specified in Annex 15 and PANS-ATM (Doc 4444).

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 and aerodrome operations shall be provided in order to take appropriate action, particularly in respect of the following:

- a) construction or maintenance work;
- b) rough or broken surfaces on a runway, a taxiway or an apron;
- c) snow, slush, ~~or~~ ice, wet ice, wet snow on ice or frost on a runway, a taxiway or an apron;
- d) water on a runway, a taxiway or an apron;
- e) snow banks or drifts adjacent to a runway, a taxiway or an apron;
- f) anti-icing or de-icing liquid chemicals or other contaminants on a runway, ~~or a~~ taxiway or 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.

Note 1.— Other contaminants may include mud, dust, sand, volcanic ash, oil and rubber. Annex 6, Part 1, Attachment C provides guidance on the description of runway surface conditions. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

Note 2. — Particular attention may be given to the simultaneous presence of snow, slush, ice, wet ice, wet snow on ice with anti-icing or de-icing liquid chemicals.

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The above proposal seeks to clarify the purpose of reporting information on the movement area. Paragraph 2.9.1 addresses the need to inform the pilots while paragraph 2.9.2 relates to the initiation of appropriate maintenance actions or operational procedures at the aerodrome to prevent or mitigate potential hazards. The list of contaminants that can affect aircraft performance have been expanded to included references to relevant documents.
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

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 (Doc 9137), Part 8 and in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

2.9.4 Recommendation.— *Personnel assessing and reporting runway surface conditions required in 2.9. 2 and 2.9.7 should be trained and competent to meet criteria set by the State.*

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

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The above proposal introduces the need for personnel involved in the runway surface condition assessment and reporting to have the skills necessary to ensure the quality and accuracy of information reported for maintenance and operational purposes.
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

Water on a runway

2.9.45 Recommendation.— ~~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, should be made available using the following terms:~~

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

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

~~**WATER PATCHES**—significant patches of standing water are visible.~~

~~**FLOODED**—extensive standing water is visible.~~

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

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> Proposed amendment to the above paragraph seeks to align the existing definitions with those in Annex 6, Part 1, Amendment 33A. In general, terms not reflecting operational needs are proposed to be deleted. The term <i>DAMP</i> is proposed to be removed following changes to Annex 6, Part 1, Attachment C, Section 2. Definitions, which defines the state of the runway surface as either dry, wet or contaminated. A <i>DAMP</i> surface should be considered <i>WET</i> and the term <i>DAMP</i> removed from the information reported in SNOWTAM and through ATC. This is in line with changes in harmonized US/European specification criteria and underlying documentation. However, the FTF is aware of the use of the term <i>DAMP</i> in EU regulation for aircraft operations, and that there are interests in retaining the term. <i>The term WATER PATCHES is considered to be of no practical value and is proposed for deletion. Also, the FTF is aware that the term FLOODED is rarely reported and is therefore proposed to be replaced by the term STANDING WATER.</i>
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

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

2.9.6 A ~~When a paved runway or portion thereof does not meet shall be determined as being slippery when wet when the measurements~~ the requirements specified in 10.2.3, notification shall be issued to aerodrome users in a manner ~~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 conducting a runway surface friction characteristics evaluation programme that includes 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—**Recommendation.**—When it is suspected that a runway may become slippery under unusual conditions, then additional measurements should 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.~~

Origin:	Rationale:
FTF/1 to 5 AOSWG/5 to 8 AP-WG/WHL-5 and 6	The above amendments aim at making a clear distinction between the assessment of runway surface friction characteristics for maintenance purpose and the evaluation for operational purpose. For maintenance purpose, the prime criterion is the Minimum Friction Level (MFL) below which notification shall be issued to aerodrome users. The MFL is defined by each State and replaces in existing paragraph 2.9.6 the generic and vague “slippery when wet” criteria. Existing paragraph 2.9.5 is proposed to be deleted since, hitherto, there has not been a relation established between aircraft wheel braking and the friction values measured by friction-measuring devices. For the purpose of operations, the prime parameter is the estimated surface friction which is estimated on the basis of the assessments made for maintenance, the actual state of the runway, the weather conditions, and other criteria. The estimated surface friction is communicated, in compliance with existing paragraph 2.9.1, to pilots and aircraft operators through SNOWTAM. Existing paragraph 2.9.7 is proposed to be deleted because a determination of the surface to be slippery does not rest solely with friction levels as measured with a measuring device. The notion of relying only on friction measurement should be replaced by the notion of runway surface condition assessment and estimated surface friction. Furthermore, as each aerodrome operator can use a friction measuring device provided its performance meet the standard and correlation criteria set or agreed by the State (see new paragraph 2.9.8 below), this device may differ from the one which the State may use as a reference or for its own inspections. The promulgation of this information is misleading and has proven to be a contributing factor to accidents. The proposed deletion of existing paragraph 2.9.7 requires a consequential amendment to Annex 15. Existing paragraph 2.9.8 is proposed to be deleted to avoid being interpreted as a recommendation for assessment for operational use. Friction measurements are to be used primarily for maintenance purpose according to a maintenance programme taking into account unusual conditions; however, they can be used for operational evaluation under defined conditions according to different operational procedures. Additional guidance

Preliminary review by the WG/PDP	will be provided in Annex 14, Vol. I, Attachment A (green pages), sections 6 and 7. PDP recommends retaining the original paragraph 2.9.5 to make available information that a runway or portion thereof may be slippery when wet. It is felt that such information, including instances where a runway may be slippery when wet due to the presence of rubber deposits or paint markings, is of operational significance. The PDP suggests that this issue be addressed by the PANS-Aerodromes as well as other relevant PANS documents.
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Snow, slush, or ice or frost on a runway

Note 1.— The intent of these specifications is to satisfy the SNOWTAM and NOTAM promulgation requirements contained in Annex 15.

Note 2.— Runway surface condition sensors may be used to detect and continuously display current or predicted information on surface conditions such as the presence of moisture, or imminent formation of ice on pavements.

2.9.97 Recommendation.— Whenever an operational runway is affected by snow, slush, or ice, or frost, and it has not been possible to clear the precipitant fully, the condition of the runway surface condition ~~should~~ shall be assessed, and the friction coefficient measured reported.

Note.— Guidance on ~~determining and expressing the friction characteristics~~ assessment of snow- and ice-covered paved surfaces is provided in Attachment A, Section 6.

2.9.108 Recommendation.— When friction measurements are taken as part of the assessment, ~~the readings performance of the friction measuring device on compacted snow-, slush-, or ice-covered surfaces should adequately correlate with the readings of one other such device~~ meet the standard and correlation criteria set or agreed by the State.

Note.— The principal aim is to measure surface friction in a manner that is relevant to the friction experienced by an aircraft tire, thereby providing correlation between the friction measuring device and aircraft braking performance. Guidance on criteria for, and correlation between, friction measuring devices is included in the Airport Services Manual (Doc 9137), Part 2.

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The amendment proposed in existing paragraph 2.9.9 seeks to require that the runway surface condition is assessed and reported when affected by snow, slush, ice or frost. Proposed amendment to existing paragraph 2.9.10 requires that friction measurement devices meet the standards set by the State when they are used for the assessment of the runway surface condition in order to ensure the quality and accuracy of the information reported. This provision is complementary with the requirements proposed in the new paragraph 2.9.4.
Preliminary review by the WG/PDP	The WG/PDP recommends replacing the word ‘affected’ with ‘contaminated’ in the new paragraph 2.9.7, and to insert a new paragraph 2.9.7A, which reads “Surface friction measurements for assessment and reporting purposes shall not be made on a runway that is contaminated by slush, wet snow or wet ice.”
Recommendation	... 2.9.97 Recommendation.— Whenever an operational runway is affected contaminated by snow, slush, or ice, or frost, and it has not been possible to clear the precipitant fully, the condition of the runway surface condition should shall be assessed, and the friction coefficient measured reported. 2.9.7A Surface friction measurements for assessment and reporting purposes shall not be made on a runway that is contaminated by slush, wet snow or wet ice.

2.9.9 Recommendation.— *Whenever snow, slush, ice or frost is present and reported, the description of the runway surface condition should use the following terms:*

DRY SNOW;

WET SNOW;

COMPACTED SNOW;

WET COMPACTED SNOW;

SLUSH;

ICE;

WET ICE;

FROST;

DRY SNOW ON ICE;

WET SNOW ON ICE;

CHEMICALLY TREATED.

SANDED.

and should include, where applicable, the assessment of contaminant depth.

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The Recommendation proposed in the new paragraph 2.9.9 makes a clear linkage to the operational use of the information through the reporting format (see also proposed amendments to paragraphs 2.9.2 and 2.9.5) and is harmonized, to the extent possible, with the SNOWTAM format in Annex 15.
Preliminary review by the WG/PDP	The WG/PDP recognizes the need to include ‘chemically treated’ and ‘sanded’, and enquired from the Secretariat if more than two of these terms can be reported together. It is noted that these two items, which increase runway friction, could be misinterpreted as an unfavourable contamination. <i>Secretariat comments:</i> Annex 14, Vol. I, paragraph 10.2.12 urges caution when using chemicals to remove or prevent the formation of ice so as not to create a more slippery condition. Additionally, Annex 14, Vol. I, paragraph 2.9.2 f) requires, among others, the presence of these chemicals to be reported since they concern matters of operational significance. Seen in this light, these chemicals have the potential to reduce runway friction. As for sand, it is noted that its use in increasing runway friction is reported in at least one State. Further, the <i>Airport Services Manual</i> (Doc 9137), Part 2, <i>Pavement Surface Conditions</i> describes the use of abrasives such as sand in paragraph 7.7.13 to increase traction and to control slipperiness. The Secretariat confirmed that more than two of the terms can be reported together.

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CHAPTER 3. PHYSICAL CHARACTERISTICS

3.1 Runways

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Surface of runways

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

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

Note 2.— Guidance on design tolerances and other information is given in Attachment A, Section 5. Additional guidance is included in the Aerodrome Design Manual (Doc 9157), Part 3.

3.1.23 ~~The surface of a~~ A paved runway shall be so constructed or resurfaced as to provide good surface friction characteristics ~~when the runway is wet~~ at or above the minimum friction level set by the State.

3.1.23A **Recommendation.**— *The surface of a paved runway should be evaluated when constructed or resurfaced to determine that the surface friction characteristics achieve the design objectives.*

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

3.1.24 **Recommendation.**— *Measurements of the surface friction characteristics of a new or resurfaced runway should 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 surface friction characteristics of new runway surfaces is given in Attachment A, Section 7. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

3.1.25 **Recommendation.**— *The average surface texture depth of a new surface should be not less than 1.0 mm.*

Note 1.— Macrotexture and microtexture are taken into consideration in order to provide the required surface friction characteristics. This normally requires some form of special surface treatment. Guidance on surface design is given in Attachment A, Section 8.

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

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

3.1.26 Recommendation.— *When the surface is grooved or scored, the grooves or scorings should be either perpendicular to the runway centre 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 (Doc 9157), Part 3.

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The amendments proposed seek to replace an ambiguous objective in existing paragraph 3.1.23 with a quantifiable level established by the regulator. The availability of appropriate guidance to assist the State, in this regard, is provided in the associated Notes. The importance of micro- and macro-texture, and its contribution towards surface friction characteristics is highlighted, with appropriate guidance provided.
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

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3.2 Runway shoulders

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

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

3.2.6 Recommendation: *The surface of a runway shoulder should be so prepared as to resist erosion and prevent the ingestion of the surface material by aeroplane engines.*

Note. — Where a runway shoulder is not paved, additional surface treatment or inspections may be necessary, especially for runways that accept operations by 4-engined aircraft.

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<i>Origin</i>	<i>Rationale</i>
AP/1 AGA-8603	As part of its review of code letter F requirements, the Aerodrome Design Working Group (ADWG) discussed the dimensions and construction of runway shoulders at the ADWG/5 meeting. This review identified that some States mandate paved shoulders, in the absence of which runway inspections are to be conducted after each movement by 4-engined aircraft. Additionally, it was noted that information regarding the ability of runway shoulders to resist erosion and prevent FOD ingestion is not provided in the Annex, instead being limited to guidance material in the Aerodrome Design Manual, Part 1. Additional SARPs will assist States in reducing the identified hazards and the note provides guidance for unpaved shoulders.
Preliminary review by WG/PDP	Regarding the proposed new Recommendation in paragraph 3.2.6, some members of the WG/PDP thought that this Recommendation for runway shoulders should be upgraded to a Standard, while others had concerns about the global impact and the fact that all the other provisions related to runway shoulders were only Recommendations. In view of the above and taking into consideration that there is some ongoing work (as part of the review of Chapter 3 of Annex 14, Volume I) of the panel involving a study of inner/outer shoulders, and the work on PANS-Aerodrome, the WG/PDP recommends sending this item (paragraph 3.2.6 and the note under it) back to the Panel for further consideration of making paragraph 3.2.6 a Standard and to determine what could be removed from Annex 14 and placed into PANS-Aerodrome.

3.3 Runway turn pads

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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 aeroplane using the turn pad.

3.3.11 **Recommendation.**— *The surface of a runway turn pad should be so constructed or resurfaced as to provide good suitable surface friction characteristics, for aeroplanes using the facility when the surface is wet.*

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3.4 Runway strips

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Objects on runway strips

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

3.4.6 **Recommendation.**— *An object situated on a runway strip which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.*

3.4.7 No fixed object, other than visual aids required for air navigation or those required for aircraft safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirement in Chapter 5, shall be permitted on a runway strip:

...

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

3.4.12 **Recommendation.**— *Where these areas have paved surfaces they should, if required, be able to accommodate the occasional passage of the critical aircraft for runway pavement design.*

Note. — *The areas adjacent to the end of a runway are sometimes referred to as blast pads.*

Editorial Note.— Re-number the subsequent paragraphs accordingly.

<i>Origin</i> WG/WHL/4 DP/12	<i>Rationale</i> WG/WHL/4 DP/12 identified actions required in response to safety recommendations arising from states investigations into aircraft accidents/incidents, one of which involved the provision of blast pads at the end of runways. The WG/WHL had recognized that Annex 14 does not currently address blast pads and that design and strength requirements would be required. Markings would be recommended to the VAWG. In its review the ADWG noted the need to differentiate the runway ends from the runway shoulders and to identify the areas before the runway ends as blast pads if provided. It was agreed that strength specifications should be consistent with those for runways shoulders, as detailed in 3.4.12.
Preliminary review by WG/PDP	Delete the word “aircraft” in paragraph 3.4.7 for the proposed new text allowing the installation of an arresting system. This is because the proposed text “for aircraft safety purposes”, as opposed to “for safety purposes”, is considered to be too restrictive. The WG/PDP agrees with the proposed Recommendation of paragraph 3.4.12, with some modification to the wording.
Recommendation	3.4.7 No fixed object, other than visual aids required for air navigation or those required for safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirement in Chapter 5, shall be permitted on a runway strip: 3.4.12 Recommendation.— <i>Where the areas in 3.4.11 have paved surfaces, they should be able to withstand the occasional passage of the critical aeroplane for runway pavement design.</i> <i>Note. — The area adjacent to the end of a runway may be referred to as a blast pad.</i>

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.

3.5.2 **Recommendation.**— A runway end safety area should be provided at each end of a runway strip where the code number is 1 and 2 and the runway is a non-instrument one.

Dimensions of runway end safety areas

3.5.3 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m where:

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

Where a recognized arresting system of demonstrated performance capability is installed, the specifications above may be reduced in accordance with the design specification of the arresting system.

Note.— Guidance on the means to achieve the standard is provided in Attachment A, Section 9.

3.5.4 **Recommendation.**— A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:

- a) 240 m where the code number is 3 or 4; ~~and~~
- b) 120 m where the code number is 1 or 2 ~~and the runway is an instrument one; and~~
- c) 30m where the code number is 1 or 2 and the runway is an non-instrument one.

Where a recognized arresting system of demonstrated performance capability is installed, the specifications in (a) and (b) above may be reduced in accordance with the design specification of the arresting system.

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

Editorial Note.— Re-number subsequent paragraphs accordingly.

Origin	Rationale
AP/1 (para 1.6) AGA-8603	At AP/1 the ADWG was tasked to examine RESA as part of the Chapter 3 Review; subsequently, at WG/WHL/5 the RESA task had been separated from the review as it would be complete by AP/2 (the Chapter 3 review would not be complete before 2012). Additionally, the ADWG was also tasked at WG/WHL/5 to examine the use
WG/WHL/5	

DP/3	of Engineered Material Arresting Systems as an alternative to RESA. The Notes below, and amendments to RESA SARPs and guidance material arising are the result of the examination conducted by the ADWG. 3.5.2 – Recommended Practice arises from overrun data demonstrating that based on studies carried out in some States, the risk from overruns is also present for visual runways; accordingly, requirements should be introduced. 3.5.3 – Clarifies the Standard distances for those runways already requiring RESAs. It also introduces the use of arresting systems of demonstrated performance capability. The Note to 3.5.3 arises from the introduction of arresting systems and other possible mitigating measures, including reduction of declared distances, and points to guidance material. 3.5.4 – Clarifies the recommended practice distances for those runways already requiring RESAs, and for non-instrument runways. The distance for non-instrument runways arises from distances already implemented in some states. ADWG had accepted that the landing dispersion for non-instrument runways justified a need to include minimum distances and distances had been implemented in the USA (42m) and the Netherlands (60m). The Group agreed a figure of 30m as the starting point, with a review as future studies are made available. Chapter 9 changes have to be made to facilitate the use of arresting systems which have been demonstrated not to present a hazard to aircraft. This also applies to 3.4.7 above.
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Preliminary review by WG/PDP	The WG/PDP agrees in principle with the proposed amendment on RESA, including the installation of an arresting system with demonstrated performance based on which the length of RESA may be reduced. Besides some wording modification, the WG/PDP proposes a separate paragraph to introduce arresting system into the RESA provision (as opposed to including the notion of arresting system in both the Standard and Recommendation for the RESA length). It also proposes new paragraphs to be included in Attachment A of Annex 14, Volume I addressing principles to be followed in the design of an arresting system.
Recommendation	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. <i>Note. – Guidance on runway end safety areas is given in Attachment A, Section 9.</i> 3.5.2 Recommendation. - A runway end safety area should be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one. Dimensions of runway end safety areas 3.5.23 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m where:

- the code number is 3 or 4; and

- the code number is 1 or 2 and the runway is an instrument one.

3.5.34 **Recommendation.**— A runway end safety area should, ~~as far as practicable,~~ extend from the end of a runway strip to a distance of at least:

a) 240 m where the code number is 3 or 4; ~~and~~

b) 120 m where the code number is 1 or 2 and the runway is an instrument one; and

c) 30m where the code number is 1 or 2 and the runway is a non-instrument one.

3.5.5 Notwithstanding the provisions in 3.5.3 and 3.5.4 a) and b) , the length of a runway end safety area may be reduced where an arresting system is installed with demonstrated performance that provides a level of protection at least equivalent to the prescribed runway end safety area.

Note. – Guidance on arresting systems is given in Attachment A, Section 9.

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

Secretariat's comments

The word “notwithstanding” in paragraph 3.5.5 above may not be a suitable word to be used in the Annex. Without changing the intent of the provision, the Secretariat proposes the following wording:

3.5.5 The length of a runway end safety area in 3.5.3 and 3.5.4 a) and b) may be reduced where an arresting system is installed with demonstrated performance that provides a level of protection at least equivalent to the prescribed runway end safety area.

Note. – Guidance on arresting systems is given in Attachment A, Section 9.

3.7 Stopways

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Surface of stopways

3.7.4 **Recommendation.**— The surface of a ~~paved~~ stopway ~~should~~ shall be so constructed or resurfaced as to provide ~~a good coefficient of~~ surface friction characteristics ~~to be compatible with that~~ at or above those of the associated runway ~~when the stopway is wet~~.

3.7.5 **Recommendation.**— ~~The friction characteristics of an unpaved stopway should not be substantially less than that of the runway with which the stopway is associated.~~

...

3.9 Taxiways

...

Surface of taxiways

3.9.14 **Recommendation.**— *The surface of a taxiway should not have irregularities that cause damage to aeroplane structures.*

3.9.15 **Recommendation.**— The surface of a ~~paved~~ taxiway should be so constructed or resurfaced as to provide ~~good~~ suitable surface friction characteristics ~~when the taxiway is wet~~.

Origin: FTF/1 to 5 AOSWG/5 to 8 AP-WG/WHL-5 and 6	Rationale: Proposed amendments to paragraphs 3.3.11, 3.7.4 and 3.9.15 require the provision of suitable friction characteristics under wet and other conditions when designing and constructing pavement surfaces.
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

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CHAPTER 5. VISUAL AIDS FOR NAVIGATION

5.2.8 Taxiway centre line marking

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5.2.8.5 Where provided, enhanced taxiway centre line marking shall be installed at all each taxiway/runway intersections at that aerodrome.

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~~5.2.8.9 Where provided, an enhanced taxiway centre line marking shall extend from the runway holding position pattern A (as defined in Figure 5-6, Taxiway markings) to a distance of up to 45m (a minimum of three (3) dashed lines) in the direction of travel away from the runway or to the next runway holding position, if within 45m distance.~~

5.2.8.9 Where provided:

(1) an enhanced taxiway centre line marking shall extend from the runway-holding position Pattern A (as defined in Figure 5-6, Taxiway markings) to a distance of up to 47m in the direction of travel away from the runway. See Figure 5-7(a).

(2) If the enhanced taxiway centre line marking intersects another runway-holding position marking, such as for a precision approach category II or III runway, that is located within 47m of the first runway-holding position marking, the enhanced taxiway centre line marking shall be interrupted 0.9m prior to and after the intersected runway-holding position marking. The enhanced taxiway centre line marking shall continue beyond the intersected runway-holding position marking for at least 3 dashed line segments or 47m from start to finish, whichever is greater. See Figure 5-7(b).

(3) If the enhanced taxiway centre line marking continues through a taxiway/taxiway intersection that is located within 47m of the runway-holding position marking, the enhanced taxiway centre line marking shall be interrupted 1.5m prior to and after the point where the intersected taxiway centre line crosses the enhanced taxiway centre line. The enhanced taxiway centre line marking shall continue beyond the taxiway/taxiway intersection for at least 3 dashed line segments or 47m from start to finish, whichever is greater. See Figure 5-7(c).

(4) Where two taxiway centre lines converge at or before the runway-holding position marking, the inner dashed line shall not be less than 3m in length. See Figure 5-7(d).

(5) Where there are two opposing runway-holding position markings and the distance between the markings is less than 94m, the enhanced taxiway centre line markings shall extend over this entire distance. The enhanced taxiway centre line markings shall not extend beyond either runway-holding position marking. See Figure 5-7(e).

Editorial Note.— Replace existing Figure 5-7 with the following new Figure 5-7.

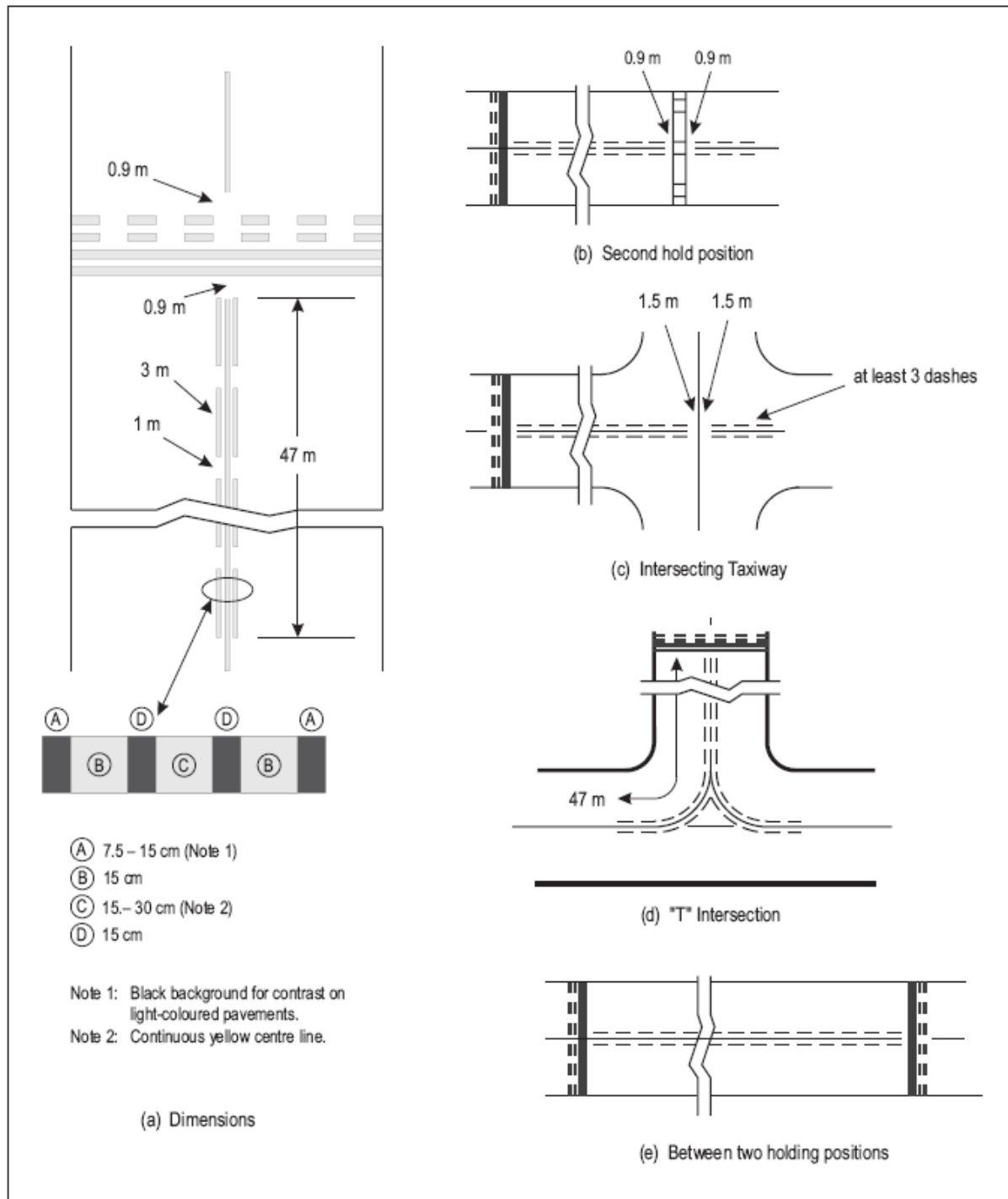


Figure 5-7. Enhanced Taxiway Centre Line Marking

<i>Origin</i> AP/1 VAWG/6	<i>Rationale</i> The purpose of this amendment is two-fold. Firstly there were errors in the original paper presented to and accepted by AP/1, in that the graphic did not represent the existing markings correctly. Additionally, the mathematics indicated an enhanced length of 47m where the graphic and description indicated 45m. Additional clarification on the graphic is added to the description in 5.2.8.9 (2-5). Figure 5-7 is corrected to show the proper markings.
Preliminary review by WG/PDP	Initial proposal remains unchanged.

...

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. ~~There shall be no more than two runway holding position markings at any single runway/taxiway intersection.~~

<i>Origin</i> VAWG/4-6 APWGWHL/4	<i>Rationale</i> This proposal stems from various discussion points raised during several meetings, when it became apparent that there was much confusion existing over the number of holding positions that might be associated with a taxiway/runway intersection. In an effort to reduce the possibility of an incursion it was decided to propose a maximum of two runway holding positions.
Preliminary review by WG/PDP	The WG/PDP recommends retaining the original text and referring the proposed 5.2.10.3 back to the panel for further development. Specifically, the WG/PDP feels that more data is needed to indicate that the number of RHPs is a source of flight crew confusion, that the restriction to a maximum of 2 RHPs would reduce that flight crew confusion, and that the extent of the operational impact of this restriction is not out of balance with any benefit derived.

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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 aeroplanes with similar approach guidance requirements;~~ Object(s) penetrate the Approach surface in Chapter 4 for the appropriate runway code and level of service,
- b) ~~the pilot of any type of aeroplane may have difficulty in judging the approach due to:~~ the Approach surface is off set, or
 - 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;~~
 - 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 aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects;~~ an Aeronautical study indicates the need to provide, due to conditions such as;
 - i. the approach being over water or other featureless terrain,
 - ii. deceptive surrounding terrain or runway slopes,
 - iii. unlighted obstacles (such as trees) where the danger of descending below a normal flight path cannot be easily ascertained, or
 - iv. terrain and prevailing winds making the aircraft likely to experience significant turbulence;
- d) ~~physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway; and~~
- e) ~~terrain or prevalent meteorological conditions are such that the aeroplane may be subjected to unusual turbulence during approach.~~

5.3.5.2 **Recommendation.** - A visual approach slope indicator system should be provided to serve the approach to a runway where the runway is used by turbojet, or other aeroplanes with similar approach guidance requirements, whether or not the runway is served by other visual approach aids or by non-visual aids.

Note.— Guidance on the priority of installation of visual approach slope indicator systems is contained in Attachment A, Section 12

5.3.5.2 ~~3~~ 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~~7~~ to 5.3.5.2~~2~~ ~~23~~
inclusive;
- b) PAPI and APAPI systems conforming to the specifications contained in 5.3.5.2~~3~~-~~24~~ to 5.3.5.4~~0~~
~~41~~ inclusive;

as shown in Figure 5-16.

5.3.5.3 ~~4~~ 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 ~~5~~ 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 ~~6~~ **Recommendation.**— *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 should 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 ~~7~~ 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 5-17.

5.3.5.7 ~~8~~ 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 ~~9~~ The light units shall be constructed and arranged in such a manner that the pilot of an aeroplane 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.

Siting

5.3.5.9-~~10~~ The light units shall be located as shown in Figure 5-17, 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 5.3.5.67 and 5.3.5.1920), 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

5.3.5.40 **11** The systems shall be suitable for both day and night operations.

5.3.5.41 **12** 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 5.3.5.2122.

5.3.5.42 **13** 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.

5.3.5.43 **14** The colour 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'.

5.3.5.44 **15** At full intensity the red light shall have a Y coordinate not exceeding 0.320.

5.3.5.45 **16** 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.

5.3.5.46 **17** The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

5.3.5.47 **18** 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 19 The approach slope shall be appropriate for use by the aeroplanes using the approach.
- 5.3.5.19 20 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 21 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 5-18).
- 5.3.5.21 22 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 aeroplane 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 23 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.

Note.— See 5.3.5.4142 to 5.3.5.4546 concerning the related obstacle protection surface.

PAPI and APAPI

Description

- 5.3.5.23 24 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 25 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 ~~25~~ 26 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 ~~26~~ 27 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 ~~27~~ 28 The light units shall be located as in the basic configuration illustrated in Figure 5-19, 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 aeroplane 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 ~~28~~ 29 The system shall be suitable for both day and night operations.
- 5.3.5.29 ~~29~~ 30 The colour 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 ~~30~~ 31 At full intensity the red light shall have a Y coordinate not exceeding 0.320.
- 5.3.5.31 ~~31~~ 32 The light intensity distribution of the light units shall be as shown in Appendix 2, Figure A2-23.

Note.— See the Aerodrome Design Manual (Doc 9157), Part 4, for additional guidance on the characteristics of light units.

- 5.3.5.32 ~~32~~ 33 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 ~~33~~ 34 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 35 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 36 The approach slope as defined in Figure 5-20 shall be appropriate for use by the aeroplanes using the approach.
- 5.3.5.36 37 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 38 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 aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin (see Table 5-2).
- 5.3.5.38 39 The angle of elevation settings of the light units in an APAPI wing bar shall be such that, during an approach, the pilot of an aeroplane observing the lowest onslope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin (see Table 5-2).
- 5.3.5.39 40 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 5.3.5.4142 to 5.3.5.4546 concerning the related obstacle protection surface.

- 5.3.5.40 41 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, ATVASIS, PAPI and APAPI.

- 5.3.5.41 42 An obstacle protection surface shall be established when it is intended to provide a visual approach slope indicator system.
- 5.3.5.42 43 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 5-21.

5.3.5.43 44 New objects or extensions of existing objects shall not be permitted above an obstacle protection surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

5.3.5.44 45 Existing objects above an obstacle protection surface shall be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of aeroplanes.

5.3.5.45 46 Where an aeronautical study indicates that an existing object extending above an obstacle protection surface could adversely affect the safety of operations of aeroplanes 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 (Doc 9157), Part 4.

<i>Origin</i> VAWG/7 APWGWHL/6	<i>Rationale</i> The current application specification in section 5.3.5 of Annex 14, Volume I is a mixture of level of service and safety standards contained within one specification. In particular, the current wording of paragraph 5.3.5.1a would result in the cessation of turbojet operations on a runway if the visual approach slope indicator system went unserviceable as the facility would no longer be in compliance, regardless if the operations were using an ILS system for vertical guidance of a stabilized approach. In reviewing this there was support to have a visual approach slope indicator system as an enhancement to operations, but not as an absolute safety requirement that had to be present to maintain an acceptable level of operational safety. Available data does not justify the safety issue that would make these systems an absolute for ongoing operations of modern turbojet aircraft.
Preliminary review by WG/PDP	The WG/PDP strongly believes that visual approach slope indicator systems should remain a Standard and therefore recommends that the existing SARPs for Annex 14, Volume I, paragraph 5.3.5, Visual approach slope indicator systems, remain as they currently exist.

5.3.13.7 Simple Touchdown Zone Lights

Note.— The purpose of Simple Touchdown Zone Lights is to provide pilots with enhanced situational awareness in all visibility conditions and to help enable pilots to decide whether to commence a go around if the aircraft has not landed by a certain point on the runway. It is essential that pilots operating at aerodromes with Simple Touchdown Zone Lights be familiar with the purpose of these lights.

Application

5.3.13.7.1 Recommendation.- *Except where TDZ lights are provided in accordance with paragraph 5.3.13, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the Landing Distance Available combined with other factors increases the risk of an overrun, Simple Touchdown Zone Lights should be provided.*

Location

5.3.13.7.2 Simple Touchdown Zone Lights shall be located both sides of the runway centreline at the upwind edge of the final Touchdown Zone marking. The lateral spacing between the pair shall be equal to the lateral spacing selected for the touchdown zone marking.

5.3.13.7.3 Recommendation.- *Where provided on a runway without TDZ markings, Simple Touchdown Zone lights should be installed in such a position that provides the equivalent TDZ information.*

Characteristics

5.3.13.7.4 Simple Touchdown Zone Lights shall be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.13.7.5 Simple Touchdown Zone Lights shall be in accordance with the specifications in Appendix 2, Figure A2-5.

Note.— Simple Touchdown Zone Lights should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

Origin VAWG/7 APWGWHL/6	Rationale The installation of additional pairs of inset runway lights has been shown to help prevent runway excursions where a causal factor has been shown to be late touchdown of an aircraft beyond the TDZ markings.
Preliminary review by WG/PDP	The WG/PDP requests the Secretariat to identify any operational procedures that might need to be included in PANS-ATM, PANS-OPS or other documents

	for the use of this lighting system. The WG/PDP also recommends this be addressed by the PASG. The WG/PDP requests that the Note to paragraph 5.3.13.7.5 be written to include “independent switchable”. The WG/PDP requests the Secretariat to determine whether this system needs to be included in the switch over time requirements of Table 8-1. <i>Secretariat comments: Table 8-1 addresses secondary power supply requirements for lighting aids based on their requirement by category of approach for which the runway is intended to be used. Simple Touchdown Zone Lights are not being introduced based on the operating minima within which aircraft are intended to operate on the runway, so the Secretariat feels that they do not belong in Table 8-1.</i> The WG/PDP expressed concern about whether or not the reference to 3.5 degrees will encourage high angles of approach and requests the Secretariat to consider whether the identification of a 3.5 degree angle of approach should be made more performance based. <i>Secretariat comments: The angle of approach is determined by obstacles, not the infrastructure on the runway. The installation of runway overrun mitigating measures does not affect the angle of approach. The 3.5 degree angle of approach has been confirmed with the Secretary of the IFPP as being the maximum glide slope angle for a normal approach. As this lighting system is only being proposed by the panel for high-angle approaches the Secretariat feels that the objectively defined boundary of a high angle of approach of 3.5 degrees is appropriate.</i>
Recommendations	<i>Note.- Simple Touchdown Zone Lights should be supplied with power on a separate independent switchable circuit to other runway lighting so that they may be used when other lighting is switched off.</i>

...

5.3.16.6 Except as provided for in 5.3.16.8, 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 aeroplanes 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 5-25). The first light in the exit centre

line shall always show green and 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.~~

5.3.16.8 Recommendation.— *Where it is necessary to denote the proximity to a runway, taxiway centre line lights should be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:*

- a) their end point near the runway centre line; or*
- b) in the case of the taxiway centre line lights crossing the runway, to the opposite perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.*

Note 1.— Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2.— The provisions of 5.3.16.8 can form part of effective runway incursion prevention measures.

Editorial Note.— Re-number existing 5.3.16.8 to 5.3.16.9 and cascade the number changes (and all references) through the remainder of Section 5.3.16.

<i>Origin</i> VAWG/6	<i>Rationale</i> This proposal seeks to add to the runway incursion reduction effort by matching the runway entrance taxiway lighting to the existing exit taxiway lighting (described in 5.3.16.7). Additionally, this matches the current FAA requirements for low visibility entrance taxiway lighting.
Preliminary review by WG/PDP	Initial proposal remains unchanged.

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 manoeuvring area to one at a time; and

2) vehicles on the manoeuvring 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 manoeuvring area to one at a time; and

2) vehicles on the manoeuvring area to the essential minimum.

5.3.19.3 Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be active.

5.3.19.34 **Recommendation.**— *A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.*

5.3.19.45 **Recommendation.**— *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 should be added to each end of the stop bar.*

Location

5.3.19.56 Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 5.3.19.45 are provided, these lights shall be located not less than 3 m from the taxiway edge.

Characteristics

5.3.19.67 Stop bars shall consist of lights spaced at uniform intervals of no more than 3m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

Note - Where necessary to enhance conspicuity of an existing stop bar, extra lights are installed uniformly.

Origin VAWG/7 APWGWHL/6	Rationale Proposed 5.3.19.3 seeks to clarify the installation and use of stop bars in support of both low and normal visibility operations with respect to reducing the potential for runway incursions as well as reducing possible confusion when more than one runway holding position (RHP) is associated with an intersection. There have been cases where multiple stop bars have been active at a single RHP leading to confusion on the part of crews as to their correct clearance limit. In regard to the proposed 5.3.19.7, field tests in a member State have demonstrated that increasing the overall number of lights in a stop bar by decreasing the space between individual lights increases the conspicuity of the stop bar while maintaining the consistency of the visual cue given flight crews and vehicle operators.
Preliminary review by WG/PDP	In regard to the proposal for paragraph 5.3.19.3 the WG/PDP recommends replacement of the word “active” with “illuminated” as it more clearly conveys the technical intent of the provision. In regard to the proposal for paragraph 5.3.19.7, the initial proposal remains unchanged. In regard to the proposal for a new section providing for “No-entry bars”

	(proposed Section 5.3.29 of the Appendix to this paper), the WG/PDP recommends that the similarity of the characteristics of no-entry bars with stop bars does not warrant a section of its own. The WG/PDP requests the insertion of a recommendation in Section 5.3.19 Stop bars for the use of stop bars in the application of a no-entry bar.
Recommendation	5.3.19.3 Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be illuminated. 5.3.19.6 Recommendation.— <i>A stop bar should be provided, where it is deemed necessary, as a no-entry bar across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of vehicles or aircraft to that taxiway.</i>

5.3.19.78 Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

5.3.19.89 Where the additional lights specified in 5.3.19.45 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 **Recommendation.**— *Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.*

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

5.3.19.12 **Recommendation.**— *Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of 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 **in conjunction with an ATC clearance**.*

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 (Doc 9157), Part 5.

Origin VAWG/4-6 APWGWHL/4 AP/1	Rationale 5.3.19.9 is proposed for deletion and replaced with the combination of the new 5.3.19.3 and the expanded text in the proposed 5.3.19.13. This introduces a clarification to indicate that the stop bar extinguishing does not, in itself, constitute a clearance to proceed and must be done in compliance with an ATS clearance.
Preliminary review by WG/PDP	In regard to the proposed change to Note 1 to paragraph 5.3.19.13 the WG/PDP, while agreeing in principle to the proposal, proposes that Annex 14 is not the proper place to address this operational requirement. The existing Note 1 is recommended to be deleted and the consequential amendments to Annex 2 and PANS-ATM proposed in paragraph 2.2.18 of AN-WP/8545 are recommended to be referred to the ATM Section for separate action.
Recommendation	<i>Note 1.— A stop bar is switched on to indicate that traffic stop and switched off to indicate that traffic proceed.</i>

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 5-28.

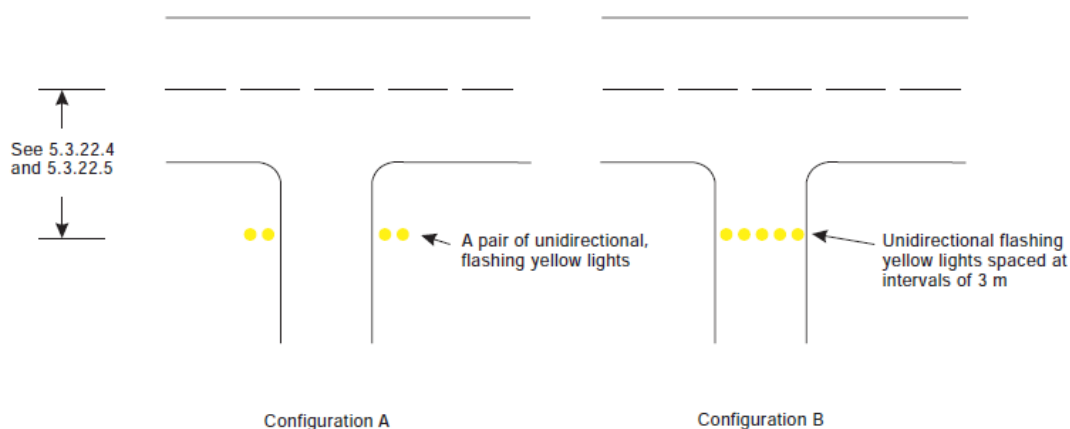


Figure 5-28. Runway guard lights

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 1 200 m where the traffic density is heavy.

5.3.22.2 **Recommendation.**— *As part of runway incursion prevention measures, Runway guard lights, Configuration A or B, should be provided at each taxiway/runway intersections where an increased probability for runway incursions can be expected, and used under all weather conditions during day and night.*

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 1 200 m where the traffic density is medium or light.

~~5.3.22.3 **Recommendation.**— Runway guard lights, Configuration A or Configuration B or both, should 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 should not be collocated with a stop bar.~~

Location

5.3.22.43 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.

5.3.22.54 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

5.3.22.65 Runway guard lights, Configuration A, shall consist of two pairs of yellow lights.

5.3.22.76 **Recommendation.**— *Where there is a need to enhance the contrast between the on and off state of runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture should be located above each lamp.*

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

5.3.22.87 Runway guard lights, Configuration B, shall consist of yellow lights spaced at intervals of 3 m across the taxiway.

5.3.22.98 The light beam shall be unidirectional and aligned so as to be visible to the pilot of an aeroplane taxiing to the holding position.

5.3.22.109 **Recommendation.**— *The intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-24.*

5.3.22.1110 **Recommendation.** — *Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-25.*

5.3.22.1211 **Recommendation.**— *Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-25.*

Note.— Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities.

5.3.22.1312 **Recommendation.**— *The intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-12.*

5.3.22.14~~13~~ **Recommendation.**— Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.22.15~~14~~ **Recommendation.**— Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.22.16~~15~~ The lights in each unit of Configuration A shall be illuminated alternately.

5.3.22.17~~16~~ For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.

5.3.22.18~~17~~ 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.

<i>Origin</i> VAWG/4-6 APWGWHL/4	<i>Rationale</i> During discussions at these meetings, it was realized that the original intent of the Runway Guard Lights (RGLs) was not being met by the visibility requirement of the Annex. Since runway incursions occur during all weather conditions, and, in fact, more often occur in good visibilities, it was decided to remove the link to operating visibilities in 5.3.22.2 and recommend installation at all runway/taxiway intersections. This resulted in the proposed deletion of 5.3.22.3. Additionally, the text in 5.3.22.2 (sub a and b) became redundant and is proposed for deletion. <i>Secretariat's Comments:</i> During discussions at the panel meetings identified above it was also noted that the current wording of the Note to 5.3.22 did not reflect the original purpose of the introduction of RGLs. The meetings noted that the original intent of RGLs was to provide a final warning to flight crews and vehicle operators that they were immediately entering a runway. It was noted that a runway can switch between active and inactive several times a day and at any moment based on wind direction, etc. The original runway incursion prevention intent of providing RGLs at all runways, not only "active" runways, was proposed to be strengthened by the deletion of the word "active".
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Preliminary review by WG/PDP	The WG/PDP agrees in principle with the expanded application of RGLs as a runway incursion prevention measure. However, the WG/PDP concurs with the Secretariat proposal (paragraph 2.2.10 of AN-WP/8545) that 5.3.22.2 needs stronger rationale (such as that proposed by the VAWG to the AP), which recommends their use as part of runway incursion prevention measures for all weather conditions - day or night. Regarding the proposed change to the Note to 5.3.22 the WG/PDP requested the Secretariat to strengthen the Rationale for RGL's to be included for any runway. (See the Secretariat comments added to the panel Rationale box above.)
Recommendation	5.3.22.2 Recommendation.- <i>As part of runway incursion prevention measures, Runway guard lights, Configuration A or B, should be provided at each taxiway/runway intersection and used under all weather conditions during day and night. associated with a runway intended for use in:</i>

5.3.28 Runway Status Lights

Note 1.—Where it is desired or necessary to provide a direct warning system to the flight crew of an incursion potential ahead it is important that the signal provided to the flight crew is universally understood, and reacted to in a very short time. While other sensing and logic systems may be developed, it is of high importance that common visual characteristics be defined to enable crews to quickly understand the message and react accordingly.

Note 2.—Runway Status Lights (RWSL) are an automated autonomous system that may be installed in conjunction with enhanced taxiway centre line markings, stop bars or runway guard lights, and functions independently of any other visual system.

5.3.28.1 Recommendation.—*Where, following a risk analysis at a specific airport, it is deemed necessary to install a Runway Status Light System, the guidance in Attachment A to this Annex, Section 20, should be followed.*

Editorial Note.— The following content is the new Section 20 of Attachment A to Annex 14, Volume I.

20. Runway Status Lights

20.1 Runway Status Lights (RWSL) are a visual lighting system designed to provide direct warning to a flight crew of an incursion danger on the runway ahead. They have been developed in the United States and are currently being installed in major international airports in that country. The systems come in two basic forms, Runway Entrance Lights (RELs) and Take-off Hold Lights (THLs). Either system may be installed by itself, but it is preferred that the two systems are installed complementary to each other.

20.2 Runway Entrance Lights (RELs) consist of a single line of fixed in-pavement lights showing red in the direction of aircraft approaching the runway. RELs illuminate as an array at each taxiway/runway intersection where they are installed.

20.3 Take-off Hold Lights (THLs) consist of two rows of fixed in-pavement lights showing red in the direction of aircraft taking off on the runway. THLs illuminate as an array on the runway.

20.4 Intensity and beam spread of RELs and THLs are in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

20.5 RELs and THLs are automated to the extent that the only control over each system is to disable one or both systems. ATS personnel do not have operational control over the light array.

20.6 RELs are offset 0.6m from the taxiway centre line on the opposite side to the taxiway centre line lights, where provided, and begin 0.6 m before the runway hold position extending to the edge of the runway. An additional single light is placed on the runway 0.6 m from the runway centre line and aligned with the taxiway RELs. (See Figure 5-29.)

20.7 RELs consist of 6 light units and are spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for the single light installed near the runway centre line as shown in Figure 5-29.

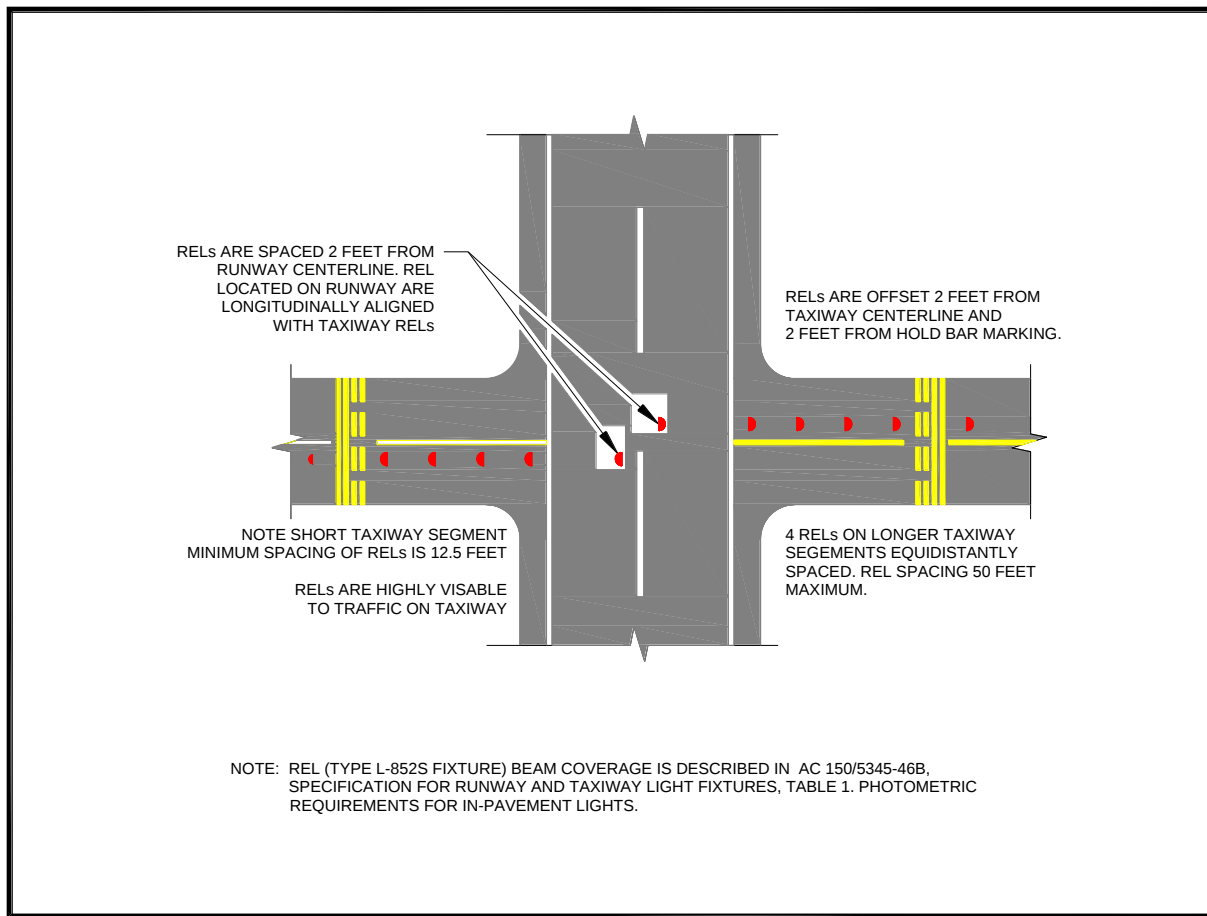


Figure 5-29. Runway Entrance Lights

20.8 THLs are offset 1.8m on each side of the runway centre line lights, where provided, and extend, in pairs, starting at a point 115 m from the beginning of the runway and thereafter every 30 m for at least 450 m. (See Figure 5-30.)

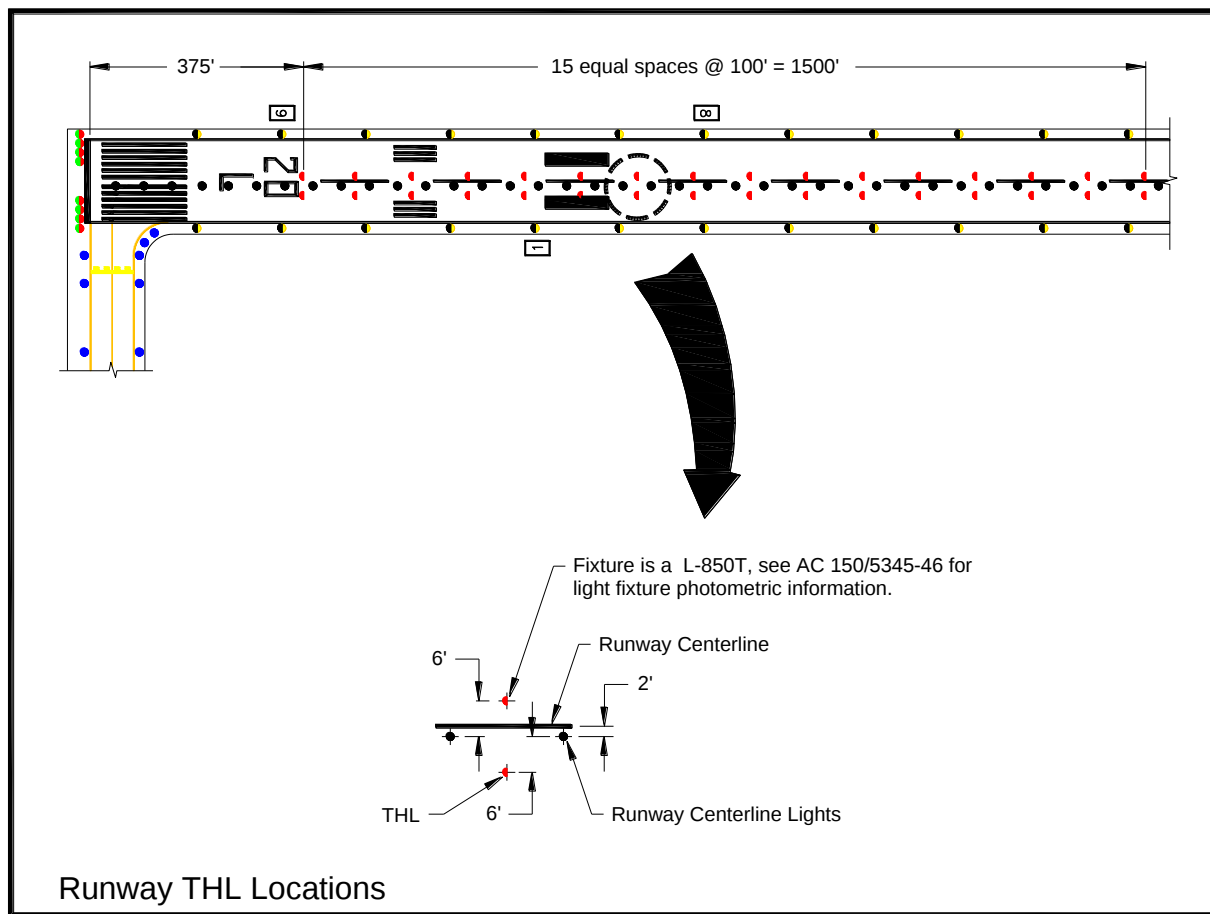


Figure 5-30 Take-off Hold Lights

Editorial Note.— Re-number existing Figure 5-29 (and all references) to Figure 5-31, and cascade the re-numbering through the remainder of Chapter 5.

<i>Origin</i> VAWG/5-6 APWGWHL/4	<i>Rationale</i> This is an entirely new section being proposed to establish the lighting configuration for Runway Status Lights (RWSL) systems. The configurations described are being installed over the next few years at 22 major United States airports. Additionally interest in and development of other similar systems around the world by at least three other States has prompted this proposal for the configuration. The primary concern is to provide a direct, independent warning of a potential conflict to the flight crew. As such, the warning must be universally recognized and reacted to very quickly due to the dynamic nature of the conflict. Therefore it is essential to establish a common lighting configuration globally, to ensure the greatest possible recognition and least possible reaction time to the warning. Much research has been accomplished in the United States by MIT Lincoln Laboratories and by MITRE corporation before the current configuration was agreed to. Prototype systems have been installed at San Diego (KSAN) Dallas-Fort Worth (KDFW) Los Angeles (KLAX) and Boston (KBOS). Information derived from those prototype installations has been used to develop the final configuration of lights proposed here. While other data sensor systems might be put in place, and different threat algorithms developed, the end result, the lighting configuration, must be common. These proposals seek to establish those configurations.
Preliminary review by WG/PDP	The WG/PDP agrees with the intent of the RWSL system. However, before RWSL provisions can be added to Annex 14 there needs to be associated PANS-OPS and PANS-ATM procedures for pilots and ATC. Therefore WG-PDP recommends removing RWSL provisions from Annex 14 but would recommend that the Secretariat facilitate the development of an ICAO circular that would provide the complete package of system and operating procedures.

5.3.29 No Entry Bar

Note 1.— The provision of a no entry bar requires its manual activation and deactivation by air traffic control.

Note 2.— Runway incursions may take place in all visibility or weather conditions. The provision of no entry bars and their use at night and in all visibility conditions can form part of effective runway incursion prevention measures.

Application

5.3.29.1 Recommendation.—*A no entry bar should be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of vehicles or aircraft to that taxiway.*

Location

5.3.29.2 Recommendation.—*A no entry bar should be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.*

Characteristics

5.3.29.3 Recommendation.—*A no entry bar should consist of unidirectional lights spaced at intervals of no more than 3 m across the taxiway, showing red in the intended direction(s) of approach to the runway.*

Note. — *Where necessary to enhance conspicuity, extra lights are installed uniformly.*

5.3.29.4 Recommendation.— *Where the normal no entry bar lights might be obscured (from a pilot's view), for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft, a pair of elevated lights should be added to each end of the no entry bar.*

5.3.29.5 The intensity in red light and beam spreads of no entry bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.29.6 Recommendation.— *Where no entry bars are provided and where, from an operational point of view, higher intensities are required to maintain light perception in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no entry bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.*

Note.— *High-intensity no entry bars are typically only used in case of an absolute necessity and following a specific study.*

5.3.29.7 Recommendation.— *Where a wide beam fixture is required, the intensity in red light and beam spreads of no entry bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.*

5.3.29.8 The lighting circuit shall be designed so that:

- a) no entry bars are switchable selectively or in groups;
- b) when a no entry bar is illuminated, any taxiway centre line lights installed beyond the no entry bar, when viewed towards the runway, shall be extinguished for a distance of at least 90 m; and
- c) when a no entry bar is illuminated, any stop bar installed between the no entry bar and the runway shall be extinguished.

<i>Origin</i> VAWG/5-6	<i>Rationale</i> This is a new section developed to assist in runway incursion prevention. It addresses the installation of no-entry bars (essentially stop bars not associated with a Runway Holding position or an intermediate holding position) to prevent inadvertent access by aeroplanes or vehicles onto a specific taxiway. An example of this would be when the airport configuration establishes some taxiways as Rapid Exit Taxiways, the no-entry bar would be illuminated to prevent any aircraft or vehicle from entering the RET in the wrong direction. While primarily Recommendations, there are two Standards associated with this proposal. Both seek to establish the required characteristics of the no-entry bar, if installed, while not requiring their installation. Those primary characteristics are that they must be visible to the aircraft or vehicle operator approaching the no-entry bar and the associated lighting (taxiway centre line, etc.) must not produce conflicting visual signals to the operator (interlocked).
Preliminary review by WG/PDP	The WG/PDP believes the similarity of the characteristics of no-entry bars with stop bars does not warrant a section of its own. Therefore, the WG/PDP recommends deleting section 5.3.29, with the exception that the proposed text of 5.3.29.1 should be inserted with appropriate clarifying editorial changes as a new 5.3.19.5A in the 5.3.19 Stop bars section.

CHAPTER 6 – VISUAL AIDS FOR DENOTING OBSTACLES

6.1 Objects to be marked and/or lighted

Editorial Note.— Please note renumbering of Chapter 6.

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 Objects within obstacle limitation surfaces (within the lateral boundaries of the OLS)

~~6.1.6~~ 6.1.1.1 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~~ 6.1.1.2 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~~ 6.1.1.3 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 taxilane shall be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, lighted.

~~6.1.1~~ 6.1.1.4 **Recommendation** – *A fixed obstacle that extends above a take-off climb surface within 3000 m of the inner edge of the take-off climb surface should 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~~ 6.1.1.5 **Recommendation** – *A fixed object, other than an obstacle, adjacent to a take-off climb surface should 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~~ **6.1.1.6** A fixed obstacle that extends above an approach or transitional surface within 3000 m of the inner edge of the approach surface or above a transitional 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~~ **6.1.1.7** **Recommendation** – A fixed obstacle *that extends* above a horizontal surface should be marked and, if the aerodrome is used at night, lighted, except that:

- a) *such marking and lighting may be omitted when:*
 - a. *the obstacle is shielded by another fixed obstacle; or*
 - b. *for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or*
 - c. *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~~ **6.1.1.8** 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.

6.1.1.9 Recommendation – *Other objects inside the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).*

Note.- See note below 4.4.2.

~~6.1.10~~ **6.1.1.10 Recommendation** – Overhead wires, cables, etc., crossing a river, **waterway**, valley or highway should be marked and their supporting towers marked and lighted if an aeronautical study indicated that the wires or cables could constitute a hazard to aircraft.

6.1.2 Objects outside obstacle limitation surfaces (outside the lateral boundaries of the OLS).

~~6.1.9~~ **6.1.2.1 Recommendation** – Obstacles in accordance with 4.3.2 should be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

6.1.2.2 A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.

Note – see 4.3.1 and 4.3.2

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

~~6.1.10~~ **6.1.2.4 Recommendation** – Overhead wires, cables, etc., crossing a river, **waterway**, valley or highway should 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.

6.2 Marking and/or lighting of objects

6.2.1 General

~~6.3.1~~ **6.2.1.1** The presence of objects which must be lighted, as specified in 6.1, shall be indicated by low-, medium- or high-intensity lights, or a combination of such lights.

~~6.3.23~~ **6.2.1.2** Low-intensity obstacle lights ~~on fixed objects~~, Types A and B, C and D, medium-intensity obstacle lights, types A, B and C, high-intensity obstacle lights Type A and B, shall be in accordance with the specifications in Table 6-3 and Appendix 1. ~~shall be fixed red lights.~~

~~6.3.22~~ **6.2.1.3** The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that **adjacent** object **or the part of the object** that is **shielding the light**, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

6.2.2 Mobile objects

Marking

~~6.2.2~~ **6.2.2.1** All mobile objects to be marked shall be coloured or display flags.

Marking by colour

~~6.2.6~~ 6.2.2.2 **Recommendation** – When mobile objects are marked by colour, a single conspicuous colour, preferably red or yellowish green for emergency vehicles and yellow for service vehicles should be used.

Marking by flags

~~6.2.11~~ 6.2.2.3 Flags used to mark mobile 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~~ 6.2.2.4 Flags used to mark mobile objects shall not be less than 0.9 m square on each side and shall consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours 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 colours merge with the background.

Lighting

~~6.3.4~~ 6.2.2.5 Low intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

Note – See Annex 2 for lights to be displayed by aircraft.

~~6.3.25~~ 6.2.2.6 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.

~~6.3.5~~ 6.2.2.7 Low intensity obstacle lights, type D, shall be displayed on follow-me vehicles.

~~6.3.28~~ 6.2.2.8 Low intensity obstacle lights on objects with limited mobility such as aerobridges shall be fixed-red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, type A, in table 6-3. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

6.2.3 Fixed objects

Marking

~~6.2.1~~ 6.2.3.1 All fixed objects to be marked shall, whenever practicable, be coloured, 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 colour need to be otherwise marked.

Marking by colour

~~6.2.3~~ 6.2.3.2 **Recommendation** – An object should be coloured to show a chequered 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 should consist of rectangles not less than 1.5 m and not more than 3 m on a side, the corners being of the darker colour. The colours of the pattern should contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white should be used, except where such colours merge with the background. (see figure 6-1).

6.2.4 6.2.3.3 Recommendation – An object should be coloured 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 should be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. The colours of the bands should contrast with the background against which they will be seen. Orange and white should be used, except where such colours are not conspicuous when viewed against the background. The bands on the extremities of the object should be of the darker colour. (see figure 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 colour.

6.2.5 6.2.3.4 Recommendation – An object should be coloured in a single conspicuous colour if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red should be used, except where such colours merge with the background.

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

Marking by flags

6.2.11 6.2.3.5 Flags used to mark **fixed** objects shall be displayed around, on top of, or around the highest edge of the object. When flags are used to mark extensive objects or a group of closely spaced objects, they shall be displayed at least every 15 m. Flags shall not increase the hazard presented by the object they mark.

6.2.12 6.2.3.6 Flags used to mark fixed objects shall not be less than 0.6 m square on each side and flags used to mark mobile objects, not less than 9 m square.

6.2.14 6.2.3.7 Recommendation – **Flags used to mark fixed mobile objects should be orange in colour or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colours merge with the background, other conspicuous colours should be used.**

Marking by markers

~~6.2.7~~ **6.2.3.8** 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.

~~6.2.10~~ **6.2.3.9** **Recommendation** – *A marker should be of one colour. When installed, white and red, or white and orange markers should be displayed alternately. The colour selected should contrast with the background against which it will be seen.*

Lighting

~~6.3.11~~ **6.2.3.10** In case of an object to be lighted 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.~~

Note – Recommendations on how a combination of low-, medium-, and/or high-intensity lights on obstacles should be displayed are given in Appendix 6.

~~6.3.12~~ **6.2.3.11** **Recommendation** – *In the case of a chimney or other structure of like function, the top lights should be placed sufficiently below the top so as to minimize contamination by smoke etc. (see Figures 6-2 and 6-3. (see figure 6-2).*

~~6.3.13~~ **6.2.3.12** 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 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~~ **6.2.3.13** In case of an extensive object or a group of closely spaced objects to be lighted that are:

- a) penetrating a horizontal OLS or located outside an OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and
- b) penetrating a sloping OLS the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area shall be marked.

~~6.3.15~~ **6.2.3.14** **Recommendation** - *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 should be placed on the highest point of the object.*

6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

- a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m.
- b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

~~6.3.32~~ 6.2.3.16 High-intensity obstacle lights, Type A, ~~M~~ medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.

~~6.3.24~~ 6.2.3.17 **Recommendation** – The installation setting angles for high-intensity obstacle lights, Types A ~~and B~~, should be in accordance with Table 6-2.

Note – High intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, operation and the location of high-intensity obstacle lights is given in the Aerodrome Design Manual, Part 4.

~~6.3.10~~ 6.2.3.18 **Recommendation** – Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, type A, or medium-intensity obstacle lights, Type A ~~or B~~, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system should be provided. This system should be composed of high intensity obstacle lights, Type A ~~or B~~ or medium intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle light, Type B or C, for night-time use.

Objects with a height less than 45m above the level of the surrounding ground

~~6.3.2~~ 6.2.3.19 **Recommendation** – Low-intensity obstacle lights, Type A or B, should 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~~ 6.2.3.20 **Recommendation** – 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 should be used.

~~6.3.6~~ 6.2.3.21 **Recommendation** – Low-intensity obstacle lights, Type B, should be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with ~~6.3.7~~ 6.2.3.22.

~~6.3.7~~ 6.2.3.22 **Recommendation** – Medium-intensity obstacle lights, Type A, B or C, should 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, should be used alone, whereas medium intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.

Note – A group of ~~trees or~~ buildings is regarded as an extensive object.

Objects with a height not more than 150 m but not less than 45m above the level of the surrounding ground

~~6.3.7~~ 6.2.3.23 **Recommendation** – Medium-intensity obstacle lights, Type A, B or C, should be used. ~~where the object is an extensive one or its height above the surrounding ground is greater than 45m.~~

Medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.

~~6.3.16~~ 6.2.3.24 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.

~~6.3.17~~ 6.2.3.25 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~~ 6.2.3.26 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~~ 6.2.3.27 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~~ 6.2.3.10 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.

Objects which height exceeds 150 m above ground level or the level of the surrounding ground

~~6.3.8~~ 6.2.3.28 **Recommendation** – *High-intensity obstacle lights, Type A, should 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.*

~~6.3.19~~ 6.2.3.29 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~~ 6.2.3.10 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.

~~6.3.7~~ 6.2.3.30 **Recommendation** – ~~Medium-intensity obstacle lights, Type A, B or C, should be used, where the object is an extensive one or its height above the level of the surrounding ground is greater than 45m. Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium-intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.~~

~~6.3.16~~ **6.2.3.31** 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.

~~6.3.16~~ **6.2.3.32** Where an object is indicated by medium-intensity obstacle lights, Type A ~~B~~, ~~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 ~~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~~ **6.2.3.33** 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.

6.2.4 Wind turbines

Markings

~~6.4.2~~ **6.2.4.1** **Recommendation** – *The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.*

Lighting

~~6.4.3~~ **6.2.4.2** **Recommendation** – *When lighting is deemed necessary, medium intensity obstacle lights should be used. In the case of a wind farm, i.e. group of two or more wind turbines it should be regarded as an extensive object and the lights should be installed:*

- a) *to identify the perimeter of the wind farm;*
- b) *respecting the maximum spacing, in accordance with ~~6.3.14~~ **6.2.3.15**, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;*
- c) *so that, where flashing lights are used, they flash simultaneously; and*
- d) *so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located.*

~~6.4.4~~ **6.2.4.3** **Recommendation** – *The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.*

6.2.5 Overhead wires, cables, etc. and supporting towers

Marking

6.2.5.1 Recommendation - *The wires, cables, etc. to be marked should be equipped with markers; the supporting tower should be coloured.*

Marking by colours

~~6.1.10~~ **6.2.5.2 Recommendation** - ~~Overhead wires, cables, etc., crossing a river, valley or highway should 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.~~ *The supporting towers of overhead wires, cables, etc. should be marked in accordance with 6.2.3.1 to 6.2.3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.*

Marking by markers

~~6.2.7~~ **6.2.5.3** 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 1 000 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~~ **6.2.5.4 Recommendation** – *A marker displayed on an overhead wire, cable, etc. should be spherical and have a diameter of not less than 60 cm.*

~~6.2.9~~ **6.2.5.5 Recommendation** – *The spacing between two consecutive markers or between a marker and a supporting tower should be appropriate to the diameter of the marker, but in no case should 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 should be located not lower than the level of the highest wire at the point marked.

~~6.2.10~~ **6.2.5.6 Recommendation** – *A marker should be of one colour. When installed, white and red, or white and orange markers should be displayed alternately. The colour selected should contrast with the background against which it will be seen.*

~~6.1.11~~ **6.2.5.7 Recommendation** – *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, should be provided on their supporting towers.

Lighting

6.3.9 6.2.5.8 Recommendation – High intensity obstacle lights, Type B, should be used to indicate the presence of the tower supporting overhead wires, cables, etc. where:

- a) an aeronautical study indicates such light to be essential for the recognition of the presence of wires, cables, etc.; or
- b) it has not been found practicable to install marker on the wires, cables, etc.

6.3.20 6.2.5.9 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.

6.3.36 6.2.5.10 Recommendation – High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., should flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights should be approximate the following ratios:

Flash interval between	Ratio of cycle time
<i>middle and top light</i>	<i>1/13</i>
<i>top and bottom light</i>	<i>2/13</i>
<i>bottom and middle light</i>	<i>10/13.</i>

Editorial Note.— The following Note is re-located from existing 6.3.1.

Note – High intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, operation and the location of high-intensity obstacle lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

6.3.10 6.2.5.11 Recommendation.- Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A or B, or medium-intensity obstacle lights, Type A or B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant

environmental concerns, a dual obstacle lighting system should be provided. This system should be composed of high-intensity obstacle lights, Type 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. Where medium-intensity lights are used they should be installed at the same level as the high-intensity obstacle light Type B.

~~6.3.21~~ **6.2.5.12 Recommendation** – The installation setting angles for high-intensity obstacle lights, Types A and B, should be in accordance with Table 6-2.

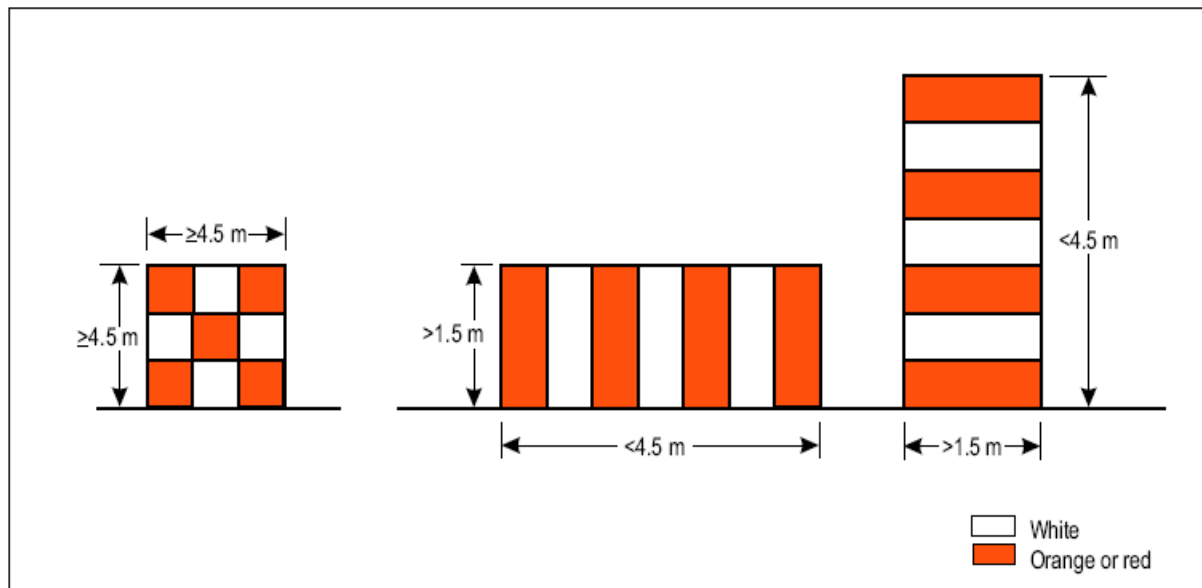


Figure 6-1. Basic marking patterns

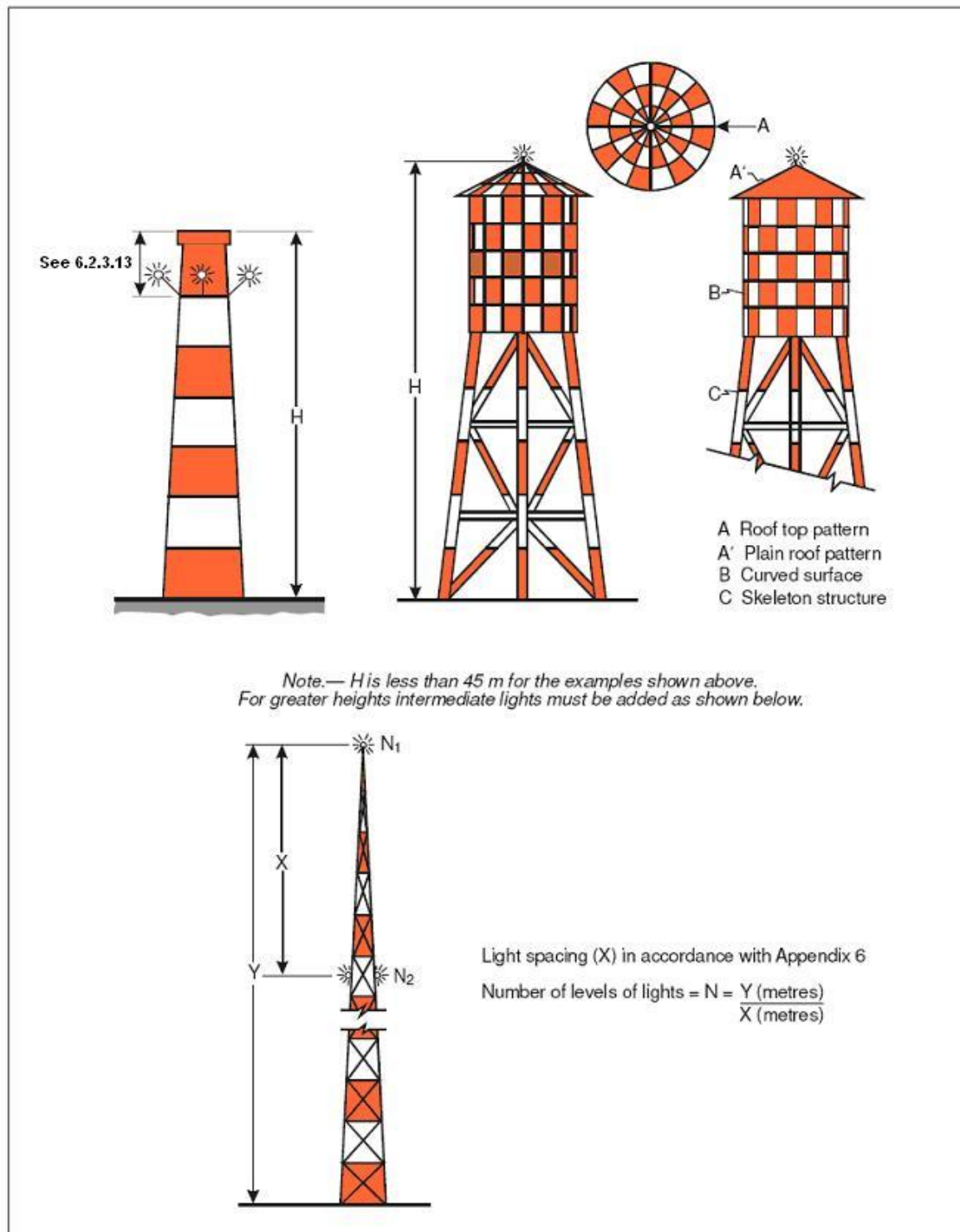


Figure 6-2. Examples of marking and lighting of tall structures

Figure 6-3 Lighting of buildings

Table 6-1 Marking band widths

Longest dimension		Band width		
Greater than	Not exceeding	of longest dimension		
1.5 m	210 m	1/7	“	“
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	“	“

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°

Table 6-3. Characteristics of obstacle lights

1	2	3	4	5	6	7
Light Type	Colour	Signal type/ (Flash rate)	Benchmark intensity (cd) at given Background Luminance (b)			Light Distribution Table
			Day (Above 500 cd/m ²)	Twilight (50-500 cd/m ²)	Night (Below 50 cd/m ²)	
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	6-X
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	6-X
Low-intensity, Type C (mobile obstacle)	Yellow/ Blue (a)	Flashing (60-90 fpm)	N/A	40	40	6-X
Low-intensity, Type D Follow-me vehicle	Yellow	Flashing (60-90 fpm)	N/A	200	200	6-X
Medium-intensity, Type A	White	Flashing (20-60 fpm)	20 000	20 000	2 000	6-Y

Medium-intensity, Type B	Red	Flashing (20-60 fpm)	N/A	N/A	2 000	6-Y
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2 000	6-Y
High-intensity, Type A	White	Flashing (40-60 fpm)	200 000	20 000	2 000	6-Y
High-intensity, Type B	White	Flashing (40-60 fpm)	100 000	20 000	2 000	6-Y

(a) See §6.2.2.6

(b) For flashing lights, effective intensity as determined in accordance with the Aerodrome Design Manual, Part 4.

Table 6-X Light distribution for low intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10cd (b)	N/A	10°	5cd
Type B	32cd (b)	N/A	10°	16cd
Type C	40cd (b)	400cd	12° (d)	20cd
Type D	200cd (c)	400cd	N/A (e)	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual, Part 4.

(b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(d) Peak intensity should be located at approximately 2.5° vertical.

(e) Peak intensity should be located at approximately 17° vertical.

(f) Beam spread is defined as the angle between the horizontal plan and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Table 6-Y Light distribution for medium and high intensity obstacle lights according to benchmark intensities of table 6-3

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

- (a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual, Part 4.
- (b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.
- (c) Beam spread is defined as the angle between the horizontal plan and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Note.— an extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

ORIGIN AP/1	RATIONALE Restructure of Chapter 6 to improve readability for end user (e.g.: obstacle owners)	
Old number	What happened?/why?	New number
Note	We have put this note in 6.1 as a general item because it is applicable to all kind of marking and lighting.	Note below 6.1
6.1.1	We have put this in section 6.1.1 because it is only applicable to obstacles within obstacle limitation surfaces.	6.1.1.4
6.1.2	We have put this in section 6.1.1 because it is only applicable to obstacles within obstacle limitation surfaces.	6.1.1.5
6.1.3	We have put this in section 6.1.1 because it is only applicable to obstacles within obstacle limitation surfaces. We also changed the wording “ <i>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...</i> ” into “ <i>a fixed obstacle that extends above an approach surface within 3000 m of the inner edge or above a transitional surface shall be marked and, if the runway is used at night, lighted...</i> ”, because this corresponds with 4.2.10 and clarifies the application.	6.1.1.6
6.1.4	We have put this in section 6.1.1 because it is only applicable to obstacles within obstacle limitation surfaces.	6.1.1.7
6.1.5	We have put this in section 6.1.1 because it is only applicable to obstacles within obstacle limitation surfaces.	6.1.1.8
Note	We have put this in section 6.1.1 because it is only applicable to obstacles within obstacle limitation surfaces.	Note below 6.1.1.8
6.1.6	We have put this into section 6.1.1 because it is only applicable to mobile objects within the obstacle limitation surfaces. (Since the movement area is located within the area of the obstacle limitation surfaces.)	6.1.1.1
6.1.7	We have put this into section 6.1.1 because it is only applicable to elevated ground lights, etc. on the movement area. (Since the movement area is located within the area of the obstacle limitation surfaces.)	6.1.1.2
6.1.8	We have put this into section 6.1.1 because it is only applicable to objects on the movement area. (Since the movement area is located within the area of the obstacle limitation surfaces.)	6.1.1.3
6.1.9	We have put this into section 6.1.2 because it is only applicable to objects outside the obstacle limitation surfaces.	5.1.2.1
6.1.10	We have put the first part of this article into section 6.1.1 and 6.1.2 because it could apply to cables, etc. outside obstacle limitation surfaces as well as cables, etc. within obstacle limitation surfaces. [We also added the word waterway beside river, valley or highway because a waterway may be used as a visual flight route. The definition waterway covers more the definition river (e.g. canals). On the other hand a river is not always a waterway.] We have put the second part of this article into the marking part of 6.2.4 because it is regulating how these structures have to be marked and/or lighted.	First part in 6.1.1.10 and 6.1.2.4 Second part in 2 nd part of 6.2.5.2
6.1.11	We have put this section into section 6.2.5 because it only addresses how wires, cables, etc. have to be marked and/or their supporting towers lighted,	6.2.5.7

6.2.1	We have put this in the general marking section of fixed objects (6.2.3.) because it is applicable to all fixed objects to be marked. It says that the object shall be coloured or display markers or flags.	6.2.3.1
6.2.2	We have put this in the marking section of mobile objects because it is only applicable to the marking of mobile objects.	6.2.2.1
6.2.3	We have put this in the marking section of fixed objects (6.2.3) because it recommends how a fixed object should be marked.	6.2.3.2
6.2.4	We have put this in the marking section of fixed objects (6.2.3) because it recommends how a fixed object should be marked.	6.2.3.3
Note	We have put this in the marking section of fixed objects (6.2.3) because it recommends how a fixed object should be marked.	Note below 6.2.3.3
6.2.5	We have put this in the marking section of fixed objects (6.2.3) because it recommends how a fixed object should be marked.	6.2.3.4
Note	We have put this in the marking section of fixed objects (6.2.3) because it recommends how a fixed object should be marked.	Note below 6.2.3.4
6.2.6	We have put this in the marking section of mobile objects (6.2.2 marking by colour) since it recommends how a mobile object should be marked by a colour.	6.2.2.2
6.2.7	We have put this article in the part marking by markers' of fixed objects (6.2.3) and the part 'marking by markers' of overhead wires, cables, etc. (6.2.5) since it is regulated how markers shall be displayed. Markers are especially used at cables, wires, etc., but can also be applied to fixed objects.	6.2.3.8 and 6.2.5.3
6.2.8	We have put this in the 'marking by markers section of overhead wires, cables, etc. (6.2.5) because it is applicable to markers displayed on an overhead wires, cable, etc.	6.2.5.4
6.2.9	We have put this in the 'marking by markers section of overhead wires, cables, etc. (6.2.5) because it is applicable to markers displayed on an overhead wires, cable, etc.	6.2.5.5
6.2.10	We have put this article in the part marking by markers' of fixed objects (6.2.3) and the part 'marking by markers' of overhead wires, cables, etc. (6.2.5) since it recommends how markers shall be coloured. Markers are especially used at cables, wires, etc., but can also be applied to fixed objects.	6.2.3.9 and 6.2.5.6
6.2.11	We have put this article in the part 'marking by flags' of <u>fixed</u> objects (6.2.3). We have also put the first part of this article in the section 'marking by flags' of mobile objects (6.2.2) because it is also applicable to mobile objects. However the last part (applicable to a group of extensive objects, we left away because this will not be applicable to mobile objects.)	6.2.2.3 and 6.2.3.5
6.2.12	We have put the first part of this article in the part 'marking by flags' of fixed objects (6.2.3) because it is applicable to flags on fixed objects. The second part of this article is located in the part 'marking by flags' of mobile objects (6.2.2) because it is applicable to flags on mobile objects. The last part is merged with the old article 6.2.14.	6.2.2.4 and 6.2.3.6
6.2.13	We have put this in the part 'marking by flags' of fixed objects (6.2.3) because it is applicable to flags on fixed objects.	6.2.3.7
6.2.14	We have put this in the part 'marking by flags' of mobile objects (6.2.2) because it is applicable to flags on mobile objects. This article is merged with the 2 nd part of the old article 6.2.12.	6.2.2.4
6.3.1	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted.	6.2.1.1

Note	We have put this article in the general lighting part of fixed objects (6.2.3) and in the lighting part of overhead wires, etc. because it is applicable to high intensity lights, which can be applied at fixed objects or structures of overhead wires, etc.	Note below 6.2.3.17 and note below 6.2.5.10
6.3.2	We have put this article in the lighting part of 'objects with a height less than 45 m...', because it is only applicable to objects with a height less than 45 m above...	6.2.3.19
6.3.3	We have put this article in the lighting part of 'objects with a height less than 45 m...', because it is only applicable to objects with a height less than 45 m above...	6.2.3.20
6.3.4	We have put this article in the part lighting of mobile objects since it is only applicable to mobile objects.	6.2.25
6.3.5	We have put this article in the part lighting of mobile objects since it is only applicable to mobile objects.	6.2.2.7
6.3.6	We have put this in the part lighting of 'objects with a height less than 45 m...' because it is only applicable to objects with a height less than 45 m...	6.2.3.21
6.3.7	We have put this article partly in the part lighting of 'objects with a height less than 45 m...' and removed the sentence 'or its height...than 45m' because this is not applicable. We have also put this article into the part lighting of 'objects with a height 45-150' and removed the sentence 'where the object...than 45 m' because this is not applicable. We have also put the last part in the part 'lighting of objects with a height more than 150m...' and we added the text 'where an object is indicated by MI lights' Because objects with a height more than 150 m... are normally indicated by HI lights.	6.2.3.22 and 6.2.3.23 and 6.2.3.30
Note	We have put this note below the new article 6.2.3.22 because it is related to that article	Note below 6.2.3.22
6.3.8	We have put this article in the part lighting of 'objects which height exceeds 150 m...' because it is applicable to objects higher than 150 m.	6.2.3.28
6.3.9	We have put this article in the lighting part of overhead wires, cables, etc. (6.2.5) because it is applicable to lighting of overhead wires, etc. and their structures.	6.2.5.8
6.3.10	We have put this article in the general lighting part of fixed objects because it could apply to all fixed objects. Since type A (HI) is only used at fixed objects (which do not include cables, etc.) we only mentioned type A. We have also put this article in the part lighting of overhead wires, etc. because it could also apply to lighting of wires and their structures. In this case we only mentioned type B (HI) because this type B is used only for overhead wires.	6.2.3.18 and 6.2.5.11
Note	We have put this note in the general lighting part of fixed objects because it is applicable to fixed objects.	Note below 6.2.3.10
6.3.11	We have put this article in the general lighting part of fixed objects, because it is related to lighting of fixed objects.	6.2.3.10 and 6.2.3.13
6.3.12	We have put this article in the general lighting part of fixed objects, because it is related to lighting of fixed objects.	6.2.3.11
6.3.13	We have put this article in the general lighting part of fixed objects, because it is related to lighting of fixed objects.	6.2.3.12
6.3.14	We have put this article in the general lighting part of fixed objects, because it is related to lighting of fixed objects. We also modified	6.2.3.13 and 6.2.3.15

	this part and split it into 2 separate articles.	
6.3.15	We have put this article in the general lighting part of fixed objects, because it is related to lighting of fixed objects.	6.2.3.14
6.3.16	We have put this article in the lighting part of “objects with a height 45-150” and “objects with a height more than 150 m” because it could only apply to those objects. We only modified the article with regarding to objects higher than 150m.	6.2.3.24 and 6.2.3.31
6.3.17	We have put this article in the lighting part of “objects with a height 45-150” and “objects with a height more than 150 m” because it could only apply to those objects. We only modified the article with regarding to objects higher than 150m.	6.2.3.25 and 6.2.3.32
6.3.18	We have put this article in the lighting part of “objects with a height 45-150” and “objects with a height more than 150 m” because it could only apply to those objects. We only modified the article with regarding to objects higher than 150m.	6.2.3.26 and 6.2.3.33
6.3.19	We have put this article in the lighting part of “objects with a height 45-150” and “objects with a height more than 150 m” because it could only apply to those objects.	6.2.3.27 and 6.2.3.29
6.3.20	We have put this article in the part ‘lighting of overhead wires, cables, etc.’ because it is applicable to overhead wires, etc.	6.2.5.9
6.3.21	We have put this in the general lighting part of fixed objects with a limitation to HI type A lights, because only HI type A will be used on fixed objects. We have also put this article in the lighting part of cables, wires, etc. because HI lights will also be used on these objects.	6.2.3.17 and 6.2.5.12
6.3.22	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted.	6.2.1.3
6.3.23	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.24	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.25	We have put this article in the part lighting of mobile objects since it is only applicable to mobile objects.	6.2.2.6
6.3.26	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.27	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.28	We have put this article in the part lighting of mobile objects since it is only applicable to mobile objects. We merged this article with the old article 6.3.29.	6.2.2.8
Note	We have put this note in the part lighting of mobile objects since it is related to mobile objects.	Note below 6.2.2.5
6.3.29	We have put this article in the part lighting of mobile objects since it is only applicable to mobile objects. We merged this article with the	6.2.2.8

	old article 6.3.28.	
6.3.30	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.31	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.32	We have put this article in the general lighting part of fixed objects and merged it with the old article 6.3.35.	6.2.3.16
6.3.33	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.34	We have put this article in the general part of marking and/or lighting of objects (6.2.1) because it is applicable to every object to be lighted. We changed the article into a reference to table 6-3 because the characteristics of the light are described in table 6-3.	6.2.1.2
6.3.35	We have put this article in the general lighting part of fixed objects and merged it with the old article 6.3.32.	6.2.3.16
6.3.36	We have put this article in the part 'lighting of overhead wires, cables, etc.' because it is applicable to overhead wires, etc.	6.2.5.10
6.4.1	We have put this in the section objects outside OLS	6.1.2.2
6.4.2	We have put this in the part of wind turbines	6.2.4.1
6.4.3	We have put this in the part of wind turbines	6.2.4.2
6.4.4	We have put this in the part of wind turbines	6.2.4.3
Figure 6-2	Reference 6.3.12 was changed in 6.2.3.13	Figure 6-2
Figure 6-3	This figure introducing more confusion (too many lights) in regard with the text, it was better to delete it.	
Preliminary review by WG/PDP	The WG/PDP recommends the relocation of paragraph 6.1.2.2 to a subparagraph under paragraph 6.2.4. Windturbines.	

CHAPTER 9. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

9.1 Aerodrome emergency planning

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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 or~~

b) a series of modular tests commencing in the first year and concluding in a full scale emergency exercise at intervals not exceeding three years;

~~and~~ reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

Note 1.— *The purpose of a full-scale exercise is to ensure the adequacy of the plan to cope with different types of emergencies. The purpose of a partial exercise is to ensure the adequacy of the response to individual participating agencies and components of the plan, such as the communications system. The purpose of modular tests is to enable concentrated effort on specific components of established emergency plans.*

Note 2.— *Guidance material on airport emergency planning is available in the Airport Services Manual, Part 7.*

<i>Origin:</i> <i>RFFWGs 4 to 7</i> <i>AP-WG/WHLS-5 and 6</i>	<i>Rationale:</i> The current requirement to conduct full scale aerodrome emergency field exercise every two years is proving difficult for some States, because some emergency agencies that should be involved are unable and/or unwilling to participate. The proposed modular approach will present an aerodrome operator an opportunity to conduct a series of tests (10 in total) for their emergency plans with more concentration and detail on a specific element. The 10 modules are to be conducted over a 3 year period and culminate in a full scale field exercise. The modular approach should afford the aerodrome operator the opportunity to improve and/or enhance their aerodrome emergency plans because the modular concept will allow them to focus their attention on each element that comprises the 10 modules.
Preliminary review by WG/PDP	Initial proposal remains unchanged.

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 **Recommendation.**— *At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan should include the establishment, testing and assessment at regular intervals of a predetermined response for the specialist rescue services.*

9.1.15A **Recommendation.**— *An assessment of the approach and departure areas within 1,000 m of the runway threshold should be carried out to determine the options available for intervention.*

Note.- Guidance material on assessing approach and departure areas within 1,000 m of runway thresholds can be found in Chapter 13 of the Airport Services Manual (Doc 9137), Part 1.

<i>Origin:</i> <i>RFFWGs 6 and 7</i>	<i>Rationale:</i> It is well known and documented that aircraft accidents and incidents do occur predominantly within the vicinity of runway thresholds during aircraft approaches and/or departures. This can also be evidenced through the Airport Services Manual Part 1,
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AP-WG/WHL-6	Chapter 9 Figure 9-1. At many aerodromes there are difficult environments, such as large bodies of water, swamps, mud flats, busy motorways, high density residential housing or similar. With a view to being able to expediently and safely respond to those environments, specialist equipment, knowledge and/or training may be required. Conducting assessments of difficult environments would assist in determining what specialist equipment, knowledge and/or training may be required for the preservation of life and/or property in the event of an aircraft accident or incident in these areas.
Preliminary review by WG/PDP	Initial proposal remains unchanged.

9.2 Rescue and fire fighting

Extinguishing agents

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9.2.8 Recommendation.— *Both principal and complementary agents should normally be provided at an aerodrome.*

Note.— *Descriptions of the agents may be found in the Airport Services Manual (Doc 9137), Part 1.*

9.2.9 Recommendation.— *The principal extinguishing agent should be:*

- a) a foam meeting the minimum performance level A; or*
- b) a foam meeting the minimum performance level B; or*
- c) a foam meeting the minimum performance Level C; or*
- ed) a combination of these agents;*

except that the principal extinguishing agent for aerodromes in categories 1 to 3 should preferably meet the minimum a performance level B or C foam.

Note.— *Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance level A, or B or C rating is given in the Airport Services Manual (Doc 9137), Part 1.*

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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, 1 kg of complementary agent shall be taken as equivalent to 1.0L of water for foam production, 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 and 3.75L/min/m² for a foam meeting performance Level C.

Note 2.— When any other complementary agent is used, the substitution ratios need to be checked.

9.2.11A From 1 January 2022, 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 9-3, except that for aerodrome categories 1 and 2, up to 100 percent of the water may be replaced by complementary agent.

For the purpose of agent substitution, 1 kg of complementary agent shall be taken as equivalent to 1.0L of water for foam production.

Note 1.- The amounts of water specified for foam production are predicted on an application rate of 8.2 L/min/m² for a foam meeting performance Level A, 5.5 L/m/m² for a foam meeting performance Level B and 3.75 L/m/m² for a foam meeting performance Level C.

Note 2.- When any other complimentary agent is used, the substitution ratios need to be checked.

9.2.12 **Recommendation.**— At aerodromes where operations by aeroplanes larger than the average size in a given category are planned, ~~the quantities of water should be recalculated and the amount of water for foam production and the discharge rates for foam solution should be increased accordingly not be less than that shown in Table 9-3.~~

Note.— Additional guidance is available in Chapter 2 of the Airport Services Manual (Doc 9137), Part 1.

9.2.13 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.

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9.2.16 **Recommendation.**— ~~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 should 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. When different performance level foams are provided at an aerodrome the conversion ratio should be calculated, documented for each rescue and fire fighting vehicle and applied to the overall rescue and fire fighting requirement.

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Table 9-2. Minimum usable amounts of extinguishing agents

Aerodrome category	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate Foam solution/minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
		(3)		(5)		(7)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	350	350	230	230	160	160	45	2.25
2	1 000	800	670	550	460	360	90	2.25
3	1 800	1 300	1 200	900	820	630	135	2.25
4	3 600	2 600	2 400	1 800	1 700	1 100	135	2.25
5	8 100	4 500	5 400	3 000	3 900	2 200	180	2.25
6	11 800	6 000	7 900	4 000	5 800	2 900	225	2.25
7	18 200	7 900	12 100	5 300	8 800	3 800	225	2.25
8	27 300	10 800	18 200	7 200	12 800	5 100	450	4.5
9	36 400	13 500	24 300	9 000	17 100	6 300	450	4.5
10	48 200	16 600	32 300	11 200	22 800	7 900	450	4.5

Note.— The quantities of water shown in columns 2, 4, and 6 are based on the average overall length of aeroplanes in a given category.

Table 9-3. Minimum usable amounts of extinguishing agents

Aerodrome category	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate foam solution/minute (L)	Water (L)	Discharge rate Foam solution/minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
		(3)		(5)		(7)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
11	690	690	460	460	320	320	45	2.25
12	1 200	920	780	620	530	420	90	2.25
13	2 200	1 700	1 500	1 100	1 000	770	135	2.25
14	4 400	2 800	2 900	1 800	2 000	1 300	135	2.25
15	9 100	5 200	6 100	3 500	4 200	2 400	180	2.25
16	14 900	7 500	10 000	5 000	6 800	3 400	225	2.25
17	21 500	9 400	14 400	6 300	9 800	4 300	225	2.25
18	31 100	12 300	20 900	8 300	14 200	5 600	450	4.5
19	41 500	15 400	27 900	10 300	19 000	7 000	450	4.5
10	54 300	18 700	36 400	12 500	24 800	8 600	450	4.5

Note.- The quantities of water shown in columns 2, 4 and 6 are based on the largest overall length of aeroplanes in a given category.

<i>Origin:</i> <i>RFFWGs 4,6 and 7</i> <i>AP-WG/WHLs-5 and 6</i>	<i>Rationale:</i> For many years there have been two levels of foam available for RFF purposes, namely, performance levels A and B. Level A, which is a protein-based foam, requires more water for foam production than Level B foam as well as a greater discharge rate. Level C foam is, in essence, a concentrate of Level B foam, which requires less water for foam production, a lesser discharge rate and is more efficient in its extinguishing ability than Level B foam. The benefits of using Level C foam is that the size of fire vehicles can be reduced in agent carrying capacity (size) or, by using the same fire vehicles, the fire fighting capability is increased. Table 9-2 was originally developed in the 1980's based on median aircraft in a given category. With today's range of aircraft, there are quite a few more aircraft types within the category, making the "older" calculations redundant for this purpose. For example, the Dash 8 – 400 series aircraft is a category 6 aircraft and the agent quantities listed in the current table may be adequate. However, the much larger Airbus A320, which has the capacity to carry greater amounts of fuel, is also a category 6 aircraft and the current table for agent quantities is most likely inadequate. In addition, recent information for six aircraft accidents for the period from 1991 to 2000 indicated that the amount of water actually used in combating aircraft fires ranged from 600% to 900% more than the quantities specified in Table 9-2. The updated Table 9-3 takes into account current aircraft ranges and is proposed to be applicable from 1 January 2022. This should provide a realistic time frame for RFF service providers to prepare for the agent increases on the basis that aviation fire vehicles normally have their half life re-fit after 10 years.
Preliminary review by WG/PDP	The PDP is of the opinion that the proposal in paragraph 9.2.11A which requires a mandatory provision of extinguishing agents based on the largest overall length of aeroplane in a given Aerodrome Category irrespective of the type of aeroplanes actually using the aerodrome, is excessively onerous. Therefore, PDP recommends the deletion of paragraph 9.2.11A and requested the Secretariat to draft proposed text that would upgrade the existing Recommended Practice in 9.2.12 to a Standard, including instructions on the usage of Table 9-2 and Table 9-3. The PDP also strongly recommends that the statement in the rationale box that findings indicate that 600% – 900% more water is needed over and above the quantities specified in Table 9-2, be removed. <i>Secretariat comments</i> Paragraph 9.2.11A is rejected as per PDP's proposal. Paragraph 9.2.12 is retained as per existing Annex 14, Volume I but the existing Note thereto is modified as per Champion Team's proposal. The effect of this is Table 9-3 will be moved to Doc 9137 ASM Part 1. A new Standard is now proposed in 9.2.12A which is an upgrade of existing RP 9.2.12, with a protection date of 1 January 2015. This date allows for a sufficient

period of three years from the introduction of level C foam in 2012 for States and operators to prepare for the change. Arising from these proposals, aerodromes receiving aeroplanes no larger than the median in each category will continue to use Table 9-2 as stipulated in 9.2.11, whereas aerodromes receiving aeroplanes larger than the median will continue to use existing 9.2.12 as a Recommended Practice and as a Standard in 9.2.12A starting 1 January 2015. Para 9.2.12, as a RP, will need to be deleted as from 1 January 2015.

The texts of the proposal are as follows:

~~9.2.11A From 1 January 2022, 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 9-3, except that for aerodrome categories 1 and 2, up to 100 percent of the water may be replaced by complementary agent.~~

~~For the purpose of agent substitution, 1 kg of complementary agent shall be taken as equivalent to 1.0L of water for foam production.~~

~~Note 1. The amounts of water specified for foam production are predicted on an application rate of 8.2 L/min/m² for a foam meeting performance Level A, 5.5 L/m/m² for a foam meeting performance Level B and 3.75 L/m/m² for a foam meeting performance Level C.~~

~~Note 2. When any other complimentary agent is used, the substitution ratios need to be checked.~~

9.2.12 Recommendation.— At aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water should be recalculated and the amount of water for foam production and the discharge rates for foam solution should be increased accordingly.

~~Note.~~— ~~Additional~~ Guidance on the determination of quantities of water and discharge rates based on the largest overall length of aeroplane in a given category is available in Chapter 2 of the Airport Services Manual (Doc 9137), Part 1.

9.2.12A From 1 January 2015, at aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water shall be recalculated and the amount of water for foam production and the discharge rates for foam solution shall be increased accordingly.

~~Note.~~— Guidance on the determination of quantities of water and discharge rates based on the largest overall length of aeroplane in a given category is available in Chapter 2 of the Airport Services Manual (Doc 9137), Part 1.

~~9.2.21 **Recommendation.**— 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, should 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 should be increased.~~

9.2.21A Recommendation.— A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table 9-2, should be maintained on the aerodrome for vehicle replenishment purposes.

Note.— Foam concentrate carried on fire vehicles in excess of the quantity identified in Table 9-2 can contribute to the reserve.

9.2.21B Recommendation.— A reserve supply of complementary agent, equivalent to 100 per cent of the quantity identified in Table 9-2, should be maintained on the aerodrome for vehicle replenishment purposes. Sufficient propellant gas should be included to utilize this reserve complementary agent.

9.2.21C Recommendation.— Category 1 and 2 aerodromes that have replaced up to 100 per cent of the water with complementary agent should hold a reserve supply of complementary agent of 200 per cent.

9.2.21D Recommendation.— Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply in 9.2.19A, 9.2.19B and 9.2.19C should be increased as determined by a risk assessment.

Note.— See Airport Services Manual (Doc 9137), Part 1 for guidance on the conduct of a risk analysis to determine the quantities of reserve extinguishing agents.

Origin:	Rationale:
RFFWGs 4 to 7 AP-WG/WHLs-5 and 6	Current reserve requirement is ambiguous as the quantities of agents to be provided in the vehicles can be based on either the Standard in 9.2.13 or the Recommendation in 9.2.14. Additionally, the quantities of reserve agent should be based on the actual quantities required as per Table 9-2, irrespective of the number of vehicles to be provided so that States and operators are not penalised should they provide vehicles over and above that required by 9.2.37.
Preliminary review by WG/PDP	Initial proposal remains unchanged.

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Response time

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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 point of each operational runway, in optimum visibility and surface conditions.

Note. –See Annex 14, Volume II for heliport operation response times.

<i>RFFWGs 6 and 7</i>	<i>Rationale:</i> Although there is currently no Standard for response times in Annex 14, Volume II, Chapter 6, there is a Recommendation for response times for surface level heliports. The proposed Note provides a logical link from Annex 14 Volume 1 across to Annex 14, Volume II for heliports.
Preliminary review by WG/PDP	Arising from WG/PDP's recommended rejection of the amendment proposal to Annex 14, Volume II, paragraphs 6.1.9 and 6.1.9A, WG/PDP also proposes that this new note be rejected.

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Personnel

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9.2.40 **Recommendation.**— During flight operations, sufficient ~~trained~~ **competent** personnel should be ~~detailed designated and~~ **to** be readily available to ride the rescue and fire fighting vehicles and to operate the equipment at maximum capacity. These ~~trained~~ personnel should be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate(s) can be fully maintained. Consideration should 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.

9.2.41 **Recommendation.**— In determining the **minimum** number of **rescue and fire fighting** personnel required, ~~to provide for rescue, consideration should be given to the types of aircraft using the aerodrome a task resource analysis should be completed and the level of staffing promulgated in, or reference to, the Aerodrome Manual.~~

Note: - Guidance on the use of a task resource analysis can be found in the Airport Services Manual, Part 1.

<i>Origin:</i>	<i>Rationale:</i>
<i>RFFWGs 1 to 4 and 6 to 7</i>	The essence of the proposed changes goes back to the perceived need to establish the competence of fire fighters and how the levels of staffing were to be achieved and documented in order that the minimum response times and continuous agent application at the appropriate rate/s could be fully achieved and maintained.
<i>AP-WG/WHLS-5 and 6</i>	There is currently no SARP or guidance for the establishment of staffing numbers for a RFF service. The proposed amendments to Annex 14 Volume I paragraphs 9.2.40 and 9.2.41 will be supported by detailed guidance in the Airport Services Manual Part 1.
Preliminary review by WG/PDP	Initial proposal remains unchanged.

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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 (Doc 9157), Part 6.

9.9.1 Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be:

- a) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in 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 or for aircraft safety 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 Recommendation.— *Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip should be regarded as an obstacle and should be frangible and mounted as low as possible.*

Note.— *Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual (Doc 9157), Part 6.*

9.9.5 Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be located within 240 m from the end of the strip and within:

- a) 60 m of the extended 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 or for aircraft safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:

- a) is situated 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 Recommendation.— *Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance in accordance with 4.2.4, 4.2.11, 4.2.20 or 4.2.27 should be frangible and mounted as low as possible.*

Origin AP/1 (para 1.6) WG/WHL/5 DP/3	Rationale At AP/1 the ADWG was tasked to examine RESA as part of the Chapter 3 Review; subsequently, at WG/WHL/5 the RESA task had been separated from the review as it would be complete by AP/2. Additionally, the ADWG was also tasked at WG/WHL/5 to examine the use of Engineered Material Arresting Systems as an alternative to RESA. The amendments to SARPs regarding the siting of equipment and installations on operational areas are required to support the installation of Engineered Material Arresting Systems which are frangible and intended to enhance safety in the event of an aircraft overrun.
Preliminary review by WG/PDP	The WG/PDP proposes deletion of the word “aircraft” in paragraphs 9.9.1, 9.9.2, 9.9.4, 9.9.5, 9.9.6 and 9.9.8 for the proposed new text allowing the installation of an arresting system. This is because the proposed text “for aircraft safety purposes”, as opposed to “for safety purposes”, is considered to be too restrictive. The WG/PDP requests the Secretariat to review paragraphs 9.9.3 and 9.9.7, where a protection date of 1 January 2010 is included, while the provisions are already in effect. <i>Secretariat’s comments</i> With regard to the request of the WG/PDP for the Secretariat to review paragraphs 9.9.3 and 9.9.7, the Secretariat considers that paragraphs 9.9.3 and 9.9.7 could be deleted as the protection date has already passed. There might be other provisions in the Annex where a similar situation exists. Therefore, the Secretariat suggests that a complete check of the Annex be conducted and action taken in the final review for all the provisions where a protection date has passed. It is considered that any amendment in this regard would be of an editorial nature.

Recommendation	... 9.9.1 Unless its function requires it to be there for air navigation or for safety purposes, no equipment or installation shall be: 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 or for safety 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 Recommendation.— <i>Any equipment or installation required for air navigation or for safety purposes which must be located on the non-graded portion of a runway strip should be regarded as an obstacle and should be frangible and mounted as low as possible.</i> <i>Note.</i>— <i>Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual (Doc 9157), Part 6.</i> 9.9.5 Unless its function requires it to be there for air navigation or for safety purposes, no equipment or installation shall be located within 240 m from the end of the strip and within: a) 60 m of the extended 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;
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of a precision approach runway category I, II or III.

9.9.6 Any equipment or installation required for air navigation or for safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:

- a) is situated 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 **Recommendation.**— Any equipment or installation required for air navigation or for safety purposes which is an obstacle of operational significance in accordance with 4.2.4, 4.2.11, 4.2.20 or 4.2.27 should be frangible and mounted as low as possible.

CHAPTER 10. AERODROME MAINTENANCE

10.1 General

10.1.1 **Recommendation.**— A maintenance programme, including preventive maintenance where appropriate, ~~should~~ shall be established at an aerodrome to maintain facilities ~~in a condition which does not impair the safety, regularity or efficiency of air navigation~~ such as pavements, visual aids, fencing and drainage systems.

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.

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The proposal to strengthen existing paragraph 10.1.1 places emphasis on the importance of maintenance in the provision of safe, regular and efficient facilities for air navigation. As aerodromes become increasingly privatised, the new Standard ensures sufficient resources are being allocated to the oft-neglected domain of maintenance. This proposal to upgrade paragraph 10.1.1 to a Standard is also consistent with other SARPs such as, but not limited to, existing paragraphs 10.2.2, 10.2.4 and other amendments being proposed dealing with maintenance which are, by themselves, Standards.
Preliminary review by the WG/PDP	The WG/PDP agrees to add some words at the end of the last sentence, to read ‘in a condition which does not impair the safety, regularity or efficiency of aircraft operations’. The PDP also recommends the addition of a Note 2 under para 10.1.1, to read ‘<i>Note2.- Where the pavement is used by large aircraft or aircraft with large tire pressures, particular attention should be given to the integrity of light fittings in the pavement and pavement joints.</i>’ including replacing the word “large” tire pressures with “high” tire pressures. <i>Secretariat comments:</i> It is noted that section 10.1 is entitled “General” and it is felt that inserting a note on a specific subject (ie. pavements) in a SARP that calls for an overarching maintenance program seems out of place. The next section 10.2 deals with pavement and paragraph 10.2.1 talks about “..surfaces of movement areas including pavements ...loose objects/debris ...” and the note, as proposed, seems better placed here. Additionally, this new note in 10.2.1 could be cross-referenced by way of inserting a new note in para 2.6.6 (c).

Recommendation	10.1.1 Recommendation.— A maintenance programme, including preventive maintenance where appropriate, should shall be established at an aerodrome to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation such as pavements, visual aids, fencing and drainage systems in a condition which does not impair the safety, regularity or efficiency of air navigation. <i>Note 1.</i>— Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities. <i>Note 2.</i>— “Facilities” are intended to include such items as pavements, visual aids, fencing, drainage systems and buildings. Where the pavement is used by large aircraft or aircraft with high tire pressures in 2.6.6(c), particular attention should be given to the integrity of light fittings in the pavement and pavement joints
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10.1.2 Recommendation.— The design and application of the maintenance programme should observe Human Factors principles.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual (Doc 9683) and in the Airport Services Manual (Doc 9137), Part 8.

10.2 Pavements

10.2.1 The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas shall be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any loose objects/debris that might cause damage to aircraft or impair the operation of aircraft systems.

Note 1.— See 2.9.3 for inspections of movement areas.

Note 2.— Guidance on carrying out daily inspections of the movement area is given in the Airport Services Manual (Doc 9137), Part 8, the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and the Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830).

Note 3.— Additional guidance on sweeping/cleaning of surfaces is contained in the Airport Services Manual (Doc 9137), Part 9.

Note 4.— Guidance on precautions to be taken in regard to the surface of shoulders is given in Attachment A, Section 8, and the Aerodrome Design Manual (Doc 9157), 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 A paved runway shall be maintained in a condition so as to provide surface friction characteristics at or above the minimum friction level specified by the State.

Note.— Guidance on determining and expressing the surface friction characteristics during snow or ice conditions is given in Attachment A, Section 6. The Airport Services Manual (Doc 9137), Part 2, contains further information on this subject, on improving surface friction characteristics and on clearing of runways

10.2.34 Measurements of the runway surface friction characteristics of a runway surface for maintenance purpose shall be made periodically with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements shall be sufficient to determine the trend of the surface friction characteristics of the runway.

Note 1.— Guidance on evaluating the friction characteristics of a runway is provided in Attachment A, Section 7. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

Note 2.— The objective of 10.2.3 to 10.2.7 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level specified by the State.

10.2.5 **Recommendation.**— The frequency of measurements should be based on environmental conditions, the number of movements and characteristics of the aeroplanes using the runway.

Note.— Guidance for the determination of the required frequency is provided in Attachment A, Section 7 and in the Airport Services Manual (Doc 9137), Part 2, Appendix 5.

10.2.46 Corrective maintenance action shall be taken to prevent the runway surface when the friction characteristics for either the entire runway or a portion thereof are from falling 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 **Recommendation.**— Corrective maintenance action should be considered when the friction characteristics for either the entire runway or a portion thereof are below a maintenance planning level specified by the State.~~

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The new paragraph 10.2.3, which is performance-based, contains part of the existing 10.2.8 and is relocated here, for consistency. The remaining part of existing paragraph 10.2.8, dealing with the removal of contaminants, has been re-designated as paragraph 10.3.1 and placed in a new section 10.3. While a similar provision in Chapter 3 deals with design and construction aspects, the prime objective of the proposed amendments here are to ensure that the surface friction characteristics of the runway is maintained at or above a minimum friction level specified by the State. Amendment proposed to existing paragraph 10.2.3 and the new paragraph 10.2.5, establishes the control of the surface friction characteristics for maintenance purpose through measurements at a suitable frequency, with reference to the availability of appropriate guidance material in the Notes. The proposed amendment to existing paragraph 10.2.4 seeks to require a corrective maintenance action before a portion of a runway falls below the minimum friction level (MFL). The Recommended Practice in existing paragraph 10.2.5 is now proposed to be deleted since the upgraded paragraph 10.1.1 and the new paragraph 10.2.6 adequately capture the intent of the safety requirement. This implies the aerodrome operator defines a mandatory maintenance programme, including preventive maintenance, as stipulated in paragraph 10.1.1, which may utilize the concept of Maintenance Planning Level (MPL). The use of a MPL to establish a maintenance programme can be proposed as guidance but is not seen as appropriate for a SARP, as it relates more to economic considerations rather than safety.
Preliminary review by the WG/PDP	The WG/PDP identified that paragraph 10.2.5 is just a supplemental provision to para10.2.4, and recommends deleting 10.2.5 but retaining the note as ‘Note 3’ under paragraph10.2.4.
Recommendation	10.2.34 Measurements of the runway surface friction characteristics of a runway surface for maintenance purposes shall be made periodically with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements shall be sufficient to determine the trend of the surface friction characteristics of the runway. <i>Note 1.— Guidance on evaluating the friction characteristics of a runway is provided in Attachment A, Section 7. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.</i> <i>Note 2.— The objective of 10.2.3 to 10.2.7 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level specified by the State.</i>

	10.2.5 Recommendation.— The frequency of measurements should be based on environmental conditions, the number of movements and characteristics of the aeroplanes using the runway. <i>Note 3.— Guidance for the determination of the required frequency is provided in Attachment A, Section 7 and in the Airport Services Manual (Doc 9137), Part 2, Appendix 5.</i>
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10.2.67 Recommendation.— When there is reason to believe that the drainage characteristics of a runway, or portions thereof, are poor due to slopes or depressions, then the runway surface friction characteristics should be assessed under natural or simulated conditions that are representative of local rain, and corrective maintenance action should be taken as necessary.

10.2.78 Recommendation.— When a taxiway is used by turbine-engined aeroplanes, the surface of the taxiway shoulders should be maintained so as to be free of any loose stones or other objects that could be ingested by the aeroplane engines.

Note.— Guidance on this subject is given in the Aerodrome Design Manual (Doc 9157), Part 2.

(new section) 10.3 Removal of contaminants

~~10.2.8~~ **10.3.1** 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 from the surface of a paved runway as rapidly and completely as possible to minimize accumulation.

Note.— ~~Guidance on determining and expressing the friction characteristics when conditions of snow or ice cannot be avoided is given in Attachment A, Section 6. The Airport Services Manual (Doc 9137), Part 2, contains further information on this subject, on improving friction characteristics and on clearing of runways.~~ The above requirement does not imply that winter operations on compacted snow and ice are prohibited. Guidance on snow removal and ice control is given in the Aerodrome Design Manual (Doc 9157), Part 2, Chapter 7.

~~10.2.9~~ **10.3.2 Recommendation.**— A Taxiways should 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~~ **10.3.3 Recommendation.**— Aprons should be kept clear of snow, slush, ice, etc., to the extent necessary to enable aircraft to manoeuvre safely or, where appropriate, to be towed or pushed.

~~10.2.11~~ **10.3.4 Recommendation.**— Whenever the clearance of snow, slush, ice, etc., from the various parts of the movement area cannot be carried out simultaneously, the order of priority after the runway(s) in use should be set in as follows but may be altered following, as necessary, consultation with the aerodrome users and other interested parties:

- ~~1st — runway(s) in use;~~
- ~~2nd — taxiways serving runway(s) in use;~~
- ~~3rd — apron(s);~~
- ~~4th — holding bays; and~~
- ~~5th — other areas.~~

....

Origin:	Rationale:
FTF/1 to 5	Given the importance of proper management of surface contaminants and its impact on aircraft safety, it is felt necessary to establish a new section germane to the removal of contaminants vis-à-vis other aspects of maintenance since the former is perceived to be of a more operational nature.
AOSWG/5to 8	
AP-WG/WHL-5 and 6	The amendment proposed to existing paragraph 10.2.11 concerning the priority for the removal of contaminants after the runway in use is performance-based and provides flexibility to take into account local conditions which were hitherto not considered, but nevertheless vital, such as the need to remove contaminants such as snow and ice from ingress and egress routes of aerodrome rescue and fire fighting stations.
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

10.3.4 Runway pavement overlays

Note.— The following specifications are intended for runway pavement overlay projects when the runway is to be returned temporarily to an operational status before ~~overlay of the entire runway~~ resurfacing is complete. ~~this normally~~ This may necessitate a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the Aerodrome Design Manual (Doc 9157), Part 3.

~~10.3.1~~ 10.4.1 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.

....

Editorial Note.— Renumber subsequent paragraphs accordingly.

...

10.4.5 Recommendation.— *The overlay should be constructed and maintained above the minimum friction level specified in 10.2.3.*

Editorial Note.— Renumber subsequent paragraphs accordingly.

<i>Origin:</i>	<i>Rationale:</i>
<i>FTF/1 to 5</i>	The amendment proposed in this section is driven primarily by two serious accidents that occurred in one State where the friction characteristics of the temporary runway surface undergoing resurfacing and re-profiling work was found to be wanting. The reduced friction on the wet base course sections of the runway caused flight crews to experience reduced braking action and reduced lateral controllability on landing in strong crosswinds.
<i>AOSWG/5 to 8</i>	
<i>AP-WG/WHL-5 and 6</i>	
Preliminary review by the WG/PDP	Initial proposal remains unchanged.

10.4 Visual aids

Note 1. — *These specifications are intended to define the maintenance performance level objectives. They are not intended to define whether the lighting system is operationally out of service.*

Note 2. — *Lights that use Light Emitting Diodes (LEDs) as opposed to incandescent lamps have been shown to exhibit greater reliability and longer mean times between failures. However, preventive maintenance specified in 10.4.2 remains in place where these are installed as other factors can reduce performance.*

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.

<i>Origin</i> VAWG/7 APWGWHL/6	<i>Rationale</i> Field Reports from aerodromes that have installed LED light fittings indicate that a major benefit is the extended mean time between failures (MTBF) over traditional Tungsten Halogen (TH) lamps. There is, as a consequence of better in service reliability, the possibility that an adverse approach to preventive maintenance could develop, that is, to "install and forget". In order to alert aerodromes to this potential problem and to reinforce the guidance that existing maintenance recommendations would also apply to LED fixtures, an additional note is proposed for insertion after the first note in paragraph 10.4 of Annex 14, Volume I.
Preliminary review by WG/PDP	The WG/PDP considers that the proposed Note 2 is unnecessary as the preventive maintenance requirement of 10.4.2 is not currently tied to incandescent or any other technology, but to the broad category of visual aids (regardless of technology), and so is already applicable. The WG/PDP considers it appropriate, however, to include a note to advise readers that the loss of infra-red signature when converting from incandescent to LED technology eliminates the snow and ice melting capability of lamps and has deleterious effects on the use of enhanced vision systems. It is also proposed that readers should be advised that the change to LED technology is considered a significant change that constitutes a NOTAM and AIP item per existing requirements of Annex 15.
Recommendations	<i>Note 2.- The energy savings of light emitting diodes (LEDs) are due in large part to the fact that they do not produce the infra-red heat signature of incandescent lamps. Aerodrome operators who have come to expect the melting of ice and snow by this heat signature may wish to evaluate whether or not a modified maintenance schedule is required during such conditions, or evaluate the possible operational value of installing LED fixtures with heating elements.</i> <i>Note 3.- Enhanced vision systems (EVS) technology relies on the infra-red heat signature provided by incandescent lighting. Annex 15 protocols provide an appropriate means of notifying aerodrome users of EVS when lighting systems are converted to LED.</i>

ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO ANNEX 14, VOLUME I

6. Assessing the surface friction characteristics of snow-, slush-, ice- and frost-covered paved surfaces

6.1 There is an operational need for reliable and uniform information concerning the surface condition of contaminated runways. Contaminant type, distribution and for loose contaminants, depth are assessed for each third of the runway. An indication of surface friction characteristics is helpful in conducting runway condition assessment. It can be obtained by friction measuring devices; however, there is no international consensus on the ability to correlate the results obtained by such equipment directly with aircraft performance.

6.2 Any friction measuring device intended to predict aircraft braking performance according to an agreed local or national procedure should be shown to correlate such performance in a manner acceptable to the State. Information on the practice of one State providing correlation directly with aircraft braking performance can be found in the *ICAO Circular XX Runway Surface Condition Assessment, Measurement and Reporting, Appendix A*.

6.3 The friction conditions of a runway can be assessed in descriptive terms of “estimated surface friction”. The estimated surface friction is categorized as good, medium to good, medium, medium to poor, and poor, and promulgated in Annex 15, Appendix 2-SNOWTAM format as well as in PANS-ATM, Chapter 12.3-ATC phraseologies.

6.4 The table below with associated descriptive terms was developed from friction data collected only in compacted snow and ice and should not therefore be taken to be absolute values applicable in all conditions. If the surface is affected by snow or ice and the estimated surface friction is reported as “good”, pilots should 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 aeroplanes should not experience directional control or braking difficulties, especially when landing. The figures in the “Measured Coefficient μ ” column are given as an indication. At each aerodrome a specific table can be developed according to the measuring device used on the aerodrome and according to the standard and correlation criteria set or agreed by the State. The μ values given are specific to each friction measuring device as well as to the surface being measured and the speed employed.

Measured Coefficient μ	Estimated surface friction	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

6.5 It has been elusive trying to relate braking action to friction measurements over the years. The main reason is that the industry to date has not achieved the ability to control the total uncertainty associated with the readings from these devices. Consequently, readings from a friction measuring device should only be used as part of an overall runway condition assessment. A major difference between the decelerometer type of devices and the other types is that when using the decelerometer type the operator is an integrated part of the measuring process. In addition to carrying out the measurement, the operator can feel the behavior of the vehicle where the decelerometer is installed and by that feel the deceleration process. This gives additional information in the total assessment process.

6.6 It has been found necessary to provide assessed surface condition information, including estimated surface friction, 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. Assessments 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 assessment is to determine the type, depth and coverage of the contaminants and its effect on estimated surface friction, given the prevailing weather conditions 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. In cases where a spot measuring friction measuring device is used as part of the total assessment of estimated surface friction, each third of the runway should have three tests carried out on it where achievable. Information collected and assessed on the state of pavement surface is disseminated using forms prepared by the State for SNOWTAM and NOTAM (see *Airport Services Manual*, Part 2).

6.7 The *Airport Services Manual*, Part 2 provides guidance on the uniform use of test equipment and other information on removal of surface contamination and improvement of friction conditions.

Origin:	Rationale:
FTF/1 to 6 AOSWG/5 to 8 AP-WG/WHL-5 and 6	The existing texts are premised on the assumption that the friction characteristics of snow- and ice-covered paved surfaces could be determined with friction measurement using appropriate measuring devices. Although some States have developed, or are developing, a methodology and procedures to predict aircraft braking performance, there are presently no internationally agreed methodology and procedures. The proposed revision to Annex 14, Volume I, Attachment A, section 6 stems from the proposed amendments to Annex 14, Volume I, (new) paragraphs 2.9.7 and 2.9.8. It acknowledges a) the absence of internationally agreed methodology and procedures and b) the existence of proven or experimental national or regional

	methodology and procedures which requires friction measurement devices meet the standards set by the State when they are used for the assessment of the runway surface condition in order to ensure the quality and accuracy of the information reported.
Preliminary review by WG/PDP	The WG/PDP did not have the opportunity to review Champion Team (CT-5) comments on this issue.

7. Determination of surface friction characteristics for construction and maintenance purposes

The guidance in this section deals with the functional measurement of friction-related aspects related to runway construction and maintenance. Excluded in this section is the operational, as opposed to functional, measurement of friction for contaminated runways. However, the devices used for functional measurement could also be used for operational measurement, but in the latter case, the figures given in Table A-1 are not relevant.

7.1 The surface friction characteristics of a paved runway should be:

- a) assessed to verify the surface friction characteristics of new or resurfaced paved runways (Chapter 3, (*Secretariat's note: existing but to be renumbered*) 3.1.24); and
- b) assessed periodically in order to determine the slipperiness of paved runways (Chapter 10, 10.2.3);

7.2 The condition of a runway pavement is generally assessed under dry conditions using a self wetting continuous friction measuring device. Evaluation tests of runway surface friction characteristics are made on clean surfaces of the runway when first constructed or after resurfacing.

7.3 Friction tests of existing surface conditions are taken periodically in order to avoid falling below the minimum friction level specified by the State. When the friction of any portion of a runway is found to be below this minimum friction level value, then such information is promulgated in a NOTAM specifying which portion of the runway is below the minimum friction level and its location on the runway. A corrective maintenance action must be initiated without delay. Friction measurements are taken at time intervals that will ensure the identification of runways in need of maintenance or of special surface treatment before their condition becomes serious. The time intervals and mean frequency of measurements depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and pavement service and maintenance requirements.

7.4 Friction measurements of existing, new or resurfaced runways are made with a continuous friction measuring device provided with a smooth tread tire. The device should use self-wetting features to allow measurements of the surface friction characteristics to be made at a water depth of 1 mm.

7.5 When it is suspected that the surface friction characteristics of a runway may be reduced because of poor drainage, owing to inadequate slopes or depressions, then an additional measurement is made, but

this time under natural conditions representative of a local rain. This measurement differs from the previous one in that water depths in the poorly cleared areas are normally greater in a local rain condition. The measurement results are thus more apt to identify problem areas having low friction values that could induce aquaplaning than the previous test. If circumstances do not permit measurements to be conducted during natural conditions representative of a rain, then this condition may be simulated. (*See section 8*)

7.6 When conducting friction tests using a self wetting continuous friction measuring device, 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.

7.7 Annex 14, Volume I requires States to specify a minimum friction level below which corrective maintenance action should be taken. As criteria for surface friction characteristics of new or resurfaced runway surfaces and its maintenance planning, the State can establish a maintenance planning level, below which appropriate corrective maintenance action should be initiated to improve the friction. Table A-1 provides guidance on establishing maintenance planning and minimum friction levels for runway surfaces in use.

7.8 As the devices used to measure the pavement friction are made according to various designs (such as measurement systems integrated in a vehicle or trailer), they are equipped with tires made with different rubber compounds, inflation pressures and with different self-wetting systems leading to different results of the tested surfaces. It is hence understandable that the values of the measurements are not identical. Table A-1 has been expanded in order to allow a coherency between the measures provided by different devices.

Test equipment Friction measuring device	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)	(5) (6)	(6) (7)
Mu-meter trailer MK6	A	70	65	1,0	0.72	0.52	0.42
	A	70	95	1,0	0.66	0.38	0.26
Skiddometer BV11	B	210	65	1,0	0.82	0.60	0.50
	B	210	95	1,0	0.74	0.47	0.34
SFT Vehicle	B	210	65	1,0	0.82	0.60	0.50
	B	210	95	1,0	0.74	0.47	0.34
RFT 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
RUNAR trailer	B	210	65	1,0	0.69	0.52	0.45
	B	210	95	1,0	0.63	0.42	0.32
SARSYS STFT	B	210	65	1,0		Tbd 0.60	0.74
	B	210	95	1,0		Tbd 0.47	0.24
IMAG	C	150	65	1,0		0.37	0.30
	C	150	95	1,0		0.27	0.20

Note 1.- Table A-1 only includes typical reference values useful to assess the intrinsic characteristics of a pavement with friction measurements. These measurements should be carried out on a dry pavement with a self-wetting continuous friction measuring device and according to a procedure established by the competent authority of the State.

Note 2.- The values in Table A-1 may be adapted according to the reference device used in each State as each friction measuring device indicated in Table A-1 is in fact representative of a type of device, meaning that another test device of the same type could give different measurements, even though it is of a same make.

Note 3.- The test water depth (column (4)) is the water depth provided by the self-wetting system on the tested surface in front of the tire of the device.

Note 4. A pavement with measured surface friction value equal to or higher than the value in column (6), corresponding to the test equipment used, is considered as meeting the required friction level.

Note 5. The performance of each test equipment should be correlated to the minimum friction level specified by the State according to the State's correlation criteria.

7.9 The values in Table A1 were originally developed from research study conducted by one State and later expanded to include research studies from other States. The specifications of the tires to be used for friction measuring devices (i.e. Types A, B and C) are contained in the Airport Services Manual, Part 2.

7.10 Other friction measuring devices can be used, provided they have been correlated with at least one

measurement device mentioned above. The Airport Services Manual, Part 2 provides guidance on the methodology for determining the friction values corresponding to the , maintenance planning level and minimum friction level for a friction tester not identified in the above table.

<i>Origin:</i> <i>FTF/1 to 6</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The existing guidance gives rise to a possible confusion between functional friction measurement i.e. the friction measurements made for construction and maintenance purposes and operational friction measurement ie. the eventual friction measurements performed to assess the estimated surface friction on contaminated runways for operational use. The misuse of figures given in Table A-1 has contributed to at least to two accidents in one State. The confusion is further compounded by the use of the operative word “should”, giving the misconception that the text is an extension of an Annex 14, Vol. I, Recommended Practice. The changes which are proposed aim at resolving this possible confusion by a) focusing on construction and maintenance aspects, b) removing parts of the guidance which are considered too detailed and c) using a more neutral wording which avoids the use of “should”. The FTF is cognizant that, subsequent to the development of Table A-1, tests performed by some States had revealed that the maintenance planning level (MPL) and minimum friction level (MFL) values indicated for the various test equipments might be obsolete and the correlation between them is therefore questioned. However a consensus for updated values cannot be achieved as “Each friction measuring device indicated in table A1 is in fact representative of a type of device, meaning that another test device of the same type could give different measurements, even though it is of a same make.” The FTF envisaged removing Table A-1 from the Annex but in the end it was considered more suitable to keep it almost unchanged but with multiple caveats related to its use. Two new equipment are proposed to be included in Table A-1 ie. IMAG, which is the reference test equipment of the French DGAC and the SARSYS STFT. The proposal to delete the existing column (5) concerning design objective for new surfaces stems from the proposition that the selection of design objectives for new surfaces is the responsibility of the aerodrome operator which may be driven by economic considerations while the determination of the MFL is the responsibility of the State which is driven by safety concern in line with proposed amendment to Annex 14, Vol. I, (new) paragraph 10.2.6.
Preliminary review by WG/PDP	The WG/PDP did not have the opportunity to review Champion Team (CT-5) comments on this issue.

New section – incorporate Section 8 following paragraph 7.10 with the following.

8. Drainage characteristics of the movement area and adjacent areas

8.1 General

8.1.1 Rapid drainage of surface water is a primary safety consideration in the design, construction and maintenance of pavements and adjacent areas. The objective is to minimize water depth on the surface by draining water off the runway in the shortest path possible and particularly out of the area of the wheel path. There are two distinct drainage processes taking place:

- a) natural drainage of the surface water from the top of the pavement surface until it reaches the final recipient such as rivers or other water bodies; and
- b) dynamic drainage of the surface water trapped under a moving tire until it reaches outside the tire-to-ground contact area.

8.1.2 Both processes can be controlled through:

- a) design;
- b) construction; and
- c) maintenance;

of the pavements in order to prevent accumulation of water on the pavement surface.

8.2 Design of pavement.

8.2.1 Natural drainage is achieved through design of slopes on the various parts of the movement area allowing the surface water to flow away from the pavement to the recipient as surface water flow or through a sub surface drainage system. The resulting combined longitudinal and transverse slope is the path for the natural drainage runoff. This path can be shortened by adding transverse grooves.

8.2.2 Dynamic drainage is achieved through built-in texture in the pavement surface. The rolling tire builds up water pressure and squeezes the water out the escape channels provided by the texture. The dynamic drainage of the tire-to-ground contact area is improved by adding transverse grooves.

8.3 Construction of pavement

8.3.1 Through construction, the drainage characteristics of the surface are built into the pavement. These

surface characteristics are:

- a) Slopes;
- b) Texture
 - i) Microtexture;
 - ii) Macrotexture;

8.3.2 Slopes for the various parts of the movement area and adjacent parts are described in Annex 14, Volume I, Chapter 3 and figures are given as per cent. Further guidance is given in Aerodrome Design Manual, Part 1, Runways, Chapter 5.

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

8.3.4 Microtexture is the texture of the individual stones and is hardly detectable by the eye. Microtexture is considered a primary component in skid resistance at slow speeds. On a wet surface at higher speeds a water film may prevent direct contact between the surface asperities and the tire due to insufficient drainage from the tire-to-ground contact area.

8.3.5 Microtexture is a built-in quality of the pavement surface. By specifying crushed material that will withstand polishing microtexture, drainage of thin waterfilms are ensured for a longer period of time. Resistance against polishing is expressed through the polished stone values, which are in principle a value obtained from a friction measurement in accordance with international standards .

8.3.6 A major problem with microtexture is that it can change within short time periods without being easily detected. A typical example of this is the accumulation of rubber deposits in the touchdown area which will largely mask microtexture without necessarily reducing macrotexture.

8.3.7 Macrotexture is the texture among the individual stones. This scale of texture may be judged approximately by the eye. Macrotexture is primarily created by the size of aggregate used or by surface treatment of the pavement. Macrotexture is the major factor influencing drainage capacity at high speeds.

8.3.8 The primary purpose of grooving a runway surface is to enhance surface drainage. Natural drainage can be slowed down by surface texture, but grooving can speed up the drainage by providing a shorter drainage path.

8.3.9 For measurement of macrotexture, simple methods such as the “sand and grease patch”– methods described in the *Airport Services Manual* (Doc 9137), Part 2 were developed. These methods were used for the early research on which current airworthiness requirements are based upon, which refer to a classification categorizing macrotexture from A to E. This classification was developed, using sand or grease patch measuring techniques, and issued in 1971 by the Engineering Sciences Data Unit (ESDU).

Runway classification based on texture information from ESDU 71026:

Classification	Texture depths (mm)
A	0.10 – 0.14

B	0.15 – 0.24
C	0.25 – 0.50
D	0.51 – 1.00
E	1.01 – 2.54

8.3.10 Using this classification the threshold value between microtexture and macrotexture is 0.1 mm mean texture depth (MTD). Related to this scale the normal wet aircraft performance is based upon texture giving drainage and friction qualities midway between classification B and C (0.25 mm) Improved drainage through better texture might qualify for a better aircraft performance class. However such credit must be in accordance with aeroplane manufacturers documentation and agreed by the State. Presently credit is given to grooved or porous friction course runways following design, construction and maintenance criteria acceptable to the State. The harmonized certification standards of some States refer to texture giving drainage and friction qualities midway between classification D and E (1.0 mm)

8.3.11 For construction, design and maintenance, States use various international standards. Currently *ISO 13473-1: Characterization of pavement texture by use of surface profiles -- Part 1: Determination of Mean Profile Depth* links the volumetric measuring technique with non contact profile measuring techniques giving comparable texture values. These standards describe the threshold value between microtexture and macrotexture as 0.5 mm. The volumetric method has a validity range from 0.25 to 5 mm MTD. The profilometry method has a validity range from 0 to 5 mm mean profile depth (MPD). The values of MPD and MTD differ due to the finite size of the glass spheres used in the volumetric technique and because the MPD is derived from a two-dimensional profile rather than a three-dimensional surface. Therefore a transformation equation must be established for the measuring equipment used to relate MPD to MTD.

8.3.12 There is a standard describing drainage capacity by the use of an outflow meter measuring the horizontal drainage. This method has a validity range from 0 to 0.4 mm MPD and can for that reason only be used on smooth surfaces. This test method does not necessarily correlate with other methods of measuring pavement surface characteristics.

8.3.13 The ESDU scale groups runway surfaces based on macrotexture from A through E, where E represents the surface with best dynamic drainage capacity. The ESDU scale thus reflects the dynamic drainage characteristics of the pavement. Grooving any of these surfaces enhances the dynamic drainage capacity. The resulting drainage capacity of the surface is thus a function of the texture (A through E) and grooving. The contribution from grooving is a function of the size of the grooves and the spacing between the grooves. Aerodromes exposed to heavy or torrential rainfall must ensure that the pavement and adjacent areas have drainage capability to withstand these rainfalls or put limitations on the use of the pavements under such extreme situations. These airports should seek to have grooved pavements in the E classification to ensure that safety is not impaired.

8.4 Maintenance of drainage characteristics of pavement

8.4.1 Macrotexture does not change within a short timespan but accumulation of rubber can fill up the texture and as such reduce the drainage capacity, which can result in impaired safety. Furthermore the runway structure may change over time and give unevenness which results in ponding after rainfall. Guidance on rubber removal and unevenness can be found in *Airport Services Manual* (Doc 9137), Part 2. Guidance on methods for improving surface texture can be found in *Aerodrome Design Manual* (Doc 9157), Part 3.

Editorial Note.— Renumber subsequent paragraphs accordingly.

<i>Origin:</i> FTF/1 to 6 AOSWG/5 to 8 AP-WG/WHL-5 and 6	<i>Rationale:</i> Drainage performance of the movement area and of the adjacent areas is an essential element to minimize water depth on the pavement surface. The FTF proposes to introduce a new section 8 entitled <i>Drainage characteristics of the movement area and adjacent areas</i> in Attachment A to Annex 14, Volume I in order to provide up-to-date guidance. Detailed guidance will be provided later with the planned update of Doc 9157, <i>Aerodrome Design Manual</i>, Part 3 — <i>Pavements</i>.
Preliminary review by WG/PDP	The WG/PDP did not have the opportunity to review Champion Team (CT-5) comments on this issue.

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9. Runway end safety areas

9.1 Where a runway end safety area is provided in accordance with Chapter 3, consideration should be given to providing an area long enough to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localizer is normally the first upstanding obstacle, and the runway end safety area should extend up to this facility. In other circumstances 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 should 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, normally this would involve a reduction in the declared distances. However, to ensure that the length of RESA is sufficient, additional runway pavement may be provided at either end of the runway.

9.3 Research programs, as well as evaluation of actual aeroplane overruns into arresting systems, have demonstrated that the performance of some arresting systems is predictable, and that such systems are effective in arresting aircraft overruns.

9.4 Additional information is contained in the Aerodrome Design Manual (*Doc 9157*), *Part 1*.

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Origin AP/1 (para 1.6) AGA-8603 WG/WHL/5 DP/3	Rationale At AP/1 the ADWG was tasked to examine RESA as part of the Chapter 3 Review; subsequently, at WG/WHL/5 the RESA task had been separated from the review as it would be complete by AP/2 (the Chapter 3 review would not be complete before 2012). Additionally, the ADWG was also tasked at WG/WHL/5 to examine the use of Engineered Material Arresting Systems as an alternative to RESA. The Notes below, and amendments to RESA SARPs and guidance material arising are the result of the examination conducted by the ADWG. 3.5.2 – Recommended Practice arises from overrun data demonstrating that based on studies carried out in some States, the risk from overruns is also present for visual runways; accordingly, requirements should be introduced. 3.5.3 – Clarifies the Standard distances for those runways already requiring RESAs. It also introduces the use of arresting systems of demonstrated performance capability. The Note to 3.5.3 arises from the introduction of arresting systems and other possible mitigating measures, including reduction of declared distances, and points to guidance material.
Preliminary review by WG/PDP	The proposed text in paragraph 9.2 of Attachment A presents a contradiction about the runway length and the length of RESA. Therefore, the original text of paragraph 9.2 should be retained. The WG/PDP also proposes new paragraphs to be included in Attachment A of Annex 14, Volume I addressing principles to be followed in the design of an arresting system.

Recommendation	ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO ANNEX 14, VOLUME I 9. Runway end safety areas 9.1 Where a runway end safety area is provided in accordance with Chapter 3, consideration should be given to providing an area long enough to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localizer is normally the first upstanding obstacle, and the runway end safety area should extend up to this facility. In other circumstances 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 should 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. 9.3 Research programmes, as well as evaluation of actual aircraft overruns into arresting systems, have demonstrated that the performance of some arresting systems are predictable and effective in arresting aircraft overruns. 9.4 Demonstrated performance of an arresting system can be achieved by a validated design method, which can predict the performance of the system. The design and performance should be associated to that type of aircraft anticipated to use the associated runway that imposes the greatest demand upon the arresting system. 9.5 The design of an arresting system must consider multiple aircraft parameters, including but not limited to, allowable aircraft gear loads, gear configuration, tire contact pressure, aircraft center of gravity and aircraft speed. Additionally, the design must allow safe ingress and egress of fully loaded rescue and fire fighting vehicles. 9.6 The design of an arresting system must ensure that it will not endanger an aircraft undershooting the runway. 9.7 Additional information is contained in the Aerodrome Design Manual (Doc 9157), Part 1.
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APPENDIX 1. COLOURS FOR AERONAUTICAL GROUND LIGHTS, MARKINGS, SIGNS AND PANELS

1. General

Introductory Note.— The following specifications define the chromaticity limits of colours 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 colours such that there is no possibility of confusion. For reasonably certain recognition, it is important that the eye illumination be well above the threshold of perception, that the colour not be greatly modified by selective atmospheric attenuations and that the observer's colour vision be adequate. There is also a risk of confusion of colour at an extremely high level of eye illumination such as may be obtained from a high-intensity source at very close range. Experience indicates that satisfactory recognition can be achieved if due attention is given to these factors

*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. Colours 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 $y = 0.050 + .750x$ and $y = 0.382$

f) White (LED only)

Yellow boundary $x = 0.440$ Blue boundary $x = 0.320$ Green boundary $y = 0.150 + 0.643x$ Purple boundary $y = 0.050 + .757x$

fg) Variable white

Yellow boundary $x = 0.255 + 0.750y$ and $x = 1.185 - 1.500y$ Blue boundary $x = 0.285$ Green boundary $y = 0.440$ and $y = 0.150 + 0.640x$ Purple boundary $y = 0.050 + 0.750x$ and $y = 0.382$

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

Origin APWGWHL/6	Rationale For LEDs, the white boundaries need to be redefined independently of the color limitations of incandescent light sources to better coincide with the colors that people identify as white, thereby removing any unnecessary restrictions that limit LED or other new light sources from being considered. Research was performed that investigated the region, or boundaries, in chromaticity space that define what people naturally identify as white in the context as described by the current standards. A range of test sources were evaluated having chromaticity points both within and outside the current aviation white boundaries. From these evaluations, the objective was to develop recommendations for aviation white boundaries that can include newer LED technology.
Preliminary review by WG/PDP	The WG/PDP seeks clarification from the Secretariat in regard to whether or not the 1983 CIE specifications referred to in the introductory notes covers LEDs. <i>Secretariat's comments: The CIE chromaticity limits are not affected by the propagation source of the light.</i>

Editorial Note.— The following proposals are for Annex 14, Volume I, Appendix 2.

APPENDIX 2. AERONAUTICAL GROUND LIGHT CHARACTERISTICS

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Figure A2-12. Isocandela diagram for taxiway centre line (15 m spacing), no entry bar 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

Figure A2-13. Isocandela diagram for taxiway centre line (15 m spacing), no entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m

Figure A2-14. Isocandela diagram for taxiway centre line (7.5 m spacing), no entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of less than a value of 350 m

Figure A2-15. Isocandela diagram for taxiway centre line (30 m, 60 m spacing), no entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of 350 m or greater

Figure A2-16. Isocandela diagram for taxiway centre line (7.5 m, 15 m, 30 m spacing), no entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of 350 m or greater

Figure A2-17. Isocandela diagram for high-intensity taxiway centre line (15 m spacing), no entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required and where large offsets can occur

Figure A2-18. Isocandela diagram for high-intensity taxiway centre line (15 m spacing), no entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required

Figure A2-19. Isocandela diagram for high-intensity taxiway centre line (7.5 m spacing), no entry bar and stop bar lights in curved sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required

<i>Origin</i> VAWG/5-6	<i>Rationale</i> These amendments were proposed by the panel in support of the introduction of the No-entry bar addressed previously in this paper.
Preliminary review WG/PDP by	These amendments were proposed by the panel in conjunction with the No-entry bar proposals addressed previously in this paper. The WG/PDP supports these proposed amendments to Appendix 2, with the editorial change of “no entry bar” to “no-entry bar” to reduce any possible confusion with the possible interpretation of meaning that there is - no “entry bar”.

Recommendations	Figures A2-12 through A2-19: Change no entry bar to no-entry bar.
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ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO ANNEX 14, VOLUME I

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21. Alternate light source technologies

21.1 With the need to reduce power consumption and maintenance, alternate light source technologies are being applied for visual aids lighting. One of these technologies is light emitting diodes (LED). There is a concern regarding the intermixing of LED light fixtures and LED lights with incandescent filament lamps. Intensity requirements are the same; however, LED fixtures may be perceived as having a difference in colour saturation and/or brightness, thus distorting the visual presentation to the pilot. This is due to the LED emitting essentially a narrow frequency range light signal.

21.2 Caution should be exercised when intermixing LEDs or LEDs with incandescent lamped fixtures for certain lighting applications as listed below because of possible differences in perception of color and/or brightness. For example, if a runway is to be extended and it is desired to use LED fixtures, then the entire runway facility should be retrofitted so that the pilot is presented with only one technology.

- Runway Guard Lights
- Touchdown Zone Lights
- Runway Edge Lights including Threshold, End and Stopway
- Signs per location
- Taxiway curved segments (centre line and edge)
- Taxiway straight segments (centre line and edge)
- Approach Light Systems
- Stop Bars
- Runway centre line
- Rapid Exit Taxiway Indicator Lights (RETIL) (up until the holding position or runway vacated position)
- PAPI

21.3 Failed lights within a facility should be replaced with the existing technology and thus maintaining a uniform appearance.

21.4 In the case of taxiway lighting a change of technology may occur within segments that are defined by visually distinctive points of transition. For example, a "segment" may be that between intersections. In as much a taxiway system may have numerous segments within a relatively short distance the authority

may wish to stipulate that a change to LED light sources from existing incandescent sources should be done on a system rather than a segment basis.

Maintenance

21.5 LED light units tend to be marketed on the basis of having an exceedingly long life. The airport operator, however, should be aware that even LED sources degrade during that lifetime and other factors may be cause for reduction of light output. Therefore, it is still required to carry out inspections and undertake repair as necessary.

<i>Origin</i> VAWG/7 APWGWHL/6	<i>Rationale</i> LED lighting fixtures should not be intermixed with incandescent lamped fixtures, or LEDs of other manufacturers, for certain lighting applications as listed below because of observed differences in perception of colour and/or brightness.
Preliminary review by WG/PDP	The WG/PDP does not support the inclusion of this material into the Annex, but recommends its inclusion into the <i>Airport Design Manual</i> (Doc 9157) Part 4, <i>Visual Aids</i> as a part of the proposed future work programme item to update this manual. The WG/PDP also recommends referring the issue of the proposed paragraph 21.3 back to the panel for further evaluation as to whether or not it should be elevated to a Recommended Practice.

APPENDIX B
PROPOSED AMENDMENT TO
INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES
AERONAUTICAL INFORMATION SERVICES
ANNEX 15
TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

PROPOSED AMENDMENT TO

Annex 15 — Aeronautical Information Services

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

1.

- | | |
|---|-----------------------------------|
| 1. Text to be deleted is shown with a line through it. | text to be deleted |
| 2. New text to be inserted is highlighted with grey shading. | new text to be inserted |
| 3. Text to be deleted is shown with a line through it followed by the replacement text which is highlighted with grey shading. | new text to replace existing text |

Annex 15 — Aeronautical Information Services

**APPENDIX 1. CONTENTS OF
AERONAUTICAL INFORMATION PUBLICATION (AIP)**

(see Chapter 4)

PART 1 — GENERAL (GEN)

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PART 2 — EN-ROUTE (ENR)

...

PART 3 — AERODROMES (AD)

**AD 1. AERODROMES/HELIPORTS —
INTRODUCTION**

**AD 1.1 Aerodrome/heliport
availability**

Brief description of the State's designated authority responsible for aerodromes and heliports, including:

- 1) the general conditions under which aerodromes/heliports and associated facilities are available for use;
- 2) a statement concerning the ICAO documents on which the services are based and a reference to the AIP location where differences, if any, are listed;
- 3) regulations, if any, concerning civil use of military air bases;
- 4) the general conditions under which the low visibility procedures applicable to Cat II/III operations at aerodromes, if any, are applied; and
- ~~5) friction measuring device used and the runway friction level below which the State will declare the runway to be slippery when wet; and~~
- 6) other information of a similar nature.

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The proposed amendment recognizes that the use of a friction measuring device is not the sole means to assess the runway surface friction characteristics. In addition, as each aerodrome operator can use a friction measuring device provided its performance meet the standard and correlation criteria set or agreed by the State (see requirement in new paragraph 2.9.8, Annex 14, Volume I), this device may differ from the one which the State may use as a reference or for its own inspections. The promulgation of this information is misleading and has proved being a contributing factor to accidents. Furthermore, the existing sub-paragraph 5) did not specify whether the friction measuring device was used for maintenance or operational purposes. The information required in sub-paragraph 5) above was, at best, incomplete for its intended use, and at worse, misleading; hence its proposed deletion.
Preliminary review by WG/PDP	The WG/PDP did not have the opportunity to review Champion Team (CT-5) comments on this issue.

(see Chapter 5, 5.2.3)

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(CLEARED RUNWAY WIDTH, IF LESS THAN PUBLISHED WIDTH <i>(m; if offset left or right of centre line add "L" or "R")</i>)																	E)																																			
(DEPOSITS OVER TOTAL RUNWAY LENGTH <i>Observed on each third of the runway, starting from threshold having the lower runway designation number</i>) <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">NIL</td> <td style="width: 5%;">—</td> <td style="width: 90%;">CLEAR AND DRY</td> </tr> <tr> <td>1</td> <td>—</td> <td>DAMP</td> </tr> <tr> <td>21</td> <td>—</td> <td>WET or water patches</td> </tr> <tr> <td>32</td> <td>—</td> <td>RIME OR FROST COVERED <i>(depth normally less than 1 mm)</i></td> </tr> <tr> <td>43</td> <td>—</td> <td>DRY SNOW</td> </tr> <tr> <td>54</td> <td>—</td> <td>WET SNOW</td> </tr> <tr> <td>65</td> <td>—</td> <td>SLUSH</td> </tr> <tr> <td>76</td> <td>—</td> <td>ICE</td> </tr> <tr> <td>87</td> <td>—</td> <td>COMPACTED OR ROLLED SNOW</td> </tr> <tr> <td>98</td> <td>—</td> <td>FROZEN RUTS OR RIDGES</td> </tr> <tr> <td>9</td> <td>—</td> <td>CHEMICALS</td> </tr> </table>																	NIL	—	CLEAR AND DRY	1	—	DAMP	21	—	WET or water patches	32	—	RIME OR FROST COVERED <i>(depth normally less than 1 mm)</i>	43	—	DRY SNOW	54	—	WET SNOW	65	—	SLUSH	76	—	ICE	87	—	COMPACTED OR ROLLED SNOW	98	—	FROZEN RUTS OR RIDGES	9	—	CHEMICALS	F)		
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32	—	RIME OR FROST COVERED <i>(depth normally less than 1 mm)</i>																																																		
43	—	DRY SNOW																																																		
54	—	WET SNOW																																																		
65	—	SLUSH																																																		
76	—	ICE																																																		
87	—	COMPACTED OR ROLLED SNOW																																																		
98	—	FROZEN RUTS OR RIDGES																																																		
9	—	CHEMICALS																																																		
(MEAN DEPTH <i>(mm)</i> FOR EACH THIRD OF TOTAL RUNWAY LENGTH)																	G)																																			
(FRICTION MEASUREMENTS ESTIMATED SURFACE FRICTION ON EACH THIRD OF RUNWAY AND FRICTION MEASURING DEVICE) <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 40%;">MEASURED OR CALCULATED COEFFICIENT or</td> <td style="width: 60%;">ESTIMATED SURFACE FRICTION</td> </tr> <tr> <td>0.40 and above</td> <td>GOOD — 5</td> </tr> <tr> <td>0.39 to 0.36</td> <td>MEDIUM/GOOD — 4</td> </tr> <tr> <td>0.35 to 0.30</td> <td>MEDIUM — 3</td> </tr> <tr> <td>0.29 to 0.26</td> <td>MEDIUM/POOR — 2</td> </tr> <tr> <td>0.25 and below</td> <td>POOR — 1</td> </tr> <tr> <td>9 — unreliable</td> <td>UNRELIABLE — 9</td> </tr> </table> <i>(When quoting a measured coefficient, use the observed two figures, followed by the abbreviation of the friction measuring device used. When quoting an estimate, use single digit. The intermediate values of 'MEDIUM/GOOD' and 'MEDIUM/POOR' provides for more precise information in the estimate when conditions are found to be between medium and either good or poor))</i>																	MEASURED OR CALCULATED COEFFICIENT or	ESTIMATED SURFACE FRICTION	0.40 and above	GOOD — 5	0.39 to 0.36	MEDIUM/GOOD — 4	0.35 to 0.30	MEDIUM — 3	0.29 to 0.26	MEDIUM/POOR — 2	0.25 and below	POOR — 1	9 — unreliable	UNRELIABLE — 9	H)																					
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0.40 and above	GOOD — 5																																																			
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0.25 and below	POOR — 1																																																			
9 — unreliable	UNRELIABLE — 9																																																			
(CRITICAL SNOWBANKS <i>(If present, insert height (cm)/distance from the edge of runway (m) followed by "L", "R" or "LR" if applicable)</i>)																	J)																																			
(RUNWAY LIGHTS <i>(If obscured, insert "YES" followed by "L", "R" or both "LR" if applicable)</i>)																	K)																																			
(FURTHER CLEARANCE <i>(If planned, insert length (m)/width (m) to be cleared or if to full dimensions, insert "TOTAL")</i>)																	L)																																			
(FURTHER CLEARANCE EXPECTED TO BE COMPLETED BY . . . <i>(UTC)</i>)																	M)																																			
(TAXIWAY <i>(If no appropriate taxiway is available, insert "NO")</i>)																	N)																																			
(TAXIWAY SNOWBANKS <i>(If more than 60 cm, insert "YES" followed by distance apart, m)</i>)																	P)																																			
(APRON <i>(If unusable insert "NO")</i>)																	R)																																			
(NEXT PLANNED OBSERVATION/MEASUREMENT IS FOR) <i>(month/day/hour in UTC)</i>																	S)																																			
(PLAIN-LANGUAGE REMARKS <i>(Including contaminant coverage and other operationally significant information, e.g. sanding, de-icing)</i>)																	T) <<≡																																			
NOTES: 1. *Enter ICAO nationality letters as given in ICAO Doc 7910, Part 2. 2. *Information on other runways, repeat from C to P. 3. *Words in brackets () not to be transmitted.																																																				

INSTRUCTIONS FOR THE COMPLETION OF THE SNOWTAM FORMAT

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9. *Item H* — ~~Friction measurements on each third of the run way and friction measuring device. Measured or calculated coefficient (two digits) or, if not available, e~~Estimated surface friction on each third of the runway (single digit) in the order from the threshold having the lower runway designation number. ~~Insert a code 9 when surface conditions or available friction measuring device do not permit a reliable surface friction measurement to be made. Use the following abbreviations to indicate the type of friction measuring device used:~~

- ~~— BRD — Brakemeter Dynometer~~
- ~~— GRT — Grip tester~~
- ~~— MUM — Mu-meter~~
- ~~— RFT — Runway friction tester~~
- ~~— SFH — Surface friction tester (high pressure tire)~~
- ~~— SFL — Surface friction tester (low pressure tire)~~
- ~~— SKH — Skiddometer (high pressure tire)~~
- ~~— SKL — Skiddometer (low pressure tire)~~
- ~~— TAP — Tapley meter~~

~~If other equipment is used, specify in plain language.~~

Friction measurement devices can be used as part of the overall runway surface assessment. Some States may have developed procedures for runway surface assessment which may include the use of information obtained from friction measuring devices and the reporting of quantitative values. In such cases, these procedures should be published in the AIP and the reporting made in Item (T) of the SNOWTAM format.

<i>Origin:</i>	<i>Rationale:</i>
<i>FTF/1 to 5</i> <i>AOSWG/5to 8</i> <i>AP-WG/WHL-5 and 6</i>	The assessment of the runway surface friction characteristics for operations relies on a variety and combination of factors which depend on local conditions. The friction measurements which are made for maintenance or, under specific conditions, operational uses, are not the sole means to assess the surface friction characteristics. Information required by pilots includes, inter alia, an assessment and report of the runway surface conditions and estimated braking action. Such data was needed by pilots when preparing a flight and before landing and take-off. The notion of friction measurements should therefore be replaced by the notion of surface conditions assessment. The use of devices to measure friction coefficient was a part of the means for a total assessment of the runway surface condition as the determination of the contaminant (such as amount of contaminant expressed as a percentage of surface contaminated) and the type and texture of the runway surface.

	The braking action of a specific aircraft on a runway surface results from a combination of various factors, inter alia: pavement surface friction characteristics, depth and type of contaminants, tire surface and layout, landing gear design, tire pressure. The aerodrome operator is only able to assess and report on the ground factors, including an estimated runway surface friction, and the pilots have to make their judgment on the estimated braking action on the basis of this information and of their operating manual. This is the reason why the term “estimated braking action” is to be replaced by “estimated surface friction” in the SNOWTAM format as well as in the ATC phraseology for aerodrome information. Specific competence is required for a proper understanding of the science of friction measurement which depends on, among others, the type of equipment used, its calibration and operating methods including a good understanding of local conditions. In certain cases, the provision of specific measured friction values has proved to be misleading and has contributed to accidents; hence the proposed amendment to paragraph 9, sub-item <i>H</i>, Annex 15, Appendix 2.
Preliminary review WG/PDP by	The WG/PDP did not have the opportunity to review Champion Team (CT-5) comments on this issue.

APPENDIX C

PROPOSED AMENDMENT TO

Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT

The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

1. ~~Text to be deleted is shown with a line through it.~~ text to be deleted
2. New text to be inserted is highlighted with grey shading. new text to be inserted
3. ~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading. new text to replace existing text

Chapter 12

PHRASEOLOGIES

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12.3 ATC PHRASEOLOGIES

12.3.1 General

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12.3.1.10 AERODROME INFORMATION

- a) [(location)] RUNWAY SURFACE CONDITION
RUNWAY (number) (condition);
- b) [(location)] RUNWAY SURFACE CONDITION
RUNWAY (number) NOT CURRENT;
- c) LANDING SURFACE (condition);
- d) CAUTION CONSTRUCTION WORK (location);
- e) CAUTION (specify reasons) RIGHT (or LEFT), (or
BOTH SIDES) OF RUNWAY [number];
- f) CAUTION WORK IN PROGRESS (or
OBSTRUCTION) (position and any necessary advice);
- g) RUNWAY REPORT AT (observation time) RUNWAY
(number) (type of precipitant) UP TO (depth of deposit)
MILLIMETRES. BRAKING ACTION ESTIMATED
SURFACE FRICTION GOOD (or MEDIUM TO GOOD,
or MEDIUM, or MEDIUM TO POOR, or POOR or
UNRELIABLE) [and/or BRAKING COEFFICIENT
(equipment and number)];
- h) BRAKING ACTION REPORTED BY (aircraft type) AT
(time) GOOD (or MEDIUM to GOOD, or MEDIUM, or
MEDIUM to POOR, or POOR);

C-3

- i) ~~BRAKING ACTION [(location)] (measuring equipment used), RUNWAY (number), TEMPERATURE [MINUS] (number), WAS (reading) AT (time);~~
- ji) RUNWAY (or TAXIWAY) (number) WET [or ~~DAMP, WATER PATCHES, FLOODED (depth)~~ **STANDING WATER**, or SNOW REMOVED (length and width as applicable), or TREATED, or COVERED WITH PATCHES OF DRY SNOW (or WET SNOW, or COMPACTED SNOW, or SLUSH, or FROZEN SLUSH, or ICE, or **WET ICE**, or ICE UNDERNEATH, or ICE AND SNOW, or SNOWDRIFTS, or FROZEN RUTS AND RIDGES)];
- kj) TOWER OBSERVES (weather information);
- hk) PILOT REPORTS (weather information).

<i>Origin:</i> <i>FTF/1 to 5</i> <i>AOSWG/5 to 8</i> <i>AP-WG/WHL-5 and 6</i>	<i>Rationale:</i> The braking action of a specific aircraft on a runway surface results from a combination of various factors, <i>inter alia</i>, pavement surface friction characteristics, depth and type of contaminants, tire surface and layout, landing gear design and tire pressure. The aerodrome operator is only able to assess and report on the ground factors, including an estimated runway surface friction, and the pilots have to make their judgment on the estimated braking action on the basis of this information and of their operating manual. This is the reason why the term “estimated braking action” is to be replaced by “estimated surface friction” in the item g). In addition, the result of any assessment is the provision of an estimated qualitative surface friction level of the runway. With the present state-of-the-art technology, the correlation of friction levels with an estimated aircraft braking action is an inexact science as it depends on each aircraft and other operational factors; hence the proposed deletion of item i).
Preliminary review by WG/PDP	The WG/PDP did not have the opportunity to review Champion Team (CT-5) comments on this issue.