International Civil
Aviation Organization

Aerodrome Best Practice

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Runway Excursion Risk Reduction

ICAO Aerodrome Best Practice

Purpose

This document contains guidance material prepared, primarily for use by aerodrome operators, to concisely state processes considered by ICAO to be best practice. They may be adopted in order to reduce the risk of an aeroplane experiencing a runway excursion due to factors that are primarily within the control and management of aerodrome operators.

These practices draw on the lessons learned in global aviation over many years, and reflect, and comply with, the Standards and Recommended Practices of various ICAO Annexes, but particularly Annex 14 Aerodromes Volume 1, Aerodrome Design and Operation. These practices are intended to assist aerodrome operators and Civil Aviation Authorities in identifying developments that have been shown to improve safety in particular circumstances related to runway excursions.

The information provided will be subject to review as changes to design, operational and maintenance activities associated with runway safety are identified, assessed and implemented. Readers and users of the guidance material should act on it only after consideration of national safety regulations and requirements, as it is not possible to provide material which will be applicable to all situations at all times. It is recommended that action be taken in respect of the material provided only in conjunction with appropriate technical advice.

Although ICAO has made every effort to ensure accuracy, it shall not be held responsible for any loss or damage caused by errors, omissions, misprints, or misinterpretation of the contents hereof. Readers are invited to give their views, comments and suggestions about the contents of this document. These should be directed to the Secretary General of ICAO.

Aerodrome Design

Item	Aim	Best Practice	Comments
ICAO Aerodrome Reference Code	Aerodrome operator's staff members are able to distinguish between a runway reference field length and the runway lengths that may need to be available for actual operational conditions. They should be able to explain the concept and its application to other associated stakeholders.	In Annex 14 Aerodromes Volume 1, Aerodrome Design and Operations, the use of an aerodrome reference code is important to ensure the correct application of ICAO SARPs for design of aerodrome physical characteristics prior to construction or installation of new facilities, and prior to commencement of work on upgraded facilities at an aerodrome. Technical and managerial staff of an aerodrome operator should be completely familiar with the concept of the aerodrome reference field length. This is used to determine code element 1 of the aerodrome reference code, including the relationship of reference field length to the actual runway length, and the impact that may have on aircraft performance. Guidance on the determination of actual length of runway to be provided can be found in the Aerodrome Design Manual (Doc. 9157) Part 1.	
Aerodrome declared distances	Declared distances, and any amendments, need to accurately reflect the available take-off and landing distances available. This needs to take into account runway length, and, if appropriate, penetrations of the OLS, displaced threshold positions and useable clearway and stopway dimensions so that aircraft performance calculations can be made with confidence.	An aerodrome operator's technical staff members need to be competent to calculate accurate declared distance information and ensure its effective promulgation so airline operators and pilots have certainty of information when making operational performance decisions.	Consider the need to ensure sufficient number of staff members are capable and available to determine and promulgate TORA, TODA, ASDA and LDA for each runway direction. Provide initial and recurrent training as necessary. Note that if a runway or its Obstacle Limitation Surfaces (OLS) become obstructed, there may be a need for amended declared distances to be calculated rapidly, especially in the case of a single runway aerodrome, if closure of the aerodrome is to be avoided. Similarly, declared distances may have to be reduced in order to provide a runway end safety area (RESA)

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Notified aeronautical information	The AIP and NOTAMs contain complete, current and accurate information about the data for the aerodrome, and they are issued in time to be available to aerodrome users.	Information about, including changes to, the condition of the movement area and related facilities must be provided for aerodrome users. The aerodrome operator must have trained staff who are competent and authorised to advise aeronautical information units in a timely manner about aeronautical data and any changes to published information. Personnel assigned to these tasks need to be provided with recurrent training as necessary.	Consider adopting a reporting system so that the aerodrome operator staff members are able to notify ATM/AIM units in a consistent, effective and timely manner about matters of operational significance.
Runway drainage	To ensure rapid drainage of rainfall runoff water away from runways to minimise wet runway hazards.	Provide adequate but not excessive transverse gradients on runway and shoulder pavements and ensure graded runway strip surface transverse gradients are adequate to shed rainfall runoff rapidly.	Consider the aerodrome design for new facilities and for major resurfacing or grading projects. Any non-conformance with SARPs must be particularly considered and the safety impact assessed before approval, because the application of standards specified in the Annexes has been recognised as necessary for operational safety, and the application of recommended practices as desirable in the interest of safety.
Runway surface	To ensure new or resurfaced runway surfaces have, and retain, good wet friction characteristics	Ensure new runway surfaces have adequate surface texture depth to generate good wet runway friction characteristics.	Consider properties of materials to be used and apply appropriate surface treatment to ensure minimum texture depth is achieved. Ensure exposed surface aggregate used is not prone to polishing. Adequate texture depth normally requires some form of special surface treatment, which may include pavement grooving or scoring, or (for asphalt pavements) incorporating a porous friction course or applying a surface dressing treatment.

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Runway friction	Runway friction measurement of new or resurfaced pavements demonstrates design objectives have been successfully achieved and irregularities do not exist that would impair the runway surface friction characteristics for an aeroplane landing or taking off. Runway surface friction measurement of new or resurfaced pavements also establishes a baseline for assessing pavement performance over time by comparative future runway friction measurements.	Friction measurement of the runway surface needs to be conducted and recorded for all new or resurfaced runways to demonstrate that surface friction characteristics have been achieved that are at or above minimum promulgated levels. Friction measurement should be done with approved equipment, and results need to meet or exceed State-determined specifications.	Consider options available to obtain approved equipment and operators – buy, lease, share approved equipment or utilise consultancy services.
Runway shoulder	Runway shoulders minimize the hazard to an aeroplane running off a runway and mitigate against the ingestion of foreign objects.	When provided, shoulders allow for a transition from the full strength of the runway pavement to the unpaved surface of the runway strip. This is especially important in the event of a veer-off. Shoulder surfaces also mitigate against foreign object debris hazards on the runway. A slight increase in transverse gradient from runway edge to runway strip transversely across the shoulder surface is beneficial in improving runway drainage under heavy rainfall conditions.	Consider that shoulder pavement strength needs to be adequate to support an aeroplane running over it without inducing structural damage, and of being capable of supporting ground vehicles including emergency vehicles.
Runway strip	An aircraft that suffers a runway excursion, either to the side of or beyond the end of a runway, should not be put at risk of additional damage from objects within the runway strip.	Keep runway strips smooth and free of fixed objects, unless they are required for air navigation purposes. An object required for air navigation purposes must be frangibly mounted so an aircraft impact during a veer-off or over-run will present a minimal hazard. Mobile objects (including aircraft) should be kept clear of specified areas of the runway strip while the runway is in use for landing or take-off.	Consider options for locating required equipment to be as far as possible from runway centre line. Does an object really need to be within the runway strip or can it be installed outside the limits of the runway strip without functional disadvantage? Also consider use of intermediate holding positions as necessary to assist in ensuring the runway strip remains clear of mobile objects.

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	Protect aircraft against the danger of striking an exposed edge of solid pavement.	Establish a flush join between paved (including shoulder pavement, if provided) and unpaved surfaces	The joint between a runway strip surface and a paved manoeuvring surface must be maintained in a smooth condition without an abrupt drop-off.
Stopway	That information is published for pilots to use when making operational decisions that accurately reflects the actual physical characteristics of the runway	Provision of a stopway is optional and is related to cost /benefit feasibility considerations of design parameters to cater for operational performance of the critical aircraft. If it is provided, ensure it conforms to the ICAO Annex 14 SARPs with regard to width, surface gradient, pavement strength and friction characteristics. Ensure the runway strip dimensions are adequate so that the stopway is included within the runway strip.	Consider the physical characteristics to ensure correct declared distance information is calculated and promulgated.
Stopway surface	A wet stopway surface needs to have frictional characteristics comparable with or better than that of the associated runway.	When a stopway is provided ensure the surface friction characteristic is at least equal to that of the runway.	Consider at the design stage and monitor during construction to ensure the stopway surface friction characteristics are equal to or exceed those of the associated runway surface.
Wind speed and direction information	Accurate representative wind data needs to be provided to pilots on approach and before take-off, and the wind condition locally on areas of the aerodrome may be directly observed and assessed by operating crew	Wind speed and direction information is important information for pilots and can be critical for operational decision making in the take-off and landing phases of flight. Each aerodrome is to be equipped with a standard wind direction indicator (WDI) located so as to be visible from an aircraft in flight or on the movement area. The wind direction and velocity indicated should be free from the effects of disturbances caused by nearby objects. Where an aerodrome is intended for use at night, WDI must be illuminated. Additionally, wind speed and direction meteorological sensors need to be installed so as to give representative wind observations for each runway in use. A display in the ATS unit is to be available for each sensor in use.	Consider that provision of additional wind direction indicators may be necessary near the ends of instrument approach runways especially when significant wind variations are known to occur, or when runway profile characteristics prevent a single installation being visible to the pilot from each threshold.

Aerodrome Operation and Maintenance

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Runway strip condition	Aircraft operators can have confidence that in the event of a veer-off or overrun from the runway onto the runway strip, the aircraft will not be endangered.	Runway strips are areas, provided around a runway (and stopway if provided), which are intended to be smooth and clear of objects which may endanger an aircraft. The runway strip should be smooth and prepared to an adequate strength so as to not permit the collapse of a nose undercarriage should an aircraft veer-off or overrun a runway (or stopway). Annex 14 specifies runway strip dimensions and characteristics according to the critical aircraft aerodrome reference code. Aircraft manufacturers consider that 15cm is the maximum depth to which a nose wheel may sink without the nose undercarriage collapsing. While only required equipment, eg visual approach slope indicator system (VASIS) and meteorology equipment, navigation and radar installations, is permitted to be located within a runway strip, such equipment must be of minimum practicable mass and height and be frangibly mounted. ICAO Document 9157 Aerodrome Design Manual Part 6 was published in 2006 and provides details about frangibility of aerodrome equipment which must be installed within or near movement areas. However, equipment is generally mounted on concrete (non-frangible) foundations, and additionally the runway strip may contain significant reinforced concrete or fabricated steel structures to permit access to buried cable and drainage systems. Aerodrome operators should ensure such foundations and access pits do not protrude above the surface level of the runway strip. To ensure the functions of a runway strip are satisfied, measures should be taken to prevent an aeroplane's wheel from striking a hard vertical face of a constructed structure (often called 'delethalisation').	Consider: Burying structures to a significant depth when the function of an installation does not require it to be flush with the runway strip surface; Chamfering the top of constructions to at least 30 cm below the strip surface level; Providing a prepared pavement, of lower strength than runway pavement, within the runway strip between the structure and the runway edge so that in the event of a veer-off or overrun, the aircraft undercarriage wheels will have increased support from the runway strip surface to ride over the structure and will not suddenly impact a hard vertical surface; and Ensuring after maintenance activity the runway strip surface is immediately restored completely to a safe condition without leaving open excavations or stockpiled materials within the runway strip.

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Runway marking	The aerodrome operator can be confident that conspicuous markings are displayed to provide pilots with visual cues relating to the runway while on approach and when on the ground.	Markings are intended to provide critical visual cues to pilots in daylight, and it is important that they be clear and correctly displayed. On runway surfaces, markings shall be white. On paved runways provide at least a runway designation marking and runway centreline marking. Depending on what operations are conducted on individual runways, additional markings in accordance with SARPs will need to be provided, including but not limited to, markings for threshold, aiming point, the touchdown zone and runway side stripes. If a runway has a displaced threshold, ensure the relevant transverse stripe and centre line arrows are marked. Painted runway markings deteriorate over time due to exposure and traffic action. Ensure inspection and maintenance activities are able to identify when the marking needs to be repainted to ensure clarity. This work should be done before the markings fade or are obliterated and become inconspicuous.	Consider provision of a black outline to increase the conspicuity of white markings on a light coloured surface, e.g. concrete runway pavements. Consider also that various elements of the runway markings may require repainting at different intervals, e.g. runway centre line in the touchdown zone may require much more frequent re-marking than less trafficked markings such as runway side stripes.
Runway and approach lighting	To ensure standard and consistent approach and runway lighting is displayed to provide pilots with positional cues in relation to approach to, and operations on, the runway during hours of darkness and in conditions of reduced visibility.	Approach and runway lighting systems can be critical to safe aircraft operations at night and in reduced visibility conditions. Annex 14 Volume 1 SARPs specify the lighting requirements for runways under various categories such as non-instrument, non-precision and precision approach runways, and specify installation requirements for approach, VASIS and runway lighting in detail. Lighting installations may utilise inset or elevated light fittings, or a mixture of types. Because of the location of light fittings is in close proximity to aircraft operational areas, ensure fittings are compliant with frangibility and colour display requirements.	Consider the provision of lighting displays conforming to SARPs and determination of serviceability standards for runway lighting systems.

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		Establish at a minimum a basic maintenance programme to ensure aerodrome lighting systems continue to operate as designed and installed.	Consider the capability of the aerodrome maintenance staff to respond to reports, conduct inspections, perform in-field repairs, and conduct workshop testing, servicing and overhauls as necessary.
		A maintenance programme should be designed, documented and implemented so that it is systemic in nature and able to support inspections, scheduled and non-scheduled repairs, and be capable of generating reports, and promulgating information, about system serviceability status changes over time. The maintenance programme should be integrated within the organisational structure of the airport operator, be sufficiently funded and staffed with adequately trained technicians and provide for access to an appropriate and adequate supply of spare parts.	Consider that the maintenance programme should extend to defining serviceability of lights in terms of deciding when to replace equipment components, and ensure conformity with requirements for switch-over times of specified critical elements of the lighting system where secondary power supply is provided.
Movement area guidance signs	Ensure pilots are provided with appropriate information relating to positive confirmation of position on the runway especially relating to runway exits, and correct data is provided for operational considerations.	Provide standard signs at locations as required to indicate mandatory, direction and location information to pilots. Signs are almost always located within the runway strip, and frangibility is a requirement. Signs need to be illuminated when RVR is less than 800 metres and at night for instrument runways and for code 3 or 4 non-instrument runways. Aerodrome operators must ensure adequate inspection of, and maintenance to, signs to ensure continued proper operation and that readability is not impaired by breakage, fading, obstruction by grass or vegetation or other faults that impair the readability and clarity of movement area signs.	Consider that pilots need to identify exit taxiways and they rely on aerodrome operators to provide and maintain clear and consistent standard movement area signs. Consider that when intersection departures are permitted it introduces an additional hazard being that a pilot may attempt a take off with insufficient runway available. Wherever an intersection departure is permitted, a guidance sign should be provided to indicate the reduced take-off run distance available.

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Aerodrome Inspections	To have an inspection process that identifies safety deficiencies in a timely manner which could contribute to hazards associated with runway excursion risk factors and to ensure those deficiencies are remedied appropriately.	The surface of a pavement needs to be maintained in a condition so as to provide good friction characteristics and low rolling resistance, and other aerodrome facilities are needed to provide guidance to the pilot. While this may be achieved initially by careful design, conformity with standards and proper construction techniques, the pavement surface and other facilities will slowly degrade over time and with use. Aerodrome operators need to ensure careful monitoring and reporting of facilities and conditions to ensure that runway safety is not compromised. Such monitoring can be accomplished by ensuring safety and technical inspections are conducted to identify conditions not conducive to operational safety, report on those conditions and initiate rectification action as required. Safety Inspections: These are intended to be frequent (daily, weekly, monthly etc) physical checks by staff of the aerodrome operator to ensure that facilities and any work areas continue to meet national standards and to identify any new condition or change that may be hazardous to continuing operations. The results of inspections indicate maintenance and repair actions. A typical process for safety inspections should consider: Who — Trained staff of the aerodrome operator, competent to operate vehicles on the manoeuvring area and to assess compliance of physical characteristics with standards; When — At least two inspections daily, but may be more frequent and include inspections at dawn, morning, afternoon, dusk and at night depending on number of movements, works in progress, weather conditions and so on. Additional inspections should always be conducted after significant occurrences and prior to a facility being brought back into service following a closure;	Consider the organisational aspects - training must be kept up-to-date, resources (personnel and equipment) have to be available, ATC needs to understand the time requirements for inspections and ensure timely access to manoeuvring areas. Ensure quality assurance of the inspection process to ensure its viability, and modify process as necessary to maintain effectiveness. The inspection process has to extend to, or be integrated with, a reporting function for ATM/AIM to alert users in regards non-standard or unsafe conditions.

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		What: Paved and unpaved areas, RESA, markings, signs, lighting, VASIS, WDI, obstructions, wildlife hazards, to indicate evidence of failures, establish the condition of runway surfaces, visual aids, FOD, water, rubber, snow and ice contamination, security, obstacles, and for remediation of previously reported issues; Ensure safety requirements for work in progress (WIP) have not been compromised; For special inspections an abbreviated scope of inspection may be used; How: Ensure proper communications with ATM personnel and maintain radio listening watch, inspect by vehicle with an inspector and assistant (observer) per vehicle, two passes per runway (stop if necessary to conduct close inspection on suspect areas or equipment), follow standard operating procedures and use the checklist, ensure records of inspection results are maintained and alert responsible persons regarding findings.	
	The aerodrome operator will establish and implement appropriate systematic technical inspection programmes to ensure short and long term runway condition issues are identified, reported on and remedied	Technical inspections: All runway pavements and associated facilities need a maintenance programme, including preventative maintenance activity where appropriate, to preserve the facility operationally and to ensure the economic investment is maximised. Preventative maintenance is programmed work done to prevent a failure or degradation of facilities. From time to time major maintenance of pavements will be required, and this can be a complex exercise that needs adequate prior consultation and planning with stakeholders. Major	Consider the introduction of a pavement management system to track pavement engineering performance from design, through construction and during operations so as to be able to predict future maintenance and /or reconstruction activity and allow for adequate planning of those activities.

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		maintenance to aircraft pavements, especially runway pavements, is not just an engineering problem. Technical pavement inspections by qualified airport engineers should be conducted on a periodic basis to monitor and assess pavement engineering performance and to predict major pavement maintenance requirements.	
Runway surface friction	Aerodrome operators will be aware of the surface friction characteristics of runway pavements and by appropriate testing can determine expected degradation over time and so be able to plan and execute appropriate maintenance action in a timely manner to ensure runway surface friction characteristics remain within satisfactory parameters. Where the friction of a runway pavement is less than a pre-determined minimum level, NOTAM advice to aerodrome users regarding the runway condition will be promulgated and corrective maintenance action will be taken.	Runway surface friction is one of the prime factors determining effective stopping of aircraft, either as a part of the landing or during a rejected take-off, when the rate of deceleration depends, among other things, on the coefficient of friction acting between the pavement surface and the footprint of the main aircraft's undercarriage tyres in contact with that pavement surface. Additionally, the ability of the crew to steer an aircraft, either to vacate via a runway exit or to maintain tracking along the centreline depends to a great extent on the available runway surface friction characteristics between the nose wheel undercarriage tyres and the pavement. While pavements may be constructed properly and initially provide good friction characteristics, the surface will change over time with use by aircraft traffic. Operational activity will lead to consequent deterioration of the skid resistance. This is due to wear and polishing of stones within the surface material and/or reduction of surface texture depth caused by aircraft operations on the pavement surface or by contamination of the surface, e.g. by rubber deposits. For detailed information regarding the surface friction characteristics of pavements, see the draft ICAO Circular "Runway Surface Condition Assessment, Measurement and Reporting".	Consider what testing is required. ICAO guidance identifies several different apparatus, all of which have continuous wet testing capability and each has specific test parameters (e.g. speed, tyre pressure) and related test results. Consider also when testing will be necessary. Busy runways with high rubber deposition rates will require more frequent testing, as will pavements that exhibit worn or polished materials in the pavement surface.

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		Accurate visual inspection of pavements for surface friction characteristic assessment is not possible, so aerodrome operators must periodically measure the friction characteristics of each runway surface with a continuous friction measuring device using self-wetting features. The friction measurement results can then be compared to established standard values to indicate if the surface friction is still satisfactory or if it has deteriorated to a condition where maintenance action should be planned to restore and improve the pavement surface friction characteristic. If the testing identifies significant deterioration of the surface friction to a level that is less than pre-determined minimum requirements, the aerodrome operator must initiate safety notification action by NOTAM advice to pilots and airline operators, and take corrective maintenance action.	
Reporting aerodrome data changes	The aerodrome operator can demonstrate competency to report about changes to aeronautical data that may affect operational aspects in an accurate and timely manner	Aeronautical data originated by the aerodrome operator is published by AIM and ATM services to facilitate safe aircraft operations. Any changes to the published data may potentially impact on the safety of operations at an airport. Aerodrome operators should develop and implement procedures for reporting changes affecting aerodrome information either through a request for amendment of the AIP or by issue of NOTAM. These procedures should be determined in conjunction with the ATM service provider and deal with: • arrangements for reporting any changes, and recording the reporting of changes, during all hours of operation of the aerodrome; and • identifying the names, contact details and responsibilities for personnel authorised to initiate change notifications.	Consider change notification in the context of time needed for the preparation and production of relevant material and whether the change will affect maps and charts and or CNS related systems. Ensure also that personnel assessing and reporting on runway surface conditions are trained and qualified to meet any State criteria.

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Runway contamination	The aerodrome operator can be confident that the runway surface is being maintained in a clean condition so as to avoid hazards due to contamination of the surface that may contribute to reduced friction characteristics or due to damage to an aircraft through foreign object debris.	During service a runway may become contaminated with a variety of materials – snow, slush, ice, water, mud, dust, sand, oil, chemicals and rubber to name a few – and the effect of all contaminants is detrimental to the friction characteristics of the pavement surface. Runway surfaces may also be contaminated by debris – fragments of loose material such as sand, stone, paper, wood, metal and pavement material to name a few – which have the potential to be detrimental to aeroplane structures or engines or that might impair the operation of aeroplane systems if they strike the structure or are ingested into engines. Contaminants cause a reduction of frictional characteristics and need to be removed and /or/cleaned to restore the runway surface to normal condition. Techniques are readily available to sweep paved surfaces to remove or collect debris, to remove accumulated rubber build up and to remove snow and control ice deposits. Inspection, assessment and reporting of the surface condition of a runway is particularly important during periods of contamination. Whenever water is present on a runway, a description of the runway surface condition should be made using the terms: • DAMP - surface shows a change of colour due to moisture; • WET - surface is soaked, but there is no standing water; or • WATER PATCHES - significant patches of standing water is visible (e.g. runway has more than 25% of its area covered by water more than 3 mm deep); or • FLOODED - extensive standing water over the pavement.	

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		Whenever an operational runway is affected by snow, ice, slush or frost the runway surface condition shall be assessed and reported and the description of the surface condition should be in terms of: • DRY SNOW; • WET SNOW; • COMPACTED SNOW; • WET COMPACTED SNOW; • SLUSH; • ICE; • WET ICE; • FROST; • DRY SNOW ON ICE; • WET SNOW ON ICE; • CHEMICALLY TREATED; or • SANDED.	

Abnormal Aerodrome Occurrences

Aerodrome operators have the opportunity to make runways safe by compliance with global standards, by ensuring the adoption of best practices in the operation and maintenance of the airport and by ensuing comprehensive and clear communications between the various entities providing services. Airlines also have stringent processes in place to reduce runway excursion risks, and ATM operators take care to reduce excursion hazards to a level as low as reasonably practicable. Nevertheless when dealing with man/machine systems where safety cannot be entirely guaranteed, there is always the potential for an adverse event. Aerodrome operators need to prepare for such situations by allowing for means to mitigate the outcome of an adverse event, including provision of a Rescue and Fire Fighting Service, establishment of aerodrome emergency and disabled aircraft removal plans, provision of Runway End Safety Areas and consideration of the feasibility for installing arresting systems beyond the runway ends.

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Rescue and Fire Fighting Service (RFFS)	Aerodrome operators need to consider the aerodrome environment, facilities and equipment, staffing and training to be confident that the RFFS can operate efficiently to achieve the principal objective of saving lives.	The RFFS primary objective is to save lives in the event of an accident or incident on or in the immediate vicinity of an aerodrome. This is done by creating and maintaining survivable conditions, providing egress routes and then initiating the rescue of those unable to do so without assistance. The ability of the RFFS to meet its objective depends on training provided to fire fighters, available effective equipment and the speed of response to any given situation. Aerodrome operators need to assess the hazards and potential risks when aircraft operations take place close to water or swampy areas, or in close proximity to difficult terrain. In such cases specialist rescue services and equipment shall be available appropriate to the assessed risk. It is not necessary that specialist services or equipment be provided by the aerodrome operator, but at least mutual aid agreements or other similar forms of co-operative arrangements need to be established by the aerodrome operator with service and equipment providers.	

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		Emergency access roads with convenient access to areas outside the aerodrome boundary should be provided. Aeroplane runway overrun incidents may result in the aircraft coming to rest a considerable distance beyond the end of the runway and the ability of the RFFS to assist in a rescue action depends on the ability for equipment to rapidly arrive on the scene. Particular attention should be given to enabling ready access to areas up to 1000 metres from the runway end. Close collaboration involving good communications between the Fire Station and responding vehicles and the ATC tower operators while the aerodrome is operational is necessary to ensure a rapid response to any incident. ATC and the RFFS personnel need to be prepared to activate aerodrome emergency procedures if it is obvious that an aircraft is in distress. Response time is minimised when sufficient staff are detailed and are readily available at all times to ride the RFFS vehicles at maximum capacity. RFFS staff should be trained to understand the risk factors associated with runway excursions. Heightened risk awareness actions may be established as conditions dictate. Often, visibility and surface conditions significantly less than optimum are associated with an increased risk of a runway excursion event, and the RFFS needs to be able to avoid delays in responding to an incident on or in the vicinity of the aerodrome under such adverse conditions	
Runway end safety area (RESA) and arresting systems	RESA is an essential aerodrome physical characteristic specified by ICAO as a buffer for safety in the event of an overrun or premature touchdown. In some cases provision of acceptable arrestor systems may be provided to supplement RESA.	There is clear evidence that aircraft which undershoot or overrun the runway and runway strip are likely to suffer significant damage, and ICAO considers the provision of a RESA necessary for instrument runways, and other runways used by large aircraft (code 3 or 4.) Additionally ICAO recommends provision of RESA for other runways.	

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		RESA is specified by defined locations and dimensions. RESA commences at the end of the runway strip and must have a width at least twice the width of the runway it serves. It must extend for a distance of at least 90 metres from the end of the runway strip, but where practicable the length should be 240 metres. RESA is intended to be prepared or constructed so as to reduce the risk of damage to aircraft which enter it either by undershoot or overrun, to enhance deceleration and to be capable of facilitating the movement of RFFS equipment. No objects which may endanger aircraft are permitted within a RESA, except items required for air navigation purposes that are frangibly mounted. The RESA needs to comply with specified surface gradient requirements so that other aerodrome safety elements are not compromised. At some aerodromes, RESA was not a requirement at the time of construction. In such cases may be extremely impracticable to provide RESA, and consideration may be given to providing minimum RESA by amending the declared distances and associated pavement marking and lighting. An alternative means of arresting an aeroplane involved in a runway overrun excursion may be considered, for example by means of an installed arresting system. Note that ICAO does not support the use of military style arrestor net barriers at the runway end or other similar types of equipment for civil aircraft operations. Before committing to alternative arresting systems, aerodrome operators need to carefully consider all the safety aspects. What material is to be used, what is its fire retardant capability? Will the design avoid pooling of spilt fuel? Once installed, arrester beds must be capable of being properly maintained. If not maintained properly, foreign objects and other contamination materials may clog gravel and other soft material beds and reduce the	

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		probability of aircraft wheels penetrating the material as designed. Is the width appropriate to catch and contain the aircraft completely, what outcome could be expected if only one side of the undercarriage enters the arresting material? What are the safety considerations for the location of an arresting bed in case of premature touchdown? Arresting installations should only be considered as a supplement to, and not a total replacement for, the RESA.	
Aerodrome emergency plan	Each airport will be prepared to manage an emergency situation in a manner to minimise loss of life and to maintain operational capacity or resume it with least disruption to regular services.	The Aerodrome Emergency Plan (AEP) is the best method an aerodrome operator has to prepare the airport staff and others to cope with an emergency situation and to minimise the effect of the emergency, particularly with regard to saving of life and maintaining operations. To be effective, the AEP must cater for activities that are commensurate with the type and level of operations generally conducted. The AEP contains process for actions to be taken at organisational and individual levels, procedures to be adopted for various functions, and co-ordination activity required to ensure efficiency of the overall effort. The effectiveness of any AEP depends on regular review and development including full scale and table top exercises. A typical AEP contains: • A list of emergencies to which the airport is able to respond; • The list of agencies (on-airport and off-airport) committed to assist, together with their roles and responsibilities for procedures and activities; • Provision for command post and emergency operations room including manning and communications arrangements;	

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		• Notification details for participants; • A grid map of the airport and its environs; and • Arrangements for periodic full scale and table top exercises of the AEP.	
Disabled aircraft removal	In the event of an aircraft becoming disabled on or near a manoeuvring area, the aerodrome operator will have considered the eventualities and will have suitable and co-ordinated removal procedures available.	Each airport operator needs to consider the effect that a disabled aircraft on or immediately adjacent to a runway will have on safety and regularity of operations, and to be prepared to manage and co-ordinate such removal action as may be necessary. A recovery plan will need to consider and be based on the characteristics of the aircraft that normally operate to the aerodrome, and include items such as: • Name and contact details for the co-ordinator; • A list of available equipment and the source of such equipment; • A list of personnel who can be available to assist; • Arrangement for the receipt of aircraft recovery kits from other aerodromes; and • Ability to communicate with the aircraft owner regarding removal action or approval. ICAO Document 9137 Airport Services Manual Part 5 Removal of Disabled Aircraft is available to State, airlines and aerodrome operators to address the issues related to immobilized and disabled aircraft in an aerodrome environment, including the new large aeroplanes recently introduced to airline service. This document has been issued in the 4th Edition - 2009.	Consider also that a disabled aircraft removal plan must address and allow for issues associated with requirements regarding accident investigation, protection of evidence, and legal aircraft custody and release issues. Consider also that each airline operating at your aerodrome should have a disabled aircraft recovery procedure for each aircraft type in operation. It would be prudent for the aerodrome operator to hold copies of such procedures.

Role for the Civil Aviation Authority

Item	Aim	Best Practice	Comments
Civil Aviation Authority	The CAA will conduct safety oversight to ensure service providers are competent and capable of compliance with national aviation requirements including operational procedures, safety performance, data accuracy and promulgation and reporting. Additionally the CAA will encourage co-operation with industry to pursue and attain common goals to improve aviation safety.	In an organisational context it is not only the service providers and operators that can contribute to a reduction in the risk factors associated with runway excursions. The State regulatory authority (usually the CAA) is the responsible entity for the safety of the aviation system. Aviation safety includes, but is not limited to, regulatory oversight as well as safety training and education. In terms of aerodrome activity, the CAA is responsible for ensuring regulatory safety oversight, and that responsibility may be exercised through various means. The Annexes contain vast amounts of data which together can systemically describe safe standards for facilities and the procedures to operate and maintain those facilities and provide services. The CAA role includes establishing State safety policy, conducting the oversight of aviation safety activity, and training, educating and encouraging aviation industry participants to not only just comply with rules but to strive for improved safety outcomes. Certification of aerodromes is a major area where the CAA can have a beneficial safety influence. Aerodrome certification is the process which allows a CAA to establish a regulatory regime so that safety oversight and service provision can be separated. Certification is a CAA function undertaken through a regulatory framework so that aerodrome users may be assured that a certified aerodrome meets the specifications regarding the aerodrome facility and it's operation and that the aerodrome operator has demonstrated the capability to maintain these specifications and operations.	

Item	Aim	Best Practice	Comments
		A regulatory framework for aerodrome certification includes the establishment of criteria – legislation, regulation, mandatory standards – and procedures for CAA staff to adopt in respect of regulatory oversight action. Oversight actions include not only the initial aerodrome certification but also continuing surveillance and an ability to impose appropriate sanctions in respect of non-compliance with mandatory requirements by aerodrome operators. Certification requires that aerodrome operators prepare and submit a satisfactory Aerodrome Manual that includes information about the aerodrome site, facilities, services, equipment, operating procedures, organization and management and the safety management system in place. The safety management system, among other things, must ensure clear lines of safety accountability throughout the aerodrome operator's organizational structure, including a direct accountability for safety by senior management. It is critically important that for the CAA to perform its safety oversight functions it must be managed and staffed accordingly. In many cases this will require executive management to recognise a need for a dedicated Directorate of Aerodrome Safety and Standards (DASS). Organizationally, DASS needs to have active and competent senior manager leadership and be staffed by qualified and trained aerodrome inspectors/engineers. Not only will the DASS be involved with certification of aerodromes, but also other regulatory framework oversight additional actions such as on-going surveillance, standards revision and updating, notification of differences to ICAO and in AIP and industry consultation, co-ordination, support and education.	

Item	Aim	Best Practice	Comments
		The CAA should be at the forefront in developing and assisting operators to implement pro-active safety enhancements such as multi-disciplinary Runway Safety Teams to examine potential runway excursion contributing factors and develop preventative actions either as stand-alone activities or as innovations developed through Safety Management System initiatives.	