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PBAOM
CONCEPT OF OPERATIONS

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PBAOM- CONOPS

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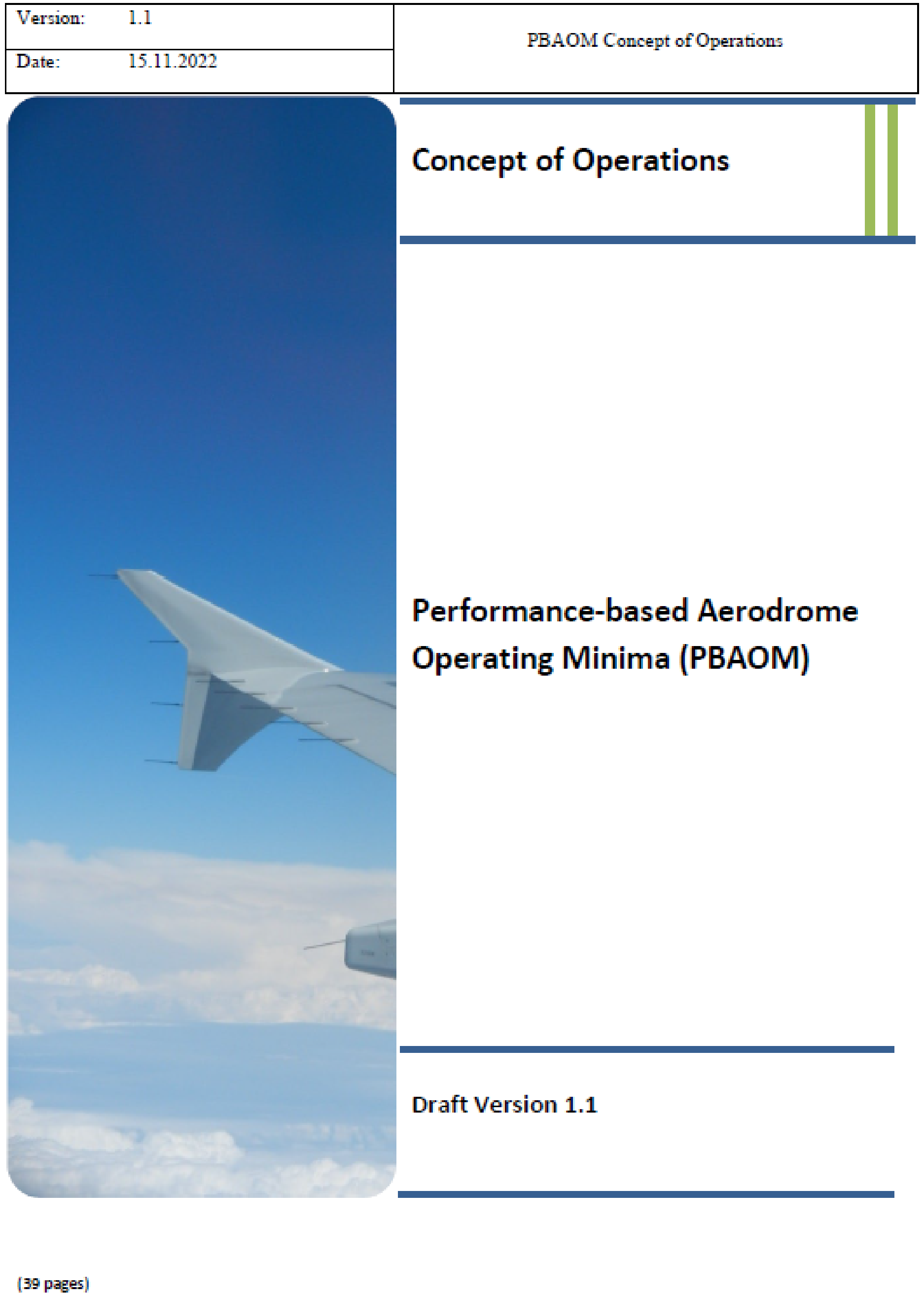
Concept of Operations

PBAOM CONOPS discusses

- Flight planning aspects: Destination with ops credits, alternates without
- Specific authorizations, when and how
- Differences between enhanced and natural vision, effect of HUD, FD and AP
- CAT II/III operations with reduced infrastructure
- All-weather take-off aspects
- Safety and risk assessment
- Training and Qualification
- Aerodrome aspects
- ATM aspects
- Appendix providing practical examples how PBAOM will influence the interaction between operators, ATC and aerodromes.

PBAOM CONOPS is provided as at **Attachment A** to this presentation



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Concept of Operations

Performance-based Aerodrome Operating Minima (PBAOM)

Draft Version 1.1

(39 pages)

Action by the meeting

The meeting is invited to :

a) take note of the PBAOM Concept of Operations (CONOPS);

b) discuss any relevant matters as appropriate; and

c) encourage States to raise awareness at National level (Operators, ATM and Aerodromes) about the PBAOM CONOPS

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Thank You!

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Performance-based Aerodrome Operating Minima (PBAOM)

Draft Version 1.1

(39 pages)

CONCEPT OF OPERATIONS FOR PERFORMANCEBASED AERODROME OPERATNG MINIMA

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1. Executive Summary, Purpose and Benefits

The purpose of Performance Based Aerodrome Operating Minima (PBAOM) is to permit aircraft operations in poorer meteorological conditions than may have been possible hitherto. PBAOM can be used to facilitate successful instrument approaches into aerodromes with reduced facilities, with appropriately equipped aircraft, in meteorological conditions that would otherwise increase the number of missed approaches or diversions. There are numerous benefits to operator, aerodrome, and CNS/ATM (Communications, Navigation and Surveillance / Air Traffic Management) service providers with the adoption of Performance-based Aerodrome Operating Minima (PBAOM). The benefits can be summarized as:

- **Increase in efficiency to the aerodrome and the ATM operations in times of marginal weather.** Previously, an aerodrome might suspend takeoffs and/or landings when the weather went below the category of minima that the ground infrastructure supported. PBAOM assists controllers in expediting advanced aircraft on a greater variety of instrument approach procedures and destination aerodromes. Localized congestion during marginal weather conditions is expected to decrease as efficiency increases at more aerodromes.

- **Increased access benefit to all actors**, since advanced aircraft allow more operations during periods of marginal and low-visibility weather and reduce the need for diversions. This regularizes operations and in consequence improves planning for users, aerodromes and operators.

- **Infrastructure savings with benefits to operators and aerodromes.** The existing AOM concept directly ties lower minima to more visual aids and other facilities on the aerodrome. These visual aids such as centerline lights, touchdown zone lights, and high intensity approach lighting systems are very expensive to install and expensive to maintain. The operational credits in PBAOM allow operators to achieve similar minima at lesser equipped aerodromes, as long as their aircraft provides the performance to mitigate the traditional visual aid requirements. This provides a large benefit for the aerodrome as well, since they can reduce operational maintenance budgets. The same infrastructure leads to lower minima, or the same minima can be achieved with reduced infrastructure, principally through better situational awareness under all weather conditions.

- **Environmental benefit**. Increased efficiency at aerodromes means fewer diversions and therefore reduced CO2 emissions from the burning of aviation fuel. Additionally, aerodromes can achieve an environmental benefit with a reduction in the lighting infrastructure. technology.

- **Safety benefit**. Current technologies such as head-up displays (HUD or equivalent display), EFVS, SVGS, and autoland provide safety benefits to the operator. For example, many commercial operators have chosen to equip with head-up displays for the safety benefit long before there was an operational credit to be gained from their use. Additionally, the ability to authorize an instrument procedure at an aerodrome where there was not one previously is a definite safety benefit for advanced aircraft. Fewer diversion also increase safety. PBAOM incentivizes better aircraft equipage which has a safety benefit outside the precision approach.
- **Passenger Benefit:** higher regularity of flights due to better airport accessibility. This may lead to lower prices.

2. Glossary

2.1 Explanation of Terms

Advanced aircraft. An aircraft with equipment in addition to that required for a basic aircraft for a given take-off, approach or landing operation (see also “basic aircraft”).

Advisory vertical guidance. Vertical path deviation guidance indications provided as a non-essential aid to help pilots meet barometric altitude restrictions.

Aerodrome operating minima. The limits of usability of an aerodrome for:

a) take-off, expressed in terms of runway visual range and/or visibility and, if necessary, cloud conditions;
b) landing in two-dimensional (2D) instrument approach operations, expressed in terms of visibility and/or runway visual range and minimum descent altitude/height (MDA/H) and, if necessary, cloud conditions; and
c) landing in three-dimensional (3D) instrument approach operations, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H) as appropriate to the type and/or category of the operation.

Aircraft State Awareness Synthetic Vision System (ASA-SVS). A flight instrument display that combines the perspective view synthetic terrain depiction and overlaid primary flight display symbology. The ASA-SVS flight instrument provides a continuous geospatially correct depiction of the external scene topography, including obstacles, augmented by the display of the runway of intended landing. The ASA-SVS provides the pilot with a virtual day Visual Meteorological Conditions (VMC) display regardless of the outside conditions.

Alert height. A height above the runway threshold based on the characteristics of the aircraft and its fail operational landing system, above which a Cat III operation would be discontinued and a missed approach initiated if a failure occurred in one of the redundant parts of the landing system, or in the relevant ground equipment.

All-weather operations. Any surface movement, take-off, departure, approach or landing operations in conditions where visual reference is limited by weather conditions.

Alternate aerodrome. An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing. Alternate aerodromes include the following:

Take-off alternate. An alternate aerodrome at which an aircraft can land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

En-route alternate. An aerodrome at which an aircraft would be able to land after experiencing an abnormal or emergency condition while en-route.

Destination alternate. An alternate aerodrome to which an aircraft may proceed should it become either impossible or inadvisable to land at the aerodrome of intended landing.

Note.— The aerodrome from which a flight departs may also be an en-route or a destination alternate aerodrome for that flight.

Approach ban point. The point from which an instrument approach shall not be continued below 300 m (1 000 ft) above the aerodrome elevation or into the final approach segment unless the reported visibility or controlling RVR is at or above the aerodrome operating minima.

Approved vertical guidance: Vertical guidance provided on instrument procedures where VNAV is required.

Automatic flight control system (AFCS) with coupled approach mode. An airborne system which provides automatic control of the flight path of the aircraft during approach.

Automatic landing system. The airborne system which provides automatic control of the aircraft during the approach and landing.

Basic aircraft. An aircraft which has the minimum equipment required to perform the intended take-off, approach or landing operation (see also "advanced aircraft").

Categories of aeroplanes. The following five categories of aeroplanes have been established based on 1.3 times the stall speed in the landing configuration at maximum certificated landing mass:

Category A — less than 169 km/h (91 kt) IAS

Category B — 169 km/h (91 kt) or more but less than 224 km/h (121 kt) IAS

Category C — 224 km/h (121 kt) or more but less than 261 km/h (141 kt) IAS

Category D — 261 km/h (141 kt) or more but less than 307 km/h (166 kt) IAS

Category E — 307 km/h (166 kt) or more but less than 391 km/h (211 kt) IAS.

Ceiling. The height above the ground or water of the base of the lowest layer of cloud below 6 000 m (20 000 ft) covering more than half the sky.

Note.— The definition of ceiling may differ in some States.

Circling approach. An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

Combined Vision System (CVS) combines EVS/EFVS with SVS/SVGS on a Head Down or Head Up Display. CVS correlates and combines image content from the real-time sensed enhanced vision imagery and the database-derived computer-generated synthetic vision imagery. It presents the content from both simultaneously on the flight instrument display. The CVS intended function varies upon intended use. CVS that are used for operational credits must also meet the requirements of an EFVS or SVGS.

Commercial air transport operation. An aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire.

Continuous descent final approach (CDFA). A technique, consistent with stabilized approach procedures, for flying the final approach segment (FAS) of a non-precision approach (NPA) procedure as a continuous descent, without level-off, from an altitude/height at or above the final approach fix altitude/height to a point approximately 15 m (50 ft) above the landing runway threshold or the point where the flare manoeuvre begins for the type of aircraft flown; ; for the FAS of an NPA procedure followed by a circling, the CDFA technique applies until circling minima (circling MDA/H) or visual flight manoeuvre altitude/height are reached.

Converted meteorological visibility (CMV). A value (equivalent to an RVR) which is derived from the reported meteorological visibility.

Decision altitude (DA) or ***decision height (DH).*** A specified altitude or height in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

Note 1.— Decision altitude (DA) is referenced to mean sea level (MSL) and decision height (DH) is referenced to the threshold elevation or touchdown zone elevation as appropriate for the State of the Aerodrome.

Note 2.— The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In Cat III operations with a decision height the required visual reference is that specified for the particular procedure and operation.

Note 3.— For convenience where both expressions are used they may be written in the form "decision altitude/height" and abbreviated "DA/H".

Enhanced flight vision system (EFVS). An installed aircraft system using an electronic means to provide the flight crew with a real-time sensor-derived display of the external scene topography (the natural or man-made features of a place or region especially in a way to show their relative positions and elevation) through the use of imaging sensors; an EFVS is integrated with a flight guidance system and is implemented on a head-up display or an equivalent display system; if an EFVS is certified according to the applicable airworthiness requirements and an operator holds the necessary specific approval (when required), then it may be used for EFVS operations and may allow operations with operational credits.

Enhanced vision system (EVS). A system to display electronic real-time images of the actual external scene achieved through the use of image sensors. An EVS provides topographic awareness, but does not qualify for operational credit.

Note.— EVS does not include night vision imaging system (NVIS).

Fail-operational automatic landing system. An automatic landing system is fail-operational if, in the event of a failure, the approach, flare and landing can be completed by the remaining part of the automatic system.

Fail-operational hybrid landing system. A system which consists of two or more independent landing systems and in the event of failure of one system, guidance or control is provided by the remaining system(s) to permit completion of the landing.

Note.— A fail-operational hybrid landing system may consist of a fail-passive automatic landing system with a monitored head-up display which provides guidance to enable the pilot to complete the landing manually after failure of the automatic landing system.

Fail-passive automatic landing system. An automatic landing system is fail-passive if, in the event of a failure, there is no significant deviation of aircraft trim, flight path or attitude but the landing will not be completed automatically.

Final approach. That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified:

a) at the end of the last procedure turn, base turn or inbound turn of a racetrack procedure, if specified; or

b) at the point of interception of the last track specified in the approach procedure, and ends at a point in the vicinity of an aerodrome from which:

   1) a landing can be made; or

   2) a missed approach procedure is initiated.

Final approach segment. That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

Flight visibility. The visibility forward from the cockpit of an aircraft in flight.

Flight Guidance System (FGS) the means available to the flightcrew to maneuver the aircraft in a specific manner either manually or automatically. It may include a number of components such as the autopilot, flight directors (F/D), and relevant display and annunciation elements.

GLS. An instrument approach operation that is based on GBAS.

Ground-based augmentation system (GBAS). An augmentation system to GNSS in which the user receives augmentation information directly from a ground-based transmitter.

Head-up display (or Equivalent Display). A transparent display system that presents flight information into the pilot's forward external field of view. Required features vary depending on the intended function (take-off, approach, landing, rollout) and the information must be presented conformal with the external scene.

Head-up display approach and landing guidance system (HUDLS). An airborne instrument system which presents sufficient information and guidance in a specific area of the aircraft windshield, superimposed for a conformal view with the external visual scene, which permits the pilot to manoeuvre the aircraft manually by reference to that information and guidance alone to a level of performance and reliability that is acceptable for the category of operation concerned.

Hybrid system. Two or more systems that are combined and regarded as one system for performance and approval purposes.

Note: The component systems are normally approved as stand-alone systems.

ILS critical area. An area of defined dimensions about the localizer and glide path antennas where vehicles, including aircraft, are excluded during all ILS operations.

Note.— The critical area is protected because the presence of vehicles and/or aircraft inside its boundaries will cause unacceptable disturbance to the ILS signal-in-space.

ILS sensitive area. An area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations.

Note.— The sensitive area is protected against interference caused by large moving objects outside the critical area but still normally within the airfield boundary.

Instrument approach operations. An approach and landing using instruments for navigation guidance based on an instrument approach procedure. There are two methods for executing instrument approach operations:

a) a two-dimensional (2D) instrument approach operation, using lateral navigation guidance only; and

b) a three-dimensional (3D) instrument approach operation, using both lateral and vertical navigation guidance.

Note.— Lateral and vertical guidance refers to guidance provided either by a ground-based radio navigation aid, or by computer-generated navigation data from ground-based, space-based, self-contained navigation aids or a combination of these.

Instrument approach procedure. A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en-route obstacle clearance criteria apply. Instrument approach procedures are classified as follows:

Non-precision approach (NPA) procedure. An *instrument* approach procedure designed for 2D instrument approach operations with DH of 250ftat or above 250ft.

Note.— Non-precision approach procedures may be flown using a continuous descent final approach (CDFA) technique. CDFAs with advisory vertical guidance calculated by on-board equipment are considered 3D instrument approach operations. CDFAs with manual calculation guidance of the required rate of descent are considered 2D instrument approach operations. For more information on CDFA refer to PANS-OPS (Doc 8168), Volume I, Part II, Section 5.

Approach procedure with vertical guidance (APV). A performance-based navigation (PBN) instrument approach procedure designed for 3D instrument approach operations with DH at or above 250ft.

Precision approach (PA) procedure. An instrument approach procedure based on navigation systems (ILS, MLS, GLS and SBAS Cat I) *designed* for 3D instrument approach operations.

Instrument flight rules (IFR). A set of rules governing the conduct of flight under instrument meteorological conditions.

Note.— IFR specifications are found in Chapter 5 of Annex 2 — Rules of the Air*. Instrument flight rules may be followed in both IMC and VMC.*

Instrument meteorological conditions (IMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, as defined in Annex 2, less than the minima specified for visual meteorological conditions.

Note.— The specified minima for visual meteorological conditions are contained in Chapter 4 of Annex 2.

Instrument runway. As defined in Annex 14 to the ICAO convention

Localizer performance (LP). The label to denote minima lines associated with the lateral element of APV-1 performance on approach charts.

Localizer performance with vertical guidance (LPV). The label to denote minima lines associated with APV-I or SBAS Category I performance on approach charts.

Low-visibility operations (LVO). Approach operations in RVRs less than 550 m and/or with a DH less than 60 m (200 ft) or take-off operations in RVRs less than 400 m.

Low-visibility procedures (LVP). *S*pecific procedures applied by an aerodrome for the purpose of ensuring safe operations during Cat II and III approach operations and/or low-visibility take-offs.

Low-visibility take-off (LVTO). A term used by the European Regulation on air operation referring to a take-off on a runway where the RVR is less than 400 m.

Minimum descent altitude (MDA)* or *minimum descent height (MDH). A specified altitude or height in a 2D instrument approach operation or circling approach operation below which descent must not be made without the required visual reference.

Note 1.— Minimum descent altitude (MDA) is referenced to MSL and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

Note 2.— The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In the case of a circling approach the required visual reference is the runway environment.

Note 3.— For convenience when both expressions are used they may be written in the form "minimum descent altitude/height" and abbreviated "MDA/H".

Missed approach point (MAPt). That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed.

Missed approach procedure. The procedure to be followed if the approach cannot be continued.

MLS critical area. An area of defined dimensions about the azimuth and elevation antennas where vehicles, including aircraft, are excluded during all microwave landing system (MLS) operations.

Note.— The critical area is protected because the presence of vehicles and/or aircraft inside its boundaries will cause unacceptable disturbance to the guidance signals.

MLS sensitive area. An area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the MLS signals during MLS operations.

Note.— The sensitive area provides protection against interference caused by large objects outside the critical area but still normally within the airfield boundary.

Obstacle clearance altitude (OCA)* or *obstacle clearance height (OCH). The lowest altitude or the lowest height above the elevation of the relevant runway threshold or the aerodrome elevation as applicable, used in establishing compliance with appropriate obstacle clearance criteria.

Note 1.— Obstacle clearance altitude is referenced to MSL and obstacle clearance height is referenced to the threshold elevation or in the case of non-precision approach procedures to the aerodrome elevation or the threshold elevation if that is more than 2 m (7 ft) below the aerodrome *elevation. An obstacle clearance height for a circling approach procedure is referenced to the aerodrome elevation.*

Note 2.— For convenience when both expressions are used they may be written in the form "obstacle clearance altitude/height" and abbreviated "OCA/H".

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

Operational credit. A credit authorized for operations with an advanced aircraft enabling a lower aerodrome operating minimum than would normally be authorized for a basic aircraft, based upon the performance of advanced aircraft systems utilizing the relevant external infrastructure

Performance-based navigation (PBN). Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity and functionality needed for the proposed operation in the context of a particular airspace concept.

Performance-based aerodrome operating minimum (PBAOM*).* A lower aerodrome operating minimum, for a given take-off, approach or landing operation, than is available when using a basic aircraft.

Note 1.— The PBAOM is derived by considering the combined capabilities of the aircraft and available ground facilities.

Note 2.— PBAOM may be based on operational credits.

Note 3.— PBAOM are not limited to PBN operations

Procedure turn. A manoeuvre in which a turn is made away from a designated track followed by a turn in the opposite direction to permit the aircraft to intercept and proceed along the reciprocal of the designated track.

Note 1.— Procedure turns are designated "left" or "right" according to the direction of the initial turn.

Note 2.— Procedure turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual instrument approach procedure.

Required navigation performance (RNP). A statement of the navigation performance necessary for operation within a defined airspace.

Note.— Navigation performance and requirements are defined for a particular RNP type and/or application.

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

Note.— In radiotelephony phraseologies, the expression "holding point" is used to designate the runway-holding position.

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

Satellite-based augmentation system (SBAS). A wide coverage augmentation system in which the user receives augmentation information from a satellite-based sensor.

Special Approval Category I Operations (SA CAT I) *A* CAT I approach operation that has a decision height not lower than 45 m (150 ft) and a RVR not less than RVR 1400 ft/400 m and is subject to specific approval.

Special Approval Category II Operations (SA CAT II) *A* CAT II approach operation to a runway that does not fulfil all CAT II infrastructure requirements and which is subject to specific approval.

Stabilized approach. An approach which is flown in a controlled and appropriate manner in terms of configuration, energy and control of the flight path from a pre-determined point or altitude/height down to a point 15 m (50 ft) above the threshold or the point where the flare manoeuvre is initiated, if higher.

State of Registry. The State on whose register the aircraft is entered.

State of the Aerodrome. The State in whose territory the aerodrome is located.

State of the Operator. The State in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence.

Surveillance radar. Radar equipment used to determine the position of an aircraft in range and azimuth.

Synthetic Vision Guidance System (SVGS). SVGS is a type of SVS which combines flight guidance display technology and high precision position assurance monitors. It includes a flight instrument display, which provides a continuous, geo-spatially correct depiction of the external scene topography, including obstacles, augmented by the display of the runway of intended landing. SVGS requires specific symbology elements, integrity and performance monitors and annunciations that support and enable low visibility operations.

Synthetic vision system (SVS). A system to display data-derived synthetic images of the external scene from the perspective of the flight deck.

Touchdown zone (TDZ). The portion of a runway, beyond the threshold, where it is intended that landing aircraft first contact the runway.

Vertical navigation (VNAV). A method of navigation which permits aircraft operation on a vertical flight profile using altimetry sources, external flight path references, or a combination of these.

Visibility. Visibility for aeronautical purposes is the greater of:

a) the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background;

b) the greatest distance at which lights in the vicinity of 1 000 candelas can be seen and identified against an unlit background.

Note 1.— The two distances have different values in air of a given extinction coefficient, and the latter b) varies with the background illumination. The former a) is represented by the meteorological optical range (MOR).

Note. 2.— The definition applies to the observations of visibility in local routine and special reports, to the observations of prevailing and minimum visibility reported in METAR and SPECI and to the observations of ground visibility.

Visual approach. An approach by an IFR flight when either part or all of an instrument approach procedure is not completed and the approach is executed by visual reference to terrain.

Visual flight rules (VFR). A set of rules governing the conduct of flight under visual meteorological conditions.

Note.— VFR specifications are found in Chapter 4 of Annex 2.

Visual meteorological conditions (VMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, as defined in Annex 2, equal to or better than specified minima.

Note.— The specified minima for visual meteorological conditions are contained in Chapter 4 of Annex 2.

Visual segment surface (VSS). Vertically, the VSS originates at the runway threshold height and has a slope of 1.12 degrees less than the promulgated approach procedure angle. The lateral surface of the VSS is defined in PANS-OPS, Volume II.

2.2 Acronyms

ACAS	Airborne collision avoidance system
AFCS	Automatic flight control system
AFM	Aircraft flight manual
AIC	Aeronautical information circular
AIP	Aeronautical information publication
AIS	Aeronautical information service
ALS	Approach lighting system
AOC	Air operator certificate
AOM	Aerodrome operating minima
APV	Approach procedure with vertical guidance
ASA-SVS	Aircraft State Awareness Synthetic Vision System
A-SMGCS	Advanced surface movement guidance and control system
ATC	Air traffic control
ATIS	Automatic terminal information service
ATS	Air traffic services
AVG	Advisory vertical guidance
AWO	All-weather operations
BALS	Basic approach lighting system
BARO-VNAV	Barometric vertical navigation
Cat I	Category I
Cat II	Category II
Cat III	Category III
CDFA	Continuous descent final approach
CFIT	Controlled flight into terrain
CMV	Converted meteorological visibility
CRM	Collision risk model
CS	Certification specifications (EASA)

CVFP	Charted visual flight procedures
CVS	Combined vision system
DA	Decision altitude
DA/H	Decision altitude/height
DDM	Difference in depth of modulation
DH	Decision height
DME	Distance measuring equipment
EASA	European Aviation Safety Agency
ED	Equivalent Display
EDTO	Extended diversion time operations
EFVS	Enhanced flight vision system
EVS	Enhanced vision system
FAF	Final approach fix
FALS	Full approach lighting system
FGS	Flight guidance system
FMS	Flight management system
FOR	Field of regard
FPA	Flight Path Angle
FSTD	Flight simulation training device
GBAS	Ground-based augmentation system
GLS	GBAS landing system
GNSS	Global navigation satellite system
HATh	Height above threshold
HIALS	High intensity approach lighting system
HUD	Head-up display
HUDLS	Head-up display landing system
HWD	Head-Worn Display
IALS	Intermediate approach lighting system
IAS	Indicated airspeed
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ISA	International standard atmosphere
JAR	Joint aviation requirements
LDA	Landing distance available
LED	Light emitting diode
LOC	Localizer
LNAV	Lateral navigation
LP	Localizer performance
LPV	Localizer performance with vertical guidance
LVO	Low-visibility operations
LVP	Low-visibility procedures
MALS	Medium intensity approach lighting system
MAPt	Missed approach point

MDA	Minimum descent altitude
MDA/H	Minimum descent altitude/height
MDH	Minimum descent height
MEL	Minimum equipment list
MET	Meteorological
METAR	Aviation routine weather report
MID	Runway mid-point
MLS	Microwave landing system
MOC	Minimum obstacle clearance
MSL	Mean sea level
MTBO	Mean time between outages
NALS	No approach lighting system
NDB	Non-directional beacon
NOTAM	Notice to airmen
NPA	Non-precision approach
NVIS	Night Vision Imaging Systems
OCA	Obstacle clearance altitude
OCA/H	Obstacle clearance altitude/height
OCH	Obstacle clearance height
OFZ	Obstacle-free zone
PA	Precision approach
PAR	Precision approach radar
PBAOM	Performance Based Aerodrome Operating Minima
PBN	Performance-based navigation
PFD	Primary Flight Display
RCLL	Runway centre line lights
RNAV	Area navigation
RNP	Required navigation performance
RTZL	Runway touchdown zone lights
RVR	Runway visual range
SARPs	Standards and Recommended Practices
SBAS	Satellite-based augmentation system
SDF	Step-down Fix
SID	Standard instrument departure
SIGMET	Significant weather report
SMGCS	Surface movement guidance and control system
SOP	Standard Operating Procedures
SPECI	Aerodrome special meteorological report
SRA	Surveillance radar approach
STAR	Standard instrument arrival
SVR	Slant visual range
SVGS	Synthetic Vision Guidance System

SVS	Synthetic vision system
TDZ	Touchdown zone
THR	Threshold
VDF	Very high frequency direction-finding station
VDP	Visual descent point
VFR	Visual flight rules
VGSI	Visual glideslope indicators
VIS	Visibility
VMC	Visual meteorological conditions
VNAV	Vertical navigation
VOR	Very high frequency omnidirectional radio range
V/S	Vertical Speed

2.3 References

In addition to various ICAO references, the following documents may help to understand the PBAOM concept application:

European Regulation (EU) 965/2012 "Air Ops regulation" as amended by EASA Decision 09/2021

And with European Aviation Safety Agency (EASA) Decision 2012/18/R on Part-CAT

EASA Decision 2012/19/R on Part-SPA

European Guidance Material on All Weather Operations at Aerodromes (EUR Doc 013)

European Guidance Material on Management of ILS Critical and Sensitive Areas (EUR DOC 040)

Advisory Circular AC 120-118 *Criteria for Approval/Authorization of All Weather Operations (AWO) for Takeoff, Landing, and Rollout*

AC 20-191 – Airworthiness Approval of Airborne Systems used for Takeoff, Precision Approach, Landing, and Rollout in low-visibility conditions

AC 20-185A Airworthiness Approval of Synthetic Vision System Synthetic Vision Guidance Systems and Aircraft State Awareness Synthetic Vision Systems

AC 90-106A Change 1, Enhanced Flight Vision Systems

3. Introduction

3.1 Background

Traditionally aerodrome operating minima (AOM) have been predicated upon the navigational guidance, non-visual and visual facilities provided for the runway and on the instrument approach procedures related to those facilities (NPA, APV or PA). These minima and the requirements for aerodrome facilities are designed to support operations with those aircraft carrying only the minimum equipment required for the particular operation. This existing concept is retained and further extended by the introduction of advanced aircraft and the consideration of both ground and airborne capabilities when determining AOM.

Modern aircraft are increasingly equipped with additional systems like head-up displays, EFVS, auto-land, etc. Based on appropriate airworthiness and operational approvals, these aircraft can safely operate to lower RVR and/or DH, or operate to traditional minima with less reliance on ground facilities. The higher performance capabilities of new and improved avionics have mitigated some of the performance requirements of the ground-based navigation equipment.

In the PBAOM concept, the minima will be predicated upon the combined capabilities of the ground and airborne facilities, i.e. the resulting performance for providing guidance during the instrument and visual segments of the approach and landing, hence the concept “Performance Based Aerodrome Operating Minima” (PBAOM). This concept will allow increased aerodrome availability and/or less costly infrastructure. The intention, however, is not to lower the existing standards for aerodromes, because those will still be needed for the aircraft without additional equipage. The ability to use improvements in either the ground or airborne components leads to a flexible implementation path, where different options can be used to generate improvements in AOM as required by the operator and aerodrome.

Note: - The term Performance Based Aerodrome Operating Minima is not directly connected to PBN operations.

In recognition of the concept of PBAOM, Annex 6, paragraph 4.2.8.1.1 says the following,

4.2.8.1.1 The State of the Operator shall authorize operational credit(s) for operations with advanced aircraft. Where the operational credit relates to low visibility operations, the State of the Operator shall issue a specific approval. Such authorizations shall not affect the classification of the instrument approach procedure.

For General Aviation, the specific approval will be issued by the State of Registry. “Operational credits” are described in paragraph 3.3 and aircraft classification is described in paragraph 3.4 below. Some examples are provided in Figure 3.4.1.

Several states have already implemented the concept of PBAOM for better equipped aircraft augmenting available ground systems to expand aerodrome availability in otherwise restrictive weather conditions. The implementation of better equipped aircraft as a means to meet operational and safety requirements has enabled greater aerodrome use, more operational value and greater potential for economic growth with no additional investment on the part of the aerodrome. This also provides an increase in efficiency and capacity at aerodromes that do not have a sufficient number of daily operations to justify the expense of additional ground infrastructure.

The advances in aircraft systems are one of the keys to the implementation of Performance Based Aerodrome Operating Minima but training is also a key element in maintaining the level of safety for these operations. Training and qualification is considered in section 3.6.

3.2 Purpose

The purpose of this document is primarily to provide information on the proposed concepts of Performance Based Aerodrome Operating Minima. The purpose is also to describe the expected impact for other domains such as aerodromes, air traffic management and navigation systems providers. . Thereby, this document is intended as a coordination instrument between the domains affected by attempting to describe all aspects of PBAOM. Such coordination is intended to be the first step, after which a fully coordinated CONOPS PBAOM can be developed.

3.3 Operational credits

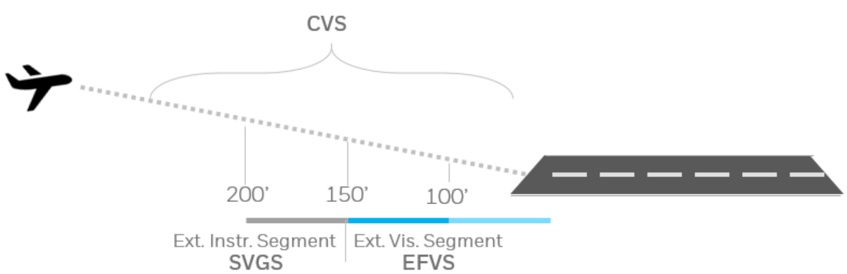
Operational credits are described in Annex 6, paragraph 4.2.8.1.1. Operational credits that are granted by specific approval, by the State of the Operator for commercial air transport and by the State of Registry for international general aviation. Operational credits can be interpreted in many ways, such as

- Lowering of the aerodrome operating minima (RVR) for the purposes of an approach ban;
- Reducing or satisfying the visibility requirements; or
- Requiring fewer ground facilities as compensated for by airborne capabilities.

An example of the use of operational credits is to use an Enhanced Flight Vision System (EFVS) to provide a means to satisfy the visibility requirements at the standard published instrument approach minimum. The approved EFVS enables the pilot to 'see' the required visual references at the described procedure minimum that could not be seen by the unaided eye, enabling the pilot to enter the visual segment of the approach. (See figure 2.3.1. *(the EFVS concept picture*). Thus, the pilot completes the instrument segment of the approach and then enters the visual segment of the approach using the enhanced vision. Advanced vision system technology makes use of available aerodrome guidance and airport lighting, but reduces the need for the additional extensive airport infrastructure typically associated with reduced visibility and lower aerodrome operating minima.

Another example is the use of advanced avionics and systems that enhance flight path management, which can lead to better performance and thus qualify for lower aerodrome operating minima. For example, the use of enhanced aircraft avionics such as Synthetic Visual Guidance Systems (SVGS) helps reduce the Flight Technical Error (FTE) in the instrument segment which allows the aircraft to use a DA(H) below 200 ft without additional aerodrome systems or infrastructure other than those typical for a 200 ft DA(H). This allows the use of such a system to operate to SA-CAT I minima.

Figure 3.3.1 EFVS, SVGS, CVS concept



SVGS is a combination of flight guidance display technology and high precision position assurance monitors. The SVGS flight instrument display provides a continuous, geo-spatially correct depiction of the external scene topography, including obstacles, augmented by the display of the runway of intended landing. SVGS includes additional, integrity and performance monitors and annunciations and symbology elements that support operational credit to minima below 200ft..

A more detailed example of where and how PBAOM can impact the pilot, ATC and aerodrome domains is provided as Appendix at the end of this concept document.

3.4 Advanced and basic aircraft

Within the concept of PBAOM there is a need to make a distinction between those aircraft that may qualify for operational credits and those that do not. The two terms used are “advanced aircraft” and “basic aircraft”.

The “basic aircraft” only has the minimum equipment required for the type and/or category of approach and landing operation intended. The aerodrome operating minima are totally dependent upon the availability of the navigational guidance, visual and non-visual aids associated with the operation. Airport infrastructure is selected and installed to permit aerodrome operating minima that will support instrument operations by basic aircraft and therefore accommodate the widest range of users. Aerodrome operators can choose to develop this infrastructure incrementally, with benefits to AOM being realized as the ground facilities are improved. This could start with a PBN approach (APV) to a non-instrument runway, resulting in a very low barrier to commencing operations with vertically guided approaches.

The "advanced aircraft" has equipment in addition to that required for the "basic aircraft". This additional equipage may qualify for lower minima or allow operations to "traditional" minima at runways with fewer infrastructures than normally required for basic aircraft. There are no specific classes of "advanced aircraft". The operational credit, which may be granted by an approval, is based upon the combined performance of on-board equipage and infrastructure available.

> "**Basic aircraft**" – An aircraft, which only has the minimum equipment required for the type and/or category of approach and landing operation intended.
>
> "**Advanced aircraft**" – An aircraft with some equipment in addition to that required for the "basic aircraft". Such equipment includes but is not limited to auto-flight systems capable of coupled approaches and/or auto-land, HUD or equivalent displays, EVS, CVS and SVS.

Below is an example of matrix minima, which is a possible application of PBAOM. The items to be covered and the actual requirement should be developed in coordination with the domains involved. The Appendix may be used to develop other applications.

Figure 3.4.1: PBAOM Example

Basic/ advanced aircraft	AOM		Approach type	Minima	Approach system	Aerodrome Standards				Ops. Spec.
	DH/ MDH	RVR				Visual Systems	Physical Standard	Equipment / Procedures	IAP	
Basic aircraft to non-instrument Rwy	500 ft	3000m (9000ft)	RNP	LNAV/VNAV	RNP	NALS	Non Instrument Rwy		RNAV	Nil
Basic aircraft to	250 ft	550m (1800ft	RNP	LNAV/VNAV	RNP with GNSS and	FALS	NPA Rwy		RNAV	Nil

NPA Rwy		)			baro VNAV					
Basic aircraft to CAT I Rwy	200 ft	550m (1800ft)	ILS/GLS/LPV CAT I	Std. IR	ILS/GLS/LPV CAT I	FALS	PA CAT I Rwy	Std	CAT I	CAT I
Advanced aircraft SA CAT I	150 ft	400m (1400ft)	ILS/GLS CAT I, HUD/ED	CAT I	ILS/GLS CAT I	FALS	PA CAT RwyI	Radalt op area, (LVP)	CAT I	CAT I OC
Advanced aircraft SA CAT I	150 ft	400m (1400ft)	SVGS ILS/GLS/LPV CAT I	CAT I	ILS/GLS CAT I	FALS	PA CAT I Rwy	Radalt op area, (LVP)	CAT I	CAT I OC
Advanced aircraft EFVS	250 ft	300m (1000ft)	LNAV/VNAV	EFVS	RNP	FALS	NPA Rwy	Std (LVP)	RNAV	EFVS
Advanced aircraft EFVS	200 ft	300m (1000ft)	ILS/GLS/LPV CAT I	EFVS	ILS/GLS/LPV CAT I	FALS	PA CAT RwyI	Std (LVP)	CAT I	EFVS
Basic aircraft to CAT II Rwy	100 ft	350m (1200ft)	ILS/GLS CAT II	CAT II	ILS/GLS CAT II (manual)	FALS CAT II	PA CAT II Rwy	Radalt op area (LVP)	CAT II	CAT II manual
Basic aircraft to CAT II Rwy	100 ft	300m (1000ft)	ILS/GLS CAT II	CAT II	ILS/GLS CAT II autoland	FALS CAT II	PA CAT II Rwy	Radalt op area (LVP)	CAT II	CAT II autoland
Advanced aircraft; SA CAT II	100 ft	300m (1000ft)	ILS/GLS CAT II	CAT II	ILS/GLS CAT II	FALS CAT II, no TDZ	PA CAT II Rwy	Radalt op area (LVP)	CAT II	CAT II
Advanced aircraft; SA CAT I	150 ft	300m (1000ft)	ILS/GLS CAT I	CAT I	ILS/GLS/LPV CAT I	Reduced FALS	PA CAT I Rwy	Radalt op area (LVP)	CAT I	CAT I
Advanced aircraft to CAT II Rwy	100 ft	300m (1000ft)	ILS/GLS CAT II	CAT II	ILS/GLS CAT III (incl. autoland	FALS CAT II	PA CAT II Rwy	Radalt op area (LVP)	CAT II	CAT III (incl. autoland)

FALS – Full Approach Light System; LVP – Low Visibility Procedures; OC – Operational Credits; OS – Operations Specification

3.5 Aerodrome operating minima
(as required to be calculated in section 5)

Aerodrome operating minima are defined in Annex 6 as the limits of usability of an aerodrome for take- off and approach operations. It is expressed in terms of RVR and/or visibility, MDA/H or DA/H and sometimes also in terms of cloud conditions. The visibility may be the flight visibility and/or the reported visibility. The operator is required to establish aerodrome operating minima in accordance with a method approved by the State of the Operator. In implementing such aircraft-dependent operating minima, the emphasis passes from all aircraft operating to a given aerodrome using the same minima to each aircraft operation to its own lowest minima give the aerodrome infrastructure. It may therefore be desirable to rename it from "Aerodrome Operating Minima" to "Aircraft Operating Minima".

If in some cases the State of the Aerodrome has established aerodrome operating minima, which must be observed by all operators even if higher than those established in accordance with the operator's method. This option should only be used by the state of the aerodrome in individually justified cases. Annex 6 lists a number of items, which have to be included in the method used by the operator. The same definitions and similar principles apply to general aviation, but for GA the aerodrome operating minima shall be established by the pilot-in-command in accordance with criteria established by the State of Registry.

The DH can never be lower than the OCH for a particular instrument approach procedure. The type or category of operation may also comprise some minimum values for MDH and DH, e.g. 200 ft for a Category I operation. The DH may, however, be reduced based on operational credits providing that it is not reduced below the OCH.

The RVR or visibility is determined by the MDH/DH and by the visual and non-visual aids provided for the runway. Those values can be reduced, by operational credit, where the on-board systems provide additional guidance (e.g. a HUD, SVGS) or where the on-board systems enhance the visual cues (e.g. EFVS). Where a flight visibility is prescribed, it can be satisfied by an equivalent means (e.g. an EFVS). The enhanced visibility provided by a certified sensor provides the flight visibility necessary to meet the visual requirements in the visual segment of the approach. This concept is called enhanced flight visibility. The difference between the flight visibility value using natural vision and the equivalent flight visibility is called the visual advantage. The visual advantage is the operational credit.

3.6 Flight planning considerations

When granting operational credits, it is necessary to consider to what extent the additional capabilities of the advanced aircraft can be taken into account. If the RVR minimum is reduced or a flight visibility requirement satisfied by means of the EFVS, the intent is obviously to be able to use this operational credit at the destination aerodrome when considering the approach ban and executing the approach.

When applying operational credits at the planning stage, different combinations of their application at destination and/or alternate is possible, depending on the state of the operator. Depending on airworthiness approval, some systems providing operational credits will have specific entries in the MEL or have added redundancy requirements.

With information on existence of operational credits to be included in the flight plan, ATS can improve flow planning by using the declared minima capabilities rather than capabilities estimated in the system parts of the flight plan. This may also be used to better apply the approach ban with the declared aircraft capabilities rather than the estimated capabilities of an aircraft

3.7 Inflight considerations

Once airborne, it remains to be determined if the requirement to have at least one suitable aerodrome available for landing can be based on the operational credits or not. When an actual approach is conducted to an alternate aerodrome, it is natural to allow the operational credits to be applied.

4. Examples

The following paragraphs of this section describe example operations using the Performance Based Aerodrome Operating Minima (PBAOM) concept, as also summarized in Figure 2.4.1. This list is not intended to be inclusive but just a representation of the PBAOM operations that are approved by some States today.

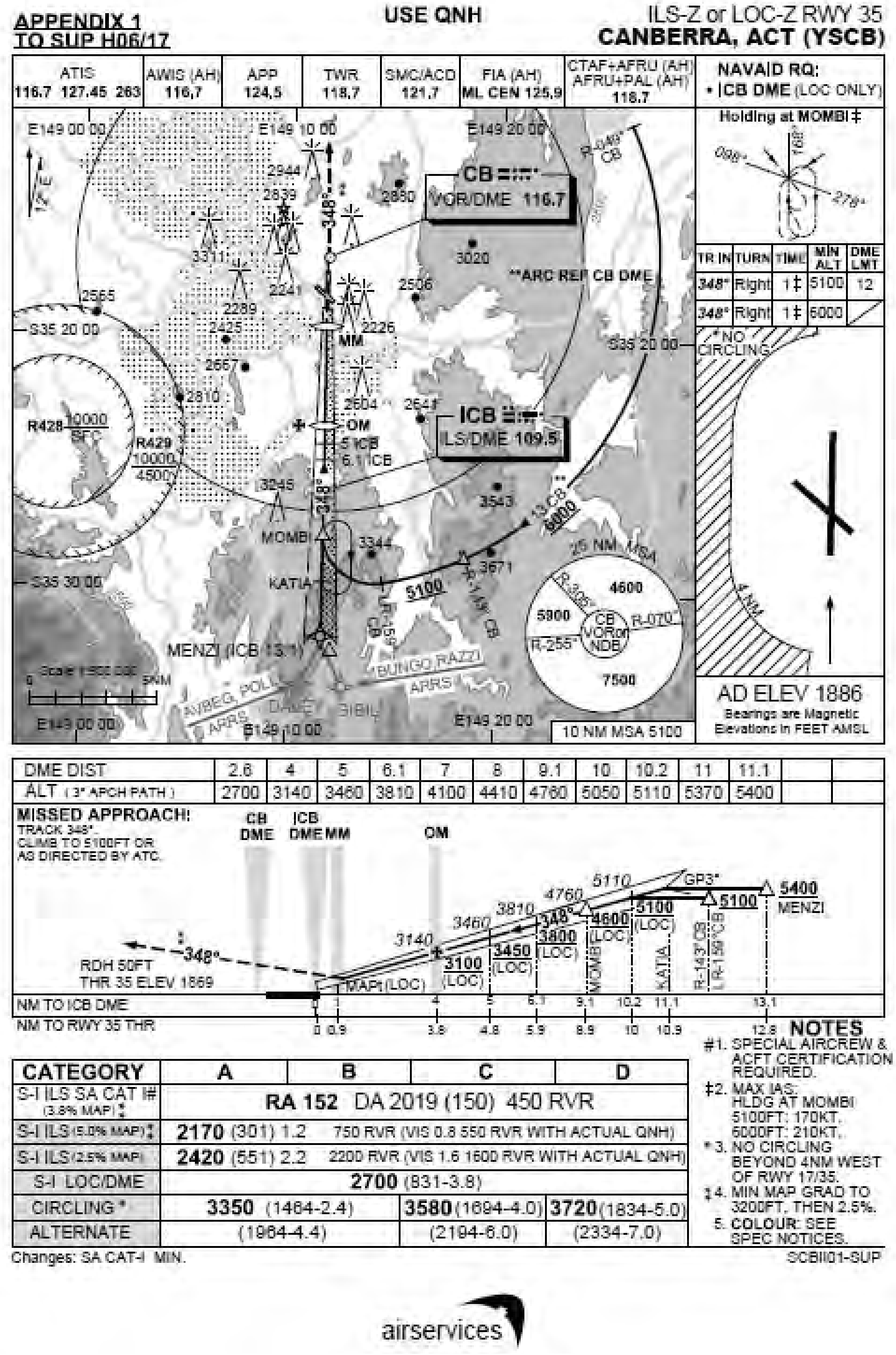
- Category I operations with DH less than 200 ft and/or RVR less than 550m (1800 ft);
- Operations comprising an enhanced visual segment;
- Category II/III operations with reduced airport infrastructure;
- Operational credit for takeoff operations.

4.1 Category I Operations with DH less than 200 ft and/or RVR less than 550m (1800 ft)

SPECIAL AUTHORISATION CAT I (SA CAT I)

This operation has an instrument segment that extends below 200 ft DH. The first condition for these operations is that the OCH for the procedure is below 200 ft, as the OCH definitively sets the minimum allowable value for the DH.

Some States have approved such operations after considering the infrastructure (e.g., center line lights), improved performance of the instrument guidance, and stricter obstacle criteria. The approvals are also based on additional aircraft equipment, radio altimeter and equipment reducing the flight technical error (e.g. a HUD, autoland, SVGS). An example of this type of operation is the Special Authorization Category I ILS at Canberra, Australia.



APPENDIX 1
TO SUP H06/17
USE QNH
ILS-Z or LOC-Z RWY 35
CANBERRA, ACT (YSCB)
ATIS 116.7 127.45 263
AWIS (AH) 116.7
APP 124.5
TWR 118.7
SMC/ACD 121.7
FIA (AH) ML CEN 125.9
CTAF+AFRU (AH) AFRU+PAL (AH) 118.7
NAVAID RQ:
• ICB DME (LOC ONLY)
Holding at MOMBI ‡
TR IN | TURN | TIME | MIN ALT | DME LMT
348° | Right | 1‡ | 5100 | 12
348° | Right | 1‡ | 6000
*NO CIRCLING
CB VOR/DME 116.7
ICB ILS/DME 109.5
**ARC REF CB DME
MM
OM
MOMBI
KATIA
MENZI (ICB 13.1)
25 NM MSA
10 NM MSA 5100
AD ELEV 1886
Bearings are Magnetic
Elevations in FEET AMSL
DME DIST | 2.6 | 4 | 5 | 6.1 | 7 | 8 | 9.1 | 10 | 10.2 | 11 | 11.1
ALT (3° APCH PATH) | 2700 | 3140 | 3460 | 3810 | 4100 | 4410 | 4760 | 5050 | 5110 | 5370 | 5400
MISSED APPROACH:
TRACK 348°.
CLIMB TO 5100FT OR
AS DIRECTED BY ATC.
RDH 50FT
THR 35 ELEV 1869
NM TO ICB DME
NM TO RWY 35 THR
CATEGORY | A | B | C | D
S-I ILS SA CAT I# (3.8% MAP)‡ | RA 152 DA 2019 (150) 450 RVR
S-I ILS (5.0% MAP)‡ | 2170 (301) 1.2 750 RVR (VIS 0.8 550 RVR WITH ACTUAL QNH)
S-I ILS (2.5% MAP) | 2420 (551) 2.2 2200 RVR (VIS 1.6 1600 RVR WITH ACTUAL QNH)
S-I LOC/DME | 2700 (831-3.8)
CIRCLING* | 3350 (1464-2.4) | 3580 (1694-4.0) | 3720 (1834-5.0)
ALTERNATE | (1964-4.4) | (2194-6.0) | (2334-7.0)
NOTES
#1. SPECIAL AIRCREW & ACFT CERTIFICATION REQUIRED.
‡2. MAX IAS: HLDG AT MOMBI 5100FT: 170KT. 6000FT: 210KT.
*3. NO CIRCLING BEYOND 4NM WEST OF RWY 17/35.
‡4. MIN MAP GRAD TO 3200FT, THEN 2.5%.
5. COLOUR: SEE SPEC NOTICES.
Changes: SA CAT-I MIN.
SCBII01-SUP
airservices

Figure 4.1.1

4.2 Operations comprising an enhanced visual segment – Enhanced Flight Visibility Systems (EFVS)

In these operations, the DA/H or MDA/H are the same as for any operation using the instrument approach procedure, and the visual segment begins at DA/H or MDA/H. The difference is that the visual cues and the ability to continue the descent below DA/H or MDA/H are based on the enhanced visual cues provided by the vision sensor. At a certain height the visual cues and control of the descent may have to be based on natural vision or the sensor image may be used all of the way to touchdown and rollout. The details of the operation will be part of the specific approval and will be dependent on the airworthiness approval of the sensor and the training of the aircrew. The minimum RVR for the operation is reduced in relation to the performance of the enhanced vision sensor. A concept of this operation is illustrated in *figure 4.2.1*.

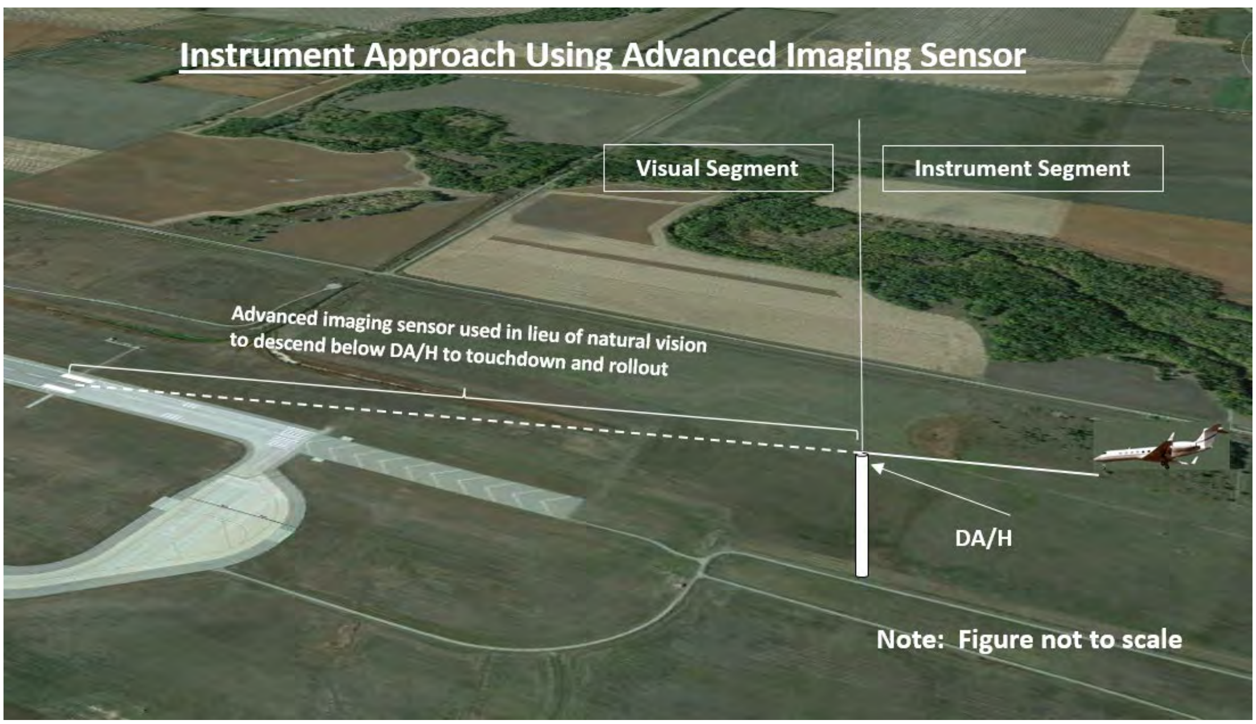


Figure 4.2.1

4.3 SA CAT II operations

These operations use a Category II instrument approach procedure. Additionally, the obstacle environment must fulfill the Category II standards. Operations are conducted with a reduced airport infrastructure - such as no touchdown zone lights and/or no centerline lights - but are compensated by the advanced on-board systems (e.g. HUD, auto-land, EFVS). In some cases, the compensation is also an increased RVR.

Practical examples are the Special Authorization CAT II (SA CAT II) illustrated by figure 4.3.1. The instrument approach and missed approach is fully compliant with Category II design criteria. If visual references are acquired and the approach is continued below DH, the lack of lights is compensated by on-board equipment and/or an increased RVR.

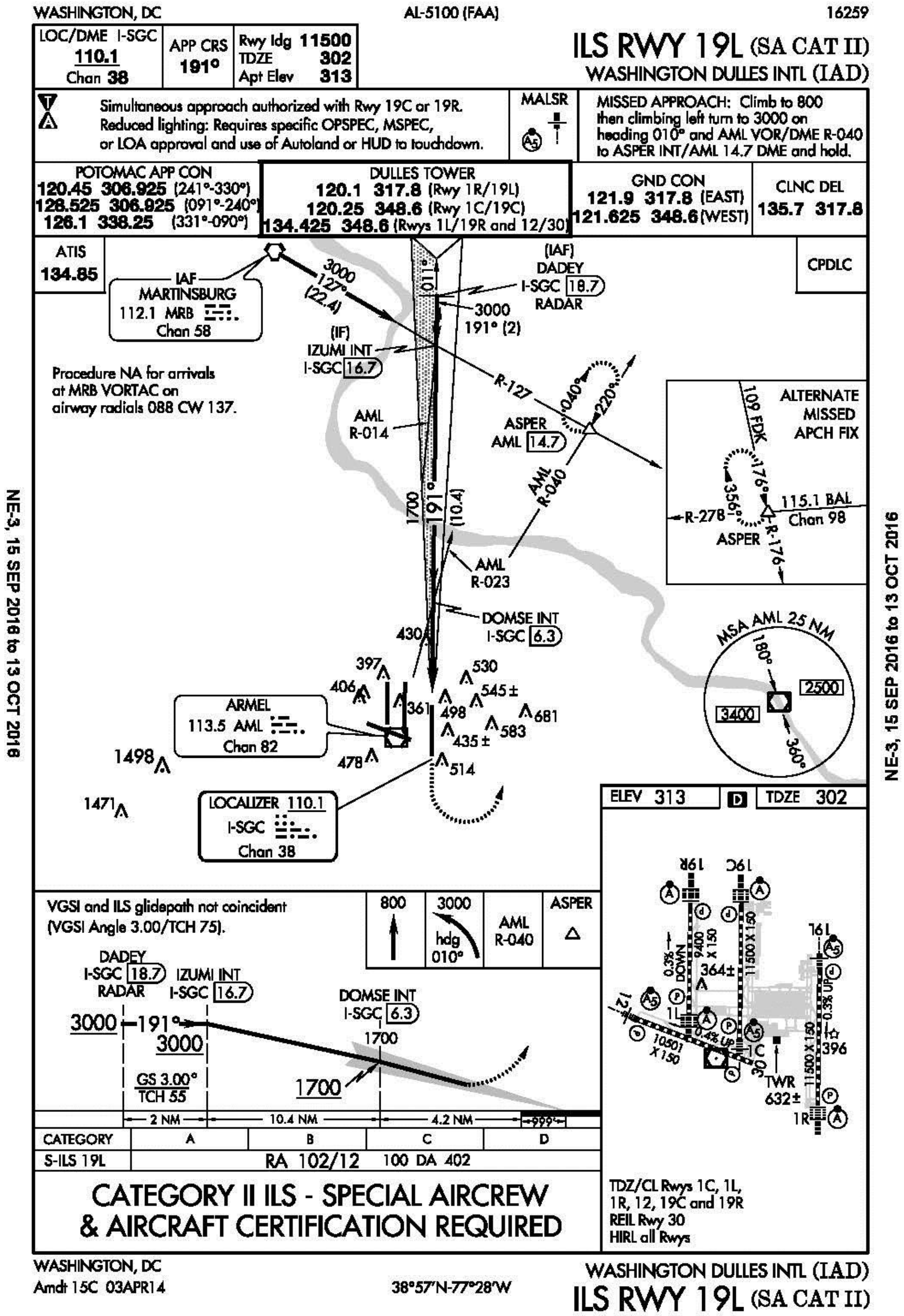

WASHINGTON, DC
AL-5100 (FAA)
16259
LOC/DME I-SGC
110.1
Chan 38
APP CRS
191°
Rwy ldg 11500
TDZE 302
Apt Elev 313
ILS RWY 19L (SA CAT II)
WASHINGTON DULLES INTL (IAD)
Simultaneous approach authorized with Rwy 19C or 19R.
Reduced lighting: Requires specific OPSPEC, MSPEC, or LOA approval and use of Autoland or HUD to touchdown.
MALSR
MISSED APPROACH: Climb to 800 then climbing left turn to 3000 on heading 010° and AML VOR/DME R-040 to ASPER INT/AML 14.7 DME and hold.
POTOMAC APP CON
120.45 306.925 (241°-330°)
128.525 306.925 (091°-240°)
126.1 338.25 (331°-090°)
DULLES TOWER
120.1 317.8 (Rwy 1R/19L)
120.25 348.6 (Rwy 1C/19C)
134.425 348.6 (Rwys 1L/19R and 12/30)
GND CON
121.9 317.8 (EAST)
121.625 348.6 (WEST)
CLNC DEL
135.7 317.8
ATIS
134.85
CPDLC
IAF
MARTINSBURG
112.1 MRB
Chan 58
3000
127°
(22.4)
(IAF)
DADEY
I-SGC 18.7
RADAR
3000
191° (2)
(IF)
IZUMI INT
I-SGC 16.7
Procedure NA for arrivals at MRB VORTAC on airway radials 088 CW 137.
R-127
040°
220°
AML
R-014
ASPER
AML 14.7
AML
R-040
ALTERNATE MISSED APCH FIX
109 FDK
176°
356°
115.1 BAL
Chan 98
R-278
ASPER
R-176
1700
191°
(10.4)
011°
AML
R-023
DOMSE INT
I-SGC 6.3
430
397
530
406
545±
361
498
681
ARMEL
113.5 AML
Chan 82
435±
583
478
514
1498
1471
LOCALIZER 110.1
I-SGC
Chan 38
MSA AML 25 NM
180°
2500
3400
360°
ELEV 313
D
TDZE 302
VGSI and ILS glidepath not coincident (VGSI Angle 3.00/TCH 75).
800
3000
hdg
010°
AML
R-040
ASPER
DADEY
I-SGC 18.7
RADAR
IZUMI INT
I-SGC 16.7
DOMSE INT
I-SGC 6.3
3000
191°
3000
1700
GS 3.00°
TCH 55
1700
2 NM
10.4 NM
4.2 NM
999
19R
19C
9400 X 150
11500 X 150
0.3% DOWN
364±
16L
0.3% UP
10501 X 150
11500 X 150
396
TWR
632±
1R
1L
1C
12
30
CATEGORY
A
B
C
D
S-ILS 19L
RA 102/12 100 DA 402
CATEGORY II ILS - SPECIAL AIRCREW & AIRCRAFT CERTIFICATION REQUIRED
TDZ/CL Rwys 1C, 1L, 1R, 12, 19C and 19R
REIL Rwy 30
HIRL all Rwys
NE-3, 15 SEP 2016 to 13 OCT 2016
WASHINGTON, DC
Amdt 15C 03APR14
38°57'N-77°28'W
WASHINGTON DULLES INTL (IAD)
ILS RWY 19L (SA CAT II)

Figure 4.3.1

4.4 Low Visibility Take-off Credits

Take-off operations have historically been a visual maneuver with a reliance on runway visual aids such as centerline markings, runway edge lights, and centerline lights. Typically, credit for lower visibility take-off operations is dependent on more runway visual aids. For example, an operator can get lower take-off credit on a runway equipped with centerline lights than on a runway without centerline lights.

The same advances in avionics in aircraft that have enabled lower landing minimums have applications for the take-off operation as well. Some states currently authorize a guided take-off using a HUD or an equivalent display on suitably equipped runways (LOC, GLS or suitable guidance equipment). Enhanced Flight Vision Systems could also be used to increase take-off credit. The concept for take-off is similar to landing: use the advanced avionics of the modern aircraft to augment the traditional airport visual aid requirements for low visibility take-off.

4.5 SMS/Risk Assessment

The standards in Annex 6 require that the aircraft operator has performed a risk assessment of operations based on operational credits to verify an equivalent level of safety. Advanced aircraft operations should perform risk assessment in accordance with established safety risk management procedures to identify potential hazards unique to the planned operations. For assessment of the adequacy of the LVP, a consistent safety assessment for the operation of the runway and taxiways under these conditions will have to be performed by the aerodrome. Please reference the Safety Management Manual (Doc 9859) for the risk assessment methods.

4.6 Training and Qualification beyond Basic License Requirements

Training and qualification should include ground training and flight training to ensure safe aircraft operation for all-weather operations. This is typically accomplished through initial qualification, recurrent qualification, upgrade qualification, differences qualification, recency of experience, and re-qualification.

Instrument approach and take off training should be as necessary for all applicable operational credits. The operator should define the content to be included in the flight crew training programs. Training and qualification for all-weather operations may be completed individually or combined as required with other operations. When combined training is completed, pilots must be aware of responsibilities for each category of minima used, including differences in methods for determination of minima, controlling visibility or RVR, use of correct procedures and callouts for each category, requirements for airborne equipment for initiation of approach, demonstration of the visual scenarios, and response to typical failure cases appropriate for each category of approach.

4.7 Aerodrome Aspects.

For a basic aircraft there is a relationship to the visual and navigation aids on an aerodrome and the categories of operations that are permitted. For example, a Category I operation requires a Category I runway and aerodrome, and Category II/III operations are not permitted. These rigid requirements were determined by the capabilities of the basic aircraft. Using this method, the aerodrome would require more visual aids and better nonvisual aids to allow a lower category of operation.

PBAOM describes the combination of the ground and airborne elements and provides the possibility of an advanced aircraft safely operating into an aerodrome at the RVR of a lower category than the traditional visual and navigation aids of the aerodrome would have normally supported. In its simplest and ideal description, PBAOM is the operator determining its aerodrome operating minima based on the capabilities of its aircraft and ground infrastructure of the aerodrome.

The granting of operational credits does not affect the classification (i.e. Type or Category) of an instrument approach procedure since they are designed to support instrument approach operations conducted using aeroplanes with the minimum equipment prescribed.

There is understanding that this ideal description does not always work at every aerodrome. There are unique aerodrome characteristics and procedures that must be considered when developing PBAOM. One of the main objectives of this CONOPS is foster the necessary communication and coordination between aerodrome, air traffic, navigation facility provision and flight operations authorities to determine each domain's concerns.

4.8 CNS/ANSP Aspects

It is not intended that PBAOM has an impact on existing provision of CNS systems; it has been developed to better use the existing facilities and in some cases, enable operations that otherwise would require significant increase in ground CNS facilities, but without additional ground investment.

4.9 ATM Aspects

It is very important for air traffic controllers to have knowledge and understanding of PBAOM, the capabilities of advanced aircraft and be appropriately trained. The efficiency and safety of the air traffic control system is improved with PBAOM due to the reduction of holding, weather diverts, and missed approaches. An advanced aircraft may also require less handling during low visibility conditions. In order to facilitate the tactical ATM planning, it is necessary to agree on how to communicate the minima that apply to any particular flight, e.g. by insertion of the RVR capability in the flight plan. In order to optimize the benefits of PBAOM in high density traffic situations it may be necessary to explore how to handle advanced aircraft, e.g. by using other, less equipped, runways for those aircraft.

5. Process to determine the operating minima by the Operator

The starting point for the method for establishing aerodrome operating minima (AOM) is the standard value/s provided by the Service Providers (SP) which usually covers the majority of aerodrome operating minima; therefore, the operators' method should focused in the deviations (positive or negative) from those standard conditions based on the rules, the Operations Specifications, and circumstances applicable to each case. The method must be based on relevant safety assessment, and described in sufficient detail to be used as guidance for the personnel involved in establishing and applying the AOM.

Note: the SP is expected to explain the method they apply to calculate the aerodrome operating minima and to specify what is not included in their considerations.

The table below offers a description of the process that may be followed.

Items (EASA CAT.OP.MPA.110 (b))	**Standard delivery by SP**	**Action by the Operator**	Remarks
(1) the type, performance, and handling characteristics of the aircraft;	Approach category covered	Identification and application of approach category and handling issues affecting AOM if relevant	
(2) the equipment available on the aircraft for the purpose of navigation, acquisition of visual references, and/or control of the flight path during take-off, approach, landing, and the missed approach;	AOM based on minimum equipment required.	Effects of any additional equipment, e.g. auto-pilot, EFVS	
(3) any conditions or limitations stated in the aircraft flight manual (AFM);	Not included	To be identified and applied by the operator.	
(4) the relevant operational experience of the operator;	Not included	Any difference from standard non-LVO conditions to be identified and applied by the operator. Assessment of previous operational data related to runway	Normally nothing for non-LVO. Runway suitability is normal part of the operator´s LVO considerations.

		suitability for LVO.	
(5) the dimensions and characteristics of the runways/final approach and take-off areas (FATOs) that may be selected for use;	Not included	Any difference from standard conditions to be identified and applied by the operator	Normally nothing.
(6) the adequacy and performance of the available visual and non-visual aids and infrastructure;	AOM based on the tables in the OPS rules, e.g. length of approach lights, xLS category, system minima.	Any difference from standard conditions to be identified and applied by the operator	Normally nothing.
(7) the obstacle clearance altitude/height (OCA/H) for the instrument approach procedures (IAPs);	AOM based on IAPs published in AIP	Any difference from standard conditions to be identified and applied by the operator	Normally nothing.
(8) the obstacles in the climb-out areas and necessary clearance margins;	AOM based on compliance with published climb gradients	Verification of ability to comply with published gradients, identification of any measures needed for compliance or establishing visual procedures where visual avoidance of obstacles is needed	Adherence with published gradients is normally achieved by stating the applicable MTOM. Need for visual obstacle avoidance is rather rare.
(9) the composition of the flight crew, their competence and experience;	AOM based on flight crew without any competency restrictions (add-on)	Identification and application of the add-on required by the OPS rules and any additional values that may be imposed by the operator.	One example is the add-on required for pilots inexperienced on the type.
(10) the IAP;	AOM based on IAPs published in AIP including any additional values or conditions that may be published by the State of the Aerodrome	Any difference from standard conditions to be identified and applied by the operator	
(11) the aerodrome characteristics and the	AOM based on the published AIP data, e.g.	Assessment of pre-threshold terrain for	

available air navigation services (ANS);	IAC, AD2-text	determination of DH/AH and of LSAA for landing system performance. These may affect the AOM. The form of ATS at the aerodrome, e.g. TWR or AFIS may affect LVO, e.g. LVTO	
(12) any minima that may be promulgated by the State of the aerodrome;	Included in the AOM if published in the AIP (or equivalent)	To be identified and applied by the operator, e.g. for AIP or Ops Spec	
(13) the conditions prescribed in the operations specifications including any specific approvals for low-visibility operations (LVOs) or operations with operational credits.	Standard MDH/DH and RVR provided including DH/RVR for CAT II/III (incl NO DH)	Any non-standard conditions, e.g. AOM based on operational credits (SA CAT I/II, EFVS)	

Appendix: Examples where PBAOM has an effect on operators, ATC and aerodromes

The list below is organised by flight phase and the text is color coded to indicate the importance of the application of PBAOM on the information needs of the different participants.

Ed. Note: Currently a preliminary version, it is intended to be improved through the Interpanel coordination.

Colours are indicated as:

- High,
- medium,
- low

amount of changes for full PBAOM application

Preflight phase

Pilot information needs:

- Infrastructure (lights, runway length/width/weight capacity/condition/surface, RVR sensor existence, (EFVS compatibility), serviceable navaids and their performance class
- weather information at destination/alternate – final discussion whether ops credit may also be applied to alternates, dispatch conditions, if destination below minima
- distance to alternates
- instrument approach procedures and their published minima
- special requirements for aircraft sensors (EFVS compatibility, GNSS RAIM prediction, …)
- ops credit based on predicted performances
- NOTAMS
- RFF/customs/… at destination/alternate (often implicit in aerodrome certification) – may need change from current practice

ANSP/aerodrome information needs:

- Aircraft RVR (and/or DA/H) capability
- enabling system(s) for the above capability (flight plan fields 10/18) – relevant if spacing or sequencing are concerned
- required infrastructure status

Approach briefing phase

Pilot information needs:

- weather/QNH/RVR and, if applicable/qualified: LVO status/SMGCS status

Runway in use and intended approach, including missed approach and minima

- **Special** approach conditions (steep, windshear, …)
- Runway condition/contamination
- Required infrastructure status

ANSP/aerodrome information needs:

- Runway/approach to use (pilot's intentions, if different to standard)
- Weather + QNH
- Aerodrome infrastructure status
- Need/capability for preferred treatment

During the approach (pilot information needs)

- Changes to approach briefing situation
  - Weather/QNH/RVR/wind
  - Strategy (CDFA, type of navaid, of runway)
  - Go-around
- Clearances

AWO Pre-departure

Pilot information needs:

- Take-off and departure instructions
- MEL constraints
- Infrastructure information, as for approach
- LVO status and clearance information, as for approach
- Tactical weather/QNH/RVR/wind information

ANSP/aerodrome information needs:

- Traffic prediction (flow management)
- Take-off and departure instructions
- Infrastructure information, as for approach
- Tactical weather/QNH/RVR/wind information

What would need to change to make the coloured items PBAOM compatible?

Pre-flight phase

pilot information needs:

- infrastructure (lights, runway length/width/weight capacity/condition/surface, RVR/Prevailing Visibility sensor existence, (EFVS compatibility), serviceable navaids and their performance class

Infrastructure: provide more precise information about lights (EFVS), more details on navaid performance; remove distinctions such as precision/non-precision, regional differences in navaid performance; link of airborne system performance to runway characteristics (slope in landing system assessment area or pre-threshold terrain). Link must be very precise for credit in the instrument segment and more guidance oriented for credit in the visual segment and also depends on criticality of the operation. Examples are critical runways, non-existence of CAT II minima on CAT III runway due to radalt instability around DH, etc.).

- special requirements for aircraft sensors (EFVS compatibility, GNSS RAIM prediction, …)

publication of required aircraft characteristics in AFM or other publication, provision of tools, etc.

- ops credit based on predicted performances

combination of the two above to determine type of credit achievable

- RFF/customs/… at destination/alternate (often implicit in aerodrome certification)

The pilot has to ensure that available airport services can support the intended operation – information exchange could be formalized to support PBAOM

ANSP/aerodrome information needs:

- RVR (and/or DA/H) capability

  Based on ops credit available for arriving aircraft, information to be relayed to ground and applied accordingly. In some cases ops credit is system related, so system identification is required to be used on ground (runway selection/sequencing/spacing/nav system protection) into appropriate services for credit to be applicable

Approach briefing

Pilot information needs:

- Runway in use and intended approach, including missed approach and minima

Are assumptions during pre-flight still valid? Confirmation of runway and approach procedure. Update rate of weather as conditions change needs to be increased to profit from ops credit (Zurich example).

- Required infrastructure status

Runway related infrastructure after a runway/approach change might have to be reassessed. Also requests for nav system protection, etc.

ANSP/aerodrome information needs:

- Need/capability for preferred treatment

Confirmation of aircraft ability to maintain minima/systems as stated in the flight plan

AWO Pre-departure

Pilot information needs:

- MEL constraints

  Confirmation that aircraft/crew capabilities match chosen departure with ops credit

- Infrastructure information, as for approach

  Infrastructure: more precise information about lights (EFVS), provide more details on navaid performance; regional differences in navaid performance; link of airborne system performance to runway and departure path characteristics.

ANSP/aerodrome information needs:

- Traffic prediction (flow management)

  Provision of ops credit constraints (limitations on available procedures on which the ops credit may be applied) to both departure and arrival airport to address flow management bottlenecks

- End of document-